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JRBuchanan
ACRS (16)
OPA (CMiles)
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Docket No. 50-293

AUGUST 17 1978

Boston Edison Company
M/C NUCLEAR
ATTN: Mr. G. Carl Andognini
800 Boylston Street
Boston, Massachusetts 02199

Gentlemen:

The Commission has issued the enclosed Amendment No. 33 to Operating License No. DPR-35 for the Pilgrim Nuclear Power Station. This amendment consists of changes to the Technical Specifications in response to your request dated December 17, 1975 and supplements thereto dated November 8, 1976, June 14, August 1, September 6, and 9, December 5, 1977, June 26, 1978 and August 10, 1978.

This amendment authorizes the installation and use of new high density storage racks for the storage of spent fuel assemblies in the spent fuel storage pool.

Copies of the Safety Evaluation, Environmental Impact Appraisal, and the Notice of Issuance and Negative Declaration are also enclosed.

Sincerely,

Original signed by

Thomas A. Ippolito, Chief
Operating Reactors Branch #3
Division of Operating Reactors

Const I

Enclosures:
1. Amendment No. 33 to DPR-35
2. Safety Evaluation
3. Environmental Impact Appraisal
4. Notice

cc w/enclosures:
See page 2

ORB #3
*SSheppard
4/13/78

*SEE PREVIEW YELLOW FOR CONCURRENCES

Subject to making indicated changes in discussion of occupational exposures
Smith

OFFICE	ORB #2	ORB #3	DOR	ORB #2	OELD	ORB #3
SURNAME	*PO'Connor	*JHannon:mjf	*BGrimes	*DZiemann	B.	TIppolito
DATE	4/13/78	4/13/78	4/14/78	/ /78	8/11/78	8/17/78

NRC FORM 318 (9-76) NRCM 0240

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Docket No. 50-293

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ATTN: Mr. G. Carl Andognini
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Boston, Massachusetts 02199

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Sincerely,

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

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4. Notice

cc w/enclosures:
See page 2

ORB #3
SSheppard
3/ /78

OFFICE	ORB #2	ORB #3	DOR	ORB #2	OELD	ORB #3
SURNAME	PO'Connor	JHannon:mjf	BGrimes	DZiemann		GLear
DATE	4/3/78	4/3/78	4/7/78	/ /78	/ /78	/ /78

NRC FORM 318 (9-76) NRCM 0240 ☆ U. S. GOVERNMENT PRINTING OFFICE: 1976 – 626-624

cc w/enclosures:
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Plymouth, Massachusetts 02360

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Plymouth Public Library
North Street
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Massachusetts Department of Public Health
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Boston, Massachusetts 02111

Water Quality & Environmental Commissioner
Department of Environmental Quality
Engineering
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Boston, Massachusetts 02202

Mr. David F. Tarantino
Chairman, Board of Selectmen
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JFK Federal Building
Boston, Massachusetts 02203

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

BOSTON EDISON COMPANY

DOCKET NO. 50-293

PILGRIM NUCLEAR POWER STATION, UNIT NO. 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 33
License No. DPR-35

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

   A. The application for amendment by the Boston Edison Company (the licensee) dated December 17, 1975, and supplements thereto dated November 8, 1976, June 14, August 1, September 6, and September 9, December 5, 1977, June 26, 1978, and August 10, 1978, 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 Facility License No. DPR-35 is hereby amended to read as follows:

"3.B Technical Specifications

The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 33 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

Brian K. Grimes, Assistant Director
for Engineering and Projects
Division of Operating Reactors

Attachment:
Changes to the Technical
Specifications

Date of Issuance: August 17, 1978

<u>ATTACHMENT TO LICENSE AMENDMENT NO. 33</u>

<u>FACILITY OPERATING LICENSE NO. DPR-35</u>

<u>DOCKET NO. 293</u>

Revise Appendix A as follows:

Remove page 207 and replace with revised page 207. Marginal lines indicate revised area.

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. Fuel in the spent fuel pool shall have a maximum fuel loading of 16.0 grams of U-235 per axial centimeter.

D. Fuel in the spent fuel pool shall have a maximum assembly average loading of 3.0 weight percent U-235.

E. The number of spent fuel assemblies stored in the spent fuel pool shall not exceed 2320.

F. Loads in excess of 1000 lbs. shall be prohibited from travel over fuel assemblies in the spent fuel storage pool.

G. No fuel which has decayed for less than 200 days shall be stored in racks within an arc described by the height of the cask around the periphery of the energy absorbing pad.

5.6 SEISMIC DESIGN

The station Class I structures and systems have been designed for ground accelerations of 0.08g (design earthquake) and 0.15g (maximum credible earthquake).

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING AMENDMENT NO. 33 TO FACILITY OPERATING LICENSE NO. DPR-35

BOSTON EDISON COMPANY

PILGRIM NUCLEAR POWER STATION, UNIT NO. 1

DOCKET NO. 50-293

1.0 INTRODUCTION

By application dated December 17, 1975 and supplements thereto dated November 8, 1976, June 14, August 1, September 6 and 9, and December 5, 1977, the Boston Edison Company (BECo)or licensee) requested authorization to increase the storage capacity in the Pilgrim Nuclear Power Station Unit No. 1 (Pilgrim 1) spent fuel storage pool from 880 fuel assemblies to 2300 fuel assemblies. The increase will be accomplished within the existing spent fuel pool, by the installation of spent fuel storage racks which utilize fixed neutron absorbers to allow higher density storage.

2.0 DISCUSSION

Criticality Considerations

The proposed spent fuel assembly racks are to be made up of individual aluminum containers which will be approximately foutreen feet long and which will have a square cross section with an inner dimension of approximately 6.3 inches. One eighth inch thick Boral plates, which are to have a minimum of 35 weight percent boron carbide in an aluminum matrix, are to be seal welded in cavities between every side of every adjacent storage container. These Boral plates are to provide 1.7×10^{21} atoms of the boron-ten nuclide per square centimeter of area between all adjacent fuel assemblies. The above dimensions result in a nominal storage lattice pitch of 7.0 inches with a fuel region volume fraction of 0.54.

BECo states that its criticality calculations are based on fresh (i.e., unirradiated) fuel with 3.0 weight percent uranium-235. For the present fuel assemblies in Pilgrim, this corresponds to a maximum fuel loading of 16.0 grams of uranium-235 per axial centimeter of fuel assembly.

To determine the neutron multiplication factor, BECo states that four energy group cross sections were used in its calculations with the PDQ-07 diffusion theory computer program and that the accuracy of this method was checked by comparision with KENO-II Monte Carlo calculations and by analysis of critical experiments.

These computer programs were first used to calculate the neutron multiplication factors for an infinite array of fuel assemblies in the nominal storage lattice. Calculations were made to determine the highest neutron multiplication factor as a function of pool water temperature. The highest value was obtained for the lowest spent fuel pool water temperature (i.e., 68°F). Accordingly, the balance of the calculations were conservatively made at this temperature.

BECo states that, when the uncertainty factor is included, these analyses for the nominal storage lattice yield a neutron multiplication factor of 0.868.

