June 2, 1987

Docket No. 50-336

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Mr. Edward J. Mroczka, Senior Vice President
Nuclear Engineering and Operations
Northeast Nuclear Energy Company
P. O. Box 270
Hartford, Connecticut 06141-0270

Dear Mr. Mroczka:

The Commission has issued the enclosed Amendment No.117 to Facility Operating License No. DPR-65 for Millstone Nuclear Power Station, Unit No. 2, in partial response to your application dated May 21, 1986, as supplemented by your letter dated May 27, 1987.

The amendment provides changes to the Technical Specifications which allow storage of consolidated fuel in the spent fuel pool. In addition, since storage of consolidated spent fuel allows eventual removal of spent fuel storage cell blocking devices, this amendment increases the spent fuel storage authorization from 1112 to 1346 fuel assemblies. It should be noted that this amendment limits spent fuel consolidation to the demonstration phase during which ten (10) spent fuel assemblies will be consolidated into five (5) cannisters. The NRC staff is continuing to review the issues associated with full scale consolidation of spent fuel.

A copy of our Safety Evaluation and Notice of Issuance are also enclosed.

Sincerely,

/s/

David H. Jaffe, Project Manager
Project Directorate I-4
Division of Reactor Projects I/II

Enclosures:
1. Amendment No.117 to DPR-65
2. Safety Evaluation

cc w/enclosures:
See next page

*Previously concurred

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Date:	6/2/87	*6/1/87	*6/2/87	*6/1/87

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A copy of our Safety Evaluation is also enclosed. The notice of issuance will be included in the Commission's next bi-weekly Federal Register notice.

Sincerely,

David H. Jaffe, Project Manager
PWR Project Directorate #8
Division of PWR Licensing-B

Enclosures:
1. Amendment No. to DPR-65
2. Safety Evaluation

cc w/enclosures:
See next page

Office:	LA/PD I-4	PM/PD I-4	PD/PD I-4	OGC
Surname:	SNorris	DJaffe:eh	JStolz	
Date:	6/1/87	6/1/87	6/2/87	6/1/87

ok as marked

Mr. Edward J. Mroczka
Northeast Nuclear Energy Company

Millstone Nuclear Power Station
Unit No. 2

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

NORTHEAST NUCLEAR ENERGY COMPANY

THE CONNECTICUT LIGHT AND POWER COMPANY

THE WESTERN MASSACHUSETTS ELECTRIC COMPANY

DOCKET NO. 50-336

MILLSTONE NUCLEAR POWER STATION, UNIT NO. 2

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 117
License No. DPR-65

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

   A. The application for amendment by Northeast Nuclear Energy Company, et al. (the licensee), dated May 21, 1986, as supplemented by letter dated May 27, 1987, 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-65 is hereby amended to read as follows:

   (2) Technical Specifications

   The Technical Specifications contained in Appendix A, as revised through Amendment No. 117, 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 issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

John F. Stolz

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

Attachment:
Changes to the Technical
  Specifications

Date of Issuance: June 2, 1987

ATTACHMENT TO LICENSE AMENDMENT NO.117

FACILITY OPERATING LICENSE NO. DPR-65

DOCKET NO. 50-336

Replace the following pages of the Appendix A Technical Specifications with the enclosed pages. The revised pages are identified by amendment number and contain a vertical line indicating the area of change. The corresponding overleaf pages are provided to maintain document completeness.

Remove Pages	Insert Pages
ii	ii
ix	ix
xiv	xiv
1-8	1-8
3/4 9-7	3/4 9-7
3/4 9-21	3/4 9-21
3/4 9-22	3/4 9-22
3/4 9-23	3/4 9-23
3/4 9-24	3/4 9-24
--	3/4 9-25
--	3/4 9-26
--	3/4 9-27
B 3/4 9-2	B 3/4 9-2
B 3/4 9-3	B 3/4 9-3
B 3/4 9-4	B 3/4 9-4
5-5	5-5
5-6	5-6

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DEFINITIONS

SECTION | PAGE

1.0 DEFINITIONS

DEFINITIONS

LIMITING CONDITIONS FOR OPERATION AND SURVEILLANCE REQUIREMENTS

INDEX

LIMITING CONDITIONS FOR OPERATION AND SURVEILLANCE REQUIREMENTS

BASES

BASES

TABLE 1.1

OPERATIONAL MODES

MODE	REACTIVITY CONDITION, K_{eff}	% RATED THERMAL POWER*	AVERAGE COOLANT TEMPERATURE
1. POWER OPERATION	$\geq$ 0.99	> 5%	$\geq$ 300°F
2. STARTUP	$\geq$ 0.99	$\leq$ 5%	$\geq$ 300°F
3. HOT STANDBY	< 0.99	0	$\geq$ 300°F
4. HOT SHUTDOWN	< 0.99	0	300°F> T_{avg} > 200°F
5. COLD SHUTDOWN	< 0.98	0	$\leq$ 200°F
6. REFUELING**	$\leq$ 0.95	0	$\leq$ 140°F

*Excluding decay heat.

**Fuel in the reactor vessel with the vessel head closure bolts less than fully tensioned or with the head removed.

VENTING

1.35 VENTING is the controlled process of discharging air or gas from a confinement to maintain temperature, pressure, humidity, concentration or other operating condition, in such a manner that replacement air or gas is not provided or required during venting. Vent, used in system names, does not imply a VENTING process.

MEMBER(S) OF THE PUBLIC

1.36 MEMBER(S) OF THE PUBLIC shall include all persons who are not occupationally associated with the plant. This category does not include employees of the utility, its contractors or its vendors. Also excluded from this category are persons who enter the site to service equipment or to make deliveries. This category does include persons who use portions of the site for recreational, occupational or other purposes not associated with the plant.

The term "REAL MEMBER OF THE PUBLIC" means an individual who is exposed to existing dose pathways at one particular location.

SITE BOUNDARY

1.37 The SITE BOUNDARY shall be that line beyond which the land is not owned, leased or otherwise controlled by the licensee.

UNRESTRICTED AREA

1.38 An UNRESTRICTED AREA shall be any area at or beyond the site boundary to which access is not controlled by the licensee for purposes of protection of individuals from exposure to radiation and radioactive materials or any area within the site boundary used for residential quarters or industrial, commercial institutional and/or recreational purposes.

STORAGE PATTERN

1.39 The Region II spent fuel racks contain a cell blocking device in every 4th rack location for criticality control. This 4th location will be referred to as the blocked location. A STORAGE PATTERN refers to a blocked location and all adjacent and diagonal Region II cell locations surrounding the blocked location.

CRANE TRAVEL - SPENT FUEL STORAGE POOL BUILDING

LIMITING CONDITION FOR OPERATION

3.9.7 Loads in excess of 1800 pounds, with the exception of the consolidated fuel storage box, shall be prohibited from travel over irradiated fuel assemblies in the storage pool.

APPLICABILITY: DURING ALL CRANE OPERATION.

ACTION:

With the requirements of the above specification not satisfied, place load in a safe condition.

