3.3 INSTALLATION AND LEVELING

The new spent fuel storage racks will arrive at the site by truck, packaged on their sides, and secured to shipping rigs. Unloading of the packaged racks will be conducted by station personnel. The racks will be brought through the reactor building receiving bay equipment air lock and lifted to the spent fuel pool operating floor elevation using the overhead crane. Racks will then be secured to the upending cradle shown on Figure 3.7 and uprighted vertically onto their legs and moved to their temporary storage locations on the operating floor. This operation will also be performed using the overhead crane.

Procedures and specifications will be used to control all operations required to remove existing and install new spent fuel racks. A sequencing system will be employed for relocation of spent
fuel within the pools. Initially, existing racks will be emptied of 5
spent fuel and removed from the pool, thereby creating the required space for the first new racks to be installed. Relocation of fuel to the new racks will then allow additional existing racks to be removed. No old racks or new racks will be lifted over stored fuel or near enough to fuel so that any postulated lifting rig failure would result in any fuel damage. A diver will assist in leveling the new racks with shims during the installation project. This will necessitate maintaining separation between the diver and the spent fuel stored in nearby racks.

Initial washdown of the existing racks will be performed at the central decontamination area on the fuel handling floor. Various methods are being investigated for disposal of the old racks including burial, shredding followed by burial, and decontamination. The final decision as to disposal method will be based upon ALARA and cost considerations.

The new racks will be unpackaged at the temporary storage area, lifted and transported to the decontamination area using the lifting frame and rigging assembly shown on Figure 3.8. Four sets of holes allow the frame to accommodate all seven new rack configurations. The lifting rods and plugs shown on Figure 3.8 will extend and thread into the leg portion of each rack. This assembly will also be used to lower the racks into final pool positions.

In addition to the procedures which will be developed for rack handling, other areas which will be addressed are: acceptance procedures; equipment and specifications for removal of existing rack supports where necessary; interim fuel pool liner repair guidelines; and controls for final disposal of existing racks. 5

