ATTACHMENT I

PROPOSED TECHNICAL SPECIFICATION CHANGES REGARDING SPENT FUEL POOL STORAGE CAPACITY (JPTS-89-035)

New York Power Authority

JAMES A. FITZPATRICK NUCLEAR POWER PLANT
Docket No. 50-333
DPR-59

5.5 (Cont'd)

B. The spent fuel storage pool is designed to maintain k_{eff} less than 0.95 under all conditions as described in the Authority's applications for spent fuel storage modification transmitted to the NRC July 26, 1978 and May 31, 1990. This k_{eff} value is satisfied if the maximum, exposure dependent, infinite lattice multiplication factor, k_{∞}, of the individual fuel bundle is less than or equal to 1.36. The number of spent fuel assemblies stored in the spent fuel pool shall not exceed 2,797.

5.6 SEISMIC DESIGN

The reactor building and all engineered safeguards are designed on a basis of dynamic analysis using acceleration response spectrum curves which are normalized to a ground motion of 0.08 g for the Operating Basis Earthquake and 0.15 g for the Design Basis Earthquake.

5.5.B Bases

The spent fuel pool and high density fuel storage racks are Class I structures designed to store up to 2,797 fuel bundles. The storage racks are designed to maintain a subcritical configuration having a multiplication factor (k_{eff}) less than 0.95 for all possible operational and abnormal conditions. The nuclear criticality analysis for the Spent Fuel Racks (References 1 and 3) concludes that fresh fuel bundles with 3.3 w/o U-235 meet the 0.95 k_{eff} limit. This design basis bundle was reanalyzed to determine its infinite lattice multiplication factor, k_{∞}, when in a reactor core geometry (Reference 2). This k_{∞} was obtained under conservative calculational assumptions and reduced by 2.33 times the standard deviation in the calculation resulting in the Technical Specification limit of 1.36.

References:

1) Increased Spent Fuel Storage Modification, Stone & Webster Engineering Corporation, Boston, Mass. March 15, 1978.

2) General Electric letter, P. Van Dieman to G. Rorke, FitzPatrick Fuel Storage K-infinity Conversion, Revision 1, dated July 10, 1986.

3) Increased Storage Capacity for FitzPatrick Spent Fuel Pool, Holtec International, Mount Laurel, New Jersey, February, 1989.

ATTACHMENT II

SAFETY EVALUATION
FOR PROPOSED TECHNICAL SPECIFICATION
CHANGES REGARDING SPENT FUEL POOL STORAGE CAPACITY
(JPTS-89-035)

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Section I DESCRIPTION OF PROPOSED CHANGES

The proposed changes to the FitzPatrick plant Technical Specifications, Appendix A, are limited to Specification §5.5.B on page 246 and Bases page 246a. They are:

Page 246, First Paragraph

[a] The first sentence will add the new spent fuel storage amendment application date. The sentence will read:

> B. The spent fuel storage pool is designed to maintain k_{eff} less than 0.95 under all conditions as described in the Authority's applications for spent fuel storage modification transmitted to the NRC July 26, 1978 and May 31, 1990.

[b] The number of spent fuel assemblies that can be stored in the spent fuel pool (SFP) will be changed from "2,244" to "2,797."

Bases Page 246a, First Paragraph

[c] The number of spent fuel assemblies stored in the spent fuel pool will be changed from "2,244" to "2,797."

[d] The third sentence adds Reference 3, deletes the 3.2% Δk margin, and reads:

> The nuclear criticality analysis for the Spent Fuel Racks (References 1 and 3) concludes that fresh fuel bundles with 3.3 w/o U-235 meet the 0.95 k_{eff} limit.

Reference 3 reads:

> 3) Increased Storage Capacity for FitzPatrick Spent Fuel Pool, Holtec International, Mount Laurel, New Jersey, February 1989.

In addition, the Stone & Webster report date in Reference 1 on page 246a, was inadvertently introduced as March 15, 1986. The date should read March 15, 1978.

Section II PURPOSE OF THE PROPOSED CHANGES

The proposed modification increases the storage capacity of the FitzPatrick plant spent fuel pool to provide safe storage for up to 2,797 spent fuel assemblies. This allows planned power operation until 1997 while maintaining the capability of a full-core offload.

Background

On October 17, 1974, the Authority obtained Operating License DPR-59 for the FitzPatrick plant. The plant commenced commercial operation on July 28, 1975. The original storage capacity was 760 fuel assemblies or approximately 1 1/2 cores.