SURVEILLANCE REQUIREMENTS

4.9.7 Crane interlocks and/or physical stops which prevent crane travel with loads in excess of 1800 pounds over irradiated fuel assemblies shall be demonstrated OPERABLE within 72 hours prior to initiation of irradiated fuel handling operations and at least once per 7 days during irradiated fuel handling operations.

SHUTDOWN COOLING AND COOLANT CIRCULATION

LIMITING CONDITION FOR OPERATION

3.9.8.1 At least one shutdown cooling loop shall be in operation*.

APPLICABILITY: MODE 6 at all reactor water levels.

ACTION:

With less than one shutdown cooling loop in operation, suspend all operations involving an increase in the reactor decay heat load or a reduction in boron concentration of the Reactor Coolant System. Close all containment penetrations providing direct access from the containment atmosphere to the outside atmosphere within 4 hours.

3.9.8.2 Two independent shutdown cooling loops shall be OPERABLE**.

APPLICABILITY: MODE 6, whenever all the following conditions are not satisfied:

a. reactor vessel water level at or above the vessel flange; and

b. the reactor vessel pit seal installed; and

c. the combined available volume of water in the refuel pool and refueling water storage tank exceeds 370,000 gallons; and

d. (1) one LPSI pump not in shutdown cooling service and aligned to take suction from the RWST and deliver flow to the RCS is OPERABLE,**; or

(2) one HPSI pump aligned to take suction from the RWST and deliver flow to the RCS is OPERABLE.**

ACTION:

With less than the required shutdown cooling loops OPERABLE, initiate corrective action to return the loop(s) to OPERABLE status within one hour.

The provisions of Specification 3.0.3 are not applicable for 3.9.8.1 and 3.9.8.2.

---

* The shutdown cooling loop may be removed from operation for up to 1 hour per 8 hour period during the performance of CORE ALTERATIONS in the vicinity of the reactor pressure vessel hot legs.

**The normal or emergency power source may be inoperable for each shutdown cooling loop.

MOVEMENT OF FUEL OVER REGION II RACKS

LIMITING CONDITION FOR OPERATION

3.9.17 Prior to movement of a fuel assembly, or a consolidated fuel storage box, over a Region II rack in the spent fuel pool, the boron concentration of the pool shall be maintained uniform and sufficient to maintain a boron concentration of greater than or equal to 800 ppm.

APPLICABILITY: Whenever a fuel assembly, or a consolidated fuel storage box, is moved over the Region II racks in the spent fuel pool.

ACTION:

With the boron concentration less than 800 ppm, suspend the movement of all fuel over Region II racks.

SURVEILLANCE REQUIREMENTS

4.9.17 Verify that the boron concentration is greater than or equal to 800 ppm within 24 hours prior to any movement of a fuel assembly, or a consolidated fuel storage box, over a Region II rack in the spent fuel pool and every 72 hours thereafter.

SPENT FUEL POOL

LIMITING CONDITION FOR OPERATION

3.9.18 The Reactivity Condition of the spent fuel pool shall be such that K_{eff} is less than or equal to 0.95 at all times.

APPLICABILITY: Whenever fuel is in the spent fuel pool.

ACTION:

Borate until $K_{eff} \leq .95$ is reached.

SURVEILLANCE REQUIREMENTS

4.9.18.1 Ensure that all fuel assemblies to be placed in Region II (as shown in Figure 3.9-2) of the spent fuel pool are within the enrichment and burn-up limits of Figure 3.9.1 by checking the assembly's design and burn-up documentation.

4.9.18.2 Ensure that the contents of each consolidated fuel storage box to be placed in Region II (as shown in Figure 3.9-2) of the spent fuel pool are within the enrichment and burn-up limits of Figure 3.9-3 by checking the design and burn-up documentation for storage box contents.

