JUN 30 1977

Dockets Nos. 50-245
and 50-336

Northeast Nuclear Energy Company
ATTN: Mr. D. C. Switzer
President
P. O. Box 270
Hartford, Connecticut 06101

Gentlemen:

The Commission has issued the enclosed Amendment No. 39 to Provisional Operating License No. DPR-21 and Amendment No. 30 to Facility Operating License No. DPR-65 for the Millstone Nuclear Power Station, Units Nos. 1 and 2. These amendments consist of changes to the Technical Specifications in response to your applications dated July 15, 1976 (supplemented by December 3, 1977 letter) and November 22, 1976 (supplemented by February 4, 1977 and May 16, 1977 letters).

These amendments will allow an increase in the spent fuel storage capability in the spent fuel pools (SFPs) through the use of high density spent fuel racks. The storage capability for Millstone Unit No. 1 will increase from 1100 to 2184 fuel assemblies while the capability for Unit No. 2 will be increased from 301 and 667 fuel assemblies.

With regard to our review of the Millstone Unit No. 1 spent fuel pool (SFP) modification, Section 6.0 of the enclosed Safety Evaluation and Environmental Impact Appraisal (SER-EIA) describes the Millstone Unit No. 1 SFP cooling and cleanup systems. Operation of these systems can adequately limit the onsite dose rate in the SFP area to an acceptable level, even taking into account the additional spent fuel in the SFP as a result of the modification. However, observations made by our staff at Millstone Unit No. 1 and conversations held with your staff indicate that these systems are not being fully utilized. Specifically, the SFP demineralizer can and should be more effectively used to reduce the dose rate in the SFP area. In addition, we note that contaminated equipment in the SFP, suspended by ropes, significantly increases the dose rate at the sides of the SFP. This practice should be used only when no other alternative exists for storing contaminated equipment.

Cont. 1
GD

OFFICE ➤						
SURNAME ➤						
DATE ➤						

Accordingly, within 60 days following receipt of this letter, we request that you submit a description of those methods which you intend to utilize to further limit personnel exposure in the spent fuel area.

Copies of the Safety Evaluation, Environmental Impact Appraisal and the Federal Register Notice are also enclosed.

Sincerely,

Original signed by

George Lear, Chief
Operating Reactors Branch #3
Division of Operating Reactors

Enclosures:
1. Amendment No. to DPR-21
2. Amendment No. to DPR-65
3. Safety Evaluation
4. Federal Register Notice

cc: See next page

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OFFICE	ORB#3	ORB#3	OELD	ORB#3	AD/ORs	
SURNAME	*CParrish	*DJaffe:acr	*JGray	GLear	KRGoller	
DATE	6/6/77	6/7/77	6/26/77	6/ /77	6/ /77	

cc: William H. Cuddy, Esquire
Day, Berry & Howard
Counselors At Law
One Constitution Plaza
Hartford, Connecticut 06103

Anthony Z. Roisman, Esquire
Roisman, Kessler and Cashdan
1025 15th Street, N. W.
5th Floor
Washington, D. C. 20005

Robert Bishop
Department of Planning & Energy Policy
20 Grand Street
Hartford, Connecticut 06115

Mr. Albert L. Partridge, First Selectman
Town of Waterford
Hall of Records - 200 Boston Post Road
Waterford, Connecticut 06385

Northeast Nuclear Energy Company
ATTN: Superintendent
Millstone Plant
P. O. Box 128
Waterford, Connecticut 06385

Chief, Energy Systems Analysis Branch (AW-459)
Office of Radiation Programs
U. S. Environmental Protection Agency
Room 645, East Tower
401 M Street, N. W.
Washington, D. C. 20460

U. S. Environmental Protection Agency
Region I Office
ATTN: EIS COORDINATOR
John F. Kennedy Federal Building
Boston, Massachusetts 02203

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

CONNECTICUT LIGHT AND POWER COMPANY
THE HARTFORD ELECTRIC LIGHT COMPANY
WESTERN MASSACHUSETTS ELECTRIC COMPANY
NORTHEAST NUCLEAR ENERGY COMPANY

DOCKET NO. 50-245

MILLSTONE NUCLEAR POWER STATION UNIT NO. 1

AMENDMENT TO PROVISIONAL OPERATING LICENSE

Amendment No. 39
License No. DPR-21

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

   A. The application for amendment by Connecticut Light and Power Company, The Hartford Electric Light Company, Western Massachusetts Electric Company, Northeast Nuclear Energy Company (the licensees) dated July 15, 1976 (supplemented by December 3, 1977 letter), 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 3.B. of Provisional Operating License No. DPR-21 is hereby amended to read as follows:

   (B) Technical Specifications

   The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 39 , are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

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

FOR THE NUCLEAR REGULATORY COMMISSION

George Lear for

Karl R. Goller, Assistant Director
for Operating Reactors
Division of Operating Reactors

Attachment:
Changes to the Technical Specifications

Date of Issuance: June 30, 1977

ATTACHMENT TO LICENSE AMENDMENT NO. 39

TO THE TECHNICAL SPECIFICATIONS

FACILITY OPERATING LICENSE NO. DPR-21

DOCKET NO. 50-245

Replace the following page of the Appendix "A" Technical Specifications with the enclosed page. The revised page is identified by Amendment number and contains vertical lines indicating the area of change.

Remove	Replace
153	153

C. Penetrations to the primary containment and piping passing through such penetrations shall be designed in accordance with standards set forth in Section V-2 of the FSAR.

5.5 Fuel Storage

A. The new fuel storage facility shall be such that the K_{eff} dry is less than 0.90 and flooded is less than 0.95.

B. The K_{eff} of the spent fuel storage pool shall be less than or equal to 0.90.

C. The fuel in the spent fuel storage pool shall have a U235 loading of less than, or equal to, 15.2 grams of U235 per axial centimeter of assembly.

5.6 Seismic Design

The reactor building and all contained engineered safeguards are designed for the maximum credible earthquake ground motion with an acceleration of 17% of gravity. Dynamic analysis was used to determine the earthquake acceleration applicable to the various elevations in the reactor building.

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

THE CONNECTICUT LIGHT AND POWER COMPANY, THE HARTFORD ELECTRIC LIGHT COMPANY, WESTERN MASSACHUSETTS ELECTRIC COMPANY, AND NORTHEAST NUCLEAR ENERGY COMPANY

DOCKET NO. 50-336

MILLSTONE NUCLEAR POWER STATION, UNIT NO. 2

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 30
License No. DPR-65

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

   A. The application for amendment by The Connecticut Light and Power Company, The Hartford Electric Light Company, Western Massachusetts Electric Company, and Northeast Nuclear Energy Company (the licensees), dated November 22, 1976, (supplemented by February 4, 1977 and May 16, 1977 letters), 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 satisifed.

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 Appendices A and B, as revised through Amendment No. 30 , are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

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

FOR THE NUCLEAR REGULATORY COMMISSION

for George Lear

Karl R. Goller, Assistant Director
for Operating Reactors
Division of Operating Reactors

Attachment:
Changes to the Technical
Specifications

Date of Issuance:

ATTACHMENT TO LICENSE AMENDMENT NO. 30

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 vertical lines indicating the area of change. The corresponding overleaf pages are also provided to maintain document completeness.

Pages

3/4 9-19 (added)
B 3/4 9-3
5-5

SHIELDED CASK

LIMITING CONDITION FOR OPERATION

3.9.16 All fuel within a distance L from the center of the spent fuel pool cask set-down area shall have decayed for at least 120 days. The distance L equals the major dimension of the shielded cask.

APPLICABILITY: Whenever a shielded cask is on the refueling floor.

ACTION:

With the requirements of the above specification not satisfied, do not move a shielded cask to the refueling floor. The provisions of Specification 3.0.3 are not applicable.

SURVEILLANCE REQUIREMENTS

4.9.16 The decay time of all fuel within a distance L from the center of the spent fuel pool cask set-down area shall be determined to be $\geq$ 120 days within 24 hours prior to moving a shielded cask to the refueling floor and at least once per 72 hours thereafter.

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 the doses from ruptured fuel assemblies will be within the assumptions of the safety analyses.

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 The new and spent fuel storage racks are designed and shall be maintained with sufficient center-to-center distance between assemblies to ensure a $k_{eff} < 0.95$ with the storage pool filled with unborated water. In addition, fuel in the storage pool shall have a U-235 loading of $\leq$ 38.0 grams of U-235 per axial centimeter of fuel assembly.

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".

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.