In 1981, the SFP was reracked with high density aluminum alloy racks increasing capacity to 2,244 fuel assembly locations. This provided significant additional storage capacity. With presently available storage, the FitzPatrick plant will lose full core off-load capability in 1991.

To provide increased capacity to store additional spent fuel assemblies, the Authority plans to add five modules containing 553 new locations. This will increase the total SFP capacity to 2,797 locations. Adding new racks provides the most economical and feasible solution to preclude the potential shortage of storage capacity.

This effort is consistent with the objective of the Nuclear Waste Policy Act (NWPA) of 1982. The NWPA established a federal program to deal with high-level nuclear waste (HLW) and spent fuel. Specifically, with regard to spent fuel, the NWPA states in §131(a)(1):

> *Persons owning and operating civilian nuclear power reactors have the primary responsibility for providing interim storage of spent nuclear fuel from such reactors, by maximizing, to the extent practical, the effective use of existing storage facilities at the site of each civilian nuclear power reactor, and by adding new onsite storage capability in a timely manner where practical.*

This NWPA was intended to resolve the storage problems created by the elimination of commercial fuel reprocessing and obligated the Department of Energy (DOE) to accept spent fuel no later than January 31, 1998. However, delays in the program have occurred and DOE currently estimates that a HLW repository will not be operational before 2010.

Based on the above, there is clearly a need for additional onsite SFP storage capacity to assure continued operation of the FitzPatrick plant.

Section III IMPACT OF THE PROPOSED CHANGES

The overall safety criterion for Specification §5.5 is to maintain the spent fuel pool subcritical with a k_{eff} less than 0.95 under all conditions. The proposed rack expansion will not significantly impact this criterion, operation or safety of the plant.

Changes [a] and [d] are administrative changes. Change [a] adds an amendment application date to supplement the Authority's existing application for amendment dated July 26, 1978. Change [d] adds the new Licensing Report Analysis performed by Holtec International, as Reference 3, in support of the increased storage capacity. The Reference 1 report date is corrected to read March 15, 1978. This typographical error was introduced in a previous amendment.

The 3.2% Δk margin in the Technical Specifications, was calculated for the existing racks. This number will be removed from the Technical Specifications, since it no longer applies to all the racks in the SFP. It was included for information only and can be found in documents supporting Amendment No. 63, page 246a.

Changes [b] and [c] will allow additional storage capacity by increasing the number of assemblies in the SFP. This proposed change to the Technical Specification is a direct result of adding the new rack modules.

The proposed modification to add new rack modules changes the physical configuration of the SFP. The primary effect of adding new spent fuel storage racks will be an increase in the amount of spent fuel assemblies that can be stored in the pool. This will increase the weight to be supported by the pool floor and increase the amount of decay heat which must be removed by the spent fuel pool cooling system.

The impact of these and other effects has been evaluated in Attachment III. This report documents the design and analysis performed to demonstrate that the new spent fuel racks satisfy requirements of applicable codes and standards including those of Reference 2. These analyses demonstrate that the consequences of postulated accidents, as a result of the proposed changes, remain well within the acceptable limits established in the FitzPatrick plant FSAR and applicable federal regulations.

The safety assessment (Attachment III) of the rack expansion addresses issues such as criticality, thermal-hydraulics, structural adequacy, and rack installation safety impact. The following is a brief summary of the analyses presented in Attachment III.

A. Criticality Safety Analysis

The racks are designed to maintain spent fuel assemblies in a space geometry which precludes the possibility of criticality during normal and abnormal conditions. Criticality analyses of the spent fuel racks were performed using NRC approved computer codes (Section 4.0 of Attachment III).

The high density spent fuel racks for the FitzPatrick plant are designed to assure that the neutron multiplication factor (k_{eff}) is less than 0.95 with the racks fully loaded with fuel of the highest anticipated reactivity; and the pool flooded with non-borated water at a temperature corresponding to the highest reactivity.

The criticality design basis for the new racks is identical to the basis used for the existing racks. Briefly stated, this basis conservatively established the infinite multiplication factor (k_{∞}) of a 3.3 w/o enriched 8 x 8 fuel bundle without gadolinium poison in the reactor core geometry at 1.36. This design basis fuel bundle had been previously shown to meet $k_{eff} \leq 0.95$ for the existing spent fuel racks. In this application, the same fuel bundle has been used to calculate subcriticality in the new racks. The new rack vendor has also performed a check calculation of the design basis bundle in the reactor lattice to verify consistency with the previous basis calculations. The results of the check calculation demonstrate that the Technical Specification basis is conservative under the methods used to analyze the new racks.