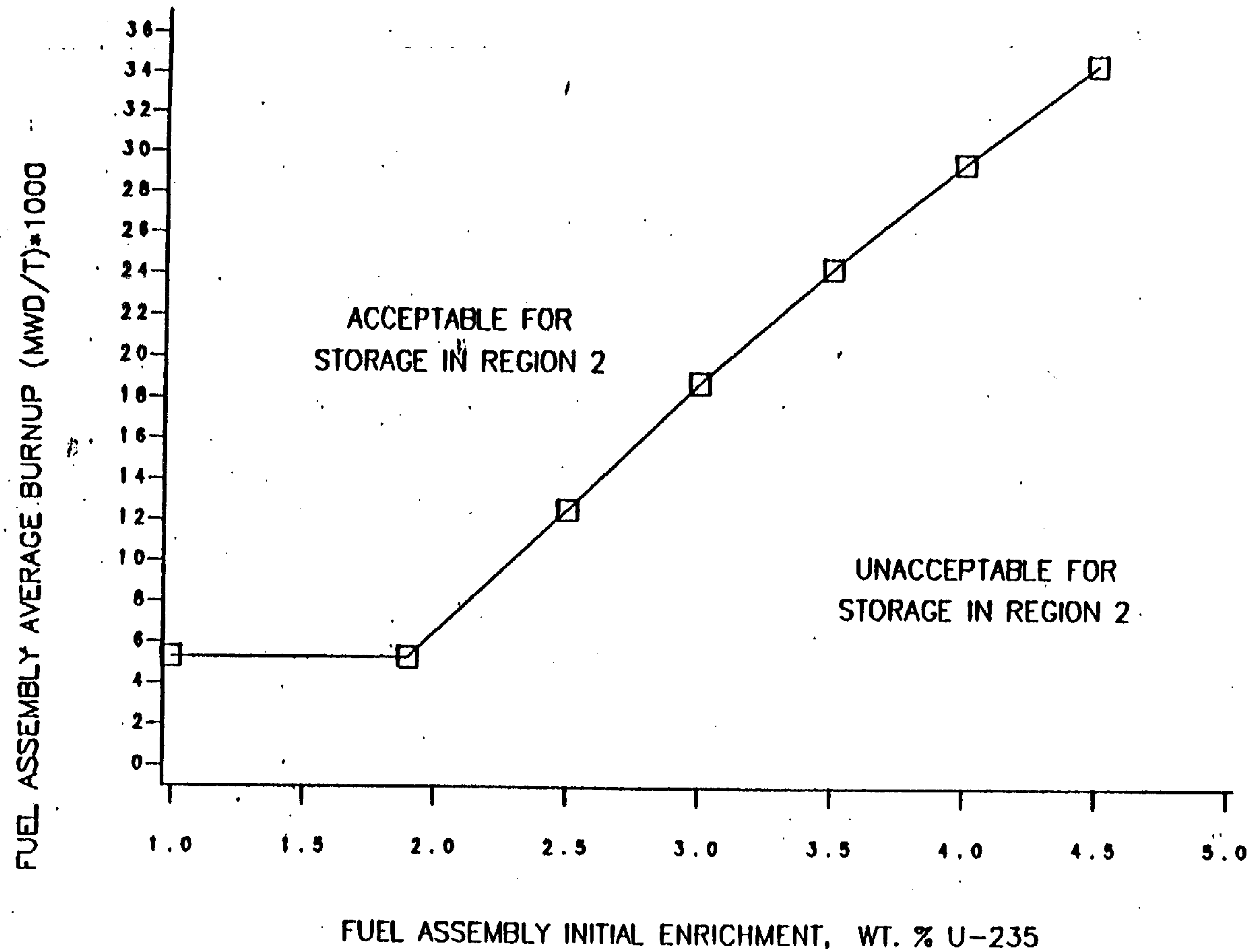
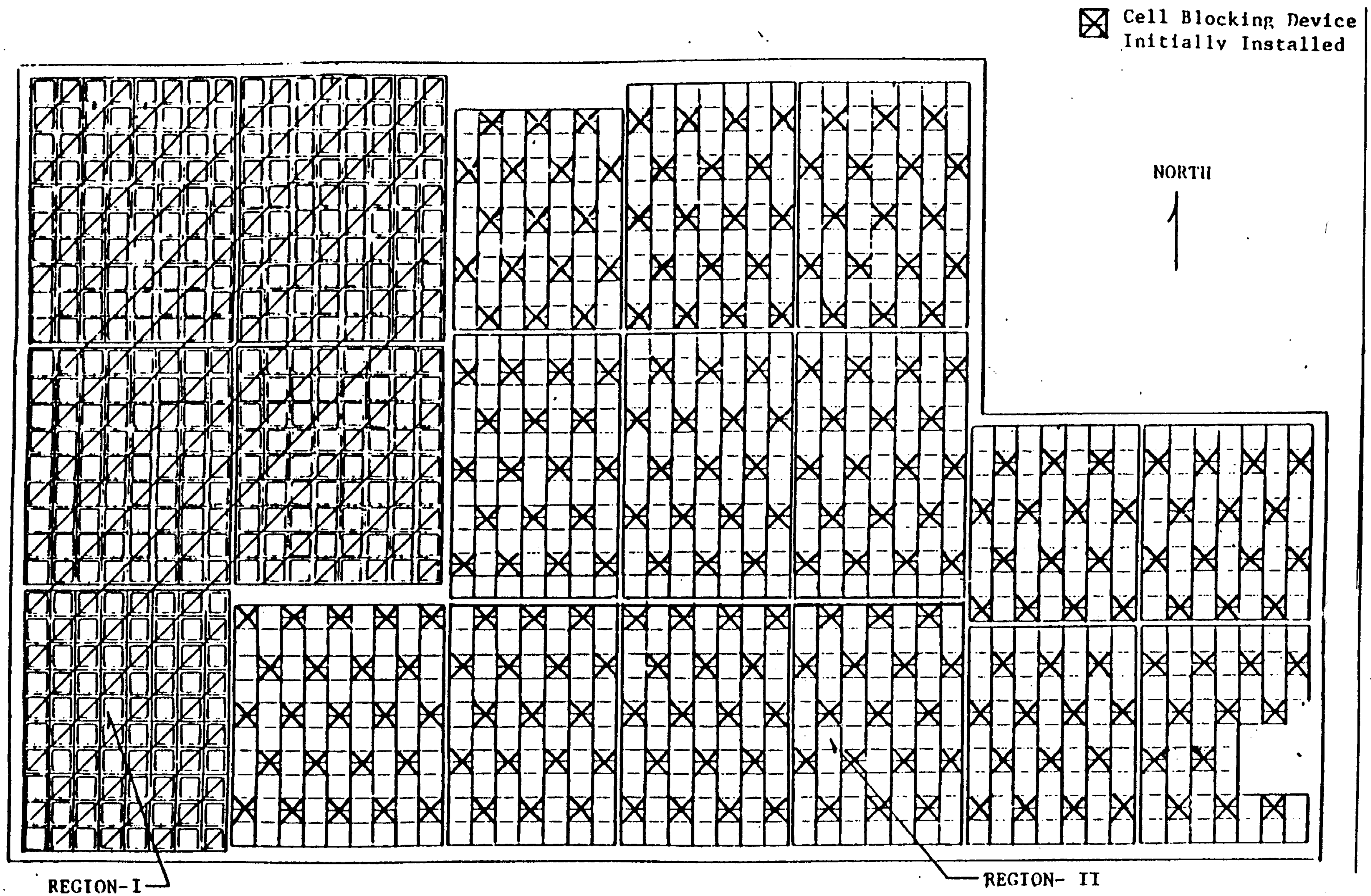