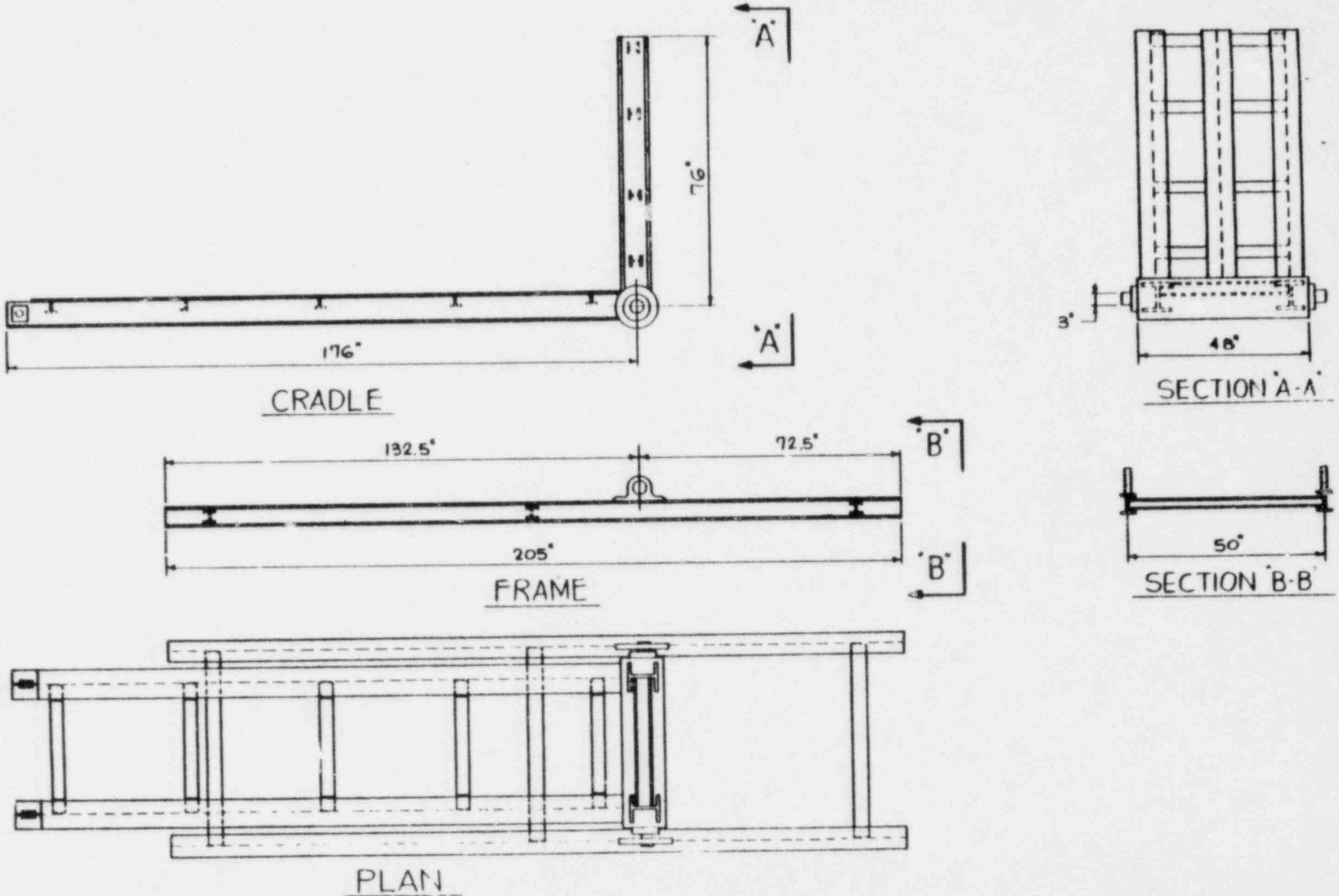

FIGURE 3-7 – SPENT FUEL RACK UPLIFTING CRADLE

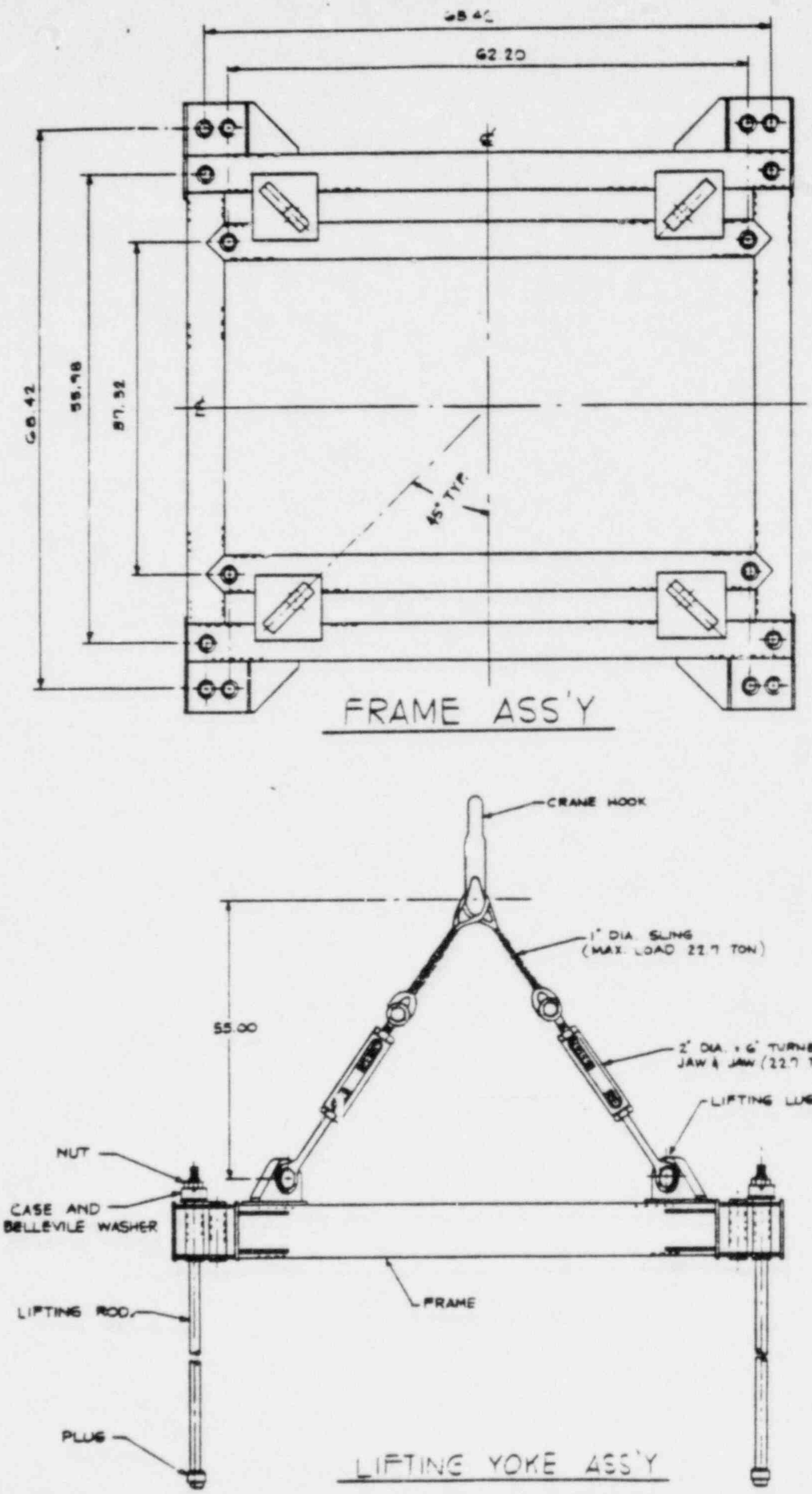

FIGURE 3-8 – SPENT FUEL RACK LIFTING FRAME ASSEMBLY

9.0 POOL STRUCTURAL CALCULATIONS

9.1 Introduction

Seismic qualification of the pool floor is carried out using the following conservative assumptions:

1. The pool floor is analyzed as a simply supported rectangular plate; no credit is taken for structural resistance offered by the adjacent pool walls.

2. Calculation of the stiffness and strength properties for the analyses is based on the assumption of complete cracking of the concrete in tension over the entire floor plan area.

