BOSTON EDISON
Pilgrim Nuclear Power Station
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BECo 94-043

U. S. Nuclear Regulatory Commission
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Docket 50-293

Boston Edison Company Response to
NRC Request for Additional Information
on Increase Allowed Fuel Assembly Storage
(TAC No. M85898)

Reference: "Proposed Technical Specification Change, Pilgrim Nuclear Power Station Spent Fuel Storage Capacity Expansion", BECo Letter 93-016, dated February 11, 1993.

This letter and the enclosure responds to the NRC Request for Additional Information concerning radiation controls presented during the March 28, 1994 telephone discussion on the referenced proposed Technical Specification change.

Should you have need for further information on these responses, please contact our Licensing staff through Mr. Paul Hamilton at (508) 830-7948.

Sincerely,

E T Boulette

E. T. Boulette, PhD

ETB/WGL/increase/nas

Enclosure

cc: See next page

A001

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Enclosure

Boston Edison Company Response to NRC
Request for Additional Information dated 3/28/94

The licensee has proposed installing "storage platforms" above the fuel storage racks. The weight of each of the platforms is apparently about 2,000 lbs.

Question:

1. What controls will be exercised to limit the types, amounts and dimensions of materials to be stored on each of these platforms?

Response:

The weight limitation on each platform is 10,000 lbs. BECo plans to keep a maximum of four boxes, each approximately 4′ x 4′ x 3′ size with a maximum weight of 2,000 lbs per box.

A total of 4,500 Ci are estimated in the material to be stored on both N1 and N2 spent fuel rack platforms. The total radioactivity in each platform (four boxes) is estimated to be 2,250 Ci.

The attached Pilgrim Nuclear Power Station (PNPS) Safety Evaluation No. 2818 dated April 5, 1994, will form the basis for revisions to existing PNPS Procedure 1.16.1 "Spent Fuel Pool Inventory Control", which governs control of storage of material in the boxes. This procedure will be completed as part of the Plant Design Change for installing the new spent fuel storage racks.

Question:

2. During normal plant operations, what affect will the stored materials have on the radiation levels in the vicinity of the pool, especially on the fuel handling bridge?

Response:

The attached Safety Evaluation No. 2818, Section F.1 provides radiological conditions due to material stored in the boxes on top of the platforms.

Question:

3. What is the most serious abnormal occurrence that could occur (e.g., pool drain-down) involving the storage platforms and stored materials and what affect (projected dose rates in and around the pool, projected worker doses) would the stored material have on recovery operations?

Response:

The attached Safety Evaluation No. 2818, Section F.1 explains the most serious abnormal occurrences and radiological exposures that could occur involving the platforms and stored material. The operations procedures referenced in Section F.5 address recovery operations in the event of an abnormal occurence.

EXHIBIT 1
Sheet 1 of 4

RTYPE A9.03

SAFETY EVALUATION
PILGRIM NUCLEAR POWER STATION

Safety Evaluation No.: 2818 (1)

Initiator: (2)	Dept: (3)	Division: (4)	Document No.: (5)	System Name: (6)
C A KUHNS	NESD	MECH ENGR	PDC 94-26 AND PNPS 1.16.1	FUEL HANDLING AND STORAGE

Description of Proposed change, test, or experiment: (7) TO SUSPEND CONTROL ROD BLADES FROM CURB OF SPENT FUEL POOL. THIS ALSO ADDRESSES STORAGE OF IRRADIATED MATERIAL ABOVE SPENT FUEL RACKS.

SAFETY EVALUATION CONCLUSIONS: (8)

	Yes	No	
1.	☐	☒	May the proposed activity increase the probability of occurrence of an accident previously evaluated in the Final Safety Analysis Report?
2.	☐	☒	May the proposed activity increase the consequences of an accident previously evaluated in the Final Safety Analysis Report?
3.	☐	☒	May the proposed activity increase the probability of occurrence of a malfunction of equipment important to safety previously evaluated in the Final Safety Analysis Report?
4.	☐	☒	May the proposed activity increase the consequences of a malfunction of equipment important to safety previously evaluated in the Final Safety Analysis Report?
5.	☐	☒	May the proposed activity create the possibility of an accident of a different type than any previously evaluated in the Final Safety Analysis Report?
6.	☐	☒	May the proposed activity create the possibility of a different type of malfunction of equipment important to safety than any previously evaluated in the Final Safety Analysis Report?
7.	☐	☒	Does the proposed activity reduce the margin of safety as defined in the basis for any Technical Specification?