In order to determine the maximum possible neutron multiplication factor in the pool, the following abnormal conditions were considered:

1. eccentric positioning of fuel assemblies in the storage array;

2. a fuel assembly placed tightly in the corner formed by an L-shaped junction of three racks; and

3. one Boral plate missing from every 3x3 group of fuel assemblies in the storage racks.

The highest neutron multiplication factor was obtained for the third case listed above. The licensee found the neutron multiplication factor for this case to be 0.891.

2.1.1 EVALUATION

The above cited results of the licensee's claculations compare favorably with results of parametric calculations made with another method for a similar fuel pool storage lattice. *With the exception of the case where certain Boral plates are assumed to be missing from the racks, the maximum neutron multiplication factor will be obtained by bringing a fuel bundle as close as possible to the outside of a filled storage rack. However, this neutron multiplication factor will not be as large as the 0.891 calculated for having one out of every 36 Boral plates (3 x 3 group of fuel assemblies) missing from the racks.

2.1.2 Conclusion

We find that when any number of fuel assemblies, which have no more than 16.0 grams of uranium-235 per axial centimeter of fuel assembly, are loaded into the proposed racks, the neutron multiplication factor will be $\leq$0.891, when it is assumed that there is no more than one plate missing out of every group of thirty-six contiguous Boral plates. Since this factor is less than our acceptance criterion of 0.95, we find the proposed design acceptable and there is reasonable assurance that the health and safety of the public will not be endangered by the installation or use of the proposed racks.

*A Graphic Method for Comparing K_∞ in Fuel Storage Pools, Transactions of American Nuclear Society Winter Meeting, November 27 - December 2, 1977 (Page 409).

To conform with the assumptions in the criticality analysis the licensee has agreed that the station's Technical Specifications be modified to prohibit the storage of fuel assemblies that contain more than 16 grams of uranium-235 per longitudinal centimeter of assembly. Additionally, a testing program has been developed, and found acceptable by the NRC, to verify at the reactor site that there is 95 percent confidence that there is no more than one missing Boral plate out of every group of 36 contiguous Boral plates.*

2.2 Spent Fuel Cooling

In its submittal, BECo states that the additional heat load in the spent fuel pool (SFP) due to the proposed modification will not increase the water temperature above the original design values. In this regard, it is stated in the FSAR that in order to handle the heat load immediately following refueling, two heat exchangers are sized for a combined heat load of 6.3×10^6 BTU/hr (1.85 MW). With both of the SFP cooling pumps operating, this heat load would result in a fuel pool temperature of 125°F.

When only one of the two pumps is operating, assuming this heat load, the fuel pool temperature will increase to no more than 135°F. The FSAR also states that for the event where the unloading of an abnormal amount of spent fuel is required, the residual heat removal (RHR) system can be interconnected to the fuel pool cooling system and that this interconnection is sized to handle up to 1200 gallons per minute of flow from the RHR system. In its submittal, BECo states that this RHR interconnection can be made in about three hours. The large volume of SFP cooling water will allow a period of more than 12.5 hours for the pool water temperature to rise from 125°F to the boiling temperature.

2.2.1 Evaluation

By using the total decay energy curve given in the NRC Standard Review Plan, "Technical Position APCSB 9-2", we find that the SFP cooling system is conservatively designed to remove the decay heat in the normal one quarter core refueling off-loads at 100 hours after the reactor is shut down. For this case, if one assumes a single failure (i.e., one of the two pumps fails to operate) the fuel pool temperature should not exceed 135°F.

For off-loading the full core, it is assumed that, as stated in the FSAR, the RHR system will be interconnected and used in conjunction with the SFP cooling system. The 1200 gallons per minute (gpm) of flow from the RHR system added to the 1340 gpm design flow for the SFP cooling system will increase by approximately a factor of two the 1.85 MW cooling capacity while maintaining the 125°F fuel pool outlet water

*BECo letter #78-78 dated May 4, 1978.

temperature. This cooling capacity will be approximately doubled again (i.e., to a total of 7.0 MW) by allowing the fuel pool outlet water temperature to increase to 135°F.

In order to calculate the maximum heat generation rate for the modified SFP, we assumed that there could be eleven quarter cores in the pool from annual reloads when the reactor is shut down and then cooled for 150 hours prior to starting the transfer of the full core to the fuel pool. We further assumed that it would take ten days to transfer a full core of 580 assemblies to the fuel pool. With these assumptions, and using the total decay energy curve in the NRC Standard Review Plan, "Technical Position APCSB 9-2", we find the maximum heat generation rate in the modified pool to be 5.8 MW.

The total volume in the Pilgrim 1 SFP is approximately 4.8×10^4 cubic feet. We find that with the proposed racks installed and completely filled with fuel assemblies, about half of this pool volume will be taken up by the fuel assemblies and the racks so that the remaining water volume would be about 2.4×10^4 cubic feet. If we assume that all of the cooling systems fail with this maximum heat source in the pool, it would take about six hours to raise the water temperature in the pool from 135°F to 212°F. This is a conservative estimate since it neglects the heat capacity of the racks and assumes no heat lost to the surroundings.

2.2.2 Conclusion

We find that the cooling capacity will be sufficient to maintain the SFP water outlet temperature at or below 135°F. We also find that in the unlikely event of multiple failures causing the complete loss of cooling, six hours would be sufficient time to find an alternate cooling method or a source of makeup water. We conclude that there is reasonable assurance that the health and safety of the public will not be endangered by the use of the proposed design.

2.3 Installation of Racks and Fuel Handling

In its submittal, BECo states the following:

1) The new spent fuel racks will be installed in phases which will provide storage space for the refueling off-loads and for a full core of 580 assemblies at any time up until about 1987.

2) The replacement of existing racks will be in accordance with written procedures which will ensure that no rack module will be moved over fuel assemblies; and

3) The area to be used for a spent fuel cask is to be unchanged by this modification, and as before, the spent fuel cask will be moved without passing over fuel or racks.

2.3.1 Evaluation

The above procedures should minimize the possibilities for dropping a rack or a fuel cask on stored fuel assemblies. The presence of the Boral plates between fuel assemblies will prevent the neutron multiplication factor from exceeding 0.95 even when the array is grossly distorted and compacted in the event of an accident.

The NRC staff has underway a generic review of load handling operations in the vicinity of spent fuel pools to determine the likelihood of a heavy load impacting fuel in the pool and, if necessary, the radiological consequences of such an event. The staff has also reviewed the cask handling evolutions anticipated to occur in connection with the fuel pool expansion to determine their acceptability in the interim prior to completion of the generic review. As a result of this evaluation, Pilgrim 1 will be required to prohibit the movement of loads with weight in excess of the weight of a fuel assembly, including the channel box, over fuel assemblies in the SFP. Additionally, no fuel which has decayed for less than 200 days will be allowed to reside in racks subject to a cask tip accident. And finally, the licensee has committed to perform a handling yoke analysis to demonstrate a minimum safety factor of 1.2 prior to the use of any rack which has not had the structural integrity of its yoke handling mechanism approved by the NRC.

With the above restrictions imposed on cask handling evolutions, the staff concludes that the consequences of fuel handling accidents in the SFP and cask drop accidents in the reactor building are not changed from those presented in the Safety Evaluation dated August 1971. The staff also considers that the above restrictions will minimize the likelihood of a fuel handling or cask drop accident while the evolutions are in progress. On this basis, we find the load handling operations associated with the SFP modification acceptable.