FIGURE 3.9-1 MINIMUM REQUIRED FUEL ASSEMBLY EXPOSURE AS A FUNCTION OF INITIAL ENRICHMENT TO PERMIT STORAGE IN REGION 2



SPENT FUEL POOL ARRANGEMENT UNIT #2
FIGURE 3.9-2

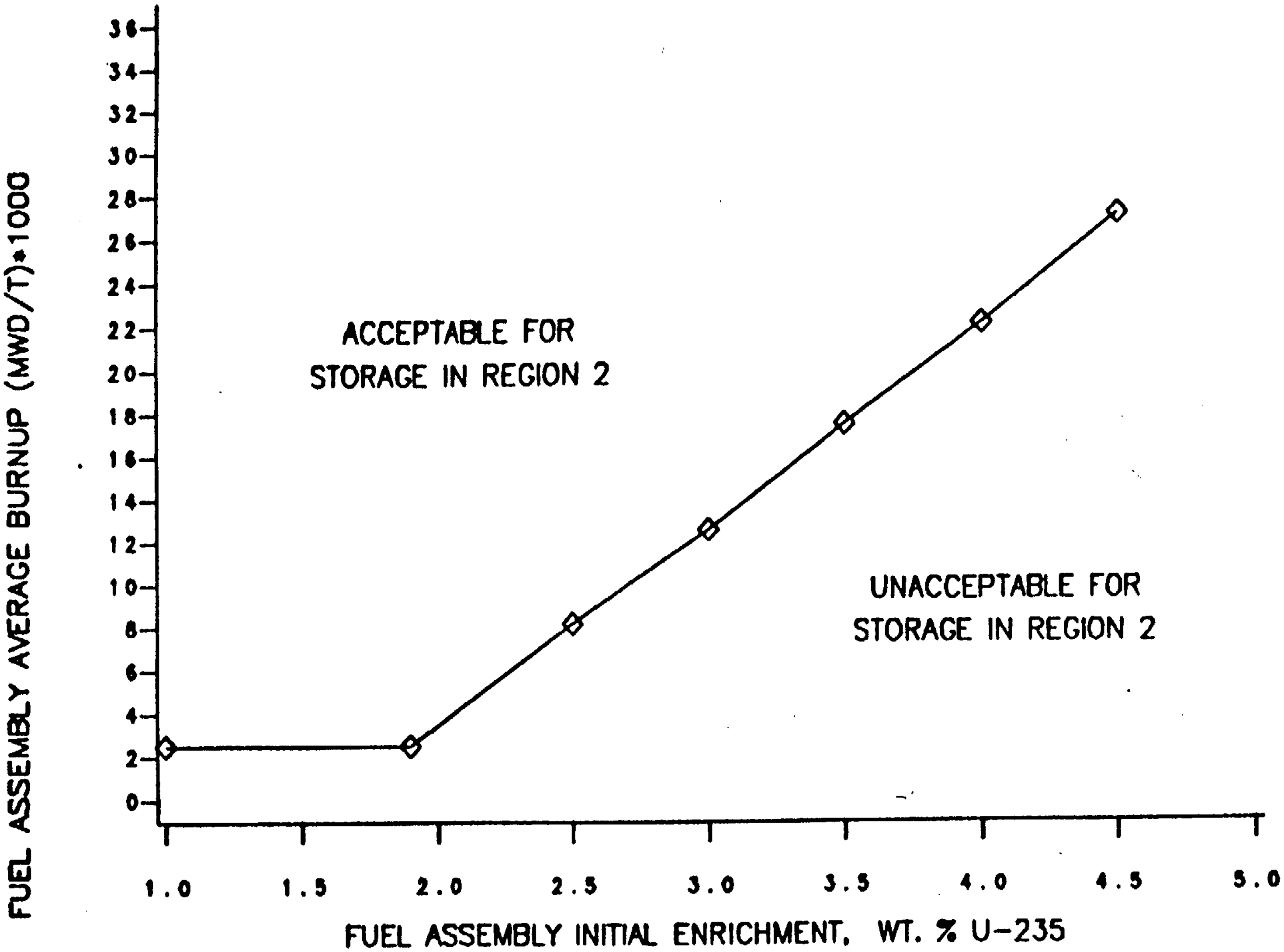


FIGURE 3.9-3 MINIMUM REQUIRED FUEL ASSEMBLY EXPOSURE AS A FUNCTION OF INITIAL ENRICHMENT TO PERMIT STORAGE IN REGION 2 AS CONSOLIDATED FUEL

SPENT FUEL POOL

LIMITING CONDITION FOR OPERATION

3.9.19 Each STORAGE PATTERN of the Region II spent fuel pool racks shall require either that:

(1) A cell blocking device is installed in those cell locations shown in Figure 3.9-2; or

(2) If a cell blocking device has been removed, all cells of the STORAGE PATTERN must have consolidated fuel in them, including the formerly blocked location; or

(3) Meet both (a) and (b):

(a) If a cell blocking device has been removed, all cells of the STORAGE PATTERN must have consolidated fuel in them except the formerly blocked location.

(b) The formerly blocked location is vacant and a consolidated fuel box or cell blocking device is immediately being placed into the formerly blocked cell.

APPLICABILITY: Fuel in the Spent Fuel Pool

ACTION:

Take immediate action to comply with either 3.9.19(1), (2), or (3).

SURVEILLANCE REQUIREMENTS

4.9.19 Verify that 3.9.19 is satisfied at the following times.

(1) Prior to removing a cell blocking device.

(2) Prior to removing a consolidated fuel storage box from its Region II storage location.

REFUELING OPERATIONS

SPENT FUEL POOL

LIMITING CONDITION FOR OPERATION

3.9.20 Prior to consolidation of spent fuel assemblies, the candidate fuel assemblies* must have decayed for at least 5 years.

APPLICABILITY: During all consolidation operations.

ACTION:

With the requirements of the above specification not satisfied, replace candidate assembly with an appropriate substitute or suspend all consolidation activities.

SURVEILLANCE REQUIREMENTS

4.9.20 The decay time of all candidate fuel assemblies for consolidation shall be determined to be greater than or equal to five years within 7 days prior to moving the fuel assembly into the consolidation work station.

*The storage of consolidated spent fuel is limited to five (5) consolidated spent fuel storage canisters (i.e., 10 spent fuel assemblies consolidated into 5 storage canisters/locations).

3/4.9.1 BORON CONCENTRATION

The limitations on reactivity conditions during REFUELING ensure that: 1) the reactor will remain subcritical during CORE ALTERATIONS, and 2) a uniform boron concentration is maintained for reactivity control in the water volume having direct access to the reactor vessel. These limitations are consistent with the initial conditions assumed for the boron dilution incident in the accident analyses.

3/4.9.2 INSTRUMENTATION

The OPERABILITY of the source range neutron flux monitors ensures that redundant monitoring capability is available to detect changes in the reactivity condition of the core.

3/4.9.3 DECAY TIME

The minimum requirement for reactor subcriticality prior to movement of irradiated fuel ensures that sufficient time has elapsed to allow the radioactive decay of the short lived fission products. This decay time is consistent with the assumptions used in the accident analyses.

The requirement for two trains of spent fuel pool cooling to be OPERABLE for 504 hours after subcriticality for the most recently discharged 1/3 core ensures that high water temperature will not degrade resin in the spent fuel pool demineralizers and that the temperature and humidity above the pool are compatible with personnel comfort and safety requirements. The shutdown cooling (SDC) system is a high capacity system. One train of the SDC is sufficient to cool both the core and the spent fuel pool should a failure occur in the spent fuel pool cooling system.

The requirement for the reactor to remain in MODE 5 or 6 until the most recent 1/3 core offload has decayed 504 hours ensures that alternate cooling is available during this time to cool the spent fuel pool should a failure occur in one train of the spent fuel pool cooling system.

3/4.9.4 CONTAINMENT PENETRATIONS

The requirements on containment penetration closure and OPERABILITY ensure that a release of radioactive material within containment will be restricted from leakage to the environment. The OPERABILITY and closure restrictions are sufficient to restrict radioactive material release from a fuel element rupture based upon the lack of containment pressurization potential while in the REFUELING MODE.

3/4.9.5 COMMUNICATIONS

The requirement for communications capability ensures that refueling station personnel can be promptly informed of significant changes in the facility status or core reactivity condition during fuel or CEA movement within the reactor pressure vessel.

3/4.9.6 CRANE OPERABILITY - CONTAINMENT BUILDING

The OPERABILITY requirements of the cranes used for movement of fuel assemblies ensures that: 1) each crane has sufficient load capacity to lift a fuel element, and 2) the core internals and pressure vessel are protected from excessive lifting force in the event they are inadvertently engaged during lifting operations.

3/4.9.7 CRANE TRAVEL - SPENT FUEL STORAGE BUILDING

The restriction on movement of loads in excess of the nominal weight of a fuel assembly and CEA over irradiated fuel assemblies ensures that no more than the contents of one fuel assembly will be ruptured in the event of a fuel handling accident. Specific analysis has been performed for the drop of a consolidated fuel storage box on an intact fuel assembly. This assumption is consistent with the activity release assumed in the accident analyses.

3/4.9.8 SHUTDOWN COOLING AND COOLANT CIRCULATION

The requirement that at least one shutdown cooling loop be in operation ensures that (1) sufficient cooling capacity is available to remove decay heat and maintain the water in the reactor pressure vessel below 140°F as required during the REFUELING MODE, and (2) sufficient coolant circulation is maintained through the reactor core to minimize the effects of a boron dilution incident and prevent boron stratification.