B. Thermal-Hydraulic Considerations

The proposed storage expansion will slightly increase the heat load in the SFP. An analyses has been performed in Attachment III that describes the design basis, method of analysis, and the numerical results.

As a result of these analyses, the present cooling capacity of the SFP cooling system is sufficient to absorb the incremental heat load. Analysis also shows that the maximum cladding temperature is kept low enough by the existing SFP cooling system. This will preclude nucleate boiling or voiding of coolant on the surface of the fuel rods and between the racks.

The increase in radioactivity released to the pool water as a result of the proposed modification is insignificant. It will be kept at levels close to which have existed prior to the modification by the SFP cooling and cleanup system. The existing SFP cooling, makeup, and cleanup systems will not require any modifications. Therefore, adequate pool water conditions are maintained.

C. Structural Analysis

Racks

The new rack modules are seismic Class I in accordance with the FitzPatrick plant Final Safety Analysis Report (FSAR). A seismic analysis of the spent fuel storage racks was performed, as presented in Section 6.0 of Attachment III, to determine the rack behavior and to ensure no loss of function resulting from either a safe shutdown earthquake (SSE) or an operating basis earthquake (OBE). The existing and new racks for the FitzPatrick plant SFP are qualified as non-impacting freestanding racks, i.e., each module is freestanding and self supporting and undergoes minimal kinematic displacements during postulated seismic events. Thus, rack-to-rack (old and new racks), and rack-to-wall impacts are precluded.

Spent Fuel Pool Floor

A structural analysis was performed (See attachment III) to show that the integrity of the pool structure is not compromised for postulated loading conditions. The reinforced concrete floor will continue to meet allowable stress limits with the addition of the new racks when fully loaded with fuel. Thus, the safety function of the pool structure is not affected.

Rack Installation

The Authority will not carry any rack directly over the stored spent fuel assemblies. All work in the SFP area will be controlled and performed in strict accordance with specific written procedures. The Reactor Building crane will be used to bring the racks onto the Reactor Building refueling floor. The crane has been evaluated to meet the guidelines of Section 5.1 of NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants," regarding rack movements. The rack installation procedure provides for the safe handling of heavy loads in the vicinity of the SFP. Therefore, the proposed new racks, existing racks, and pool structure will remain functional and withstand any postulated rack installation accident.

Section IV EVALUATION OF SIGNIFICANT HAZARDOUS CONSIDERATIONS

The changes proposed to the FitzPatrick plant Technical Specifications as a result of the expansion, will allow an increase in the number of spent fuel assemblies stored in the spent fuel pool from 2,244 to 2,797. Operation of the FitzPatrick plant in accordance with the proposed amendment will not involve significant hazards considerations as defined in 10 CFR 50.92, since it would not:

(1) involve a significant increase in the probability or consequences of an accident previously evaluated.

The evaluation of the proposed spent fuel pool modification has considered postulated accident scenarios including:

- Criticality (e.g., spent fuel assembly drop in the spent fuel pool, rack movement);
- Thermal-Hydraulic (e.g., loss of spent fuel pool system flow, heat load); and
- Structural (e.g., seismic event, spent fuel pool structure, rack movement, rack installation);

The effects of these and other potential accident scenarios have been fully analyzed in attachment III. These analyses demonstrate that the consequences of postulated accidents remain within the acceptable limits established in the FitzPatrick plant FSAR and applicable federal regulations.

Criticality analyses of the spent fuel racks were performed using NRC approved computer codes. Under normal operating conditions, these calculations demonstrate that the maximum effective neutron multiplication factor (k_{eff}) in the fuel pool will be less than 0.95, including all uncertainties. Reactivity effects of abnormal and accident conditions have also been evaluated to assure that k_{eff} would remain less than 0.95 with the racks fully loaded with fuel. The effective multiplication factor (k_{eff}) is less than 0.95 for all possible operating and accident conditions. Since the acceptable margin to criticality is not changed, the consequences of reactivity accident are not significantly increased from those previously evaluated.

The analyses show that sufficient time is available to provide alternate means of cooling in the event of a failure in the spent fuel pool cooling system, and unavailability of the Residual Heat Removal heat exchangers. Adequate cooling under both normal and abnormal conditions is maintained. The existing spent fuel pool cooling, makeup, and cleanup systems will not require any modifications. Thus, the consequences of this type of accident are not significantly increased from previously evaluated loss of cooling system flow accidents.