3. The dynamic loading used to qualify the pool floor assumes that all racks are fully loaded with channelled fuel assemblies. 5

The input loading for dynamic analysis of the pool floor is obtained from the results of detailed dynamic analysis of a single fuel rack. The dynamic mass used on the floor slab analysis includes the concrete mass, the reinforcement mass, and the virtual mass of the water set in motion by the pool floor. The pool floor stiffness properties assume that concrete is fully active on the compression side of the neutral axis, and is fully cracked on the tension side. The time history analysis of the pool floor is carried out using the Joseph Oat proprietory computer code DYNAHIS. Output floor loads, obtained from a time history analysis of an individual fuel rack, are converted to a floor pressure load time history acting on the entire floor slab, and used as the input dynamic load for the time history analysis of the pool floor. The results of the pool floor analysis are scanned during computations, and the maximum floor deformation obtained during the complete seismic event is considered as the primary output for further analysis. An equivalent static load, that yields the same value of maximum deformation, is then computed and used to perform structural integrity checks in accordance with SRP-3.8.4 (as revised July 1981) (Ref. 1).

9.2 Dynamic Analysis of Pool Floor Slab to Obtain Maximum Floor Displacements

With the dynamic model of the pool floor slab, considered as a simply supported rectangular orthotropic plate, a dynamic load history can be applied to the floor and be used to obtain the maximum displacements of the pool floor from the horizontal position. By equating the maximum displacement, obtained from an analysis over the total time of the seismic event, with the exact solution for the static deformation of the similar plate configuration, we may obtain a conservative estimate of the effective static pressure load on the pool floor slab. This effective pressure load can then be used in a standard strength qualification of the pool floor as outlined in SRP 3.8.4.

The dynamic load histories applied to the pool floor have been obtained from the results of two dynamic analyses of a fully loaded Type A rack. The resulting load from each analysis represents the algebraic sum, at each time point, of the loads in the four supports. One analysis considers a rack located near the center of the pool floor slab. The other considers a rack located near the edge of the pool floor slab. Differences in the loads are due to the presence of additional support flexibility for the centrally located rack. This additional flexibility is due to the additional elasticity of the pool 5
floor away from the edge caused by its plate-like behavior. The loadings include the dead load of the rack and full assemblies.

For the purpose of a floor dynamic analysis, it is assumed that these load histories are representative of the averaged pool floor loads from all of the different rack types acting concurrently. This load is converted into a time history of floor pressure by dividing by the base area of a single rack A after removing the dead load component. Using the obtained pressures as input to the floor slab time history analysis, the program DYNAHIS determines the pool floor displacement as a function of time, and as part of the output, gives the maximum displacement of the floor slab, δ_{max}. Structural damping, based on the lowest calculated pool floor natural frequency $f_1 = 18\ H_z$ is incorporated into the model by modification of the structural stiffness matrix according to standard practices.

To derive an effective static uniform pressure load, for subsequent strength analysis, δ_{max} is compared with the exact solution for a statically loaded plate. Using values appropriate for the Quad Cities pool floor, we may determine q_s/w_s. The effective pressure associated with the maximum dynamic deflection δ_{max} is then obtained from the equation

$$q_e = \left(\frac{q_s}{w_s}\right) \delta_{max}$$

The following effective static loads are obtained from the floor slab dynamic results:

q_e (SSE) = 7.25 KIPS/sq.ft.
q_e (OBE) = 4.224 KIPS/sq.ft.

9.3 Qualification of Quad Cities Pool Floor

The table below summarizes the loadings used in the qualification of the pool floor.

5

Table 9.1 Loading Data

	Loading Type	Computed Value (KIPS/sq.ft.)
1.	Dead Weight of Racks	.254
2.	Weight of channelled Fuel Assemblies (racks fully loaded)	2.259
3.	Weight of 40' head of water (less water displaced by racks)	2.349
4.	Dead weight of floor slab	.9397
	Total dead load =	5.80
5.	OBE Seismic Load	4.224
6.	SSE Seismic Load	7.25
7.	OBE Seismic Load due to dead weight of floor slab	.2645 5
8.	SSE Seismic Load due to dead weight of floor slab	.529

The pool floor is qual:fied using the strength design method for both service load conditions and for factored load conditions. Using the notation of SRP 3.8.4, the following load combinations are deemed critical for the qualification of the pool floor.

Service Load Conditions

a. 1.4 L + 1.9 E (Seismic in same direction as dead load)

b. .75 (1.4 D + 1.9 E + 1.7 T_o)

c. 1.2 D - 1.9 E (Seismic in opposite direction to deadload)

Factored Load Conditions

d. $D + T_o + E'$

e. D - E' (Seismic in opposite direction to dead load)

Note that the dynamic impact loads on the pool floor, due to motion of the fuel racks, has been accurately included in the loadings E and E'.

The strength analysis method is used to qualify the pool floor. Bending moments and shear forces are calculated using the pressure loadings computed for the critical load cases (a)-(e) above. Comparison of the results with the ultimate moment and shear capacity available is used to qualify the design. Slab bending moments are computed using the static formula in Ref. (2) of this section for moments at the center of a statically loaded orthotropic rectangular plate.