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

SAFETY EVALUATION AND ENVIRONMENTAL IMPACT APPRAISAL

BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING LICENSE AMENDMENT NOS. 39 AND 30

TO FACILITY OPERATING LICENSE NOS. DPR-21 AND DPR-65

NORTHEAST NUCLEAR ENERGY COMPANY

MILLSTONE NUCLEAR POWER STATION UNITS NOS. 1 AND 2

DOCKETS NOS. 50-245 AND 50-336

TABLE OF CONTENTS

1.0 Introduction

By applications dated July 15, 1976 and November 22, 1976, Northeast Nuclear Energy Company (NNECO) requested license amendments for Millstone Units Nos. 1 and 2. These license amendments would allow an increase in the spent fuel storage capability in the spent fuel pools (SFPs) through the use of high density spent fuel racks. The storage capability for Millstone Unit No. 1 would increase from 1100 to 2184 fuel assemblies while the capability for Unit No. 2 would be increased from 301 to 667 fuel assemblies.

During the course of our review, we found that we needed additional information on the installation of spent fuel racks at Millstone Units Nos. 1 and 2. Accordingly, by letters dated September 30, 1976 and December 25, 1976, we requested additional information from NNECO on Millstone Units Nos. 1 and 2, respectively. These requests were responded to by NNECO on December 3, 1976 and February 4, 1977 for Millstone Units Nos. 1 and 2, respectively. In addition, during the course of our review, we found that additional Technical

Specifications would be required for Millstone Units Nos. 1 and 2. The need for these Technical Specifications was discussed with and accepted by NNECO.

2.0 Background

The present spent fuel pool at Millstone Unit No. 1 has a capacity of 1100 fuel assemblies utilizing storage racks which provide for a center-to-center spacing of fuel bundles of approximately 6.6 inches in the rows and 11.9 inches between rows. Each rack can hold 20 assemblies in two rows of ten assemblies each. The proposed fuel rack modification at Millstone Unit No. 1 will involve removing the existing racks and replacing them with new racks that provide a uniform 6.5 inch center-to-center spacing of the fuel assemblies. The new racks would incorporate B_4C neutron absorber plates between each assembly location in each rack to insure subcriticality, and would increase the storage capability of the SFP to 2184 assemblies.

Millstone Unit No. 1 achieved initial criticality on October 26, 1970. The facility was shutdown on October 1, 1976 for a scheduled refueling and maintenance outage, at which time 124 fuel assemblies were replaced. At present, after four complete cycles of operation, there are 504 spent fuel assemblies stored in the spent fuel storage pool. Spent fuel from Unit No. 1 has never been shipped off the site. A full core for Millstone Unit No. 1 consists of 580 fuel assemblies. In 1976, eleven additional racks of the same design as the original racks were installed in the Millstone Unit No. 1 SFP in existing rack locations. This increased the spent fuel storage capacity by 220 assemblies to a total of 1100 assemblies. Thus, there is currently space in the Unit No. 1 SFP to store an additional 596 assemblies. The next refueling of Unit No. 1 is tentatively scheduled for the fall of 1977. Following this refueling, there would not be space in the Unit No. 1 SFP to offload an entire reactor core should this be necessary or desirable because of operational considerations.

The proposed spent fuel storage racks for Millstone Unit No. 1 consist of 1/8 inch thick type 304 austenitic stainless steel square tubes with 6.5 inch center-to-center spacing separated by cylindrical spacers at the tube corners. B_4C plate absorbers are placed in the cavity between the square tubes. The tubes are flared at each end and welded together at the ends to form a unitized array which is subsequently welded to a pre-assembled base. The edge welding provides a watertight seal for the B_4C plates and assures that the design center-to-center spacing of 6.5 inches is maintained. The tubes are welded into racks of 7 x 9, 6 x 9, 7 x 11 or 6 x 11 cells, the different racks being required to fully utilize the available pool storage space. The total storage of 2184 assemblies is accomplished by utilizing 12 each of the 6 x 11 and 7 x 11 racks and 4 each of the 6 x 9 and 7 x 9 racks. Each rack is enclosed on its sides by stainless steel sheet 1/8 inch thick welded to the peripheral storage tubes. The racks are welded to an elevated base plate supported in turn by a system of welded beams and stiffeners. The base serves to support the weight of the fuel assemblies and to distribute the load to the pool floor. The elevated base plate contains an opening at each storage location to accept the bottom flow nozzle of the fuel assembly. Natural circulation of pool water through the nozzle and up the assembly removes decay heat. The tubes and base plate openings are designed to accept the General Electric 7 x 7 and 8 x 8 fuel assemblies and other assemblies with the same external dimensions and similar lower nozzle design. The rack and its base plate and base assembly are fabricated completely of austenitic stainless steel. The absorber plate is B_4C power bonded together in a carbon matrix. The absorber is a minimum of 25% B_4C by volume with the remainder being carbon and voids. The absorber is fabricated of 0.21" (minimum) thick x 6" wide x 31" long plates which are inserted in the cavity between the square tubes.

Rack weights vary between 10,500 lbs. for the 6 x 9 rack to 15,000 lbs. for the 7 x 11 rack. Each rack incorporates four to six leveling pads to accommodate variations in the pool floor. The racks are restrained against the pool walls by seismic bracing and welded together in groups prior to installation in the pool, resulting in a rigid rack installation. The seismic restraints ensure that the racks will not move relative to the pool.

The present spent fuel storage racks in the Millstone Unit No. 2 SFP are designed to accommodate 301 fuel assemblies with a center-to-center spacing of 18 inches. The proposed modification at Millstone Unit No. 2 will involve removing the existing racks which never held spent fuel and replacing them with new racks having a nominal center-to-center spacing of 12.190 inches. The new racks would provide storage capacity for up to 667 fuel assemblies.

Millstone Unit No. 2 achieved initial criticality on October 17, 1975. The first refueling is scheduled for the fall of 1977. A full core for Unit No. 2 consists of 217 fuel assemblies. The present capacity of the SFP is 301 assemblies, or slightly more than 1-1/3 cores. Following the second refueling, tentatively scheduled for the fall of 1978, Millstone Unit No. 2 would not have space in the SFP to unload an entire reactor core.

The proposed spent fuel storage racks for Millstone Unit No. 2 provide storage locations for 667 fuel assemblies in a rectangular array. The rack is composed of nine modules, each containing 63 fuel assembly storage locations in a 7 x 9 array, and one module containing 100 fuel assembly storage locations in a 10 x 10 array. Each fuel assembly storage module is composed of square storage tubes fabricated from one-quarter inch thick stainless steel plate, with each space capable of accepting one fuel assembly. The fuel assembly storage cavities have lead-in surfaces at the top to provide guidance for insertion of fuel assemblies. The spaces are open at the top and bottom to provide a flow path for convective cooling of spent fuel assemblies through natural circulation. The fuel assembly storage spaces are connected by a cross-beam structure to form modules which limit structural deformations and maintain a nominal center-to-center spacing of 12.190 inches between adjacent storage cavities during design conditions including the Safe Shutdown Earthquake. The entire spent fuel storage rack is constructed of type 304 stainless steel. All welded construction is used in the fabrication of the spent fuel storage racks. Design of the individual cells provides assurance of smooth, snag-free passage in the storage cavities so that it is highly improbable that a fuel assembly could become stuck in the rack.

The weight of the 7 x 9 racks is estimated to be 26,400 lbs. each. The weight of the 10 x 10 rack is about 42,000 lbs. Thus, the total quantity of stainless to be utilized in the new spent fuel racks for Unit No. 2 is approximately 280,000 pounds. The racks for Unit No. 2 do not use a poison material such as boron impregnated stainless steel, B_4C plates or boral.

If Millstone Units Nos. 1 and 2 are refueled annually, and if expansion of the storage capacity of the SFPs is not approved, NNECO would have to shutdown Millstone Units Nos. 1 and 2 in 1981 or 1982 unless alternate storage space for spent fuel from these units could be located. The proposed modifications would extend the spent fuel storage capability of the Unit No. 1 SFP for an additional nine years (through the 1989 refueling) and the storage capability of the Unit No. 2 SFP for an additional five years (through the 1985 refueling). Modifying the fuel management program to increase the time between refuelings could extend the time to fill the SFP capacities.

The proposed modifications to the Millstone Units Nos. 1 and 2 SPFs as proposed by NNECO will not alter the SFPs external physical geometry or require additional modifications to the SFP cooling or purification systems. The proposed modifications do not affect the quantity of uranium fuel utilized in the reactors, the rate of spent fuel generation or the total quantity of spent fuel generated during the anticipated operating lifetime of the facilities. The proposed modifications will increase the number of spent fuel assemblies stored in the SFPs and the length of time that some of the fuel assemblies will be stored in the pools.