2.3.2 Conclusion

We conclude that there is reasonable assurance that the health and safety of the public will not be endangered by the installation and use of the proposed racks.

2.4 Structural and Mechanical Design

The proposed SFP modification consists of replacing the existing fuel storage racks with new spent fuel racks to increase the storage capacity from 880 to 2300 fuel assemblies. The fuel assemblies are stored in anodized aluminum modules. The modules are interconnected in a group to minimize relative displacement and prevent impact.

Each module is arranged in a 10 X 10 or a 10 X 5 array of fuel assemblies. The fuel assemblies are inserted into cavities that are formed by a cluster of cans that are arranged in a checker board pattern. The can provides separation and lateral restraints for each fuel assembly. Boral (B_4C) poison material is sealed in cavities within each can by welding. The cans are constrained by upper and lower castings that are bolted to plates along the perimeter to form a box structure. The lower casting vertically supports each fuel assembly. Each module is freestanding with no lateral restraints to the wall and is supported by five steel feet that transfer load to the pool floor. The lateral loads on the racks will be transferred by friction between the feet and the pool floor.

2.4.1 Evaluation

The new spent fuel racks will be installed on a phased basis to provide additional capacity as required during normal refueling outages. Installation has been sequenced to eliminate any interfacing between the existing racks and the new racks. During periods of phased installation, both groups of racks will be seismically supported. At no time will any object be moved over stored fuel in accomplishing these procedures.

The design and fabrication of the racks are in accordance with ASCE Task Committee on Lightweight Alloys, "Suggested Specifications for Structures of Aluminum Alloys 6061-T6 and 6067-T6"; AISC, "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings"; "Aluminum Construction Manual, Section 1, Specifications for Aluminum Structures - the Aluminum Association"; and ASME, "Boiler and Pressure Vessel Code, Section VIII, IX. The loads, load combinations and acceptance criteria used for the rack design are consistent with Sections 3.8.4.II.3 and 3.8.4.II.5 of the Standard Review Plan for steel structures. The materials and fabrication processes are essentially the same as those used at the Yankee Nuclear Power Station, which has performed satisfactorily for over 10 years. The purity of pool water is maintained by a combination of filtering and ion exchange process to assure compatibility with the aluminum spent fuel racks. Significant corrosion of the rack structure or nuclear fuel components is highly unlikely to occur. The consequences of a Boral storage cavity weld leak have been evaluated and found to be negligible. However, a vacuum and pressure test is performed to assure the integrity of these welds.

The seismic design of the racks is based upon a nonlinear dynamic anlaysis using the ANSYS computer program that was developed by Swanson Analysis Systems, Inc. Seismic excitation along three orthogonal directions was used in the design. Floor acceleration time histories corresponding to SSE and OBE ground acceleration levels of 0.15g and 0.08g were imposed.* The analysis includes the effects of friction between the rack and floor,

*BECo Letter 77-106, October 5, 1977, Comparison Between Pilgrim Unit Nos. 1 and 2 Seismic Values.
Staff Review of Seismic Input Definition, Pilgrim Unit No. 1 dated December 8, 1977

gaps between the fuel assembly and can, rack uplift, and fluid coupling due to the constrained water within the rack structure. No benefit was taken for the damping effect of water surrounding the rack. A low value of friction was used to maximize the predicted sliding displacement, while a high value of friction was used to maximize stress in the rack. Under the most severe loading conditions the racks slide a maximum between the rack and any rigid object within the pool. In addition, a clear distance of 5.25 inches will be maintained between any rack and the pool walls. Fuel assemblies were conservatively assumed to impact with the cans all at the same time. The integrity of the fuel cladding will be maintained under these conditions. Furthermore, rack to rack impact was considered although the racks are constrained to minimize relative motion. The worst case of two fully loaded racks impacting under a loading of highest sliding was evaluated assuming that all momentum is transferred from one rack to the other. The new racks have been analyzed to determine the effects of a dropped fuel assembly impacting at critical locations on the upper and lower castings. In all cases there is no change to the center to center spacing of the fuel and there is no dislocation of the Boral neutron absorbing material.

The licensee performed a review of the load carrying ability of the SFP structure and found that the existing structure is capable of supporting the increase in overall loading as a result of the proposed fuel pool modification. The steel liner and concrete floor slab were also evaluated for the effects of rack impact due to rocking to conform to the bearing stress and punching shear stress allowables of the American Institute of Steel Construction Specification for Steel Structures and the American Concrete Institute Building Code Requirements for Reinforced Concrete (ACI-318-71). The temperature limits established in the FSAR for the pool remain the same and therefore the effects of temperature gradients on the pool structure will remain unchanged.

2.4.2 Conclusion

The criteria used in the analyses, design and construction of the new spent fuel racks to account for anticipated loadings and postulated conditions that may be imposed upon the structures during their service lifetime are in conformance with established criteria, codes, standards, and specifications acceptable to the Regulatory staff. The use of these criteria provide reasonable assurance that the new fuel pool structures will withstand the specified design conditions without impairment of structural integrity or the performance of required safety functions. Accordingly, we have concluded that the structural and mechanical design of the proposed fuel storage racks is 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 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 staff. If the results of this investigation indicate that additional protective measures are warranted to protect the racks, fuel and liner from the effects of corrosion, 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 BECo to make them.

2.5 Occupational Radiation Exposure

We have reviewed the licensee's plan for the removal, disassembly and disposal of the low density racks and the installation of the high density racks with respect to occupational radiation exposure. The occupational radiation exposure for this operation is estimated by the licensee to be about 50 man-rem. This 50 man-rem estimate is based on Pilgrim 1 having had a history of leaking fuel which has in the past resulted in surface contamination of spent fuel pool walls, fuel racks, and channels which will cause exposure to people working in the spent fuel pool building. We consider this to be a reasonable estimate based on Pilgrim 1 SFP parameters, decontamination procedures to be employed, and ALARA practices that have been implemented at the station to minimize personnel exposure. We have also considered the previous personnel exposure data involving overexposures at the Pilgrim Nuclear Generating Station. Corrective measures are being implemented which include (1) retaining a consultant with appropriate staff to investigate on-going exposures and ALARA practices, and (2) conducting an engineering investigation of measures such as shielding redesign, removal of contaminated piping and improving ventilation. We conclude that there is reasonable assurance of ALARA exposures associated with the SFP modification. This modification is expected to be performed only once during the lifetime of the station.

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 the licensee and by utilizing realistic assumptions for occupancy times and for dose rates in the spent fuel 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. The occupational radiation exposure resulting from the proposed action represents a negligible burden. Based on present and projected operations in the SFP area, we estimate that the proposed modification will add less than one percent to the total annual occupational radiation exposure burden at this facility. The small increase in radiation exposure will not affect the licensee'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 SFP will not result in any significant increase in doses received by occupational workers.

2.6 Radioactive Waste Treatment

The station contains waste treatment systems designed to collect and process the gaseous, liquid and solid wastes that might contain radioactive material. The waste treatment systems were evaluated in the Safety Evaluation dated August 1971 for the station. There will be no change in the waste treatment systems or in the conclusions of the evaluation of these systems in Section 8.0 of the SER because of the proposed modification.

