June 1, 1984

Docket No. 50-219

LSO5-84-06-001

Mr. P. B. Fiedler
Vice President & Director
Oyster Creek Nuclear Generating Station
Post Office Box 388
Forked River, New Jersey 08731

Dear Mr. Fielder:

SUBJECT: REQUEST FOR ADDITONAL INFORMATION FOR EVALUATION OF SPENT FUEL POOL EXPANSION

Re: Oyster Creek Nuclear Generating Station

In the review of the high-density spent fuel rack design and analysis, the staff finds additional information is necessary. Enclosed is a list of questions that the staff needs answered so that the review may proceed orderly. Responses to these questions will be required by June 8, 1984 in order to maintain the correct schedule.

The reporting and/or recordkeeping requirements contained in this letter affect fewer than ten respondents; therefore, OMB clearance is not required under P.L. 96-511.

Sincerely,

Original signed by James Lombardo
for
Dennis M. Crutchfield, Chief
Operating Reactors Branch #5
Division of Licensing

Enclosure
Additional Information needed.

cc w/enclosure:
See next page
Docket File
NRC PDR
Local PDR
ORB #5 Reading
D. Eisenhut
OELD
EJordan
JGrace
JLombardo
LA
ACRS (10)
cc Plant service list

SE01
DSU USE 51
ADD: J. GRACE

DL:ORB #5
JLombardo:jc
6/1/84

DL:ORB #5
DCrutchfield
6/1/84

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

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James J. Lombardo for

Dennis M. Crutchfield, Chief
Operating Reactors Branch #5
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Enclosure
Additional Information needed.

cc w/enclosure:
See next page

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OYSTER CREEK NUCLEAR GENERATING STATION

Additional information regarding the following is requested.

A. High-Density Spent Fuel Rack Dynamic Structural Analysis

Based on the review of the recently submitted responses by Joseph Oat Corporation (consultant to Oyster Creek) [1, 2] and the information presented in a meeting with Joseph Oat at Franklin Research Center on May 7, 1984 [3], the following questions are prepared for additional information and/or clarification.

1. In the referenced meeting [3] and responses submitted on May 10 [2], Joseph Oat indicated that the equivalent gap was developed to take into account the hydrodynamic effects on all four sides of the rack. The following reasons are given for this concept of equivalent gap:

   a. The seismic loading should be equal to zero when taking the average of the complete seismic input time history.

   b. The hydrodynamic mass, according to Fritz [4], is related to the gap (g) by the following expression:

$$\text{Hydrodynamic mass} = M_H = \frac{\text{Constant}}{g}$$

   Please respond to the following questions:

   a. Provide the technical basis as to why the seismic loading will be zero; even if this is true, it is not clear how this would be used to justify the proposed approach.

   b. Provide a discussion of why, at the instant the motion starts, the rack is assumed to be at an artificial center position instead of its actual position.

2. In the referenced meeting [3], Joseph Oat Corporation indicated that the seismic loading in three directions was applied simultaneously to the model. Please indicate whether these three input time histories are statistically independent as specified by Regulatory Guide 1.92 [5].

3. With respect to the influence of coefficient of friction to the rack displacement, the following table is prepared based on the outputs given in Joseph Oat's submittal [6]:

Case	Rack	Loading Condition	Coefficient of Friction	Maximum X-Displacement
i	E	Full load	0.8	0.125
	F	Full load	0.8	1.298
ii	E	Full load	0.8	0.125
	E	Full load	0.2	0.655
iii	F	Full load	0.8	1.298
	F	Full load	0.2	0.535

With reference to the above table, please respond to the following questions:

a. For case i, racks E and F are very similar with the exception that E is higher than F. Explain possible reasons why F has higher maximum displacement.

b. For cases ii and iii, please provide possible reasons why a high coefficient of friction in case ii produces smaller maximum displacement and high coefficient of friction in case iii produces higher maximum displacement.

c. Please provide displacement and base support reaction time histories for case i (both racks E and F) with the following coefficients of friction: 0.2, 0.4, 0.6, and 0.8. If this information is not available, it is strongly recommended, as a minimum, that outputs for coefficients of friction 0.2 and 0.8 should be generated for review.

