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January 3, 1979

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. NUCLEAR REGULATORY COMMISSION
Washington, D. C. 20555

Attention: Mr. A. Schwencer, Chief
Operating Reactors Branch #1

Gentlemen:

DOCKET NOS. 50-266 AND 50-301
ADDITIONAL INFORMATION
SPENT FUEL STORAGE EXPANSION
POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2

Enclosed are responses to your requests for additional information which were forwarded to us with your letter dated December 6, 1978. We have designated this set of requests set "D" and have numbered the responses to match the respective information requests in your letter.

As you directed, we have provided three signed originals and forty copies of our responses. Please advise us if you require any additional clarification regarding these responses.

Very truly yours,

Sol Burstein

Sol Burstein Executive Vice President

Enclosure

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QUESTION D-1

The October 10, 1978, response to question C-13, regarding the dropped fuel assembly analysis, indicates a kinetic energy of 4,275 ft-lbs based on the 1425 lb weight of a fuel assembly. Since in the event of a crane failure the fuel handling tool would be dropped along with the fuel assembly its weight should be included in calculating the impact energy. State the impact energy of the fuel bundle and fuel handling tool together and provide the results of the drop analysis based on this impact.

RESPONSE

The drop of a fuel assembly plus the fuel handling tool would mean an increase of 350 lbs (due to the tool weight) added to the 1425 lbs fuel assembly weight for a total dropped weight of 1775 lbs. The weight of 1775 lbs would produce about 5325 ft-lbs of impact energy. Using the test results reported in the response to question C-13, the rack wall deformation would increase from approximately 5 1/4" to about 6 1/2". The increase in deformation and impact energy would be approximately 25%. Thus, the approximate load of 20,000 lbs (reported in C-13) would increase to about 25,000 lbs which still does not approach the box-to-box attachment weld strength of about 360,000 lbs. Please refer to the response to questions D-2, D-3, D-4, and D-6 for additional information.

QUESTION D-2

The response to question C-13 was incomplete. The question asked if a fuel assembly would develop the highest kinetic energy of all objects that could possibly be dropped into the spent fuel pools. Please list all heavy loads which traverse the spent fuel pools and indicate their weight and potential drop height. It is our understanding that during handling of new fuel it is carried over the spent fuel pools. Discuss the potential impact load on the racks resulting from a drop of a new fuel bundle from an elevated position or describe the procedures for excluding such a postulated drop.

RESPONSE

A listing of loads that are routinely carried across the spent fuel pool at the Point Beach Nuclear Plant was provided with our letter to Mr. Rusche dated October 2, 1975. This listing was referenced and updated in our letter to Mr. Denton dated July 28, 1978. This latter letter responded to Mr. Victor Stello's information request concerning the movement of heavy loads over spent fuel. The referenced list indicates the weights of the loads but does not present potential drop heights. Due to the necessity to clear hand rails in the general area of the spent fuel pool and given the normal water level in the spent fuel pool, a typical drop height would be approximately six feet to the surface of the fuel pool.

The heaviest of the loads which are routinely carried across the spent fuel pool are the new fuel shipping containers which weigh approximately 7,300 pounds. Our calculations have shown that if this load were placed in the spent fuel pool, it would exhibit positive buoyancy and float.

In addition to these routine loads, it is possible that other heavy loads may have to be carried across the spent fuel pool on a non-recurring and infrequent basis. These loads, such as length of pipe, spare equipment parts, system components, etc., would result for either plant maintenance or modifications and cannot be readily identified. The plant handling procedure for heavy loads is presented in Appendix F to the Point Beach Final Facility Description and Safety Analysis Report.