Corresponding to the critical load cases above, the loadings given in Table 9.1 are combined to give the following critical static pressures: 5

Table 9.2 Effective Lateral Pressures on Floor Slab

Load Case	Pressure Loading (KIPS/sq.ft.)
a	16.647
b	12.485
c	-1.567
d	13.579
e	-1.98

It is clear that cases c and e are not critical for design. Table 9.3 below summarizes the results of the structural integrity checks of the pool floor. Both long direction and short direction moments are given for each load case. The thermal moments are computed assuming that the upper surface of the pool floor is at the water temperature 145.8°F, the lower surface is exposed to still air, and that the edges of the pool floor are clamped. All of these assumptions lead to conservative estimates of the moments due to thermal gradients through the thickness of the pool floor.

Table 9.3 Structural Acceptance Checks for Pool Floor Moments

MOMENTS (KIP ft/ft)

Load Case	Moment Due To Pressure	Thermal Moment	Total Moment	Allowable Moment	
a (Long)	1099.	0	1099.	1677.	5
(Short)	1106.	0	1106.	1626.	
b (Long)	823.	234.6	1057.6	1677.	
(Short)	829.5	211.	1040.5	1626.	
d (Long)	896.	184	1080	1677.	
(Short)	902.	165.5	1067.5	1626.	

The results above indicate that the bending strength of the pool floor is adequate for the service intended.

The ultimate shear capacity of the pool floor is computed by comparing the actual floor loading applied in each load case to the ultimate shear capacity available from the four edges of the floor. Therefore, if a, b are the floor edge dimensions, V_a, V_b are the respective shear capacities along these edges, (KIP/ft) and q is required pressure loading to be supported, the condition for shear structural integrity is

$$q\ a\ b < 2(V_a\ a + V_b b)$$

Using standard formulas to compute the ultimate shear capacity of each edge of the pool floor, the above equation yields the result that to meet slab shear capacity, the net lateral load on the floor must satisfy the following condition

$$q < 18.918 \quad \text{KIPS/sq.ft.}$$

Since the thermal gradients do not contribute to gross shear at a section, examination of the pressures associated with each load case (Table 9.2) indicates that the shear capacity of the pool floor is adequate for the service intended.

9.4 Summary

The pool floor has been shown to meet all structural acceptance requirements even when conservatively analyzed as a simply supported rectangular plate with no credit taken for the supporting effects of the adjacent walls.

REFERENCES

1. NUREG-0800, U.S. Nuclear Regulatory Commission Standard Review Plan, Section 3.8.4 plus Appendices, Rev. 1, July 1981. 5

2. Timoshenko, S. P. and Woinowsky-Krieger, Theory of Plates and Shells, McGraw-Hill, 3rd edition, 1959, pp. 364-373.

12. RESPONSES TO NRC QUESTIONS

Given below are NRC questions concerning the Licensing Report on High-Density Spent Fuel Racks for Quad Cities Units 1 and 2. They are listed by date of transmittal. Also given below are responses to those questions or the word "Later" indicating that the response will be communicated at a later date.

12.1 Questions from T. A. Ippolito to J. S. Abel transmitted on May 15, 1981

12.1.1 Question:

As a result of replacing the fuel pool racks, there is an appreciable increase in the applied load to the fuel pool concrete floor. Indicate the method and the code used in the analysis of the concrete fuel pool slab.

Response: Later

12.1.2 Question:

Provide the floor response spectra or the time history used in the analysis of the spent fuel racks and state the source of this information.

Response: Section 6.7 of Supplement 4 to Rev. 1 of the Licensing Report
submitted on 10/19/81 gives the source of the time history data.
Figures 6.9 and 6.10 of Section 6.7 depict horizontal and vertical 5
pool floor accelerations used in the rack analyses.

12.1.3 Question:

Indicate the damping value used in the analysis of spent fuel racks and state whether this value conforms with Regulatory Guide 1.61.

Response: Paragraph 6.2.4 of Supplement 4 to Rev. 1 of the Licensing Report submitted on 10/19/81 states that 1% damping was used in the analysis of the spent fuel racks. This value is consistent with that used in the FSAR and conservative with that permitted by Regulatory Guide 1.61.

12.1.4 Question:

Indicate whether material, fabrication, installation, and quality control conform with the ASME code, Subsection NF.

Response: Yes, material, fabrication, inspection and quality control conforms with ASME code, Subsection NF.

12.1.5 Question:

Indicate if there is any possibility that the shipping cask may drop onto the fuel pool liner or on to the fuel pool racks and what design considerations are given to the fuel pool liner and racks.

Response: Section 10.1.2 of the Quad-Cities FSAR describes the fuel pool structure and leak detection system. In regard to cask drop this section references the Dresden-2/3 FSAR (Dockets 50-237/50-249) Amendment 16/17, Section 11, Fuel Pool Damage Protection. In response to NRC question 2.9.3.11, Section 10 of Amendment 11 of the Quad-Cities FSAR describes the fuel pool liner design and additional details of the leakage detection system. Dresden Special Report No. 28 transmitted to the NRC from Commonwealth Edison by letter dated May 31, 1973, provides a structural analysis which concludes that a dropped cask will not penetrate the bottom of the pool. This report also applies to Quad-Cities. Addenda Nos. 1 & 2 transmitted to the NRC by letters dated July 2, 1973 and August 10, 1973 provide additional information.