BASIS FOR SAFETY EVALUATION CONCLUSIONS: (9)

SEE ATTACHED

(10) Safety Evaluation Performed by CAK [signature] Date 5 APRIL 94

SAFETY EVALUATION
PILGRIM NUCLEAR POWER STATION   No.: (1) 2818

A. APPROVAL

(11) Comments: ______________________________

[signature] (12) 4/6/94
Discipline Division Mgr./Date

RW Brega (13) 4-14-94
Supporting Discipline Division Mgr./Date

B. REVIEW/APPROVAL

(14) ☐ Comments: ______________________________

(15) [signature] 4/6/94
S&SA Division Mgr./Date

[initials] 4-6-94

NOTES: 1) Items (14) and (15) are not required for Safety Evaluation prepared by the Plant Department.

2) The independent technical review of Plant Department Safety Evaluations is documented in Item C below.

C. ORC REVIEW

(16) ☐ This proposed change involves an unreviewed safety question and a request for authorization of this change must be filed with the NRC prior to implementation.

(16) ☑ This proposed change does not involve an unreviewed safety question.

(17) ORC Chairperson [signature] Date 3/14/94 (17)

(18) ORC Meeting Number 94-22

cc:

D. FSAR Review Sheet (19)

Safety Evaluation No. 2818 Date: ______

List FSAR text, diagrams, and indices affected by this change and corresponding FSAR revision.

Affected FSAR Section	Preliminary revision to the affected FSAR Section is shown on:
10.3.4.1	Attachment 1
______	Attachment 2
______	Attachment 3
______	Attachment 4
______	Attachment 5
______	Attachment 6

PRELIMINARY FSAR REVISION (to be completed at time of Safety Evaluation preparation).

Prepared by: CAK Date: 5APRIL94

Approved by: [signature] Date: 4/5/94

FINAL FSAR REVISION - Prepared in accordance with NOP83E4 following operational turnover of related systems, structures, or components for use at PNPS.

FSAR CHANGE

Special brackets have been designed to hang Control Rod Blades from the Spent Fuel Pool Curb. These brackets are to be installed with a minimum distance of 12 inches between them. A maximum of 55 Control Rod Blades, which must have their stellite rollers removed, may be hung from the Spent Fuel Pool Curb. The top of the Control Rod Blades will be approximately 8 feet under water. Hanging Control Rod Blades from the Spent Fuel Pool Curb is within the plant shielding design as specified in Sections 12.3.1.1 and 12.3.3.2.

The standard spent fuel racks, shown on Figure 10.3-1, are a modular design of varying sizes. Each rack has the capacity to store an average of 260 spent fuel assemblies. The racks provide for a maximum of 2,333 fuel assemblies to be stored in the fuel pool. However, presently, PNPS is only licensed to store 2,320 fuel assemblies in the fuel pool. The racks are free standing.

The racks are made up of welded stainless steel assemblies in the shape of cruciforms, angles, and tees. Sheets of Boraflex poison material are sandwiched between the stainless steel sheets creating a welded assembly. The rack assembly is shown on Figure 10.3-1.

The racks are designed to withstand a pullup force equal to 4,000 lb acting on the rack corner (necessary in the event that a fuel assembly or grappling device acting on the rack corner binds during removal). The maximum allowable stress on the members required to maintain the subcritical condition will not exceed 75 percent of the material yield strength or 75 percent of that stress at which local buckling occurs.

No spaces exist between normal fuel storage positions so that it is not possible to insert a fuel assembly, either deliberately or by accidental drop, in any position not intended as a fuel storage position, except as analyzed. See Section 10.3.5.