Currently, spent fuel is not being reprocessed on a.commercial basis in the United States. The Nuclear Fuel Services (NFS) plant at West Valley, New York, was shut down in 1972 for alterations and expansions; on September 22, 1976, NFS informed the Commission that they were withdrawing from the nuclear fuel reprocessing business. The Allied General Nuclear Services (AGNS) proposed plant in Barnwell, South Carolina, is not licensed to operate. The General Electric Company's (GE) Midwest Fuel Recovery Plant (MFRP) in Morris, Illinois, is in a deommissioned condition. Although no plants are licensed for reprocessing fuel, the storage pool at Morris, Illinois, and the storage pool at West Valley, New York, (on land owned by the State of New York and leased to NFS thru 1980) are licensed to store spent fuel. The storage pool at West Valley is not full but NFS is presently not accepting any additional spent fuel for storage, even from those power generating facilities that had contractual arrangements with NFS. Construction of the AGNS receiving and storage station has been completed. AGNS has applied for, but has not been granted, a license to receive and store irradiated fuel assemblies in the storage pool at Barnwell prior to a decision on the licensing action relating to the separation facility. Thus, NNECO has requested our approval of the SFP modifications at Millstone Units Nos. 1 and 2 due to a lack of alternatives, in the immediate future, for disposal of spent fuel. Our Safety Evaluation and Environmental Impact Appraisal regarding NNECO's proposed modifications are contained herein.

3.0 Safety Evaluation

In reviewing the SFP modifications for Millstone Units Nos. 1 and 2, we considered various safety aspects of the modifications. These aspects include (1) criticality, (2) SFP cooling, (3) mechanical aspects, and (4) consideration of accidents associated with the modification. A discussion and our evaluation of these aspects is contained in the following sections.

3.1.1 Millstone Unit No. 1 SFP Criticality

The proposed spent fuel assembly racks are to be made up of individual 14 feet long containers which have an overall square cross section (6.25 inches along each side). These containers are to be fabricated from 0.125 inch thick type 304 stainless steel plate, and they are to be spaced in the racks so that 0.21 inch thick carbon plates, containing a minimum of 25 volume percent boron carbide, can be inserted between every side of every two adjacent fuel assemblies to serve as a neutron absorber. This configuration results in a nominal storage lattice pitch of 6.5 inches with 2.88×10^{21} atoms of the boron-ten nuclide per square centimeter of area between every side of every two adjacent fuel assemblies.

NNECO states that the highest anticipated uranium-235 enrichment of the fuel assemblies to be placed in the SFP will be 3.0 weight percent (w/o), and this value was used in their neutron multiplication factor calculations. For a maximum uranium dioxide density of 95 percent of the theoretical density in the 8 x 8 array with 63 fuel rods, this 3.0 w/o enrichment results in a fuel loading of 15.2 grams of uranium-235 per axial centimeter of fuel assembly.

For the neutron multiplication factor calculations, NNECO states that the NUMICE computer program was used to obtain four energy group cross sections for use in PDQ-07 diffusion theory calculations and GAM-THERMOS cross sections were used in the XSDRN program to obtain 123 group cross sections for use in the KENO Monte Carlo calculations. These calculational methods were verified by comparing the results of their use in analyses of experiments with experimentally measured results. Ten shipping cask configuration experiments and one reactor critical experiment were calculated with the KENO Monte Carlo program. Based on this verification review, the neutron multiplication factor calculated by these methods was determined to have an uncertainty of ± .008. This uncertainty is in addition to the statistical uncertainty for the finite number of case histories which were calculated.

These computer programs were first used to calculate the neutron multiplication factor for an infinite array of fuel assemblies in the nominal storage lattice. This resulted in a maximum neutron multiplication factor of 0.855, with all of the uncertainties in the KENO method included. The calculation was made for a pool water temperature of 68°F. A calculation for a pool water temperature of 212°F showed that as the pool water was heated to this higher temperature the neutron multiplication factor would decrease by 0.023. Another calculation showed that removing one of every twenty-five boron carbide absorber plates would increase the neutron multiplication factor by 0.012.

The results of NNECO's calculations compare very favorably with results of parametric calculations, available to us from other sources made with another method for a similar fuel pool storage lattice with boron containing plates located between the fuel assemblies and therefore we find NNECO's analytical methods acceptable. In addition, when any number of fuel assemblies, which have no more than 15.2 grams of uranium-235 per axial centimeter of assembly, are loaded into the proposed racks, the neutron multiplication factor will be ≤ 0.867 when it is assumed that one out of every 25 boron carbide plates are randomly missing from the storage racks[1]. The 0.867 value is acceptable since it is more conservative than our acceptance criterion of 0.95. We conclude from the above, that a Technical Specification change to prohibit the storage of fuel assemblies that contain more than 15.2 grams of uranium-235 per axial centimeter of assembly will be required.

Based upon our review we conclude that those design aspects of the Millstone Unit No. 1 proposed spent fuel racks which prevent criticality are acceptable.

3.1.2 Millstone Unit No. 2 SFP Criticality

NNECO states that its criticality calculations are based on fresh (i.e., unirradiated) fuel with 3.26 w/o uranium-235. For the present fuel assemblies in Millstone Nuclear Power Station, Unit No. 2, this corresponds to a fuel loading of 38.0 grams of uranium-235 per axial centimeter of fuel assembly.

In calculating the neutron multiplication factor, NNECO states that the CEPAK program was used to obtain broad energy group cross sections for use in the two dimensional, discrete ordinates transport program, DOT-2W. The accuracy of this method was checked by using it to calculate a series of UO_2 critical experiments; a group of

1 In this regard, the in-site test program, described in NNECO's December 3, 1976 submittal, is an acceptable procedure to assure the presence of the boron carbide plates. This procedure is similar to that proposed for the Haddam Neck Plant (Docket No. 50-213) and involves the inspection of 200 randomly selected SFP rack walls.

subcritical exponential decay experiments on clusters of stainless steel clad, UO_2 rods; and ten critical configurations measured during the LaCrosse Boiling Water Reactor startup program. From these calculations it was determined, with 95 percent confidence, that the actual neutron multiplication factor in the spent fuel pool will not be more than 0.006 higher than those calculated by this method.

Using these computer programs, NNECO calculates a neutron multiplication factor of 0.88 for an infinite array of 3.26 w/o, unirradiated, fuel assemblies configured in the nominal storage lattice, which is assumed to be at a temperature of 20°C. When the most adverse lattice configuration was analyzed, taking into account the worst combination of dimensional tolerances, the neutron multiplication factor increased from 0.88 to 0.916. When it was then further assumed, in conjunction with the worst dimensional tolerances, that four fuel assemblies were moved into their most reactive positions within their containers, the neutron multiplication factor increased from 0.916 to 0.923.

We routinely consider another abnormal distribution case which occurs when a fuel assembly is inadvertently brought up to the outside of a fully loaded rack. NNECO states that for this case, a combination of crane limit switches and mechanical restraints are provided such that the closest physically achievable approach of a fuel assembly to the side of the rack will not increase the neutron multiplication factor in the storage rack. We concur with NNECO's analysis.

The above cited results for the neutron multiplication factor compare favorably with results of parametric calculations, available to us from other sources, made with another method for a similar fuel pool storage lattice. For the worst abnormal case, we find that the neutron multiplication factor in these racks will be less than 0.93. In addition, when any number of fuel assemblies, which have no more than 37.1 grams of uranium-235 per axial centimeter of fuel assembly, are loaded into the proposed racks, the neutron multiplication factor will be less than 0.93. Since this factor is less than our acceptance criterion of 0.95, we find the design acceptable. On this basis, we conclude that Technical Specification changes to prohibit the storage of fuel assemblies that contain more than 38.0 grams of uranium-235 per axial centimeter of assembly will be required.

Based upon our review we conclude that those aspects of the Millstone Unit No. 2 proposed spent fuel racks which prevent criticality are acceptable.

3.2.1 Millstone Unit No. 1 SFP Cooling

In its proposal, NNECO states that the spent fuel pool cooling system for the Millstone Unit No. 1 is designed to remove 7.84×10^6 Btu/hour (2.3 MW) of decay heat from the 4.0×10^4 cubic feet of water in the SFP while maintaining the pool outlet water temperature below 125^oF. These conditions exist for the normal refueling offload of a quarter core.

The use of the shutdown cooling system for SFP cooling is acceptable since the shutdown cooling system does not perform a safety function which could not be performed by other redundant reactor systems. For a full core offload, the shutdown cooling system would be used in conjunction with the spent fuel pool cooling system. NNECO states that this combination of systems is designed to remove 24.6 x 10^6 Btu/hour (7.2 MW) of decay heat below 140^{o}F. By comparison NNECO calculates that the heat generation rate in a quarter core which has decayed for 12 months will be 7.22 x 10^6 Btu/hour (2.1 MW).