Modifications have been made to the Reactor Building crane handling system which preclude postulated drops of a 100-ton-spent fuel shipping cask. These modifications are described in Quad-Cities Special Report No. 16 transmitted by letter from Commonwealth Edison Company to the NRC dated November 8, 1974. Supplementary information was transmitted to the NRC by letters dated June 10 and December 8, 1975 and February 9, March 2, and March 29, 1976. The NRC approved the modifications and associated changes in the Technical Specifications in the letter of January 27, 1977 to Commonwealth Edison Company.

12.1.6 Question:

Provide the names of the codes and standards used in the fuel pool liner design.

Response: Later

12.1.7 Question:

With regard to the fuel assembly drop on the top of the rack, provide the following:

a. Detailed description of the method used to satisfy the accept ance criteria for dropped fuel accident I and II.

b. Comparison between drops in the tilted position, straight drop and on the corner of the rack.

c. Indicate whether other modes of failure of the racks exist beside crushing.

Response: Later

12.1.8 Question:

Indicate in detail the methodology used to demonstrate the leaktight integrity of the fuel pool liner when subjected to either the postulated fuel assembly drop or the cask drop over the spent fuel pool liner. The heavy drop should be analyzed for the tilted position and straight drop.

Response: Later

12.1.9 Question:

Indicate whether the proposed fuel storage pool modifications conform with the staff position on "Fuel Pool Storage and Handling Application", dated April, 1978, including revisions dated January, 1979. If any deviations exist, identify and justify these deviations.

Response: Yes, the guidance is followed, with the exception of the Technical Specification for maximum enrichment. This is because of the variety of enrichments in the fuel and the existance of the subcriticality specification of k_{eff} less than or equal to 0.95.

12.1.10 Question:

The seismic analysis as presented in the submittal is not clear. Indicate in detail how all the seismic models and parameters (Figure 6.1, 6.3, 6.4, 6.5, 6.6, 6.7 and 6.8, the friction forces and floor response spectra) fit together to predict the seismic stresses. Indicate the interrelationship among the models.

Response: See Revision 1 to Chapter 6, Seismic Analyses Description, submitted to the NRC by letter from T. J. Rausch to H. R. Denton on June 24, 1981.

12.1.11 Question:

Because different type modules were used in the proposed modification with different sizes and weights, indicate which type was used in the seismic and sliding analysis. Indicate also how other types were qualified for the postulated loadings.

Response: Section 6.7 of Supplement 4 to Rev. 1 of the Licensing Report submitted on 10/19/81 indicates rack types, sizes, and weights used 5
in the seismic and sliding analyses.

12.2 Questions from T. A. Ippolito to J. S. Abel transmitted on May 18, 1981

12.2.1 Question:

When Section 5.1, Heat Generation Calculations, is provided, include the following information:

a. Indicate the minimum elapsed time between shutdown and when the dis charged fuel is in the spent pool for all anticipated fuel discharge cycles.

Reponse: See Section 5 of Supplement 2 to Revision 1 of the Licensing Reports submitted to the NRC by letter from T. J. Rausch to H. R. Denton dated August 10, 1981.

b. For Units 1 and 2 spent fuel pools, indicate the number of fuel assemb lies and their respective decay times of all fuel that will be in the pools when reracking occurs.

Response:

See Revision 1 of Licensing Report submitted to the NRC by letter from T. J. Rausch to H. R. Denton on June 24, 1981.

c. It is noted in the FSAR that portions of the RHR system may be used to augment the spent fuel pool cooling system by inserting spool pieces in the spent fuel pool cooling lines shown in Figure 10.2.1. In this regard, indicate the length of time required to install these spool pieces and describe the capability of the RHR system to remove the heat from the spent fuel pool over a range of pool temperatures and with and without the spent fuel pool cooling system in operation.

Response: The time required to install the spool pieces is discussed in the response to question 12.2.2. The capability of the RHR system to remove heat from the spent fuel pools is discussed in Section 5 of Supplement 2 to Revision 1 of the licensing report, submitted to the NRC by letter from T. J. Rausch to H. R. Denton dated August 10, 1981.

d. For Units 1 and 2 indicate the length, width and depth of the spent fuel pools and the minimum volume of water in each when all storage racks are filled with fuel assemblies.

Response: As shown in Section 2 of the licensing report, the length and width of each pool are 41 feet and 33 feet respectively. The depth of water in each pool is 39 feet. As stated in Section 5 of Supplement 2 to Revision 1 of the licensing report, submitted to the NRC by letter from T. J. Rausch to H. R. Denton dated August 10, 1981, the water inventories in the Quad-Cities Unit 1 and Unit 2 spent fuel pools are 44887 and 44471 cubic feet respectively when all racks are in place in the pools and every storage location is occupied.

e. Figure 2.1 and 2.2 of the March 26, 1981 submittal shows that the downcomer region, i.e., space between the racks and walls of the pool, is quite small. Further, the vertical dimension of the water plenum formed by the base plate of storage racks and the pool bottom is 6-1/2 inches. Assuming the maximum heat load is adversely located in the storage racks demonstrate that sufficient circulation will occur to preclude nucleate boiling.

Response: See Section 5 of Supplement 2 to Revision 1 of the Licensing Report, submitted to the NRC by letter from T. J. Rausch to H. R. Denton dated August 10, 1981.

12.2.2 Question:

Assuming the reactor is operating at power when it becomes necessary to utilize the RHR system to cool the spent fuel pool, describe and discuss the steps that must be taken and the elapsed time before the RHR system can be placed in the fuel pool cooling mode of operation.