3.0 Summary

Our evaluation supports the conclusion that the proposed modification to Pilgrim 1 is acceptable because:

(1) The increase in occupational radiation exposure to individuals due to the storage of additional fuel in the SFP would be negligible.

(2) The installation and use of the new fuel racks does not alter the potential consequences of the design basis accident for the SFP, i.e., the rupture of a single fuel assembly and the subsequent release of the assembly's radioactive inventory within the gap.

(3) The likelihood of (1) an accident involving heavy loads in the vicinity of the SFP, or (2) a cask drop accident in the reactor building has been minimized by the inclusion of restrictions on cask handling evolutions. No additional restrictions on load movement are necessary while our generic review of the issue is underway.

(4) The physical design of the new storage racks will preclude criticality for any credible moderating condition with the limits to be stated in the Technical Specifications.

(5) The SFP cooling system has adequate cooling capacity.

(6) The installation and use of the proposed fuel handling racks can be accomplished safely with the limit that no rack modules will be moved over any spent fuel assemblies.

(7) The structural design and the materials of construction are adequate to function normally for the duration of the plant lifetime and to withstand the seismic loading of the design basis earthquake.

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

Dated:

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

ENVIRONMENTAL IMPACT APPRAISAL

BY THE

OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING AMENDMENT NO. 33 TO FACILITY OPERATING LICENSE NO. DPR-35

BOSTON EDISON COMPANY

PILGRIM NUCLEAR POWER STATION, UNIT NO. 1

1.0 Description of Proposed Action

In their submittal of December 17, 1975, as supplemented, Boston Edison Company (BECo or licensee) proposed to increase the total storage capacity of the spent fuel pool (SFP) at Pilgrim Nuclear Power Station Unit No. 1 (Pilgrim 1) from 880 to 2300 fuel assemblies.

2.0 Need for Increased Storage Capacity

Pilgrim 1 is a 655 MWe boiling water reactor located near Plymouth, Massachusetts. Pilgrim 1 received Facility Operating License No. DPR-35 in June 1972 and has been in commercial operation since December 1972. The reactor spent fuel storage pool at Pilgrim 1 contains fuel storage racks for 880 fuel assemblies. This storage capacity will accommodate a full Pilgrim 1 core of 580 fuel assemblies plus an additional 300 fuel assemblies.

During a normal refueling about one fourth of the fuel assemblies are replaced by new fuel. The period between refueling intervals normally varies between twelve and eighteen months depending on plant operating history and the system wide outage schedule.

The Pilgrim SFP currently contains 580 spent fuel assemblies from the first three operating cycles. With the projected refueling cycle and the current number of empty spent fuel rack spaces, Pilgrim's spent fuel pool can accommodate the fuel assemblies discharged from only two more operating cycles and does not have the capacity to discharge the entire core that is presently in the reactor vessel.

By adding an additional 1420 fuel storage positions, the proposed modification will accommodate the discharge of about ten additional quarter-core reloads and will permit the offloading of the full core during the next seven operating cycles.

The proposed modifications to the SFP will not alter the external physical geometry or require additional modifications to the SFP cooling or purification systems. The proposed modification does not affect the quantity of uranium fuel utilized in the reactor, the rate of spent fuel generation or the total quantity of spent fuel generated during the anticipated operating lifetime of the facility. The proposed modification will increase the number of spent fuel assemblies stored in the SFP and the length of time that some of the fuel assemblies will be stored in the pool.

3.0 Fuel Reprocessing History

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 decommissioned 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.

4.0 The Plant

Pilgrim 1 is described in the Final Environmental Statement (FES) issued by the Commission in May 1972. Pilgrim is a Boiling Water Reactor (BWR) which produces approximately 655 megawatts net electrical output (MWe). Pertinent descriptions of principal features are summarized below to aid the reader in following the evaluations in subsequent sections of this appraisal.

4.1 Fuel Inventory

The Pilgrim 1 reactor core contains 580 fuel assemblies. A fuel assembly consists of a fuel bundle and the channel which surrounds it. The fuel assemblies are about 5.4 in. square by about 14.7 ft. long. A fuel bundle contains fuel rods which are spaced and supported in either a square 7x7 or 8x8 array by the lower and upper tie plates. Each fuel rod consists of fuel pellets stacked in a Zircaloy-2 cladding tube which is evacuated, back-filled with helium, and sealed by welding

Zircaloy end plugs in each end. About one-fourth of the assemblies are removed from the reactor and replaced with new fuel each operating cycle.

4.2 Station Cooling Water Systems

The Pilgrim 1 condenser circulating water system and the service water system both use sea water from Cape Cod Bay. The condenser circulating water has a normal flow rate of 310,000 gallons per minute and removes approximately 4.5 X 10^9 BTU/hr of heat from the condenser. The Station Service Water System is designed to provide sea water to various heat exchangers in the turbine and reactor auxiliary equipment cooling systems, the reactor shutdown cooling system and miscellaneous services. Heated service water returned from the intermediate cooling services is piped to the circulating water system.

The station service water cools the Reactor Building Closed Cooling Water System heat exchangers. The Reactor Building Closed Cooling Water System in turn provides cooling water to equipment within the primary containment, the reactor water cleanup system non-regenerative heat exchanger, cleanup system pump coolers, sample coolers and fuel pool heat exchangers. The Service Water System has a normal flow rate of about 10,000 gallons per minute and removes about 8X 10^7 BTU/hr from the facility Closed Cooling Water Systems.

4.3 Radioactive Wastes

The station contains waste treatment systems designed to collect and process the gaseous, liquid and solid waste that might contain radioactive material from the unit. The waste treatment systems for Pilgrim 1 are evaluated in the Final Environmental Statement (FES) dated May 1972. There will be no change in the waste treatment systems described in Section III.D.2 of the FES because of the proposed modification.

4.4 Purpose of SFP

The SFP at Pilgrim 1 was designed to store spent fuel assemblies prior to shipment to a reprocessing facility. These assemblies may be transferred from the reactor core to the SFP during a core refueling, or to allow for inspection and/or modification of core internals. The latter may require the removal and storage of up to a full core. The assemblies are initially intensely radioactive due to their fission product content and have a high thermal output. They are stored in the SFP to allow for radioactive and thermal decay.

The major portion of decay occurs during the 150-day period following removal from the reactor core. After this period, the assemblies may be withdrawn and placed into a heavily shielded fuel cask for offsite shipment. Space permitting, the assemblies may be stored for an additional period allowing continued fission product decay and thermal cooling prior to shipment.

4.5 Spent Fuel Pool Purification System

The SFP purification loop consists of two 670-gpm purification pumps, two cartridge filters, a mixed bed demineralizer and the required piping, valves and instrumentation. Each pump draws water from a skimmer surge tank and discharges through a fuel pool heat exchanger, a cartridge filter and either the demineralizer or the demineralizer bypass. The water is then returned to the pool.

Because we expect only a small increase in radioactivity released to the pool water as a result of the proposed modification as discussed in Section 5.3.1, we conclude the SFP purification system is adequate for the proposed modification and will keep the concentrations of radioactivity in the pool water to acceptably low levels.