In addition to those loads already presented and discussed in Licensee's earlier responses, single new fuel assemblies must be carried from the new fuel storage vault to the spent fuel pool and placed in the new fuel elevator. Precautions and procedures exercised by the Licensee exclude the potential for a new fuel assembly to be dropped into the spent fuel pool. The new fuel assembly is moved from the new fuel storage vault to the spent fuel pool by use of a new fuel handling tool. This tool is approximately four feet long and features a positive locking mechanism which prevents unlatching the tool from the new fuel assembly. The mechanism must be physically manipulated by a worker to allow latching of the tool to the assembly prior to lifting the fuel assembly and must be manipulated again by a worker to unlatch the tool from the assembly. The tool itself is shackled to a load cell which in turn is shackled to double lifting cables over the 20-ton auxiliary building crane hook. This hook is rigged with a keeper mechanism so that if an assembly were inadvertently set down on an unyielding surface the lifting cables could not slip off the hook.

During the movement of the new fuel assembly from the new fuel storage vault to the fuel elevator in the spent fuel pool, the fuel assembly is physically guided by a worker while it is suspended from the crane hook. The assembly, once over the spent fuel pool, is guided over the fuel elevator by the worker and then lowered into the elevator device. Once inserted into the fuel elevator, it is not possible for that assembly either to tip or fall onto the spent fuel racks. After the assembly is fully inserted into the fuel elevator, the new fuel tool is physically manipulated by a worker and the fuel element is thereby unlatched. These precautions preclude dropping a new fuel element from above the pool onto the spent fuel racks.

QUESTION D-3

The October 10, 1978, response to question C-13 regarding the straight drop of a fuel bundle on top of a rack indicates that the energy absorption capability of a box section is approximately 730 ft-lbs per 0.9 inches of deformation. This value was used to predict a total local deformation of approximately 5.25 inches due to the impact of a dropped fuel assembly. The compression test used to establish the energy absorption capacity was limited to a deformation of 0.911 inches. Since the load deformation curve was not generated beyond 0.911 inches and there is no reason to believe that the curve will repeat itself for additional increments of deformation, provide additional justification for the 5.25 inches value.

RESPONSE

The amount of deformation generated from the empirical curve presented in the response to question C-13 was the most conservative value possible. It takes no credit for any supporting material. Only the small area at the corner is assumed to deflect without any additional resistance from adjacent material and attached storage cells. Thus, linear extrapolation of the test results is considered valid.

QUESTION D-4

The October 10, 1978, response to question C-13 regarding drop of a fuel bundle directly into a storage position assumes that the maximum load which can be transferred to the bottom plate is equal to the Euler buckling load of the fuel bundle. This approach is incorrect in that a buckled column can continue to transfer load in its deflected shape. Furthermore, the buckling load of the fuel bundle has been incorrectly calculated since the bundle treated as a whole will have a higher buckling load than the sum of the individual rod's buckling loads. The integrity of the bottom plate should be re-analyzed using a correct approach such as an energy transfer mechanism.