Response: Using the Residual Heat Removal (RHR) System for fuel pool cooling will render one of the two loops (two pumps and one heat exchanger) unavailable for use in any of the safety functions (LPCI or containment cooling). Quad Cities Technical Specifications allow LPCI and one loop of containment cooling to be inoperable during reactor operation as long as 1) the other loop of containment cooling is available, both core spray systems are operable, and both diesel generators are operable, and 2) the loop used for fuel pool cooling is returned to normal within seven days, or the reactor shall be shut down.

Once it has been determined that supplemental fuel pool cooling using RHR is necessary, the RHR/LPCI Mode Outage Report Surveillance would be performed, and crews would be dispatched to install the two spool pieces which join the fuel pool cooling system to RHR. When this has been accomplished, the valving operations may begin. This involves the closing of several motor-operated valves, racking out the breaker on another motor-operated valve, and the opening of two manual valves near the fuel pool cooling heat exchangers. Next, the RHR Shutdown Cooling Mode suction header must be filled and vented and the RHR system vented. Finally, the RHR service water system is started and an RHR pump is started to commence fuel pool cooling. The total elapsed time would be approximately three hours if two maintenance crews were available (one for each spool piece) or four hours if a single crew installed both spool pieces. At times when no maintenance crew is on site, an additional one to two hours would be required to assemble the necessary personnel.

12.2.3 Question:

For both Units 1 and 2 spent fuel pool reracking operations, provide the following additional information:

a. Assuming a load drop, describe and discuss, with the aid of drawings, the travel paths of the new and existing storage racks with respect to plant equipment that may be needed to attain a cold safe shutdown or to mitigate the consequences of an accident.

Response: Diagrams will be prepared before moving racks based upon results of NUREG-0612 studies.

b. Provide the weights of the racks. Describe and demonstrate the ade quacy of the lifting rig attachment points, on the new and old racks, to withstand the maximum forces that will be experienced during the load handling operations.

Response: The weight of the racks is contained in the Revision 1 Licensing Report submitted to the NRC on June 24, 1981 by letter from T. J. Rausch to H. R. Denton. Lifting rig requirements are not yet defined and will be submitted later.

c. With the aid of a drawing, describe the lifting rigs that will be employed in handling the racks and demonstrate their adequacy.

Response: Later

d. Assuming stored spent fuel is in the pool when the storage racks are being removed or installed, demonstrate that the stored spent fuel is not within the area of influence of dropped racks should one or more of legs of the lifting rig fails.

Response: Later

e. FSAR Figures 12.1.1 and 12.1.2 shows a transfer canal joining Unit 1 pool with Unit 2 pool. Assuming a significant number of loads are transferred between the two pools, describe the merits of providing additional protection in the form of a cover over those storage racks directly under this frequently travelled path.

Response: The assumption that a significant number of loads will be transferred between the pools is incorrect. Both pools are nearly full which precludes significant transfers of fuel. With regard to adding a cover, this cover would only add another heavy object consideration in additon to thermal cooling concerns.

f. For both Units 1 and 2, with the aid of drawings, sequentially describe the movement of the stored spent fuel assemblies and storage racks in order to reduce the possiblity of fuel damage in the event of a load drop during the reracking operations.

Response: All work will be planned in advance and detailed procedures developed to reduce the possibility of load drops and resultant fuel damage.

g. Considering the limited space between the storage racks and the pool walls, describe the travel paths and laydown area for various pool gates. Demonstrate that the consequences of a dropped gate are acceptable or that one can reasonably assume that dropping of the gates is very unlikely.

Response: Later

h. Using Figure 3.7, describe and discuss the ability of the high density storage racks to protect the stored spent fuel assemblies from damage following a load drop.

Response: Two fuel assembly drop conditions are described in Section 6.6. Accident I, where the fuel assembly is postulated to drop and impact the base plate, the maximum deformation of the plate is approximately 0.5". It is proved that the base plate is not pierced. The analysis is based on a very conservative model which 5
ignores the fluid drag of water in the cells, and does not account for material strain hardening.

Accident Condition II postulates that the fuel assembly drops on top of the rack and impacts at its weakest location. Maximum local stress in the region of impact is 22900 psi which is below the material yield point.

i. In regard to the potential for damage to stored spent fuel resulting from light load drops (i.e., one fuel assembly and its associated handling tool when dropped from its maximum carrying height), it was assumed that all lesser loads that are handled above stored spent fuel would cause less damage if dropped. Verify that this assumption was correct, e.g., indicate that all lesser loads when dropped from their maximum elevation would impart less kinetic energy upon impact with the tops of the fuel assemblies and or storage racks.

Response: Later

12.2.4 Question:

Since Figure 2.2 shows that essentially all available space in Unit 2 pool will be occupied by storage racks, therefore, all Unit 2 stored spent fuel must be moved to Unit 1 pool via the transfer canal before it can be loaded into the shielded shipping cask. Describe and discuss what measures will be taken to reduce the possibility of fuel assembly damage resulting from the additional fuel handling operations.