5.0 Environmental Impacts of Proposed Action

5.1 Land Use

The Pilgrim 1 SFP is located next to the reactor inside the reactor building. The proposed modification will not alter the external physical geometry of the SFP. No additional commitment of land is required.

5.2 Water Use

There is no significant change in plant water usage as a result of the proposed modification. As discussed subsequently, storing additional spent fuel in the SFP will slightly increase the heat load on the SFP cooling system, which is transferred to the Reactor Building Closed Cooling Water System and thence to the Plant Service Water System. The modification will not change the flow rates within these cooling systems. With the increased spent fuel storage, normal refueling sequences, without a full core discharge, will result in a pool stabilization temperature below the 125°F used as a design basis in the Final Safety Analysis Report (FSAR). The maximum expected heat load occurs after discharge of a full core. The SFP cooling system has adequate design capacity following discharge of a full core to maintain the pool water temperature below the 125°F design value in the FSAR even with the increased storage of spent fuel associated with the proposed modification. Since the temperature of the SFP water during normal refueling operations will remain below 125°F, the rate of evaporation and thus the need for makeup water will not be significantly changed by the proposed modification.

5.3 Radiological

5.3.1 Introduction

The potential offsite radiological environmental impacts associated with the expansion of the spent fuel storage capacity were evaluated and determined to be environmentally insignificant as addressed below.

The additional spent fuel which would be stored due to the expansion is fuel which has decayed at least seven years. During the storage of the spent fuel under water, both volatile and nonvolatile radioactive nuclides may 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 predominately 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), Trituim and the Iodine isotopes.*

Available release data indicates that there is little radionuclide leakage from spent fuel stored in pools after the fuel has cooled for several months. The predominance of radionuclides in the SFP water appear to be radionuclides that were present in the reactor coolant system prior to refueling (which becomes mixed with water in SFP during refueling operations) or crud dislodged from the surface of the spent fuel during transfer from the reactor core to the SFP. During and after refueling, SFP purification system reduces the radioactivity concentrations considerably. It is theorized that most failed fuel contains small, pinhole-like perforations in the fuel cladding at the reactor operating condition or approximately 800°F. A few weeks after refueling, the spent fuel cools in the SFP so that fuel clad temperature is relatively cool, approximately 180°F. This substantial temperature reduction apparently reduces the rate of release of fission products from the fuel pellets by decreasing the gas pressure in the gap between pellets and clad, thereby tending to retain the fission products within the gap. In addition, most of the gaseous fission products have short half-lives and decay to insignificant levels within a few months. Based on the operational reports submitted by the licensees or discussions with the operators, there has not been any significant leakage of fission products from spent light water reactor fuel stored in the Morris Operation (MO) (formerly Midwest Recovery Plant) at Morris, Illinois, or at Nuclear Fuel Services" (NFS) storage pool at West Valley, New York. Spent fuel has been stored in these two pools which, while it was in a reactor, was determined to have significant

*Refer to NUREG-0367 Radioactive Materials Released from Nuclear Power Plants (1976).

leakage and was therefore removed from the core. After storage in the onsite SFP, this fuel was later shipped to either MO or NFS for extended storage. Although the fuel exhibited significant leakage at reactor operating conditions, there was no significant leakage from this fuel in the offsite storage facility.*

5.3.2 Radioactive Material Released to Atmosphere

With respect to gaseous releases, the only significant noble gas isotope attributable to storing additional assemblies for a longer period of time would be Krypton-85. As discussed previously, experience has demonstrated that after spent fuel has decayed 4 to 6 months, there is no significant release of fission products from defected fuel. However, we have conservatively estimated that an additional 40 curies per year of Krypton-85 may be released for the unit when the modified pool is completely filled. This increase would result in an additional total body dose at the site boundary to an individual of less than 0.0001 mrem/year. This dose is insignificant when compared to the approximately 1000 mrem/year that an individual receives from natural background radiation. The additional total body dose to the estimated population within a 50-mile radius of the plant is less than 0.001 man-rem/year. This is less than the natural fluctuations in the dose this population would receive from natural background radiation. Under our conservative assumptions, these exposures represent an increase of less than 0.1% of the exposures from the plant evaluated in the FES for the individual (Table 6) and the population (Table 7). Thus, we conclude that the proposed modification will not have any significant impact on exposures offsite.

Assuming that the spent fuel will be stored onsite for several years, Iodine-131 releases from spent fuel assemblies to the SFP water will not be significantly increased because of the expansion of the fuel storage capacity since the Iodine-131 inventory in the fuel will decay to negligible levels between refuelings for the unit.

Storing additional spent fuel assemblies is not expected to increase the bulk water temperature above the 125°F during normal refuelings used in the design analysis. Therefore, it is not expected that there will be any significant change in evaporation rates or the release of tritium or iodine as a result of the proposed modification from that

*1) NEDO 21326-I, January 1977, "Consolidated Safety Analysis Report for Morris Operations" Morris, Illinois, Vol. I.

2) Phone call between Richard Clark and Bill Oldham, Manager of Nuclear Fuel Services, West Valley, N. Y., May 13, 1977.

3) ASME publication (Morris Operations) 77-JPGC-NE-15 by L. L. Denio, et al., "Control of Nuclear Fuel Storage Basin Water Quality by Use of Powered Ion Exchange Resins and Zeolites", June 19, 1977.

previously evaluated. Most airborne releases from the plant result from leakage of reactor coolant which contains tritium and iodine in higher concentrations than the SFP. Therefore, even if there were a slightly higher evaporation rate from the SFP, the increase in tritium and iodine released from the plant as a result of the increase in stored spent fuel would be small compared to the amount normally released from the plant and that which was previously evaluated in the FES. If levels of radioiodine become too high, the air can be diverted to charcoal filters for the removal of radioiodine before release to the environment.

5.3.3 Solid Radioactive Wastes

The concentration of radionuclides in the pool is controlled by the filter and the demineralizer and by decay of short-lived isotopes. The activity is high during refueling operations while reactor coolant water is introduced into the pool and decreases as the pool water is processed through the filters and demineralizer. The increase of radioactivity, if any, should be minor because the additional spent fuel to be stored is relatively cool, thermally, and radionuclides in the fuel will have decayed significantly.

While we believe that there should not be an increase in solid radwaste due to the modification, as a conservative estimate, we have assumed that the amount of solid radwaste may be increased by 30 cubic feet of resin a year from the demineralizer (an additional resin bed/year). The annual average amount of solid waste shipped from Pilgrim 1 during 1973 to 1977 is 13,104 cubic feet per year. If the storage of additional spent fuel does increase the amount of solid waste from the SFP purification system by about 30 cubic feet per year, the increase in total waste volume shipped would be less than 0.5% and would not have any significant environmental impact.

In addition to the above, there are also the present spent fuel racks, rack bracing and rack safety curtains to be removed from the SFP and disposed of. The estimated bulk volume to be disposed of is less than 9000 cubic feet. Averaged over the lifetime of the station, this will increase the total waste shipped from the plant by less than 2% and would not have any significant environmental impact.