The requirement to have two shutdown cooling loops OPERABLE when the refuel pool is unavailable as a heat sink ensures that a single failure of the operating shutdown cooling loop will not result in a complete loss of decay heat removal capability. With the reactor vessel water level at or above the vessel flange, the reactor vessel pit seal installed, and a combined available volume of water in the refueling pool and refueling water storage tank in excess of 370,000 gallons, a large heat sink is readily available for core cooling. Adequate time is thus available to initiate emergency procedures to provide core cooling in the event of a failure of the operating shutdown cooling loop.

3/4.9.9 and 3/4.9.10 CONTAINMENT RADIATION MONITORING AND CONTAINMENT PURGE VALVE ISOLATION SYSTEM

The OPERABILITY of these systems ensures that the containment purge valves will be automatically isolated upon detection of high radiation levels within the containment. The OPERABILITY of these systems is required to restrict the release of radioactive material from the containment atmosphere to the environment.

3/4.9.11 and 3/4.9.12 WATER LEVEL-REACTOR VESSEL AND STORAGE POOL WATER LEVEL

The restrictions on minimum water level ensure that sufficient water depth is available to remove 99% of the assumed 10% iodine gap activity released from the rupture of an irradiated fuel assembly. The minimum water depth is consistent with the assumptions of the accident analysis.

3/4.9.13 STORAGE POOL RADIATION MONITORING

The OPERABILITY of the storage pool radiation monitors ensures that sufficient radiation monitoring capability is available to detect excessive radiation levels resulting from 1) the inadvertent lowering of the storage pool water level or 2) the release of activity from an irradiated fuel assembly.

3/4.9.14 & 3/4 9.15 STORAGE POOL AREA VENTILATION SYSTEM

The limitations on the storage pool area ventilation system ensures that all radioactive material released from an irradiated fuel assembly will be filtered through the HEPA filters and charcoal adsorber prior to discharge to the atmosphere. The OPERABILITY of this system and the resulting iodine removal capacity are consistent with the assumptions of the accident analyses.

3/4.9.16 SHIELDED CASK

The limitations of this specification ensure that in the event of a cask tilt accident 1) the doses from ruptured fuel assemblies will be within the assumptions of the safety analyses, and 2) K_{eff} will remain $\leq$ .95.

3/4.9.17 MOVEMENT OF FUEL OVER REGION II RACKS

The limitations of this specification ensure that, in the event of a fuel assembly or a consolidated fuel storage box drop accident into a Region II rack location completing a 4-our-of-4 fuel assembly geometry, K_{eff} will remain $\leq$ 0.95.

3/4.9.18 SPENT FUEL POOL

The limitations described by Figure 3.9-1 ensure that the reactivity of fuel assemblies and consolidated fuel storage boxes, introduced into the Region II spent fuel racks, are conservatively within the assumptions of the safety analysis.

3/4.9.19 SPENT FUEL POOL

The limitations of this specification ensure that the reactivity conditions of the Region II storage racks and spent fuel pool K_{eff} will remain less than or equal to 0.95.

The Cell Blocking Devices in the 4th location of the Region II storage racks are designed to prevent inadvertent placement and/or storage of fuel assemblies in the blocked locations. The blocked location remains empty to provide the flux trap to maintain reactivity control for fuel assembly storage in any adjacent locations. Only loaded consolidated fuel storage boxes may be placed and/or stored in the 4th location, completing the STORAGE PATTERN, after all adjacent, and diagonal, locations are occupied by loaded consolidated fuel storage boxes.

3/4.9.20 SPENT FUEL POOL

The limitations of these specifications ensure that the decay heat rates and radioactive inventory of the candidate fuel assemblies for consolidation are conservatively within the assumptions of the safety analysis.

VOLUME

5.4.2 The total water and steam volume of the reactor coolant system is 10,060 + 700/-0 cubic feet.

5.5 EMERGENCY CORE COOLING SYSTEMS

5.5.1 The emergency core cooling systems are designed and shall be maintained in accordance with the original design provisions contained in Section 6.3 of the FSAR with allowance for normal degradation pursuant to the applicable Surveillance Requirements.

5.6 FUEL STORAGE

CRITICALITY

5.6.1 a) The new fuel (dry) storage racks are designed and shall be maintained with sufficient center to center distance between assemblies to ensure a $K_{eff} \leq .95$. The maximum fuel enrichment to be stored in these racks is 3.70 weight percent of U-235.

b) Region I of the spent fuel storage pool is designed and shall be maintained with a nominal 9.8 inch center to center distance between storage locations to ensure a $K_{eff} \leq .95$ with the storage pool filled with unborated water. Fuel assemblies stored in this region may have a maximum fuel enrichment of 4.5 weight percent of U-235. Consolidated fuel storage boxes may also be stored in this region.

c) Region II of the spent fuel storage pool is designed and shall be maintained with a 9.0 inch center to center distance between storage locations to ensure a $K_{eff} \leq .95$ with the storage pool filled with unborated water. Fuel assemblies stored in this region must comply with Figure 3.9-1 to ensure that at least 85% of the design burn-up has been sustained. The contents of consolidated fuel storage boxes to be stored in this region must comply with Figure 3.9-3.

d) Region II of the spent fuel storage pool is designed to permit storage of consolidated fuel in the 4th location of the storage rack and ensure a $K_{eff} \leq 0.95$. Placement of consolidated fuel in the 4th location is only permitted if all surrounding cells of the STORAGE PATTERN are occupied by consolidated fuel.

DRAINAGE

5.6.2 The spent fuel storage pool is designed and shall be maintained to prevent inadvertent draining of the pool below elevation 22'6".

CAPACITY

5.6.3 The spent fuel storage pool is designed and shall be maintained with a storage capacity limited to no more than 384 storage locations in Region I and 962 storage locations in Region II for a total of 1346 storage locations.*

*This translates into 1277 storage locations to receive spent fuel and 69 storage locations to remain blocked.

5.7 SEISMIC CLASSIFICATION

5.7.1 Those structures, systems and components identified as Category I Items in Section 5.1.1 of the FSAR shall be designed and maintained to the original design provisions contained in Section 5.8 of the FSAR with allowance for normal degradation pursuant to the applicable Surveillance Requirements.

5.8 METEOROLOGICAL TOWER LOCATION

5.8.1 The meteorological tower location shall be as shown on Figure 5.1-1.

5.9 SHORELINE PROTECTION

5.9.1 The provisions for shoreline protection described in Amendments 34, 35 and 36 to the FSAR shall be completed by June 15, 1976.

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 117 TO DPR-65

NORTHEAST NUCLEAR ENERGY COMPANY, ET AL.