4. With respect to Response No. 3 of Reference 1, please confirm whether the following information is true:

a. For a coefficient of friction of 0.8, maximum displacement always occurs at the instant three support legs are lifted off the pool floor and the rack never gets into the sliding mode.

b. For a coefficient of friction of 0.2, the maximum displacement always occurs in the sliding mode and the rack never lifts off the pool floor.

Also, please respond to the following question:

For the case where three support legs are lifted off the pool floor, please indicate a typical number of time steps during which they are off the floor. It is noted that this is a completely unstable configuration in which the rack itself loses all of its resisting capacity against the motion along the horizontal directions, and the chance that the two horizontal components of seismic input motion would form a stable balance (no rotation of the rack) is remote. Please address this concern.

5. With respect to Response 2 of Reference 1, Joseph Oat Corporation indicated that the fluid coupling term represents the hydrodynamic mass contribution due to motion of the plane of symmetry in antisymmetric motion. Please respond to the following questions:

   o Since the analysis was carried out for one rack at a time, indicate whether the model has the capability to identify symmetric or antisymmetric motion. For symmetric motion, please confirm whether this plane of symmetry exists and how the gap is treated.

   o According to the Joseph Oat Corporation approach, the planes of symmetry around a rack, in effect, will form four rigid walls around the rack and have the motion of the pool floor. Provide a technical basis to validate this approach. In reality, it is most likely that the fluid will cross these planes of symmetry, and there should be free interaction between racks.

B. Spent Fuel Pool Analysis

1. The Licensee stated that different finite element models were used for static and dynamic (seismic) analysis of the fuel pool slab, and that the results of the two analyses are compared to determine the dynamic load factors. The resulting small value of 0.005 (Page 8-7 [7]) of the seismic multiplying factor does not seem to confirm the conservative nature of this approach.

   o A clarification of this comparison and the unusually small value of dynamic amplification factor is requested.

   o Please provide information on how the effect of a 40-ft column of water was included, and on the lumping of the distributed mass to 9 master degree of freedom.

   o Information is also requested describing how the effects of wall hydrostatic and hydrodynamic pressures on the slab were considered.

2. The Licensee has stated (Section 8.2.2) that the stiffness and strength of concrete are based on complete cracking of concrete. Please provide information whether the section capacities listed in Tables 8.2 and 8.3 are also based on the same assumption.

Please provide information on whether properties of the slab were calculated on an orthotropic or isotropic basis, and how the variation of reinforcement on the two faces of slab and in different directions was accounted for.

3. The thermal loading has been based on a 21°F temperature differential across the slab depth. The thermal moment due to a temperature gradient is calculated by a formula given on page 8-6 [7] which uses the effective Young's modulus, E*, for a homogenous slab. Please provide full details on the calculation of E* and the conservatism of using cracked sections in this calculation, if it was based on this assumption.

4. The floor slab moment capacity from Table 8.2 [7] (Mu = 48,350 lb-in/in) seems quite low in comparison to the other values. Please confirm the correct value.

REFERENCES

1. Joseph Oat Corporation, Preliminary Responses to FRC's List of Questions, May 7, 1984

2. Joseph Oat Corporation, Additional Responses to FRC's List of Questions, May 11, 1984

3. Technical Meeting with Joseph Oat at FRC on May 7, 1984

4. R. J. Fritz, "The Effects of Liquids on the Dynamic Motions of Immersed Solids," Journal of Engineering for Industry, Trans. ASME, February 1972, pp. 167-172

5. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.92, "Combining Modal Responses and Spatial Components in Seismic Response Analysis," February 1976

6. A. I. Soler, "Seismic Analysis of High-Density Fuel Racks for GPU Oyster Creek Nuclear Station," TM Report No. 678, April 24, 1984

7. GPU Nuclear, "Licensing Report on High-Density Spent Fuel Racks for Oyster Creek Nuclear Generating Station," August 1983