5.3.4 Radioactivity Released to Receiving Waters

There will not be a significant increase in the liquie release of radionuclides from the station as a result of the proposed modification. The amount of radioactivity in the pool water and on the SFP filter and demineralizer might slightly increase due to the additional spent fuel in the pool but this increase of radioactivity will not result in a significant increase in radionuclides in liquid effluents from the station.

Leakage of water from the SFP is collected in the reactor building floor drainage sump. This water is transferred to the liquid radwaste system. The radioactivity in the water will be removed by the liquid radwaste system.

The cartridge filter removes insoluble radioactive matter from the SFP water. This is periodically removed to the waste disposal area in a shielded cask and placed in a shipping container. The insoluble matter will be retained on the filter and the soluble activity will remain in the SFP water until removed by the demineralizer resins.

The resins are periodically flushed with water to the solid radwaste system. The water used to transfer the spent resin is returned to the liquid radwaste system for processing. The soluble radioactivity will be retained on the resins. If any activity should be transferred from the spent resin to this flush water, it would be removed by the liquid radwaste system.

5.3.5 Occupational Exposures

We have reviewed the licensee's plan for the removal, disassembly and disposal of the low density racks and the installation of the high density racks with respect to occupational radiation exposure. The occupational radiation exposure for this operation is estimated by the licensee to be about 50 man-rem. This 50 man-rem estimate is based on Pilgrim 1 having had a history of leaking fuel which has in the past resulted in surface contamination of spent fuel pool walls, fuel racks, and channels which will cause exposure to people working in the spent fuel pool building. We consider this to be a reasonable estimate based on Pilgrim 1 SFP parameters, decontamination procedures to be employed, and ALARA practices that have been implemented at the station to minimize personnel exposure. We have also considered the previous personnel exposure data involving overexposures at the Pilgrim Nuclear Generating Station. Corrective measures are being implemented which include (1) retaining a consultant with appropriate staff to investigate on-going exposures and ALARA practices, and (2) conducting an engineering investigation of measures such as shielding redesign, removal of contaminated piping and improving ventilation. We conclude that there is reasonable assurance of ALARA exposures associated with the SFP modification. This modification is expected to be performed only once during the lifetime of the station.

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 the licensee 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. The occupational radiation exposure resulting from the proposed action represents a negligible burden. Based on present and projected operations in the SFP area, we estimate that the proposed modification will add less than one percent to the total annual occupational radiation exposure burden at this facility. The small increase in radiation exposure will not affect the licensee'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 SFP will not result in any significant increase in doses received by occupational workers.

5.3.6 Evaluation of Radiological Impact

As discussed above, the proposed modification does not significantly change the radiological impact evaluated in the FES.

5.4 Nonradiological Effluents

There will be no change in the chemical effluents from the plant as a result of the proposed modification.

The only potential offsite nonradiological environmental impact that could arise from this proposed action would be an additional discharge of heat, mainly to the atmosphere and, to a lesser extent, the Cape Cod Bay. Storing spent fuel in the SFP for a longer period of time will add more heat to the SFP water. The SFP heat exchangers are cooled by the Reactor Building Closed Cooling Water System which in turn is cooled by the Plant Service Water System.

An evaluation of the augmented spent fuel storage facility was made to determine the effects of the increased heat generation on the plant cooling water systems, and ultimately, on the environment. The maximum heat load on the Reactor Building Closed Cooling Water System is during shutdown of the reactor plant, such as during a refueling shutdown. However, when the reactor is shutdown, heat rejection to the condenser circulating water system is greatly reduced. During reactor operation, heat rejection from the condensers to the circulating water is over 1,000 times higher than the maximum incremental heat load due to the proposed modification. In the normal mode of operation. the small additional heat load from the SFP cooling system will be less than 0.1% of the total heat load on the Circulating and Service Water Systems and will have a negligible ecological impact.

5.5 Impacts on the Community

No environmental impacts on the environs outside the spent fuel storage building are expected during installation of the new racks. The impacts within this building are expected to be limitied to those normally associated with metal working activities. No significant environmental impact on the community is expected to result from the proposed action.

6.0 Environmental Impact of Postulated Accidents

The NRC staff has underway a generic review of load handling operations in the vicinity of spent fuel pools to determine the likelihood of a heavy load impacting fuel in the pool and, if necessary, the radiological consequences of such an event. The staff has reviewed the cask handling evolutions anticipated to occur in connection with the fuel pool expansion to determine their acceptability in the interim prior to completion of the generic review. As a result of this review, Pilgrim 1 will be required to prohibit the movement of loads with weight in excess of the weight of a fuel assembly, including the channel box, over fuel assemblies in the SFP. Additionally, no fuel which has decayed for less than 200 days will be allowed to reside in racks subject to a cask tip accident. And finally, the licensee has committed to perform a handling yoke analysis to demonstrate a minimum safety factor of 1.2 prior to the use of any cask which has not had the structural integrity of the yoke handling mechanism approved by the NRC.

With the above restrictions imposed on cask handling evolutions, the staff concludes that the consequences of fuel handling accidents in the SFP and cask drop accidents in the reactor building are not changed from those presented in the Safety Evaluation dated August 1971. The staff also considers that the above restrictions will minimize the likelihood of a fuel handling or cask drop accident while the evolutions are in progress.

Although the new high density racks will accommodate a larger inventory of spent fuel, we have determined based on the above, that the installation and use of the racks will not change the radiological consequences of a postulated fuel handling accident in the SFP area from those values reported in the FES for Pilgrim 1 dated May 1972.

7.0 Alternatives

In regard to this licensing action, the staff has 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.

7.1 Reprocessing of Spent Fuel

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." The Allied General Nuclear Services (AGNS) reprocessing plant received a construction permit on December 18, 1970. In October 1973, 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 onsite storage pool, on which construction has been completed. Hearings on the materials license application have not been completed.

In 1976, Exxon Nuclear Company, Inc. submitted an application for a proposed Nuclear Fuel Recovery and Recycling Center (NFRRC) to be located at Oak Ridge, Tennessee. The plant would include a storage pool that could store up to 7,000 MTU in spent fuel.

On April 7, 1977, the President issued a statement outlining his policy on continued development of nuclear energy in the U.S. The President stated that: "We will defer indefinitely the commercial reprocessing and recycling of the plutonium produced in the U. S. nuclear power programs. From our own experience, we have concluded that a viable and economic nuclear power program can be sustained without such reprocessing and recycling."

The Nuclear Regulatory Commission issued an order dated December 30, 1977 terminating proceedings to license reprocessing facilities. (42 FR 65334)

The licensee has intended to reprocess the spent fuel to recover and recycle the uranium and plutonium in the fuel. Due to a change in national policy and circumstances beyond BECo's control, reprocessing of the spent fuel is not an available option at this time.