Each fully loaded spent fuel storage rack is designed as a Class I structure. The spent fuel racks are designed such that the stresses in a fully loaded rack do not exceed applicable American Institute of Steel Construction or American Society of Civil Engineers specification requirements when subjected to the seismic loads resulting from the Safe Shutdown Earthquake. Both the horizontal and vertical forces due to the earthquakes are considered to act simultaneously. Acceleration time-histories resulting at the spent fuel pool floor during the Safe Shutdown Earthquake are used as input to the dynamic analysis of the racks.

The storage rack structure is designed to absorb the vertical impact force imposed by a fuel assembly dropped from a height of 36 in above a rack onto any location on the rack. Under this impact force, those members, whose function is to physically maintain the normal design subcritical spacing to assure $k_{eff} \leq 0.95$, will remain intact.

All materials used in the construction of the rack are specified in accordance with the latest issue of applicable ASTM specifications, and all welds are in accordance with AWS standards or ASME Section IX for materials used. Materials selected are corrosion resistant or treated to provide the necessary corrosion resistance.

INSERT CHANGE HERE

The spent fuel storage pool has been designed to withstand earthquake loading as a Class I structure. It is a reinforced concrete structure, completely lined with seam-welded stainless steel plates welded to reinforcing members (channels, I-beams, etc) embedded in concrete. Interconnected drainage monitoring channels are provided behind the liner welds. These channels are designed to (1) prevent pressure buildup behind the liner plate, (2) prevent the uncontrolled loss of contaminated pool water to other relatively cleaner locations

Safety Evaluation
No.: 2818

E. SAFETY EVALUATION WORK SHEET (20)

A. System/Component Failure and Consequence Analyses.

	System/Component	Failure Modes	Effects of Failure	Comments
1.	CONTROL ROD BLADE	DROP	FALL ONTO RACK OR POOL FLOOR	BOUNDED BY FUEL HANDLING ACCIDENT ANALYSIS
2.	FUEL POOL WATER LEVEL	LOSS OF WATER INVENTORY	INCREASED RADIATION LEVELS	ADDRESSED IN BODY OF SE. LEVEL IS MONITORED AND ALARMED
3.				
4.				

General Reference Material Review

FSAR SECTION	PNPS TECHNICAL SPECS	CALCULATIONS DESIGN SPECS/PROCEDURES	REGULATORY GUIDES/STANDARDS/CODES
	SEE ATTACHED, SECTION C		

B. For the proposed hardware change, identify the failure modes that are likely for the components consistent with FSAR assumptions. For each failure mode, show the consequences to the system, structures, or related components. Especially show how the failure(s) affects the assigned safety basis (FSAR text for each system) or plant safety functions (FSAR Chapter 14 and Appendix G.)

Prepared by CAK [signature] Date 5 APRIL 94

Safety Evaluation

A. Description of Change:

To hang 55 Control Rod Blades (CRBS), with their stellite rollers removed, from the spent fuel pool curb using a specially designed curb bracket assembly. This is a change in the way spent control rod blades are currently stored. This also addresses an assumed 4500 curies of Cobalt-60 in material placed in storage boxes on tables above the spent fuel racks.

B. Purpose:

Hanging CRBS and consolidating material in storage boxes will assist in organizing and optimizing storage space within the fuel pool for miscellaneous irradiated materials while clearing space for additional fuel storage racks. These CRBS are at the end of useful life.

C. Systems, Subsystems, Components Affected:

1. Directly Affected:

 * Fuel Pool (including the pool liner).

2. Indirectly Affected:

 * Fuel storage racks.
 * Fuel assemblies stored in racks.
 * Fuel pool cooling system.

3. List drawings, FSAR, Tech. Spec., other documents:

FSAR 3.2, 10.3, 10.4	FSAR 14.5.5	FSAR 12.3.3.2
Tech. Spec. 3.10	SER 40-86	IEN 88-65
Tech. Spec. 6.11	SER 4-90	IEN 90-33
M 38	SOER 85-01	IEB 84-03
M 39	SER 5-81	IEN 87-13
M 44	Q List (Systems 19, 49 & 56)	
	M 231	

Calc. No. C15.0.3222, Hook for hanging CRBS
Calc. No. C15.0.01246, CRB hangers/SFP curb
Calc. No. ERHS-XIII.T-51-0, Dose Draindown/CH 94-51
Calc. No. ERHS-XIII.D-15-0, Rad. Conseq. Draindown
Calc. No. FS&MC M-249, Drainline flow rate

Reg. 87-141	CH 94-51	Reg. Guide 1.26
PNPS 1.16.1	PNPS 8.I.29.2	

Safety Evaluation (cont'd.)