RESPONSE

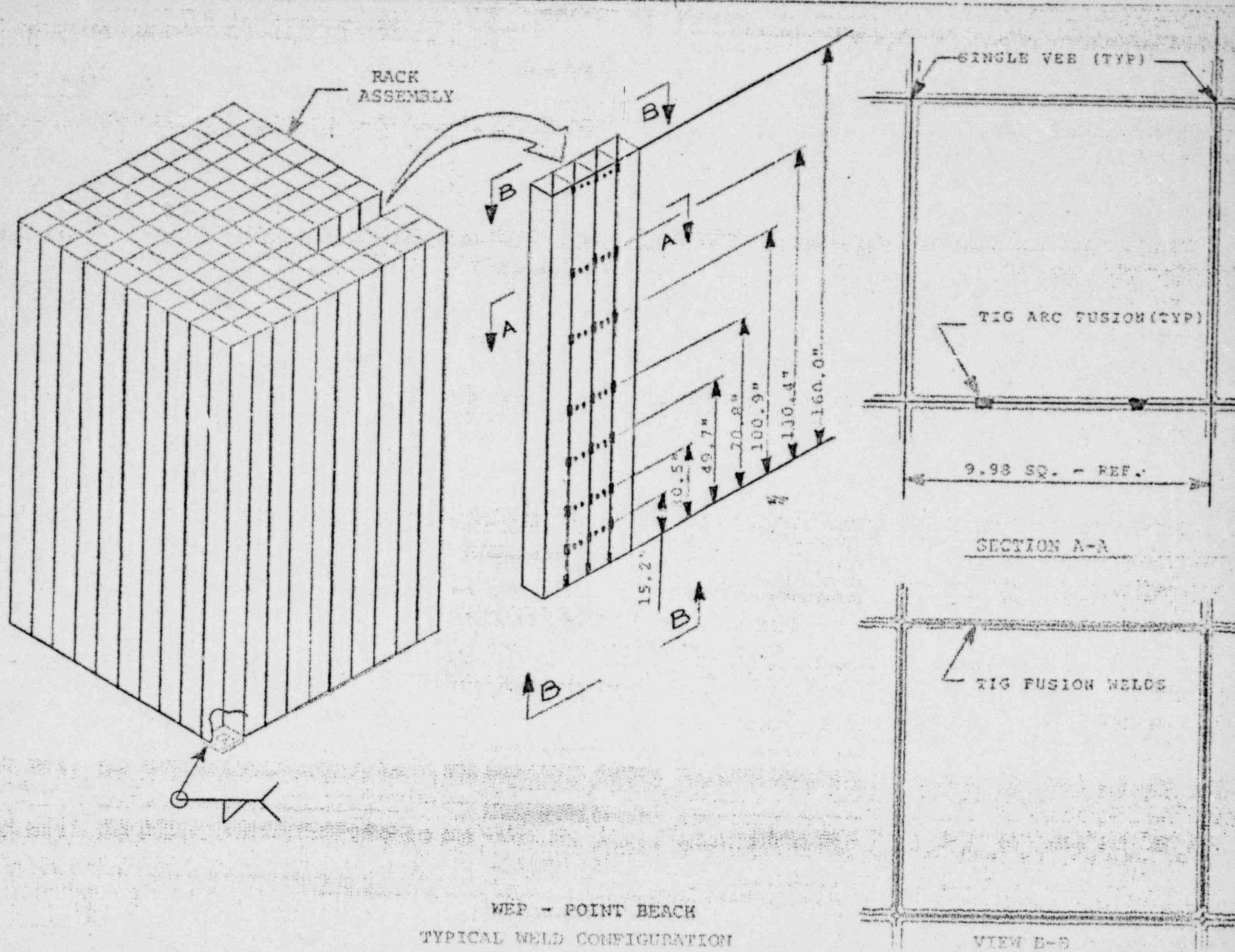
Calculations which determined the integrity of a storage box when subjected to a straight drop of a fuel assembly were made to determine order of magnitude loading. The actual velocity of impact is indeterminate because energy dissipation at entry and down through the box are unknown quantities. The value used is considered a good estimate. A straight line of descent was assumed even though it is highly probable that the fuel assembly, which is definitely not hydrodynamically stable, will deviate considerably from a straight line and bump from side to side. Because of this extremely conservative approach the order of magnitude loading value is considered to be the column buckling of the fuel rods, used on the shortest grid-to-grid span. Any calculational refinement of the simple method used is of dubious value. As the bottom plate weld strength is shown to be about four times greater than the conservatively calculated buckling load, it is concluded that the box design is adequate.

QUESTION D-5

Provide sketches and describe the welds joining the individual fuel cells together. Discuss the welding procedures that will be used in fabrication of the racks and describe the quality assurance procedures.