For its proposed design of the expanded storage capacity, NNECO calculated a maximum heat load of 17.9 x 10^6 Btu/hour (5.2 MW). This is for a full core which would be moved into the spent fuel pool in 1984 after 250 hours of cooling in the reactor vessel. At that time, a full core offload would fill the expanded spent fuel storage capacity, so this would be the maximum heat load.

A comparison of the above cited NNECO calculated spent fuel cooling heat loads with those obtained by using the total decay energy curve of the NRC Standard Review Plan, "Technical Position APCSB 9-2" shows NNECO's analysis to be adequately conservative. Moreover, if after a full core offload there were to be a complete loss of all spent fuel cooling, it would take more than eleven hours to heat the 4.0 x 10^4 cubic feet of water from 125^{o}F to 212^{o}F.

We find that the cooling capacity will be sufficient to maintain the spent fuel pool outlet water temperature below 125^{o}F. We also find that in the unlikely event all fuel pool cooling is lost, 11 hours would be sufficient time either to make repairs or to add water from an alternate source of cool makeup for the spent fuel pool such as from the condensate deminearlizer. We conclude that existing equipment designed to provide SFP cooling for Millstone Unit No. 1 is adequate to accommodate the additional requirements of the SFP modification.

3.2.2 Millstone Unit No. 2 SFP Cooling

In Table 9.5-2 of the Millstone Unit No. 2 Final Safety analysis Report (FSAR), the spent fuel pool cooling is shown to consist of two pumps and two heat exchangers with a design capacity for removing 11.0×10^6 BTU/hr (3.2 MW) assuming a fuel pool water outlet temperature of 120°F and an inlet temperature 107°F. In their November 22, 1976 submittal, NNECO states that for the periodic refueling case when the final one third core is moved into the modified fuel storage racks, thus filling their capacity, the maximum heat load will be 11.3×10^6 BTU/hr (3.3 MW). NNECO further states that this heat load will raise the fuel pool outlet water temperature to 122°F.

The original maximum heat load, as indicated in the FSAR, was defined as that from a full core unloaded into the pool at 250 hours after the reactor is shutdown plus that from one third of a core unloaded into the pool 30 days earlier. NNECO calculated that heat load to be 31.7×10^6 BTU/hr (9.3 MW). The maximum heat load for the modified pool is based on 434 spent fuel assemblies in the pool in 1984 via normal offloads followed by a full core of 217 fuel assemblies being put into the pool at 250 hours after the reactor is shutdown. This will fill the pool to its capacity. NNECO calculates this heat load to be 28.0 x 10^6 BTU/hr (8.2 MW) and states that this heat load can be removed at a maximum outlet temperature of 143^{o}F with the shutdown cooling system being operated in conjunction with the spent fuel pool cooling system.

We compared NNECO's calculated heat loads with those obtained by using the total decay energy curve given in the NRC Standard Review Plan, "Technical Position APCSB 9-2", and found them to be suitably conservative. Since the maximum heat load for the modified pool is less than the maximum heat load that was calculated for the original SFP racks, due to different but acceptable initial conditions, we find that the proposed modification will not necessitate any increase in cooling capability to satisfy the original design objective of 150^{o}F for the maximum fuel pool outlet water temperature. Thus the procedures for spent fuel cooling that were approved by the NRC for the original SFP racks are also acceptable for the proposed modification.

In the event of failure of off-site power, the spent fuel pool cooling system would be temporarily out of service. Under a maximum heat load of 28.0 x 10^6 BTU/hr, the SFP would reach 212^{o}F within 6 hours; however, emergency power is available to all SFP cooling components. We conclude that a period of 6 hours is sufficient to manually start the SFP cooling components under emergency power conditions and manually open the required valves.

We find the capacity of the cooling system to be sufficient to maintain the spent fuel pool outlet water temperature below 150°F. We also find that since the maximum heat load in the modified pool will be less than that calculated for the original design, the procedures for spent fuel pool cooling that were approved by the NRC for the original racks are acceptable for the proposed modification. We conclude that existing equipment designed to provide SFP cooling for Millstone Unit No. 2 is adequate to accommodate the additional requirements of the SFP modification.

3.3.1 Millstone Unit No. 1 - Mechanical Aspects of the SFP Modification

With regard to the mechanical aspects of the SFP modification, the design of the proposed spent fuel racks was reviewed in accordance with the criteria described in Sections 3.7 (seismic design) and 3.8 (containment) of the Standard Review Plan. Areas of our review included: supporting arrangements for the racks including their restraints, design, fabrication, installation procedures, structural analysis for all loads including seismic and impact loadings, load combinations, structral acceptance criteria, quality assurance requirements for design, fabrication and installation, and applicable industry codes.

As part of the seismic analysis, NNECO used seismic input in the form of floor response spectra as described in the Millstone Unit No. 1 FSAR. The analytical model used for seismic design is composed of a representative two dimensional section of the rack array having the smallest area moment of inertia. The spent fuel racks are represented by vertical, flexible beam elements with horizontal rigid links between them representing the interrack welding. The boundary conditions are such that the base of each rack is assumed fixed in translation and rotation. The mass of the water enclosed in each fuel cell was lumped together with the masses of the fuel assembly and the storage cell. We have concluded that the analytical techniques used will result in an acceptable design for the fuel storage racks. With regard to material aspects, the use of Type 300 series stainless steel materials for the fabrication of the spent fuel racks, and its performance requirements during the service life, were reviewed for consistency with the requirements identifed in Section 9.1.2 of the Standard Review Plan and found to be acceptable.

Due to the possibility of long term storage of spent fuel, we have investigated the effects of the SFP environment on the racks, fuel cladding and pool liner. Based upon our preliminary review and industry operating experience, we have concluded that at the assumed conditions of the SFP water, and taking no credit for inservice inspection, there is reasonable assurance that no significant corrosion of the racks, fuel cladding or pool liner over the lifetime of the plant will occur. However, this issue is still under generic review by the regulatory staff. If the results of this investigation indicate that additional protective measures are warrented to protect the racks, fuel and liner from the effects of corrossion, we will determine what steps or inspection programs, if any are necessary to assure that an acceptable level of safety is maintained. If modifications are necessary, we will require the NNECO to make them.

As a result of our review we find that analyses, design, fabrication and installation of the proposed racks are in accordance with accepted criteria, and are in conformance with the rules of Subsection NF of Section III of the ASME Boiler and Pressure Vessel Code. The racks are designed as seismic Category I equipment. Welding is performed in accordance with Section IX of the ASME Boiler and Pressure Vessel Code. In addition, the additional loads on the existing SFP structrure due to the high density storage of fuel assemblies have been reviewed and we conclude that the structural integrity and leak tightness of the spent fuel pool liner does not change from the original design condition.

We conclude that the mechanical/material aspects of the Millstone Unit No. 1 proposed spent fuel racks are acceptable and that the proposed design meets the applicable portions of 10 CFR Part 50, Appendix A, General Design Criteria 2, 4 and 61.

3.3.2 Millstone Unit No. 2 - Mechanical Aspects of the SFP Modification

Our review of the mechanical aspects of the SFP modification encompassed the same areas and criteria described herein in Section 3.3.1.

The existing SFP structure has been reviewed for the effects of increased dead and seismic loads which result from the modification. Seismic analyses of the spent fuel storage racks were performed by the time history method for each of the two horizontal directions and by the response spectrum method for the vertical direction. The model responses for the vertical direction were combined in accordance with

Regulatory Guide 1.92 entitled, "Combining Model Responses and Spatial Components in Seismic Response Analysis". Rack member and support loads and displacements were obtained by combining the absolute values of the maximum vertical and maximum horizontal response for each horizontal direction. This was stated by the licensee to be more conservative than combining the peak response of all three directions by the "square root of the sum of the squares" (SRSS) method. We concur with this assessment.

Due to the possibility of long term storage of spent fuel, we have investigated the effects of the SFP environment on the racks, fuel cladding and pool liner. Based upon our preliminary review and industry operating experience, we have concluded that at the assumed conditions of the SFP water, and taking no credit for inservice inspection, there is reasonable assurance that no significant corrosion of the racks, fuel cladding or pool liner over the lifetime of the plant will occur. However, this issue is still under generic review by the regulatory staff. If the results of this investigation indicate that additional protective measures are warrented to protect the racks, fuel and liner from the effects of corrossion, we will determine what steps or inspection programs, if any are necessary to assure that an acceptable level of safety is maintained. If modifications are necessary, we will require the NNECO to make them.

As a result of our review we conclude that analyses, design, fabrication and installation of the proposed racks are in accordance with accepted criteria, and are in conformance with the rules of Subsection NF of Section III of the ASME Boiler and Pressure Vessel Code. The racks are designed as seismic Category I equipment. Welding is performed in accordance with Section IX of the ASME Boiler and Pressure Vessel Code. In addition, the additional loads on the existing SFP structrure due to the high density storage of fuel assemblies have been reviewed and we conclude that the structural integrity and leak tightness of the spent fuel pool liner does not change from the original design condition.