MILLSTONE NUCLEAR POWER STATION, UNIT NO. 2

DOCKET NO. 50-336

1.0 INTRODUCTION

By application dated May 21, 1986 (Ref. 1), Northeast Nuclear Energy Company (NNECo) requested changes to the Technical Specifications (TS) for Millstone, Unit 2. The proposed changes to the TS would allow storage of consolidated fuel in the spent fuel pool (SFP). In addition, since storage of consolidated spent fuel allows eventual removal of spent fuel storage cell blocking devices, the proposed TS would also increase the spent fuel storage authorization from 1112 to 1346 fuel assemblies, of which 1277 could contain consolidated spent fuel and 69 would remain blocked. In accordance with the licensee's letter dated May 27, 1987, we are initially authorizing only the demonstration phase of spent fuel consolidation. During the demonstration phase, a total of ten (10) spent fuel assemblies will be consolidated into five (5) cannisters which will be stored in the spent fuel pool. The NRC staff is continuing to review the issues associated with the full scale consolidation of spent fuel.

2.0 Evaluation

The NRC staff has considered a number of aspects associated with the storage of consolidated fuel at Millstone, Unit 2, as described in the following sections. We have not reviewed the actual consolidation process which should be completed by the NRC prior to consolidation of fuel at Millstone, Unit 2.

2.1 Reactivity Effects

The safety evaluation of the current request by NNECo involves criticality considerations associated with the storage of consolidated spent fuel in the existing Millstone, Unit 2, spent fuel storage racks. The two-region Millstone, Unit 2, spent fuel storage racks have previously been described (Ref. 2). Region I contains 384 storage locations and has been approved for storage of regular intact fuel assemblies with a maximum enrichment of 4.5 weight percent U-235. The cell is made of stainless steel and uses a flux trap and Boraflex absorbers. The nominal cell center-to-center spacing is 9.8 inches. Region 2 contains 962 cells of which up to 728 (75%) may be used for storage of regular intact fuel assemblies which have experienced sufficient burnup to meet the required NRC criticality criterion of K_{eff} no greater than 0.95. The remaining unused cells (25%) act as neutron flux traps and are provided with cell blocking devices to prevent inadvertent fuel assembly insertion. The Region II cells are non-poisoned and have a nominal center-to-center spacing of 9.0 inches.

The criticality calculations for consolidated fuel were performed by Combustion Engineering (CE) with the two-dimensional DOT-2W transport theory computer code using 16 energy group neutron cross sections obtained from the AMPX library and collapsed by the XSDRNPM code. The homogenized fuel module representation contained three regions in order to represent the differing water fractions between the interior and the peripheral fuel pins in a consolidated assembly. The ability to adequately calculate the reactivity of consolidated fuel was determined by benchmarking criticality experiments performed by Babcock and Wilcox on fuel rods in tightly packed triangular and square arrays (Ref. 3). The benchmarking was performed using the KENO IV Monte Carlo criticality code employing 123 energy group neutron cross sections. The differences in calculated reactivity between a 123 group KENO IV model and a 16 group DOT-2W model were evaluated by CE and were considered to be insignificant (Ref. 4), thereby justifying the use of the 16 group DOT-2W model for consolidated fuel criticality calculations.

The previously approved criticality analyses for storage of intact fuel assemblies in Region I and Region II included calculational biases and uncertainties. Reactivity effects of mechanical tolerances, off-center fuel assembly placements, and pool temperature changes were evaluated. Boron-10 density in the Boraflex was taken at a minimum. The pool temperatures were taken at effectively maximum conditions for reactivity by adding uncertainty values to the relatively conservative temperatures used in the nominal calculations. The resulting total uncertainties, which are at least at a 95/95 probability/confidence level, were 0.021 and 0.015 k for Regions I and II, respectively. Since consolidated fuel is considerably less reactive than intact fuel because of its greatly undermoderated condition, any reactivity effects due to mechanical tolerances, off-center placements, temperature changes, and boron density would not be any greater than for intact fuel. While these conclusions are not based upon calculations, the NRC staff agrees with the licensee's premise regarding the significantly undermoderated nature of the consolidated fuel array as compared to intact fuel assemblies. Therefore, since intact fuel of 4.5 weight percent U-235 enrichment was found to be acceptable for storage in Region I, storage of consolidated fuel in Region I with a maximum fuel enrichment of 4.5 weight percent U-235 is also acceptable.

For Region II, a family of curves of reactivity versus burnup for a range of initial enrichments was generated for consolidated fuel assemblies assuming pure water moderator and using the same methods as previously approved for intact fuel. The curves were then used to define the minimum burnup for fuel with a given initial enrichment which will result in a calculated k_{eff} of 0.90 when consolidated fuel is stored in Region II. Allowing a conservative uncertainty value of 0.05, consolidated fuel which meets the required minimum burnup and initial enrichment limits would be within the NRC acceptance criterion of k_{eff} no greater than 0.95 and, therefore, would be acceptable for storage in Region II. This new burnup versus initial enrichment curve for consolidated fuel will be added to the Millstone, Unit 2, Technical Specifications. It should be noted that intact fuel assemblies may be stored in Region II in 3 out of 4 locations with cell blocking devices in 1 out of 4 locations. However, because of its lower reactivity, consolidated fuel may be stored in 4 out of 4 locations provided that cell blocking devices are not removed until all adjacent cells contain consolidated fuel.* The licensee has proposed that the removal of the cell blocking devices be undertaken in accordance with proposed TS 4.9.18 (see Section 5.0, herein). Such administrative control of spent fuel placement was previously reviewed and approved by the NRC as part of the spent fuel storage expansion (Amendment No. 109 dated January 5, 1986) and provides the basis for the conclusion that assignment of spent fuel between Regions I and II will be carried out safely.

The reactivity effects of postulated accidents have been considered. These include misloading an assembly into an incorrect region and dropping an assembly into a blocked location. The double contingency principle of ANSI N16.1-1975 can be applied in these cases. This states that it is not necessary to assume concurrently two unlikely independent events to ensure protection against a criticality accident. Since Technical Specifications require the boron concentration of the pool to be maintained greater than or equal to 800 ppm whenever an intact or a consolidated fuel assembly is moved over the Region II racks, credit can be taken for the negative reactivity effect of the boron. For these accident conditions, the presence of 800 ppm of soluble boron in the storage pool would result in a k_{eff} value much less than the NRC acceptance criterion of 0.95. In addition, the reactivity effect of less than a full consolidated fuel assembly was considered by determining the maximum number of fuel rods that can be omitted while maintaining k_{eff} at 0.95 or less (Ref. 5).

The staff concludes that the storage of consolidated fuel in the spent fuel pool of Millstone, Unit 2, meets the criticality requirements of General Design Criterion 62. This conclusion is based on the following considerations:

- o Acceptable calculational methods, which have been verified by comparison to critical experiments, have been used.
- o Conservative assumptions have been made concerning the fuel and storage rack properties and configuration.
- o Credible accidents and abnormal conditions have been considered.
- o Allowance for uncertainties has been conservatively taken.
- o The calculated k_{eff} values, including uncertainties, meet the NPC acceptance criterion.

2.2 LOAD DROP

The licensee analyzed the consequences of dropping a consolidated fuel assembly on an intact fuel assembly and a consolidated fuel assembly.

*Removal of all cell blocking devices would result in a storage capacity of 1346 locations; however, the need to achieve a 5-year decay time prior to consolidating spent fuel, limits the actual storage capacity to 1277 locations.