Response: It will not be necessary to move all Unit 2 fuel thru the Unit 1 pool when it becomes possible to ship fuel. The racks in the Unit 2 cask handling area will not be installed unless required. If they were installed, they could be removed to facilitate the use of a cask later. In addition, all fuel movements will be accomplished by approved procedures to reduce the possibility of fuel assembly damage.

12.2.5 Question:

For both Unit 1 and Unit 2 storage pools, starting with the total decay heat load that will exist in each pool following the reracking operations, provide the following information:

a. a plot of the pool's maximum anticipated total decay heat load resulting from normal discharges versus time until each pool has reached its storage capacity.

Response: Decay heat loads for several limiting cases are discussed in Section 5 of Supplement 2 to Revision 1 of the Licensing Report, submitted to the NRC by letter from T. J. Rausch to H. R. Denton dated August 10, 1981.

b. Verify that all decay heat calculations have been made in accordance with ASB technical position 9-2.

Response: All decay heat calculations have been made in accordance with Branch Technical Position APCSB 9-2 (now ASB 9-2).

c. a plot of the pool's water temperature versus time for each discharge where the total decay heat exceeds the capacity of the spent fuel pool cooling system. Indicate what cooling systems are in operation and their respective capacities.

Response: See Section 5 of Supplement 2 to Revision 1 of the Licensing Report, submitted to the NRC by letter from T. J. Rausch to H. R. Denton dated August 10, 1981.

d. a plot of maximum decay heat load in each pool, assuming a full core discharge at each of the normally scheduled refueling periods.

Response: See Section 5 of Supplement 2 to Revision 1 of the Licensing Report, submitted to the NRC by letter from T. J. Rausch to H. R. Denton dated August 10, 1981.

e. a plot of the pool's water temperature versus time following each full core discharge assumed in Item d above. Indicate what cooling systems are in operation and their respective capacities.

Response: See Section 5 of Supplement 2 to Revision 1 of the Licensing Report, submitted to the NRC by letter from T. J. Rausch to H. R. Denton dated August 10, 1981.

f. Assuming the maximum heat load exists in Unit 1 and Unit 2 pools when all external cooling was lost, indicate the time interval before boiling occurs and the boil off rate.

Response: See Section 5 of Supplement 2 to Revision 1 of the Licensing Report, submitted to the NRC by letter from T. J. Rausch to H. R. Denton dated August 10, 1981.

g. Describe and discuss the sources of makeup water, the quantity avail able, their respective makeup rates and the steps that must be carried out and the elapsed time before the makeup water will be available at the pools.

Response: There are 3 sources of makeup water available to the spent fuel pool. They are:

1. Using the condensate transfer pumps, water from the condensate storage tanks can be transferred to the skimmer surge tanks. These pumps can be started in minutes. Per FSAR Section 10.2-3, this system can deliver approximately 550 pgm of water cooler than that normally found in the spent fuel pool.

2. Water from the condensate storage tanks can also be transferred 5
to the spent fuel pool utilizing the RHR pumps. This method will require the installation of a pool piece which will require about 3 hours to install. (See response to Question 12.2.2).

The amount of water available from this source is conservatively estimated to be 1000 gpm due to all flow coming into the pool via one 6 inch header.

3. River water can be delivered to the spent fuel pool within 30 minutes by use of fire hoses and one or both fire pumps. Each pump can deliver 3,200 gpm.

12.2.6 Question:

Since the RHR system will be required to augment the spent fuel cooling system for some period of time following a discharge, describe and discuss how it will be verified that the decay heat load has decayed to a value within the capacity of the spent fuel pool cooling system and, therefore, allowing the RHR system to be safely returned to its safety function mode of operation.

Response: It has been CECO's experience that the RHR is not required for either a reload or full core discharge. It was required, its use would be phased out by throttling back the RHR and observing if the pool temperature remains stable. If it is stable, the spool pieces would be removed and the RHR returned to its safety function.

12.3 Questions from T. A. Ippolito to J. S. Abel transmitted on May 19, 1981

12.3.1 Question:

Discuss in some detail, the procedure that will be used for (1) removal of the fuel rods from the present racks, (2) removal and disposal of the racks themselves (i.e., rating them intact or cutting and drumming them), (3) installation of the new high density racks and (4) loading them with the presently stored spent fuel rods. In this discussion include, in a step by step fashion, the number of people involved in each step of the procedure including divers if necessary, the dose rate they will be exposed to, the time spent in this radiation field and the estimated man-rem required for each step of the operation.

Response: Later

12.3.2 Question:

Demonstrate that the method used for removal and disposal of the old racks will provide ALARA exposure.

Response: Later

12.3.3 Question:

What radiation levels will be used to determine whether the racks to be disposed are identified as clean or radioactive racks.

Response: 1000 DPM per cm^2 is considered clean.

12.3.4 Question:

Identify the important radionuclides and their present concentrations (ci/cc) in the spent fuel pool water including ^{134}Cs, ^{137}Cs, ^{58}Co, and ^{60}Co. What is the external dose equivalent (DE) rate (mrem/hr) from these radionuclides. Consider these DE rates at the edge and center of the pool.

Response: See Section 8 of Supplement 2 to Revision 1 of the Licensing Report, submitted to the NRC by letter from T. J. Rausch to H. R. Denton dated August 10, 1981.

12.3.5 Question:

Provide an est ‹ te of the increase in annual man-rem from more frequent changing of the ..emineralizer resin and filter cartridge.