We conclude that the mechanical/material aspects of the Millstone Unit No. 2 proposed spent fuel racks are acceptable and that the proposed design meets the applicable portions of 10 CFR Part 50, Appendix A, General Design Criteria 2, 4 and 61.

3.4.1 Millstone Unit No. 1 - Accidents Associated with the Modification

NNECO states that all fuel rack handling will be done with a redundant, single failure proof crane and that all crane movement will be controlled by procedures which will prohibit movement directly over locations in the pool where fuel assemblies are stored. The redundant, single failure proof crane will also be used to handle the spent fuel cask when it is needed for shipping fuel offsite.

The use of the redundant crane will prevent a single failure or malfunction from resulting in a drop or loss of control during the movement of the spent fuel racks or the spent fuel cask. Also, the neutron absorber plates between the fuel assemblies will make the neutron multiplication factor insensitive to an accidental compression of the racks. On this basis, we find that the probability of a rack or cask handling accident significantly increasing the neutron multiplication factor in the pool to be extremely small.

3.4.2 Millstone Unit No. 2 - Accidents Associated with the Modification

In the licensee's submittal of February 4, 1977, in Item 8, it is stated that there will be no fuel assemblies in the pool during the installation of the proposed modification, and that the new racks will be installed in a completely dry pool.

Since there will be no fuel assemblies in the fuel pool while it is being modified, it will not be possible for an accident to result in any unacceptable condition with respect to the neutron multiplication factor. After the racks are installed in the pool, the presence of the nominal refueling concentration of boron in the fuel pool water will eliminate the possibility of achieving criticality in the fuel pool under any postulated accident conditions.

The Unit No. 2 SFP overhead handling system does not possess redundant features similar to those of Unit No. 1. However, the Unit No. 2 SFP has been determined capable of withstanding the drop of a shielded cask without loss of pool integrity resulting in a significant pool water loss. Therefore, to minimize the potential radiological consequences from a cask handling accident that damages stored fuel, it appears prudent that all fuel in the SFP within a distance L from the center of the SFP cask set-down area shall have decayed for at least 120 days when the cask is in the Auxiliary Building. The distance L equals the major dimension of the shielded cask. This requirement for preferred fuel storage configuration will be implemented in the Technical Specifications for Millstone Unit No. 2.

4.0 Technical Specifications

As indicated in Sections 3.1.1 and 3.1.2, herein, the Technical Specifications for Millstone Units Nos. 1 and 2 must be modified to incorporate a limit on the U-235 content of assemblies that will be placed in the SFPs. The U-235 limit for Millstone Unit No. 1 is 15.2 grams of U-235 per axial centimeter (gm/cm) of the assembly and is incorporated in Technical Specification 5.5 entitled, "Fuel Storage". The U-235 limit for Millstone Unit No. 2 is 38.0 gm/cm and is incorporated in Technical Specifications 5.6 entitled, "Fuel Storage".

Inclusion of the above described limits in the Millstone Units Nos. 1 and 2 Technical Specifications provides assurances that criticality in the SFPs will be prevented under the most reactive conditions considered.

With regard to the potential for spent fuel cask drop, as described in Section 3.4.2 herein, Technical Specification 3.9.16 and 4.9.16 with associated Bases must be added to the Millstone Unit No. 2 Technical Specifications. These requirements will assure that the offsite dose consequences of a dropped spent fuel cask will not be more severe than previously analyzed.

5.0 Conclusion on Safety

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 this amendment will not be inimical to the common defense and security or to the health and safety of the public.

6.0 Environmental Impact Appraisal

On September 16, 1975, the NRC announced (40 F.R. 42801) its intent to prepare a generic environmental impact statement on handling the storage of spent fuel from light water reactors. In this notice, the NRC also announced its conclusion that it would not be in the public interest to defer all licensing actions intended to ameliorate a possible shortage of spent fuel storage capacity pending completion of the generic environmental impact statement.

The NRC directed that in the consideration of any such proposed licensing action, the following five specific factors should be applied, balanced, and weighed in the context of the required environmental statement or appraisal.

a. Is it likely that the licensing action here proposed would have a utility that is independent of the utility of other licensing actions designed to ameliorate a possible shortage of spent fuel capacity?

The spent fuel pools for both Millstone Units Nos. 1 and 2 were designed to permit storage of spent fuel for a year or two prior to shipment to a reprocessing facility. Therefore, a pool storage capacity for 1-1/2 or 1-1/3 cores for each reactor was considered adequate. This provided space for complete unloading of the reactor (core offload) even if the spent fuel from the previous refueling was in the pool. It is prudent engineering practice to reserve space in the SFP to receive an entire reactor core, should this be necessary to inspect or repair core internals or because of the other operational considerations. With the existing storage racks, full core discharge would no longer be possible after the next refueling of Unit No. 1, which is scheduled for fall 1977, or after the second refueling of Unit No. 2, tentatively scheduled for fall 1978. As indicated herein in Section 2.0, spent fuel reprocessing facilities cannot assuredly be available to NNECO for at least several years and thus the spent fuel cannot be shipped to a reprocessing facility for separation. The spent fuel must be stored onsite or elsewhere if the facility is to be refueled. With the existing storage racks, the spent fuel pools of Units Nos. 1 and 2 will be filled after the eighth refueling of Unit No. 1 and the fourth refueling of Unit No. 2 (1980 or 1981). If expansion of the SFP capacity is not approved or if an alternate storage facility is not located, NNECO would have to shutdown Units Nos. 1 and 2 in 1981 or 1982.

The proposed licensing action (i.e., installing new racks of a design that permits storing more assemblies in the same space) would provide NNECO with additional flexibility which is desirable even if adequate offsite storage facilities hereafter become available to the licensee.

We have concluded that a need for additional spent fuel storage capacity exists at Millstone Units Nos. 1 and 2 which is independent of the utility of other licensing actions designed to ameliorate a possible shortage of spent fuel capacity.

b. Is it likely that the taking of the action here proposed prior to the preparation of the generic statement would constitute a commitment of resources that would tend to significantly foreclose the alternatives available with respect to any other licensing actions designed to ameliorate a possible shortage of spent fuel storage capacity?

With respect to this proposed licensing action, we have considered commitment of both material and nonmaterial resources. The material resources considered are those to be utilized in the expansion of the SFP.

The total material resources that would be committed for construction of the new spent fuel racks for Millstone Units Nos. 1 and 2 are listed below and compared with the amount of these materials used annually in the U. S.

Item	Amount to be used in racks	Annual U.S. Consumption
Stainless steel	676,000 lbs	2.82×10^{11} lbs
Poison (B_4C)	16,580 lbs	303,000 to 900,000 lbs

Both of the above materials are readily available in abundant supply. The amount of stainless steel and boron carbide required for fabrication of the new racks is a small fraction of these resources consumed annually in the United States. We conclude that the amount of material required for the new racks at Millstone Units Nos. 1 and 2 is insignificant and does not represent an irreversible commitment of material resources.

The longer term storage of spent fuel assemblies withdraws the unburned uranium from the fuel cycle for a longer period of time. Its usefulness as a resource in the future, however, is not changed. The provision of longer onsite storage does not result in any cumulative effects due to plant operation since the throughput of materials does not change. Thus the same quantity of uranium will be consumed and likewise the same quantity of radioactive material will have been produced when averaged over the life of the plant. This licensing action would not consitute a commitment of resources that would affect the alternatives available to other nuclear power plants or other actions that might be taken by the industry in the future to alleviate fuel storage problems. No other resources need be allocated because the other design characteristics of the SFP remain unchanged. No additional allocation of land would be made; the land area now used for the SFP would be used more efficiently by reducing the spacings among fuel assemblies.

The increased storage capacity at the Millstone Units Nos. 1 and 2 SFPs was considered as a nonmaterial resource and was evaluated relative to proposed similar licensing actions within a year period (the time we estimate is necessary to complete the generic environmental statement) at other nuclear power plants, fuel reprocessing facilities and fuel storage facilities. We have determined that the proposed expansion in the storage capacity of the SPFs is only a measure to allow for continued operation and to provide operational flexibility at the facility, and will not affect similar licensing actions at other nuclear power plants.

We conclude that the expansion of the SFPs at the Millstone Units Nos. 1 and 2 facility, prior to the preparation of the generic statement, does not constitute a commitment of either material or nonmaterial resources that would tend to significantly foreclose the alternatives available with respect to any other individual licensing actions designed to ameliorate a possbile shortage of spent fuel storage capacity.

c. Can the environmental impacts associated with the licensing action here proposed be adequately addressed within the context of the present application without overlooking any cumulative environmental impacts?