Previous analyses have been approved for a postulated drop of an intact fuel assembly.

The licensee stated that existing restrictions on movement of loads weighing in excess of a fuel assembly or a control element assembly over irradiated fuel assemblies in the SFP assure that radioactive releases equivalent to that contained in one fuel assembly will result from a postulated load drop. The licensee stated that the analysis performed for the dropping of a consolidated fuel assembly on an intact fuel assembly confirmed that the resulting releases do not exceed those assumed in the previous design basis accident analysis for an intact fuel assembly load drop. The staff finds this to be acceptable.

The licensee also stated that, according to the methodology of NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants," approximately 15000 Millstone Unit 2 fuel assemblies which have been subcritical for 120 days would have to be ruptured to obtain a dose equivalent to 1/4 of that allowed in 10 CFR Part 100. Since a total of only 688 consolidated fuel assemblies (containing fuel from 1376 intact fuel assemblies) will be present in the SFP, it is apparent that rupture of all the consolidated fuel assemblies in the Millstone 2 SFP will not result in a sufficient radioactivity release to exceed allowable limits. The NRC agrees with the licensee's analysis of the potential consequences of a consolidated fuel assembly drop including methodology and assumptions. In view of the above, the staff finds the results of the postulated load drop of a consolidated fuel assembly on fuel stored in the Millstone 2 SFP to be acceptable and in conformance with applicable criteria.

3.0 Thermal Effects

In the storage of spent fuel, the control of fuel clad temperature is important to assure integrity of the fuel. In addition, bulk fuel pool water temperature should be limited in order to (1) control humidity and airborne radioactive material concentrations in the vicinity of the spent fuel pool, (2) protect the spent fuel pool structure and its contents, and (3) protect the spent fuel pool cooling and filtration system (especially the resins) from effects of elevated temperature. These considerations are addressed in the following sections.

3.1 Fuel Pin Cladding Temperature

The licensee calculated the maximum exit temperature of the coolant under conditions of natural circulation when passing through both consolidated and normal fuel assemblies for both normal fuel storage conditions (SFP water level at 23 feet above the racks and the water temperature at the base of the racks at 150°F), and those occurring during an accident (SFP water level at 10 feet above the racks, and the water temperature at the base of the racks at 212°F). Three cases were considered: 1) a row of normal (intact) fuel; 2) a row of consolidated fuel; and 3) a mixed row of consolidated and intact fuel (only the center cell with consolidated fuel). The accident scenario involves the loss of spent fuel pool cooling with resultant loss of pool water due to evaporation. A level of 10 feet above the fuel was chosen as the level at which action must be taken to maintain pool level due to radiological shielding considerations. Pool level can be maintained since there are several sources of water available including: (1) shutdown cooling (Refuel water storage tank), (2) spent fuel pool cooling make-up, and (3) fire suppression system. The coolant outlet temperature derived from these calculations indicated that the row of intact fuel results in the highest fuel assembly exit temperatures. The highest temperature occurs in the intact fuel since the analysis assumes that this fuel is recently off-loaded from the reactor and thus has a much higher decay heat rate than does the consolidated spent fuel.

The licensee's calculated maximum cladding temperature under worst case (accident) conditions was 253°F. This temperature is well below that for the fuel assembly during normal operation in the reactor (equal to or greater than 650°F). The staff, therefore, concludes that the cladding temperatures for intact or consolidated fuel storage in the Millstone Unit 2 SFP is acceptable.

3.2 Spent Fuel Pool Bulk Temperature

When storing consolidated fuel assemblies, the licensee stated that the maximum storage capacity in the spent fuel pool (SFP) would be 1277 assemblies consisting of 579 intact (unconsolidated) subassemblies (with less than 5 years decay time), 688 consolidated fuel assemblies (containing fuel from 1376 assemblies), and 10 defective assemblies. A total of 69 spent fuel storage cell locations would be blocked. Of the 579 intact locations, the licensee indicated that only 362 will contain spent fuel assemblies leaving 217 locations for an emergency core offload, if necessary. For the purpose of determining heat loads, the licensee assumed the spent fuel pool to contain 362 intact assemblies, 688 consolidated assemblies and 10 defective assemblies generating 15.2×10^6 BTU/hr under normal maximum conditions. In the event of an emergency offload of a full core (217 fuel assemblies) and the remainder of the SFP storage locations filled as indicated above for the maximum normal heat load case, the licensee calculated a heat load of 37.8 MBTU/hr for the maximum abnormal condition.

Previously, the licensee proposed to modify the SFP storage racks in order to increase the storage capacity from 667 to 1112 fuel assemblies. This proposal was approved by License Amendment No. 109, which was issued on January 15, 1986. With storage of 1112 fuel assemblies, the licensee determined the SFP decay heat loads to be 15.2 MBTU/hr for the normal maximum heat load condition, and 33.0 MBTU/hr for the maximum abnormal heat load condition (full core discharge). The staff noted that temperatures as high as 188°F could be realized in the SFP in the event of a failure of one SFP cooling train with the maximum normal heat load.

For the maximum normal heat load condition, the licensee proposed to require that both trains of the spent fuel pooling cooling system remain operable to allow the most recent 1/3 core offload to decay for a minimum time of 21 days in order to assure maintenance of a SFP temperature of 140°F or less in the event of a failure of a single SFP cooling train. Otherwise, the temperature in the spent fuel pool could not be maintained at a maximum of 140°F by a single SFP train as prescribed in the staff guidelines while the plant returned to normal operation. The staff found this to be acceptable as described in License Amendment No. 114, issued on December 19, 1986. Because the storage of consolidated fuel does not increase the maximum normal heat loads, the previous staff approval remains valid for this case.For the maximum abnormal heat load condition, the licensee proposed to use both spent fuel pool cooling trains and one or more trains of the shutdown cooling system to maintain the SFP temperature below 140°F which satisfies the staff guidelines of maintaining the SFP bulk temperature below boiling for the maximum abnormal case. Note that, with all fuel removed from the reactor and placed in the SFP, the shutdown cooling system may be used solely for SFP cooling. A single failure is not assumed in this condition in accordance with the staff criteria. The staff found this to be acceptable. Because the storage of consolidated fuel results in only a small increase in the maximum abnormal heat load (4.8 MBTU/hr), the SFP bulk temperature conditions will continue to be below boiling and thus the previous staff approval remains valid for this case.

4.0 Structural Evaluation

With regard to the structural evaluation in Reference 6, the licensee described a nonlinear analysis of a fully loaded consolidated fuel storage box dropping 28 inches onto the top of a stored fuel assembly. The CESHOCK computer code was used to determine the maximum impact load in the stored fuel assembly due to the drop. The result of the analysis was a maximum impact force in the stored fuel assembly of 100,000 lbf (pounds force). The calculated peak impact load was then statically applied to the fuel assembly to assess its structural integrity. Since the ultimate load capacity of the guide tubes is 37,840 lbf and an additional 148,750 lbf would be required to produce a yield stress of 25,000 psi in the fuel rods, it was concluded that a stored fuel assembly is capable of absorbing the kinetic energy of a dropped consolidated fuel box without fuel failure.