7.2 Independent Spent Fuel Storage Facility

An altervative 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 1,000 MTU of spent fuel. This is far greater than the capacities of onsite storage pools. Fuel storage pools at GE Morris and NFS are functioning as ISFSIs although this was not the original design intent. Likewise, if the AGNS receiving and storage station at its Barnwell, South Carolina reprocessing plant were licensed to accept spent fuel, it would be functioning as an ISFSI. The AGNS position, however, has generally been that it will not commercially operate a stand alone ISFSI. The license for the GE facility at Morris, Illinois was amended on December 3, 1975 to increase the storage capacity to about 750 MTU;*

*An application for an 1100 MTU capacity addition is pending, but proceedings have been suspended indefinitely.

as of June 15, 1978, approximately 310 MTU was stored in the pool in the form of 1,196 assemblies. The staff has discussed the status of storage space at Morris Operations (MO) with GE personnel. We have been informed that GE is primarily operating the MO facility to store either fuel owned by GE (which had been leased to utilities on an energy basis) or fuel which GE had previously contracted to reprocess.* We understand that the present GE policy is not to accept spent fuel for storage except for that fuel for which GE has a previous commitment. The NFS facility has capacity for about 260 MTU, with approximately 170 MTU presently stored in the pool. The storage pool at West Valley, New York is on land owned by the State of New York and leased to NFS thru 1980. Although the storage pool at West Valley is not full, since NFS withdrew from the fuel reprocessing business, correspondence we have received indicates that they are not at present accepting additional spent fuel for storage even from these reactor facilities with which they had contracts. The status of the storage pool at AGNS was discussed above.

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 Parts 19, 20, 30, 40, 51, 70, 71 and 73 would also apply.

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 detail 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. In 1974, E. R. Johnson Associates estimated their construction cost at approximately $9,000 per spent fuel assembly.

*GE letter to NRC dated May 27, 1977.

Several licensees have evaluated construction of a separate independent spent fuel storage facility and have provided cost estimates. Connecticut Yankee, for example, estimated that to build an independent facility with a storage capacity of 1,000 MTU (BWR and/or PWR assemblies) would cost approximately $54 million and take about 5 years to put into operation. Commonwealth Edison estimated the construction cost to build a fuel storage facility at about $10,000 per fuel assembly. To this would be added to costs for maintenance, operation, safeguards, security, interest on investment, overhead, transportation and other costs.

On December 2, 1976, Stone and Webster Corporation submitted a topical report requesting approval for a standard design for an independent spent fuel storage facility. No specific locations were proposed, although the design is based on location near a nuclear power facility. We estimated present day cost for such a fuel storage installation to be about $26 million. This does not include client costs associated with the nuclear power facility site preparation. On July 12, 1978 the staff concluded that the proposed approach and conceptual design was acceptable.

On a short-term basis (i.e., prior to 1983) an independent spent fuel storage installation does not appear to be a viable alternative based on cost or availability in time to meet the licensee'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.

On October 18, 1977, USDOE announced a new "spent nuclear fuel policy." USDOE will determine industry interest in providing interim fuel storage services on a contract basis. If adequate private storage services cannot be provided, the Government will provide interim fuel storage facilities.

This interim storage is expected to be available in 1983 with a National Waste Repository available in the 1988-1993 time frame. If the Pilgrim SFP is not modified as proposed, the Pilgrim Plant, which lost the ability to discharge a full core in September 1977, would have to shutdown about September 1980 since the SFP would be essentially full. The precise date that interim storage would be available is not known at this time with sufficient precision to provide for planning. Should these facilities not be available when needed, the Pilgrim plant would be forced to shutdown. Therefore, this does not appear to be a viable alternative, especially when considering the impact of plant shutdown as compared with the negligible environmental consequences of the proposed amendment.

The proposed increase in storage capacity will allow Pilgrim to operate until September 1992 by which time interim storage and probably the Federal repository for spent fuel are expected to be operable.

7.3 Storage at Another Reactor Site

Pilgrim 1 is the only nuclear power station owned by BECo. Therefore, BECo. does not have an option of storage of Pilgrim 1 fuel at another BECo station. The alternative of storage at another nuclear power station not owned and operated by the licensee is also not realistic. 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, the licensee cannot rely on any other power facility to provide additional storage capability except on a short-term emergency basis. If space were available in another reactor facility, the cost would probably be comparable to the cost of storage at a commercial storage facility.

In the absence of a general policy regarding interfacility transfer and storage of spent fuel, such action is being decided on a case-by-case basis and would not afford the timely relief needed here.

Storage at another reactor site is not a realistic alternative at this time, or in the foreseeable future.

7.4 Shutdown of Facility

If Pilgrim 1 was forced to shutdown for lack of space to store spent fuel, there would be the loss of the economic benefit from the facility (generation of electric energy) and a cost associated with purchase of replacement energy and maintaining the facility in a standby condition far in excess of the cost of the proposed modification.

Based on information gained from the licensee and comparable data for other operating reactors, the staff estimates that the loss of revenues from the idle unit would be about $330,000/day.

7.5 Summary of Alternatives

In summary, the alternatives (1) to (3) described above are presently not available to the licensee or could not be made available in time to meet the licensee's need. Assuming the nonavailability of alternatives (1) to (3), BECo would be forced to either shutdown or request additional spent fuel storage capacity. Even if available, alternatives (2) and (3) do not provide the operating flexibility or the proposed action and are likely more expensive than the proposed modification.

Alternative (4), ceasing operation of the facility, would be much 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 capacity of the SFP for Pilgrim 1 would have a negligible environmental impact.

8.0 Evaluation of Proposed Action

8.1 Unavoidable Adverse Environmental Impacts

8.1.1 Physical Impacts

As discussed above, expansion of the storage capacity of the SFP would not result in any significant unavoidable adverse environmental impacts on the land, water, air or biota of the area.

8.1.2 Radiological Impacts

Expansion of the storage capacity of the SFP will not create any significant additional adverse radiological effects. As discussed in Section 5.3, the additional total body dose that might be received by an individual or the estimated population within a 50-mile radius is less than 0.0001 mrem/yr and 0.001 man-rem/yr, respectively, and is less than the natural fluctuations in the dose this population would receive from background radiation. The total dose to workers during removal of the present storage racks and installation of the new racks is estimated by the licensee to be about 50 man-rem which averaged over the lifetime of the station is a small fraction of the total man-rem burden from occupational exposure. Operation of the plant with additional spent fuel in the SFP is not expected to increase the occupational radiation exposure by more than one percent of the present total annual occupational exposure at this facility.

8.2 Relationships Between Local Short-Term Use of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity

Expansion of the storage capacity of the SFP will not change the evaluation of long-term use of the land as described in the FES for Pilgrim 1. In the short term, the proposed modification would permit the expected benefits (i.e., production of electrical energy) to continue.

8.3 Irreversible and Irretrievable Commitments of Resources

8.3.1 Water, Land and Air Resources

The proposed action will not result in any significant change in the commitments of water, land and air resources as identified in the FES for Pilgrim 1. No additional allocation of land would be made; the land area now used for the SFP would be used more efficiently by adopting the proposed action.

8.3.2 Material Resources

It is not likely that taking licensing action here proposed would constitute a commitment of resources that would tend to significantly foreclose the alternatives available with respect to any other individual licensing action designed to ameliorate a possible shortage of spent fuel storage capacity. The time frame under consideration is two years, the staff's estimate of the time necessary to complete the generic environmental statement. The action here proposed will not have any significant effect on whether similar actions are or should be taken at other nuclear reactors since it will not affect either the need for or availability of storage facilities at other nuclear reactors. Nor will the added capacity here significantly affect the need for the total additional storage space presently planned at reprocessing facilities for which licensing actions are pending. In order to carry out the proposed modifications, the licensee will require custom-made racks of aluminum and sheets of boral. These materials are readily available in abundant supply. In the context of this criterion, the staff concludes that the amount of material (aluminum, boron, carbon) required for the racks for Pilgrim 1 is insignificant and does not represent an irreversible commitment of natural 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 radioactive material will have been produced when averaged over the life of the plant. This licensing action would not constitute 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.