Since the additional capacity of the SFPs is proposed for this site alone and for this licensee only, all the environmental impacts can be assessed within the context of this application. Potential non-radiological and radiological impacts resulting from the fuel rack conversions and subsequent operation of the expanded SFPs at this facility were considered by the NRC staff. No environmental impacts on the environs outside the spent fuel storage building (Unit No. 2) or secondary containment (Unit No. 1) were identified as a result of construction of the expanded SFPs. The impacts within these buildings are expected to be limited to those normally associated with metal working activities. Moreover, no significant environmental impacts, either onsite or offsite, could be identified as resulting from operation of expanded SFPs at this facility.

The only potential offsite nonradiological environmental impact that could arise from this proposed action would be an additional discharge of heat to the quarry and ultimately to Long Island Sound as a result of decaying of the fuel in the SFPs.

Storing spent fuel in the SFPs for a longer period of time will add more heat to the SFP water. The SFP heat exchangers in each unit are cooled by their reactor building closed cooling water system which in turn is cooled by the station service cooling water system. Compared to the existing heat load on the service cooling water system and the total heat load rejected to the quarry by the once through circulating water system, the small additional heat load from the SFP cooling system will be negligible.

The potential offsite radiological environmental impact associated with this expansion (resulting from an incremental addition in the long-lived radioactive effluents released from the facility) was evaluated and determined to be environmentally insignificant as addressed below.

The expansion of the SFPs will allow spent fuel to be stored for an additional nine years for Unit No. 1 and five years for Unit No. 2 without shipment offsite and still maintain space to off-load a full core. During the storage of the spent fuel under water, both volatile and nonvolatile radioactive nuclides will be released to the water from the surface of the assemblies or from defects in the fuel cladding. Most of the material released from the surface of the assemblies consists of activated corrosion products such as Co-58, Co-60, Fe-59 and Mn-54 which are not volatile. The radionuclides that might be released to the water through defects in the cladding, such as Cs-134, Cs-137, Sr-89 and Sr-90, are also predominantly nonvolatile. The primary impact of such nonvolatile radioactive nuclides is their contribution to radiation levels to which workers in and near the SFP would be exposed. The volatile fission product nuclides of most concern that might be released through defects in the fuel cladding are the noble gases (xenon and krypton), tritium, and the iodine isotopes.

The SFP's cooling and cleanup systems have both radiological and nonradiological effects. Radiologically, they remove impurities from the SFP's and thus reduce the onsite dose to personnel. Nonradiologically, they are a source of the thermal effluent. The impact associated with these systems due to the SFP modifications are discussed herein.

The spent fuel pools for Millstone Units Nos. 1 and 2 are provided with cooling loops which remove residual heat from fuel stored in the SFP. The Spent Fuel Pool Cooling and Cleanup System (SFPCCS) for Millstone Unit No. 1 was designed to maintain the SFP water temperature less than or equal to 125°F during normal refueling operations and less than or equal to 140°F during full core discharge situations. The corresponding temperatures predicted for the current Unit No. 2 SFP arrangement were 120°F and 150°F. The cooling and cleanup systems are described in Section 10.2.2 of the FSAR for Unit No. 1 and in Section 9.5 of the FSAR for Unit No. 2. Using a more advanced state-of-the-art analysis compared to the earlier methods used in the Millstone FSARs, NNECO predicts that with the maximum increased storage of spent fuel, the SFP bulk water temperature will be 125°F and 122°F in Units Nos. 1 and 2, respectively, during normal refueling and 140°F respectively, during an emergency core off-load condition.

Thus, the calculated temperatures of the water in the SFPs will be less than or equal with the increased storage capacity than originally predicted except in the case of Unit No. 2 during normal refuelings. Even in this case, the temperature is estimated to be only 2°F above the design temperature of 120°F.

For Millstone Unit No. 1, the existing fuel pool cooling and cleanup system consists of two 625 gpm circulating pumps, two heat exchangers, a filter and demineralizer, and the required piping, valves and instrumentation. The water from the Millstone Unit No. 1 spent fuel pool is purified by passing it through the SFP purification system and returning it to the pool. The purification system, which has been recently modified, consists of a disc type filter and a 160 ft^3 mixed bed demineralizer to remove radioactive nuclides and chemical impurities in the water. The filter yields a negligible amount (less than one drum per year) of solid waste since disposable filter media is not used. The demineralizer resin can be regenerated if activity levels are low or can be disposed of if desired. It is estimated a bed will last at least a year if not regenerated under either the existing or modified pool capacity. NNECO estimates that the total solid waste shipped annually from the system should be less than 167 ft^3 and should not significantly increase because of the SFP modification.

The cleanup system for Millstone Unit No. 2 consists of two refueling water purification pumps, two filters and a demineralizer and associated valves and piping. In addition, the SFP has been provided with a skimmer pump and two filter assemblies to remove surface dust and debris. The cleanup system has been designed to process water through the purification loop from the refueling pool and the refueling water storage tank. The clarity and purity of the spent fuel pool water is maintained by passing approximately 125 gpm of the cooling loop flow through the disposable cartridge type filters and the 42 cubic foot, mixed bed, nonregenerable demineralizer. Separate skimmer systems are provided for both the SFP and the refueling pool. The systems consist of two 60 gpm pumps, four disposable cartridge type filters and associated piping and valves. The filters are changed on the basis of pressure drop across the units. The wastes generated by the purification and skimmer systems consist of filter cartridges and resins which are packaged and shipped offsite as solids to an approved burial site.

Storing additional spent fuel in the SFP may increase the small amount of corrosion and fission product nuclides introduced into the SFP water. The purification systems for the Millstone

Units Nos. 1 and 2 SFPs are capable of removing the increased radioactivity to maintain acceptable radiation levels above and in the vicinity of the pools. This could increase the amount of radioactivity accumulated on the filters and demineralizers which are disposed of as solid waste. This increase, if any, should be minor because the fuel is relatively cool, thermally, and radionuclides will have decayed significantly, so that releases of activity should be very small when compared to the radioactivity of solid wastes normally generated by each reactor.

As a conservative estimate, we have assumed that the amount of solid radwaste may be increased by an additional resin bed a year from each SFP due to the increased operation of the spent fuel pool purification systems. From 1972 through 1975, an average of 27,000 cubic feet of solidified waste was shipped offsite from Millstone Unit No. 1. Unit No. 2 has only been in operation for a year. However, during 1975, an average of 9500 cubic feet per reactor of solidified waste was shipped offsite by PWRs. If the storage of additional spent fuel does increase the amount of solid waste from the SFP purification systems by about 200 cubic feet per year from the two facilities, (which accounts for an additional resin bed a year from each SFP) the increase in total waste volume shipped would be less than 1% and would not have any significant additional environmental impact.

In addition to the solid wastes generated by operation in the SFP area as discussed above, the present spent fuel racks and control rod racks in the Unit No. 1 SFP will probably be disposed of as low activity waste. The present racks in the Unit No. 2 SFP are not contaminated and can be sold as scrap (thus reducing the net consumption of material resources), sold to an independent spent fuel storage facility, or retained for possible later double-tiering of spent fuel. If the Unit No. 1 racks are disposed of as solid waste, the volume would be approximately 660 cubic feet and will occur once in the lifetime of the plant. Averaged over the lifetime of the plant, this would increase the total waste volume shipped from the facility by less than 0.1%. This would not have any significant additional environmental impact.

We have estimated the increment in onsite occupational dose resulting from the proposed increase in stored fuel assemblies on the basis of information supplied by NNECO and by utilizing realistic assumptions for occupancy times and for dose rates in the spent fuel pool area from radionuclide concentrations in the SFP water. The spent fuel assemblies themselves contribute a negligible amount to dose rates in the pool area because of the depth of water shielding the fuel. Our analysis indicates that the occupational radiation exposure resulting from the proposed action represents a negligible burden. Based on present and projected operations in the spent fuel pool area, the proposed modification will add less than one precent to the total annual occupational radiation exposure burden at this facility. The small increase in radiation exposure will not affect NNECO's ability to maintain individual occupational doses to as low as is reasonably achievable and within the limits of 10 CFR 20. Thus, we conclude that storing additional fuel in the SFPs will not result in any significant increase in doses received by occupational workers.