Fuel assembly drop has been analyzed for impact on the racks and presented in Attachment III. In the unlikely event of a fuel assembly drop on top of a storage rack, the resulting deformation will not distort the racks. Thus, the intended safety function of the racks will continue to be met. Also, the radiological consequences of a fuel assembly drop are not changed from those previously analyzed in Section 14.6 of the Final Safety Analysis Report.

The new racks are free standing and self supporting as are the existing racks. They are seismic Class I design in accordance with the FitzPatrick plant Final Safety Analysis Report. A seismic analysis of the spent fuel storage racks was performed to determine rack behavior and to ensure that no loss of function would result from a safe shutdown earthquake or an operating bases earthquake. The analysis demonstrates that rack-to-rack (existing and new racks), and rack-to-wall impacts are precluded. The spent fuel pool structure will continue to meet the allowable stress limits with the addition of the new racks fully loaded with fuel. The integrity of the pool structure is not compromised for postulated loading conditions. The safety function of the racks (new and existing) and pool structure is not affected. Therefore, the consequences of a seismic event are within previously evaluated limits.

(2) **create the possibility of a new or different kind of accident from those previously evaluated.**

The proposed rack addition has been reviewed and analyzed for possible types of accidents. The criteria used in the analyses, design, and installation of the new spent fuel racks to account for anticipated loadings and postulated conditions that may be imposed upon the structure during their service lifetime are in conformance with established criteria, codes, standards, and specifications acceptable to the NRC.

Factors that could affect the neutron multiplication factor in the spent fuel pool have been addressed conservatively. The Authority concludes that the maximum neutron multiplication in the pool with the addition of the high density racks will not exceed the subcriticality limit of $k_{eff} = 0.95$.

The addition of new racks and spent fuel in the spent fuel pool will produce an incremental heat load. However, analysis has shown that the present cooling capacity in the FitzPatrick plant spent fuel pool is sufficient to absorb the incremental heat load. The peak pool bulk temperature will be maintained below the threshold value to preclude local boiling. The incremental heat load will not alter the safety considerations of spent fuel pool cooling from those which the Authority previously reviewed and found to be acceptable.

Rack impact analysis has been performed (Attachment III) to investigate possible impact due to seismic events (i.e., rack-to-rack and rack-to-wall impacts). The analysis has demonstrated that the proposed storage expansion does not result in rack-to-rack or rack-to-wall impact during postulated seismic events.

In conclusion, the analyses demonstrates that there is no increase in the probability of a new or different accident from those previously evaluated. No new failure modes are created; nor is the safety function or operation of the spent fuel pool cooling, makeup, and structural systems changed by the rack addition. This amendment to the Technical Specifications will not result in the initiation of any type of accident or plant transient nor affect the plant's safe shutdown capability.

(3) involve a significant reduction in the margin of safety.

The safety function of the spent fuel pool and the racks is to preclude inadvertent criticality in a safe, specially designed, underwater storage location for spent fuel assemblies which require shielding and cooling during storage and handling. The NRC Staff has established that the issue of margin of safety, when applied to spent fuel racking modifications, should address the following criteria; 1) Nuclear criticality considerations; 2) Thermal-hydraulic considerations; and 3) Mechanical, material and structural considerations. Using these criteria assures that the new fuel pool structure will withstand specified design conditions without impairment of structural integrity or the performance of required safety functions.

The proposed change to add new racks will not significantly reduce the margin of safety for nuclear criticality, since criticality calculations show that the maximum effective multiplication factor (k_{eff}) is within NRC acceptance criterion. Criticality calculations for the new racks indicate a slightly higher k_{eff} (0.937 vs 0.918) than the existing racks for the same criticality design basis. The difference is primary due to the difference in B-10 loading in the BORAL plates. However, the margin of safety applicable to the racks (i.e., $k_{eff} \leq 0.95$, under all credible conditions given conservative assumptions) remains unchanged.

Conservative methods and assumptions are used to calculate the maximum fuel temperature and the increase of the water in the spent fuel pool. The thermal-hydraulic evaluation uses a conservative mathematical model to demonstrate that the temperature margins of safety are maintained. The proposed rack addition with the increased fuel inventory will slightly increase the heat load in the spent fuel pool. The evaluation shows that the existing spent fuel pool cooling system will maintain the bulk pool water temperature below 150° for normal discharge and for full core offload. The evaluation also shows that maximum local water temperature along the hottest fuel assembly is well below the nucleate boiling condition. Thus, there is no reduction in the margin of safety for thermal-hydraulic or spent fuel cooling concerns.