D. Functions of Affected Systems/Components:

1. Fuel Pool:

Direct Function:
The storage pool and concrete structure is a seismic class I structure and provides a sufficient depth of water and sufficient concrete thickness to adequately shield station personnel from radiation emitted by a full load of spent fuel assemblies.

2. Fuel Storage Racks:

Direct Function:
The spent fuel storage racks are designed to maintain, when fully loaded with fuel assemblies, a subcritical configuration having a Keff <0.95 for normal and abnormal conditions, as defined in Section 10.3.4 of the FSAR.

3. Fuel Assemblies:

Direct Function:
The function of the fuel assembly is to provide substantial fission product retention capability during all potential operational modes and sufficient structural integrity to prevent operational impairment of any reactor safety equipment.

E. Effect on Functions:

1. Fuel Pool:

With the fuel pool water level maintained at current administrative limits (elevation 116 feet), dose rates to plant personnel working pool side (18 in. above the pool) will increase <1 mR/hr.

Normal spent fuel pool water level is elevation 116 feet. This ensures adequate water to the skimmer surge tanks, which provide NPSH for the fuel pool cooling pumps. Operating at a lower water level would not be considered practical as skimmer surge tank level would decrease, causing the fuel pool cooling pumps to trip. Therefore, the spent fuel pool water level would not intentionally be lowered to operate at the Tech Spec limit of 33 feet (111 feet 3 inches elevation). In the unlikely situation that the pool level would decrease to the Tech Spec limit, does rates would increase to approximately 50 mR/hr at pool side.

Structurally, the hanging of the CRBS from the curb will add a load to the fuel pool curb.

If a CRB were to drop, it could fall a distance of approximately 16 feet onto the spent fuel pool floor.

E. Effect on Functions (cont'd.):

2. Fuel Storage Rack:

If a CRB were to drop, it could fall a distance of approximately 1 foot onto the fuel storage racks.

3. Fuel Assembly:

If a CRB were to drop, it could fall a distance of approximately 1 foot onto a fuel assembly.

F. Analysis of Effect on Functions:

1. Fuel Pool:

The fuel pool is designed to withstand earthquake loading as a Class I structure. Civil calculation C15.0.3222, in conjunction with civil calculation C15.0.01246 demonstrates the structural adequacy of the brackets, hardware, and fuel pool curb to support the CRBS. Administrative controls have been established to control the location and placement of the CRB brackets. The fuel pool has been designed to withstand the effects of a tornado missile impact. The effect of dropping a CRB and support bracket (approximately 250 pounds a distance of 16 feet) in the fuel pool is bounded by the above analysis.

During normal plant operation, the fuel pool gates are installed. In this configuration, leakage paths that could reduce spent fuel pool water inventory below the elevation of the skimmer surge tank weirs include the fuel pool gate gaskets, back flow through the fuel pool cooling spargers, and the fuel pool liner. The fuel pool cooling spargers are equipped with siphon breaks, located 4 inches below normal SFP water level, to prevent reverse flow. The passage between the spent fuel pool and the refueling cavity above the reactor vessel is provided with two double sealed gates, failure of these components if not considered credible as they are passive components. A liner leak would not cause large scale drainage as the SFP drainlines have a maximum flow rate of 60 gpm (Calc. FS&MC M-249). The normal makeup capacity is 200 gpm (FSAR 10.3.4.1) which will exceed the maximum flow rate through the drain lines.

F. Analysis of Effect on Functions (cont'd.):

During refueling operations, the reactor vessel is opened, the reactor cavity flooded up to the normal pool level and the fuel pool gates are removed. To avoid unintentional draining of the pool and reactor cavity, there are no penetrations that would permit the pool to be drained below a safe storage level (elevation 100 feet, approximately 10 feet above the top of the spent fuel in the SFP). The only components that have a penetration at this elevation are the reactor cavity spargers which are part of the fuel pool cooling system. The spargers are isolable from the reactor cavity with a safety related manual block valve. A safety related check valve is located downstream of the block valve to prevent reverse flow when the spargers are in use.