With respect to gaseous releases, since short-lived noble gases have decayed to negligible amounts, the only significant noble gas isotope remaining in the SFPs and attributable to storing additional assemblies for a longer period of time would be krypton-85. Based on operating experience for zircaloy clad fuel for pressurized water reactors (PWRs) such as Millstone Unit No. 2 (see NUREG-0017), we have assumed that 0.12% of all fuel rods have cladding defects which permit the escape of fission product gases. For boiling water reactors (BWR's) such as Millstone Unit No. 1, based on proprietary data from General Electric Company, we have assumed that 0.36% of all fuel rods have cladding defects which permit the escape of fission product gases. It is assumed that the fission product gases escape on a relatively linear basis with time. On this basis, we have conservatively estimated that an additional 87 curies per year of krypton-85 may be released from the Millstone Unit No. 1 SFP and that an additional 38 curies of krypton-85 may be released from the Millstone Unit No. 2 SFP when the modified pools are completely filled. The fuel storage pool areas are continuously ventilated. This air is released through the plant stack for Unit No. 1 and through the enclosure building vent for Unit No. 2. If the facilities do eventually release an additional 125 curies per year of Kr-85 as a result of the proposed modifications, the increase would result in an additional offsite dose of less than 0.01 mrem/year estimated to an individual and less than 0.1 man-rem to the population within a 50 mile radius of the plant. This dose is insignificant when compared to the approximately 100 mrem/year that an individual receives from natural background radiation. Thus, we conclude that the proposed modification will not have any significant impact on radiation levels or personnel exposure offsite.

Assuming that the spent fuel will be stored onsite for several years (rather than shipped offsite after 6 to 12 months storage as originally planned), iodine-131 releases from spent fuel assemblies will not be significantly increased by the expansion of the fuel storage capacity since the iodine-131 inventory in the fuel will decay to negligible levels between each annual refueling. Storing additional spent fuel assemblies is not expectd to increase the bulk water temperature above 125^{o}F used in the design analysis for Unit No. 1 and only 2^{o}F above the 120^{o}F used in the design analysis for Unit No. 2. This small increase in spent fuel pool temperature for Millstone Unit No. 2 will result in a slight increase in the evaporation rate from the pool. Because the water evaporating from the spent fuel pool contains tritium and may contain radioiodines, the personnel exposure in the SFP area will increase correspondingly. The iodine is removed from the SFPs water by the SFP cleanup system and by their relative short half lives. Because of high pool air sweep flow rates directly above the pools, the yearly average air temperatures and relative humidity in the SFP areas will not change as a result of small increases in spent fuel pool water temperature. Since baseline data on spent fuel pool evaporation rate and tritium and iodine concentrations do not exist for Millstone Unit No. 2, the radiological effects from the slightly increased tritium evaporation from the spent fuel pool can only be given in relative terms. Most airborne releases from the plant result from leakage of reactor coolant which contains tritium and iodine in higher concentrations than the SFPs. Therefore, even with the slightly higher evaporation rate from the Unit No. 2 SFP, the expected increase in tritium and iodine released from Unit No. 2 will be small compared to the amount normally released from Unit No. 2 and that previously evaluated.

An additional potential source of gaseous release can be associated with the drop of a spent fuel cask into a SFP. As stated in Section 3.4.1 herein, the overhead handling system provided for moving shielded casks in the area of the Unit No. 1 SFP is provided with a sufficiently high degree of redundancy that the probability of a cask drop accident which can damage the pool water-tight integrity is small enough to preclude consideration of that event (Amendment No. 27 to DPR-21 for the Millstone Nuclear Power Station, Unit No. 1). We also conclude that this degree of redundancy results in the probability of a cask and/or heavy load handling accident which could damage fuel being small enough to approve the proposed modification.

The Unit No. 2 SFP overhead handling system does not possess redundant features similar to those of Unit No. 1. However, the Unit No. 2 SFP has been determined capable of withstanding the drop of a shielded cask without loss of pool integrity resulting in a significant pool water loss. Therefore, as stated in Section 3.4.1 herein, to minimize the potential radiological consequences from a cask handling accident that damages stored fuel, it appears prudent that all fuel in the SFP within a distance L from the center of the SFP cask set-down area shall have decayed for at least 120 days when the cask is in the Auxiliary Building. The distance L equals the major dimension of the shielded cask. This requirement for preferred fuel storage configuration will be implemented in the Technical Specifications for Millstone Unit No. 2.

These limitations ensure that in the event of a cask handling accident the potential off-site doses from damaged fuel assemblies will be <1 Rem for the conservative design basis analysis. The potential off-site doses for the realistic accident assessment will be of the order of the determinations of the Environmental Impact Statement dated June 1973 for other accidents of similar or higher probability of occurrence. We conclude, therefore, that as a result of the SFP modifications, no accident previously considered will be more likely to occur or will have significantly greater consequences.

We have considered the potential cumulative environmental impacts associated with the expansion of the SFPs and have concluded that they will not result in radioactive effluent releases that significantly affect the quality of the human environment during either normal operation of the expanded SFPs or under postulated fuel handling accident conditions.

d. Have all technical issues which have arisen during the review of this application been resolved within that context?

This Environmental Impact Appraisal and Safety Evaluation point out that all questions concerning health, safety and environmental concerns have been answered.

e. Would a deferral or severe restriction on this licensing action result in substantial harm to the public interest?

In regard to this licensing action, we have considered the following alternatives: (1) shipment of spent fuel to a fuel reprocessing facility, (2) shipment of spent fuel to a separate fuel storage facility, (3) shipment of spent fuel to another reactor site, and (4) ceasing operation of the facility. These alternatives are considered in turn.

The total construction cost for the planned modification of the spent fuel pools in 1976 dollars is estimated to be about \$1900/assembly for Millstone Unit No. 1 and \$4900/assembly for Millstone Unit No. 2. This estimate includes capital costs (direct and indirect), home office engineering, contingencies and allowance for funds used during construction (AFUDC). While this is costly, the alternatives are more costly or are not available as described in the following sections.

1) <u>Shipment of Spent Fuel to a Fuel Reprocessing Facility</u>

As discussed earlier, none of the three commercial reprocessing facilities in the U. S. are currently operating. The General Electric Company's Midwest Fuel Recovery Plant (MFRP) at Morris, Illinois, is in a decommissioned condition.

On September 22, 1976, Nuclear Fuel Services, Inc. (NFS) informed the Nuclear Regulatory Commission that they were "withdrawing from the nuclear fuel reprocessing business". In their letter to NRC and letters to utilities with whom NFS had contracts for storage and reprocessing of spent fuel, NFS discussed the reasons for their decision. For several years, NFS had been seeking the licensing approval of the Commission for modifications of the reprocessing plant at West Valley to increase its operating capacity and for operation of the modified facility. When the Commission determined that such approval would require both a construction permit and an operating license amendment, NFS filed an application for amendments to Provisional Operating License No. CSF-1, which was docketed on December 17, 1973. During the course of review of this application, new regulatory requirements were periodically identified; for example, in April 1976, the NRC staff concluded that seismic requirements would have to be significantly increased. NFS estimated that the new requirements would increase the cost of the project from the $15 million originally estimated to over $600 million and delay resumption of reprocessing until 1988. On the above basis, NFS concluded "that the project is commercially impractical in light of regulatory requirements that have arisen since the project was initiated".

The Allied General Nuclear Services (AGNS) reprocessing plant received a construction permit on December 18, 1970. In October 1976, AGNS applied for an operating license for the separation facility; construction of the separation facility is essentially complete. On July 3, 1974 AGNS applied for a materials license to receive and store up to 400 MTU in spent fuel in the on-site storage pool, on which construction has been completed. Hearings are expected to be completed on the materials license application by late 1977. However, the AGNS separations plant will not be licensed until the issues presently being considered in the GESMO proceedings are resolved and these proceedings are completed.

NNECO does not have any contractual arrangements with MFRP, NFS or AGNS to store or process spent fuel assemblies from Millstone Units Nos. 1 and 2. Shipment of spent fuel for reprocessing is not an available alternative for several years. At present there is not storage available for Millstone Units Nos. 1 or 2 spent fuel assemblies at any of the fuel reprocessors. Although it is not anticipated that any storage will be available in the foreseeable future, the costs associated with this alternative would be based on a minimum storage commitment of seven to ten years which we estimate to be $6,000 to 8,000/year/assembly or $60,000 to $80,000/assembly for the ten year period. Not included in this estimate is the cost of shipping the spent fuel from Millstone Units Nos. 1 and 2 to the reprocessor's facility.

2) <u>Shipment of Spent Fuel to a Separate Fuel Storage Facility</u>
An alternative to expansion of onsite spent fuel pool storage is the construction of new "independent spent fuel storage installations" (ISFSI). Such installations could provide storage space in excess of 1000 MTU of spent fuel. This is far greater than the capacities of onsite storage pools. An ISFSI could be designed using dry storage technology. Fuel storage pools at GE Morris and NFS are functioning as ISFSIs although this was not the original design intent. Likewise, if the receiving and storage station at AGNS is licensed to accept spent fuel, it would be functioning as an ISFSI until the separations facility is licensed to operate. The license for the GE facility at Morris, Illinois, was amended on December 3, 1975 to increase the storage capacity to about 750 MTU; approximately 200 MTU is now stored in the pool. The NFS facility has capacity for about

260 MTU, with approximately 170 MTU presently stored in the pool. However, since NFS withdrew from the fuel reprocessing business, they are not at present accepting additional spent fuel for storage even from those reactor facilities with which they had contracts. The AGNS will have capacity for about 400 MTU if they are licensed to receive spent fuel.