Response: As discussed in Section 8 of Revision 1 of the Licensing Report, the ‾ ɔsed modification will have a negligible annual e‥fect on the .ool cleanup system; therefore, there is expected to be no increase in the annual frequency of changing of the filter demineralizer resin.

12.3.6 Question:

Discuss the build-up of crud (e.g., ^{58}Co, ^{60}Co) along with the sides of the pool and the removal methods that will be used to reduce radiation levels at the edge of the pool to ALARA.

Response: A buildup of crud as a result of this proposed modification would mean that the concentration of crud in the pool water has increased. Because the cleanup system removes essentially all crud deposited in the pool water from one refueling long before the next refueling, a measurable buildup will not occur. (See Section 8 of Revision 1 of the licensing submittal.) In addition, operating experience to date indicates no significant buildup of crud along the sides of the pool.

12.3.7 Question:

Provide an estimate of the total man-rem to be received by personnel occupying the spent fuel pool area based on all operations in that area in cluding those resulting from 4, 5, and 6 above. Describe the impact of the modification on these estimates.

Response: As discussed in revised Section 8 in Supplement 2 of Revision 1 of the Licensing Report, there is expected to be negligible to no increase in man-rem as a result of the modification. Assuming a radiation dose of 4 mr/hr around and above the pool (see Section 8 of Supplement 2 to Revision 1 of the Licensing Report) and occupancy of 5000 man-hour during refueling and 4000 man-hour/yr at other times, the total exposures are 20 man-rem and 16 man-rem/yr respectively.

12.3.8 Question:

Identify the monitoring systems that will be used, and its location in the spent fuel pool area, that would warn personnel whenever there is an inadvertent increase in radiation levels that could trigger the alarm setpoint.

Response: There are six monitoring systems with set-points of 5 mr/hr to 100 mr/hr presently monitoring the spent fuel pool area. These are deemed adequate for personnel protection.

12.3.9 Question:

Describe the methods used to preclude spent fuel pool water from overloading onto the spent fuel pool area floors.

Response: There are skimmers and a surge tank which will take up water displaced by the new racks.

12.3.10 Question:

Specify the present dose rate in occupied areas outside the spent fuel pool concrete shield wall and provide an estimate of the potential increase of this dose rate if the space between the spent fuel and inside concrete shield wall is reduced due to the modification.

Response: The present (5/26/81) dose rates everywhere outside the spent fuel pool shield walls are 2 mr/hr. As seen in Figures 2.1 and 2.2 of the licensing submittal, there are at least nine inches of water between the outside of the new spent fuel racks and the thick, concrete walls of the spent fuel pool. This amount of water plus the concrete supplies sufficient attenuation that the dose rate outside the walls is negligible and changes in this dose rate due to increased spent fuel storage are not measurable. Also, there are no normally occupied spaces immediately adjacent to the concrete shield walls.

12.4 <u>Questions from T. A. Ippolito to J. S. Abel transmitted on June 16, 1981</u>

12.4.1 Question:

Describe the samples and instrument readings and the frequency of measurement that are performed to monitor the water purity and need for spent fuel pool cleanup system demineralizer resin and filter replacement. How will these be affected by the proposed action?

Response: Water purity is monitored by a continuous conductivity meter installed on the inlet to the fuel pool demineralizers, and by periodic grab samples for laboratory analysis.

Once a week a representative grab sample is obtained from the fuel pool demineralizer inlet line. The analyses performed are pH, chloride, silica, and turbidity. The activity checks are gross beta and gross alpha counts.

Once a month a sample from the same location is obtained for a gamma isotopic analysis. All major peaks are identified. All identifiable isotopes are quantified, and an LLD is determined for Kr-85.

The criteria for a demineralizer backwash and precoat is a consistent excursion from the chemistry limits, or high differential pressure across the demineralizer. Each demineralizer has differential pressure instrumentation installed which will alarm in the Unit's control room and the radwaste control room if a preset value is exceeded.

The proposed change is not expected to alter the chemistry or radiochemistry of the spent fuel pool; consequently, the described measurements will not be changed.

12.4.2 Question:

State the chemical and radiochemical limits to be used in monitoring the spent fuel pool water and initiating correcting action. Provide the basis for establishing these limits, giving consideration to conductivity, gross gamma and iodine activity, demineralizer and/or filter differential pressure, demineralizer decontamination factors, pH, and crud level.

Response: The chemical and radiochemistry limits used in monitoring the spent fuel pool water are as follows:

Conductivity	1.0 mho/cm
pH	6.0 - 7.5
Chloride	0.500 ppm
Silica	1.0 ppm
Turbidity	None
Gross Beta	1E-02 Ci/ml
Gross Alpha	1E-05 Ci/ml

If any of the above limits are exceeded the recommended action is to backwash and precoat the fuel pool demineralizer.

The basis for the water chemistry limits is the G.E. Water Quality document (22A1286, Rev. 0) that provides the water specifications for various plant systems. The limits are set to minimize corrosion and to maintain the water in a "crystal clear" condition.

The radiochemistry limits have been established based on operating experience as action levels below which personnel exposure in the vicinity of the spent fuel pools is minimized.

The demineralizers are backwashed if differential pressure exceeds 25 psid for protection of the filter elements.