The reactor cavity spargers are only used:

1. To fill the reactor cavity and dryer/separator pool while the fuel pool gate is still installed and,

2. To cool fuel in the reactor cavity area while operating certain configurations of augmented fuel pool cooling.

The credible accident scenario assumes a reactor cavity sparger line break upstream of both the check valve and the manual block valve, in the non-safety related portion of piping. The reactor cavity sparger check valves are included in the IST Program and are tested for closure in accordance with PNPS 8.I.29.2. The acceptance criteria for these valves is a leak rate <3 gpm, so we can assume a maximum flow rate in the reverse condition through the check valve of 3 gpm. Operator action to close the manual block valve, located on 91 foot elevation in the Reactor Building, would be taken to stop the draindown of the pool and reactor vessel water inventory.

With no operator action, it would take approximately 5.8 days to lower the water inventory 1 foot from both pools and the reactor cavity as they are interconnected. Note that if the water level drops below the weirs (approximately 5 inches from normal water level), flow into the skimmer surge tanks would be cut off, causing the fuel pool cooling pumps to trip and initiate both a local alarm and common alarm in the Main Control Room. This would provide an early indication of a problem. To decrease water inventory to an elevation of 100 feet would require a time duration well outside the bounds of a normal refueling outage and, therefore, not credible.

F. Analysis of Effect on Functions (cont'd.):

Radiological calculations show that if the SFP water level would decrease to an elevation of 100 feet, the following dose rates would be measured on the Refuel Bridge: 200 mR/hr from spent fuel (based on complete core offload 10 days after shutdown, Reg. 87-141), 75 R/hr from the CRBS hanging from the curb of the SFP with the stellite rollers removed and 6 R/hr from the items stored in the boxes on the top of the spent fuel rack tables. The total dose rate on the Refuel Bridge would be 81.2 R/hr with the spent fuel pool water at an elevation of 100 ft. As the scenario described above would be a gradual drain down, there would be ample time for personnel to respond to a change in radiological conditions as well as refuel floor area radiation monitors without exceeding 10CFR20 limits.

The following alarms provide for early detection of SFP water inventory reduction:

1. Fuel pool low level alarms, which are set to alarm when the water level in the SFP drops 2 feet 4 inches below the SFP curb to elevation 114 feet 8 inches (1 foot 4 inches below normal SFP water level), are provided both locally and in the Main Control Room.

2. The fuel pool gate has a local flow indication alarm which alarms at a flow rate of >1 gpm and initiates a common alarm in the Main Control Room.

3. Flow alarms for the reactor vessel/drywell bellows seal leakage, which alarms at a flow rate of >1 gpm and the refueling bellows seal leakage, which alarms at a flow rate of >6 gpm are provided both locally and as a common alarm in the Main Control Room.

2. Fuel Storage Racks:

The fuel racks have been designed to withstand the effects of a fuel handling accident, which evaluates a drop of a 1360 pound fuel assembly from 36 inches. The effect of dropping a CRB and support bracket (approximately 250 pounds a distance of 1 foot) on the fuel racks in the handling/storage process is bounded by the above analyses. As a result, the racks' function, to maintain subcriticality (Keff<0.95), would remain intact in the event a CRB and bracket dropped on a rack.

F. Analysis of Effect on Functions (cont'd.):

3. Fuel Assembly:

Fuel assemblies have been analyzed for the consequences of a fuel handling accident in which one fuel assembly, grapple head, cable, and the three lower telescoping mast sections are dropped a distance of 32.95 feet onto the reactor core. The combined weight of a control rod blade and a bracket is approximately 250 pounds, which is considerably less than the weights of a fuel bundle in combination with the weight of the grapple and the lower three masts sections. The control rod blades will be handled and stored at a height of approximately 1 foot above the spent fuel storage racks. Therefore, the effect of dropping a control rod blade and bracket onto the spent fuel is bounded by the fuel handling accident analysis.