With respect to construction of new ISFSIs, Regulatory Guide 3.24, "Guidance on the License Application, Siting Design, and Plant Protection for an Independent Spent fuel Storage Installation" issued in December 1974, recognizes the possible need for ISFSIs and provides recommended criteria and requirements for water-cooled ISFSIs. Pertinent sections of 10 CFR Part 19, 20, 30, 40, 51, 70, 71 and 73 would also apply.

NNECO has investigated the possibility of constructing a separate, independent storage facility to store spent fuel discharged from Millstone Units Nos. 1 and 2. Preliminary estimates of implementing this alternative have indicated that to build an independent facility with a storage capacity of 1,000 MTU (BWR and/or PRW assemblies) would cost approximately $54 million. NNECO estimated the earliest possible completion of the independent facility would be 1981. The capital cost equates to approximately $16,400/assembly and does not include the cost of transporting the spent fuel from Millstone Units Nos. 1 and 2 to the facility.

The staff has estimated that at least five years would be required for completion of an independent fuel storage facility. This estimate assumes one year for preliminary design; one year for preparation of the license application, Environmental Report, and licensing review in parallel with one year for detailed design; two and one-half years for construction and receipt of an operating license; and one-half year for plant and equipment testing and startup.

Industry proposals for independent spent fuel storage facilities are scarce to date. In late 1974, E. R. Johnson Associates, Inc. and Merrill Lynch, Pierce, Fenner and Smith, Inc. issued a series of joint proposals to a number of electric utility companies having nuclear plants in operation or contemplated for operation, offering to provide independent storage services for spent nuclear fuel. A paper on this proposed project was presented at the American Nuclear Society meeting in November 1975. The NRC has not received any license requests for facilities conceived and designed only to store spent fuel. In 1974, E. R. Johnson Associates estimated their construction cost at approximately $9000 per spent fuel assembly. At this rate, it would cost the licensee over $7,000,000 to store the additional 808 spent fuel assemblies that the proposed modification will accommodate, plus there would be additional costs for shipment and safeguarding the fuel. An independent spent fuel storge installation is not a viable alternative based on cost or availability in time to meet NNECO's needs. It is also unlikely that the total environmental impacts of constructing an independent facility and shipment of spent fuel would be less than the minor impacts associated with the proposed action.

3) Shipment of Spent Fuel to Another Reactor Site

Northeast Nuclear Energy Company (NNECO) is a Northeast Utilities Company. At present, Northeast Utilities has one other operating nuclear power plant, Connecticut Yankee. Connecticut Yankee does not have space in the SFP to receive and store spent fuel from Millstone Units Nos. 1 and 2, since at the present time it does not have even the capability to completely offload its entire core. NRC has reviewed and approved an expansion of the storage capacity of the Connecticut Yankee SFP; modification of the pool is currently under way. However, Connecticut Yankee needs the increased storage capacity itself, for continued operation of the facility. Space could be made available in the Connecticut Yankee SFP for spent fuel from Millstone Units Nos. 1 and 2 on a short term basis but this alternative would introduce more operational and environmental impacts than the proposed actions. According to a survey conducted and documented by the Energy Research and Development Agency, up to 46 percent of the operating nuclear power plants will lose the ability to refuel during the period 1975-1984 without additional spent fuel storage pool expansions or access to offsite storage facilities. Thus, NNECO cannot assuredly rely on any other power facility to provide additional storage capability except on a short-term emergency basis.

4) Ceasing Operation of the Facility

Storage of spent fuel from Millstone Units Nos. 1 and 2 in the existing racks is possible but only for a short period of time. As discussed above, if expansion of the SFP capacity is not approved and if an alternate storage facility is not located, NNECO would have to shutdown Millstone Units Nos. 1 and 2 in 1981 or 1982 due to a lack of spent fuel storage facilities, resulting in the cessation of electric energy production. Based on current prices for low-sulphur content oil, it would cost Northeast Utilities approximately $354,000/day in differential fuel costs to replace the energy generated by nuclear fuel.

In summary, the alternatives (1) to (3) described above do not offer the operating flexibility of the proposed action nor could they be completed as rapidly as the proposed action. The alternatives of shipping the spent fuel to a reprocessing facility, an independent storage facility or to another reactor would be more expensive than the proposed action and might preempt storage space needed by another utility. The alternative of ceasing operation of the facility would also be more expensive than the proposed action because of the need to provide replacement power. In addition to the economic advantages of the proposed action, we have determined that the expansion of the storage capacities of the SFP for Millstone Units Nos. 1 and 2 would have a negligible environmental impact. Accordingly, deferral or severe restriction of the action here proposed would result in substantial harm to the public interest.

6.1 Basis and Conclusion for not Preparing an Environmental Impact Statement

We have reviewed these proposed facility modifications relative to the requirements set forth in 10 CFR Part 51 and the Council of Environmental Quality's Guidelines, 40 CFR 1500.6 and have applied, weighed, and balanced the five factors specified by the Nuclear Regulatory Commission in 40 FR 42801. We have determined that operation under these license amendments will not significantly affect the quality of the human environment. Therefore, the Commission has found that an environmental impact statement need not be prepared and that, pursuant to 10 CFR 51.5(c), the issuance of a negative declaration to this effect is appropriate.

UNITED STATES NUCLEAR REGULATORY COMMISSION

DOCKETS NOS. 50-245 AND 50-336

NORTHEAST NUCLEAR ENERGY COMPANY,
THE CONNECTICUT LIGHT AND POWER COMPANY
THE HARTFORD ELECTRIC LIGHT COMPANY, AND
WESTERN MASSACHUSETTS ELECTRIC COMPANY

NOTICE OF ISSUANCE OF AMENDMENT TO FACILITY

OPERATING LICENSE

AND NEGATIVE DECLARATION

The U. S. Nuclear Regulatory Commission (the Commission) has issued Amendment No. 39 to Provisional Operating License No. DPR-21 and Amendment No. 30 to Facility Operating License No. DPR-65 to Northeast Nuclear Energy Company, The Connecticut Light and Power Company, the Hartford Electric Light Company, and Western Massachusetts Electric Company, which revised Environmental Technical Specifications for operation of the Millstone Nuclear Power Station, Units Nos. 1 and 2, located in the Town of Waterford, Connecticut. The amendments are effective as of their date of issuance.

These amendments will allow an increase in the spent fuel storage capability in the spent fuel pools (SFPs) through the use of high density spent fuel racks. The storage capability for Millstone Unit No. 1 will increase from 1100 to 2184 fuel assemblies while the capability for Unit No. 2 will be increased from 301 to 667 fuel assemblies.

The applications for the amendment comply with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations. The Commission has made appropriate findings as required by the Act and the Commission's rules and regulations in 10 CFR Chapter I, which are set forth in the license amendment. Notices of Proposed Issuance of Amendments to Facility Operating License in connection with this action were published in the FEDERAL REGISTER on September 30, 1976 (41 FR 43257) and December 23, 1976 (41 FR 55953). No request for a hearing or petition for leave to intervene was filed following notice of the proposed action.

The Commission has prepared an environmental impact appraisal for the revised Technical Specifications and has concluded that an environmental impact statement for this particular action is not warranted because there will be no environmental impact attributable to the action other than that which has already been predicted and described in the Commission's Final Environmental Statement for the facility dated June 1973.

For further details with respect to this action, see (1) the applications for amendment dated July 15, 1976 (supplemented by letter dated December 3, 1977) and November 22, 1976 (supplemented by February 4, 1977 and May 16, 1977 letters), (2) Amendments Nos. 39 and 30 to Licenses Nos. DPR-21 and DPR-65, and (3) the Commission's related Safety Evaluation and Environmental Impact Appraisal. All of these items are available for public inspection at the Commission's Public Document Room, 1717 H Street, N. W., Washington, D. C. and at the Waterford

Public Library, Rope Ferry Road, Route 156, Waterford, Connecticut. A copy of items (2) and (3) may be obtained upon request addressed to the U. S. Nuclear Regulatory Commission, Washington, D. C. 20555, Attention: Director, Division of Operating Reactors.

Dated at Bethesda, Maryland, this 30 day of June 1977.

FOR THE NUCLEAR REGULATORY COMMISSION

George Lear

George Lear, Chief
Operating Reactors Branch #3
Division of Operating Reactors