Due to the increased load caused by the increased storage of spent fuel, the spent fuel pool and auxiliary building were re-analyzed for the increased load. The dynamic interaction between the pool structure and rack modules was accounted for by considering the mass of fully loaded rack modules in the dynamic analysis model of the auxiliary building. The pool structure was originally analyzed in accordance with the ACI-318-63 code, but the re-analysis used a more up-to-date code of ACI-349-80. The results have indicated that all stresses/strain remain within the code allowable except the liner weld stress in one condition. When thermal stress is combined with other stresses, the stress level in the weld is 55.6 ksi, which exceeds the allowable stress of 53.4 ksi by approximately 4 percent. However, the strain levels for the weld section are well within code allowables. The staff agrees with the licensee that this will not create any problem for the liner welds.

There was a concern regarding the licensee's initial response to a question about the Basis for Limiting Condition for Crane Travel in the TS (Ref. 6) which stated that no lateral deformation would result from a fully loaded consolidated fuel storage box dropping 28 inches onto the top of a stored fuel assembly. The licensee's assumption did not seem justified since it had been determined that the guide tubes would yield due to the load, and a random drop would create an eccentric load and thus increase the likelihood of buckling occurring in the guide tubes and the fuel rods. In addition, crushed guide tubes could conceivably exert lateral loads and damage adjacent fuel rods.

The licensee provided additional information regarding the analysis performed by Combustion Engineering Company in Reference 7.

Reference 7 described the geometric constraints and available clearances that justify the assumption that an eccentric drop of a fully loaded consolidated fuel box onto a stored fuel assembly is not physically possible. In addition, it was concluded that crushed guide tubes would not damage the fuel rods.

Based upon our review of information presented by the licensee, we conclude that the structural considerations associated with the storage of consolidated fuel at Millstone, Unit 2, including those associated with the consolidated fuel storage boxes, have been adequately addressed.

5.0 Technical Specifications

The licensee has proposed new TS and changes to existing TS, in order to reflect key assumptions in the consolidated fuel storage safety analyses. Associated TS Bases have also been proposed.

TS 1.39, "Storage Pattern"

A new TS 1.39 has been proposed to define the term "Storage Pattern" as it applies to spent fuel storage Region II, including the use of blocked locations (see Section 2.1, herein).

TS 3.9.7, "Crane Travel - Spent Fuel Storage Pool Building"

A change to TS 3.9.7 is proposed to allow travel of a consolidated fuel storage box over irradiated fuel in the spent fuel pool. Sections 2.2 and 4.0 describe the acceptability of the radiological and structural consequences of a consolidated fuel storage box drop. No other objects in excess of 1800 lbs are permitted to be moved over irradiated fuel in the spent fuel storage pool.

TS 3/4.9.1.7, "Movement of Fuel Over Region II Racks"

A change to TS 3/4.9.1.7, would require a spent fuel pool boron concentration equal to or greater than 800 ppm prior to movement of a consolidated fuel storage box over Region II spent fuel storage racks. Section 2.1, herein, describes the adequacy of the 800 ppm soluble boron concentration.

TS 4.9.18, "Spent Fuel Pool"

A change to TS 4.9.18 is proposed to incorporate enrichment and burn-up limits in the TS for storage of consolidated spent fuel. Section 2.1, herein, addresses the enrichment/burn-up curves for storage of consolidated spent fuel.

TS 3/4.9.19,"Spent Fuel Pool"

A new TS 3/4.9.19 is proposed to address the use of cell blocking devices. The use of cell blocking devices, including the requirement for removal of these devices, is described in Section 2.1, herein.

TS 3/4.9.20, "Spent Fuel Pool"

A new TS 3/4.9.20 requires that spent fuel assemblies decay at least five (5) years prior to being candidates for consolidation. A footnote in TS 3/4.9.20 limits the number of assemblies that can be consolidated to ten (10) fuel assemblies. This limit was proposed by the licensee in their May 27, 1987 letter and represents a demonstration of the consolidation process.

TS 5.6, "Fuel Storage"

A new Section d is proposed for TS 5.6 to require that, "Placement of consolidated fuel in the 4th location is only permitted if all surrounding cells of the STORAGE PATTERN are occupied by consolidated fuel." Removal of blocking devices for placement of a 4th consolidated fuel storage box is discussed in Section 2.1, herein.

TS 5.6.3,"Capacity"

A change to TS 5.6.3 is proposed to increase the spent fuel pool storage capacity from 1112 to 1346 storage locations. From a practical standpoint, however, no more than 1277 fuel assemblies could be stored since the licensee intends to allow five years decay time prior to consolidating spent fuel. This results in 69 locations that will remain blocked. Section 2.1, herein, discusses the removal of the cell blocking devices which results in the increase in spent fuel storage capacity.

5.1 Conclusions Concerning TS

The proposed TS described herein have been reviewed against the assumptions used in the safety analysis. We conclude that the proposed TS are consistent with the safety analysis and assure that consolidated fuel can be safely stored at Millstone, Unit 2. Accordingly, the proposed changes to the TS, and their associated Bases are acceptable.

6.0 Environmental Considerations

The NRC staff has considered the environmental impact of the storage of consolidated spent fuel at Millstone Unit 2. An "Environmental Assessment and Finding of No Significant Impact" was published in the Federal Register on June 1, 1987 (52 FR 20477).

7.0 Conclusion

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

Date: June 2, 1987

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8.0 References

1. Letter from J. F. Opeka (NNECO) to A. C. Thadani (NRC), Transmitting Attachment 1 "Technical Specification Revisions" and Attachment 2 "Safety Analysis Report" for Millstone Nuclear Power Station, Unit No. 2, Storage of Consolidated Spent Fuel, dated May 21, 1986.

2. Letter from J. F. Opeka (NNECO) to E. J. Butcher (NRC), Attachment 2, Millstone Nuclear Power Station, Unit No. 2, Spent Fuel Rerack Safety Analysis Report, dated July 24, 1985.

3. G. S. Hoovler, et al., "Critical Experiments Supporting Underwater Storage of Tightly Packed Configuration of Spent Fuel Pins," BAW-1645-4, dated November 1981.

4. Letter from J. F. Opeka (NNECO) to A. C. Thadani (NRC), Responses to NRC Request for Additional Information, dated October 22, 1986.

5. Letter to J. F. Opeka (NNECO) to A. C. Thadani (NRC), Responses to NRC Request for Additional Information, dated October 3, 1986.

6. Letter from J. F. Opeka (NNECO) to A. C. Thadani (NRC), "Millstone Nuclear Power Station, Unit No. 2 Storage of Consolidated Spent Fuel," dated October 30, 1986.

7. Letter from E. J. Mroczka (NNECO) to A. C. Thadani (NRC), "Millstone Nuclear Power Station, Unit No. 2 Storage of Consolidated Spent Fuel", dated January 2, 1987.