4. Hanger Bracket:

Civil calculation C15.0.3222 demonstrates the structural adequacy of the hanger bracket to support CRBS through handling impact loadings.

5. Radiation Protection Program:

Tech Spec 6.11 states that procedures for personnel radiation protection shall be prepared consistent with the requirements of 10CFR Part 20 and shall be approved, maintained and adhered to for all operations involving personnel radiation exposure. Memo RTS89-06 states the following procedures address appropriate actions to control radiation exposures in the event of a reactor cavity/spent fuel pool drain down: PNPS 5.4.3 "Refueling Floor High Radiation" and PNPS 2.4.31 "Reactor Basin and/or Spent Fuel Pool Drain-down".

6. Radiological Consequences:

The maximum offsite dose that would occur if the fuel pool water level decreased to an elevation of 100 feet is 1.01 mRem per hour. The maximum dose would be on Rocky Hill Road, near the entrance to the upper parking lot. Approximately 1 mRem per hour would be due to 55 suspended CRBS and .01 mRem per hour would be due to an assumed 4500 curies of Cobalt-60, in material placed in storage boxes on tables above the spent fuel racks (maximum allowed loading).

Regulatory Guide 1.26 permits "Non-Q" designation for components or systems whose failure result in less than 0.5 REM offsite dose. The potential accumulated dose to a member of the public, even assuming it would take four days to restrict access to Rocky Hill Road, would be small compared to 0.5 REM.

G. Summary:

1. Q: May the proposed activity increase the probability of occurrence of an accident previously evaluated in the final Safety Analysis report, and

2. Q: May the proposed activity increase the consequences of an accident previously evaluated in the Final Safety Analysis report?

   A: Keff will remain within acceptable limits even if an abnormal event, such as a CRB assembly drop should occur. The racks are designed to seismic Class I requirements. A CRB assembly dropped on the racks would not adversely effect the racks such that they would not perform their function. The radiological consequences of a CRB assembly drop remain within previously established limits of a fuel handling accident. Therefore, the proposed activity will not increase the probability of occurrence or consequences of an accident previously evaluated in the FSAR.

3. Q: May the proposed activity increase the probability of occurrence of a malfunction of equipment important to safety previously evaluated in the Final Safety Analysis report and,

4. Q: May the proposed activity increase the consequences of a malfunction of equipment important to safety previously evaluated in the Final Safety Analysis Report?

   A: Hanging CRBS from the curb of the spent fuel pool will not affect the probability of occurrence or consequences of a malfunction of equipment important to safety previously evaluated in the FSAR because the proposed activity has no impact on malfunctions described in the FSAR.

5. Q: May the proposed activity create the possibility of an accident of a different type than any previously evaluated in the Final Safety Analysis Report?

   A: Hanging CRBS from the curb of the spent fuel pool will not create the possibility of an accident of a different type than any previously evaluated in the FSAR as it is of the same type as the fuel handling accident.

Safety Evaluation (cont'd.)

G. Summary (cont'd.):

6. Q: May the proposed activity create the possibility of a different type of malfunction of eouipment important to safety than any previously evaluated in the Final Safety Analysis Report?

   A: Hanging CRBS from the curb of the spent fuel pool will not create the possibility of a different type of malfunction of equipment important to safety than any previously evaluated in the FSAR as no new equipment or failure mode is being introduced.

7. Q: Does the proposed activity reduce the margin of safety as defined in the basis for any Tech Spec?

   A: Tech Spec 5.5(B) states "The Keff of the spent fuel pool shall be less than or equal to 0.95". A CRB assembly drop is bounded by a fuel handling accident as addressed above and does not reduce the margin of safety for this Tech Spec.

   A: Tech Spec 5.5(E) states "Loads in excess of 1,000 pounds shall be prohibited from travel over fuel assemblies in the spent fuel storage pool". As a CRB assembly weighs approximately 250 pounds, transporting CRB assemblies over fuel in the spent fuel pool does not reduce the margin of safety for this Tech Spec.

   A: The margin of safety for Tech Spec Table 3.2.D, trip settings for refuel area will not be affected as the expected increase in general area radiation will be negligible.

In summary, this change does not constitute an unreviewed safety question.