Structural concerns have been analyzed for normal and abnormal conditions, including earthquake, spent fuel assembly drop, rack installation, rack-to-rack impact, etc. The new racks are Seismic Category I equipment and designed to remain functional during an Operating basis earthquake, as specified by NRC Regulatory Guide 1.29. The rack materials used are compatible with the spent fuel pool and spent fuel assemblies, and degradation due to material combinations (e.g., galvanic corrosion) is not expected. In addition, the spent fuel assemblies remain intact, and no criticality concerns exist. Thus, the margin of safety is not reduced by the proposed addition of rack modules.

Similar Examples

The NRC published "Example of Amendments That Are Considered Not Likely To Involve Significant Hazards Considerations" as provided in the final NRC adoption of 10 CFR 50.92 published on page 7751 of the Federal Register Volume 51, No. 44, March 8, 1986. Example X of that list is applicable to the proposed amendment to the Technical Specifications.

The example states:

(X) An expansion of the storage capacity of a spent fuel pool when all of the following criteria are satisfied:

Criterion (1)

The storage expansion method consists of either replacing existing racks with a design which allows closer spacing between stored spent fuel assemblies or placing additional racks of the original design on the pool floor if space permits.

Proposed Amendment:

The FitzPatrick spent fuel pool storage expansion involves adding racks of a new design where space permits. The new racks exceed the structural strength of the old racks, and meets the criticality and thermal-hydraulic characteristics of the old racks.

Criterion (2)

The storage expansion method does not involve rod consolidation or double tiering.

Proposed Amendment:

The proposed racks are not double tiered as all racks will rest on the spent fuel pool floor. Additionally, the proposed storage expansion does not involve rod consolidation.

Criterion (3)

The k_{eff} of the pool is maintained less than or equal to 0.95.

Proposed Amendment:

The design of the new spent fuel racks contains a neutron absorber, Boral, to allow close storage of spent fuel assemblies while ensuring that the k_{eff} remains less than 0.95 under all conditions with pure water in the pool.

Criterion (4)

No new technology or unproven technology is used in either the construction process or the analytical techniques necessary to justify the expansion.

Proposed Amendment:

The NRC has licensed at least ten other plants for rack installation of the same rack design. The construction processes and analytical techniques remain substantially the same as these other ten rack installations. Thus, no new or unproven technology is used in the construction or analysis of the new high-density spent fuel racks at FitzPatrick.

Section V IMPLEMENTATION OF THE PROPOSED CHANGES

Implementation of these changes, as proposed, will not impact the ALARA or Fire Protection Programs at the FitzPatrick plant, nor will the changes impact the environment.

Section VI CONCLUSION

The changes, as proposed, do not constitute an unreviewed safety question as defined in 10 CFR 50.59. That is, they:

a) will not increase the probability of occurrence or the consequences of an accident or malfunction of equipment important to safety previously evaluated in the safety analysis report;

b) will not increase the possibility for an accident or malfunction of a type different from any evaluated previously in the safety analysis report;

c) will not reduce the margin of safety as defined in the basis for any technical specification; and

d) involve no significant hazards consideration, as defined in 10 CFR 50.92.

Section VII REFERENCES

1. James A. FitzPatrick Nuclear Power Plant Final Safety Analysis Report (FSAR).

   Section 9.3, "Spent Fuel Storage."
   Section 9.4, "Fuel Pool Cooling and Cleanup System."
   Section 12.5, "Dynamic (Seismic Analysis)."
   Section 12.6, "Analysis of Spent Fuel Storage Pool."
   Section 14.6, "Analysis of Design Basis."

2. NRC Standard Review Plan, NUREG-0800, dated June 1987.

   Section 3.7, "Seismic Design"
   Section 9.1.2, "Spent Fuel Storage."
   Section 9.1.3, "Spent Fuel Pool Cooling and Cleanup."

3. NRC letter to all Power Reactor Licensees, "NRC Guidance On Spent Fuel Storage Modifications - Review and Acceptance of Spent Fuel Storage and Handling Applications," dated April 14, 1978, and the January 1979 revision thereto.

4. NRC NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants."

5. Increased Storage Capacity for FitzPatrick Spent Fuel Pool, Holtec International, Mount Laurel, New Jersey, February 1989.