8.4 Commission Policy Statement Regarding Spent Fuel Storage

On September 16, 1975, the Commission 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, it 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 Commission 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 reactor core for Pilgrim 1 contains 580 fuel assemblies. In their submittal of November 8, 1975, BECo presented their estimated schedule for refueling. The facility is scheduled to be refueled annually, with about 108 to 128 fuel assemblies generally scheduled to be replaced. The spent fuel pool was designed on the basis that a fuel cycle would be in existence that would only require storage of spent fuel for a year or two prior to shipment to a reprocessing facility. Therefore, a pool storage capacity for 880 assemblies (about 150% of the full core load) was considered adequate. This provided for complete unloading of the reactor even if the spent fuel from the two previous refuelings were 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 other operational considerations.

Pilgrim 1 received its operating license in June 1972 and is presently in its fourth operating cycle. The SFP currently contains spent fuel assemblies from the first three operating cycles. With the present spent fuel storage racks, Pilgrim 1 does not have room to store the 116 spent fuel assemblies that are scheduled to be replaced in January 1981. If expansion of the storage capacity of ths SFP is not approved, or if an alternate storage facility for the spent fuel is not located, Pilgrim 1 will have to shutdown in 1981. As discussed under alternatives (Section 7.0), an alternate storage facility is not now available. As a long term solution to the spent fuel storage problem, the Federal government is planning to provide a retrievable repository for spent fuel by 1983.

The proposed licensing action (i.e., installing new racks of a design that permits storing more assemblies in the same space) would allow Pilgrim 1 to continue to operate beyond 1981 and until the proposed Federal repository is expected to be in operation. The proposed modification will also provide the licensee 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 Pilgrim 1 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 stortage of 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 increased storage capacity of Pilgrim 1 SFP was considered as a nonmaterial resource and was evaluated relative to proposed similar licensing actions within a one year period (the time we estimate 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 SFP 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. Similarly, taking this action would not commit the NRC to repeat this action or a related action in 1981.

We conclude that the expansion of the SFP at Pilgrim 1, 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 possible 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?

Potential nonradiological and radiological impacts resulting from the fuel rack conversion and subsequent operation of the expanded SFP at this facility were considered by the Staff.

No environmental impacts on the environs outside the spent fuel storage building are expected during removal of the existing racks and installation of the new racks. The impacts within this building are expected to be limited to those normally associated with metal working activities and to the occupational radiation exposure to the personnel involved.

The potential nonradiological environmental impact attributable to the additional heat load in the SFP was determined to be negligible compared to the existing thermal effluents from the facility.

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

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

This Environmental Impact Appraisal and the accompanying Safety Evaluation respond to the questions concerning health, safety and environmental concerns.

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

We have evaluated the alternatives to the proposed action, including storage of the additional spent fuel offsite and ceasing power generation from the plant when the existing SFP is full. We have determined that there are significant economic advantages associated with the proposed action and that expansion of the storage capacity of the SFP will have a negligible environmental impact. Accordingly, deferral or severe restriction of the action here proposed would result in substantial harm to the public interest.

9.0 Benefit-Cost Balance

This section summarizes and compares the cost and the benefits resulting from the proposed modification to those that would be derived from the selection and implementation of each alternative. The table below presents a tabular comparison of these costs and benefits. The benefit that is derived from three of these alternatives is the continued operation of Pilgrim 1 and production of electrical energy. The remaining alternatives (i.e., reprocessing of the spent fuel or storage at other nuclear plants) are not possible at this time or in the foreseeable future except on a short term emergency basis and, therefore, have no associated cost or benefit.

From examination of the table, it can be seen that the most cost-effective alternative is the proposed SFP modification. As evaluated in the preceding sections, the environmental impacts associated with the proposed modification would not be significantly changed from those analyzed in the Final Environmental Statement for Pilgrim Nuclear Power Station Unit No. 1 issued in May 1972.

10.0 Basis and Conclusion for not Preparing an Environmental Impact Statement

We have reviewed this proposed facility modification 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, weighted, and balanced the five factors specified by the Nuclear Regulatory

Commission in 40 CFR 42801. We have determined that the proposed license amendment will not significantly affect the quality of the human environment and that there will be no significant environmental impact attributable to the proposed action other than that which has already been predicted and described in the Commission's Final Environmental Statement for the Facility dated May 1972. 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.

Dated: August 17, 1978

SUMMARY OF COST-BENEFITS

Alternative	Cost	Benefit
Reprocessing of Spent Fuel	-	None - this alternative is not available either now or in the foreseeable future.
Increase storage capacity of Pilgrim's SFP	$1500/assembly	Continued operation of Pilgrim Station and production of electrical energy.
Storage at Independent Facility	$10,000/assembly plus shipping cost	Continued operation of Pilgrim 1 and production of electrical energy. This alternative is not available for several years.
Storage at Reprocessor's Facility	$2000/yr. per assembly plus shipping costs*	Continued operation of Pilgrim 1 and production of electrical energy.
Storage at Other Nuclear Plants	-	None - this alternative is not likely to be available.
Reactor Shutdown	$330,000/day	None - No production of electrical energy.

*In order to use this alternative a minimum commitment of ten to twelve years of storage is required.

**This does not include costs of maintaining the plant in a standby condition, decommissioning costs etc.

UNITED STATES NUCLEAR REGULATORY COMMISSION

DOCKET NO. 50-293

BOSTON EDISON 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. 33 to Facility Operating License No. DPR-35, issued to Boston Edison Company (the licensee), which revised Technical Specifications for operation of the Pilgrim Nuclear Power Station Unit No. 1 (the facility) located near Plymouth, Massachusetts. The amendment is effective as of its date of issuance.

This amendment authorizes the installation and use of new high density storage racks for the storage of spent fuel assemblies in the spent fuel storage pool.

The application for the amendment complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations. The Commission has made appropriate 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. Notice of Consideration of Modification to Facility Spent Fuel Storage Pool in connection with this amendment was published in the FEDERAL REGISTER on April 22, 1976 (41 FR 16888). 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 of the action being authorized 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 significantly greater than that which has been predicted and described in the Commission's Final Environmental Statement for the facility dated May 1972.

For further details with respect ot this action, see (1) the application for amendment dated December 17, 1975 and supplements thereto dated November 8, 1976, June 14, August 1, September 6, and 9, and December 5, 1977, June 26, 1978, and August 10, 1978, (2) Amendment No. 33 to License No. DPR-35, (3) the Commission's concurrently issued related Safety Evaluation, and (4) the Commission's concurrently issued 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 Plymouth Public Library on North Street in Plymouth, Massachusetts 02360. A single 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 17th day of August 1978.

FOR THE NUCLEAR REGULATORY COMMISSION

T A Ippolito

Thomas A. Ippolito, Chief
Operating Reactors Branch #3
Division of Operating Reactors