RESPONSE

Typical welding configuration for the Point Beach spent fuel racks is shown on the attached sketch. Boxes are welded into rows. Rows are stacked and fusion welded together as shown. Bottom plates are then welded into rack bottoms. Welding control is provided by weld technique sheets which contain welding parameters in accordance with welding qualifications which meet the requirements of Section IX of the ASME Boiler and Pressure Vessel Code and 10 CFR 50 Appendix B. Quality Assurance procedures are in accordance with the WAI Quality Assurance Program Manuals and are documented on Route Cards utilized by U. S. Tool and Die which are signed off by WAI Quality Assurance after inspection of fabricated racks.



WEP - POINT BEACH
TYPICAL WELD CONFIGURATION

QUESTION D-6

The October 10, 1978, response to question C-13 indicates that the kinetic energy of one fourth the weight of the spent fuel a ,emblies was considered to be absorbed by the rack assembly. Provide justification for the assumption that only one fourth of the fuel assemblies weight should be considered as opposed to the usual factor of one half.

RESPONSE

In the response to question C-13 the kinetic energy of the complete fuel assembly was calculated, not one fourth as stated in "Request for Additional Information".

QUESTION D-7

The impact forces of the fuel assemblies on the rack structure should be combined with the seismic loads in the rack. Although the phasing may not be known the resultant stresses can be combined by SRSS. Provide results of the analysis combining the impact and seismic loads.

RESPONSE

The modal seismic load on an empty rack, using the largest 110 rack, is 800 lbs. N-S and 700 lbs. E-W. The impact force is 3900 lbs. N-S and 5700 lbs. E-W. Adding these values absolutely results in 4700 lbs. N-S or 42.7 lbs. per storage space, and 6400 lbs. E-W or 58.2 lbs. per storage space. These are OBE values. SSE values are twice these figures. Adding loads absolutely results in higher values than by the SRSS method. The racks are impacting the fuel assemblies, thus, the reactions are internal. The maximum stress condition in the storage units is at the angles which define the poison compartment. Using only the top 5.25" of only one angle results in 21,060 psi stress and a F.S. = 1.25 for the tension in bending allowable of 26,400 psi. This method takes no credit for the lead-in guide which is also impacted by the fuel assembly.

QUESTION D-8

Demonstrate that the fuel assemblies themselves will retain their integrity and will not suffer cladding damage as a result of impacting the storage can during a seismic event.

RESPONSE

For the fuel assembly/storage module impact analysis, the impact forces are approximated by equating the kinetic energy to the strain energy. The analysis was performed for a 110 storage position rack which is the largest rack configuration. Because of the low relative velocities, the impact forces are low. The total impact load, for the SSE condition, is calculated to be 11,400 lbs. For each storage position (or the impact load on a fuel assembly) this would be about 104 pounds.

This impact force is low when compared to the force of the weight of a fuel assembly when it is laid on its side for transportation. The integrity of fuel assemblies and cladding have been demonstrated by transportation from the reactor to the spent fuel pool and from the spent fuel pool to other remote storage pools without incurring any damage. Based on this experience, the fuel assemblies or cladding will not suffer damage as a result of impacting the storage can during a seismic event.

QUESTION D-9

Discuss the potential for rocking and uplift of the racks during seismic events. Is impacting at the top of the racks possible? If rocking of the racks can occur provide the calculations to demonstrate the integrity of the spent fuel pool floor under the additional impact loads.

RESPONSE

Rocking of racks will not occur, thus there is no impacting at the top of the racks.

QUESTION D-10

Section 2.5, "Cask Energy Absorbing Frame" of Revision 2 to the June 14 submittal states that the kinetic energy of the cask during SSE was calculated based on 50% average acceleration. Explain the term "50% average acceleration", and describe the failure criteria used for evaluating the frame.

RESPONSE

A straight line variation was assumed for acceleration and 50% of the maximum starting acceleration was, therefore, used as the "50% average acceleration". By trial calculational method it was determined that a 0.1 friction coefficient between the cask and pool floor resulted in a frame loading and deflection which stressed the frame to about 30,000 psi. This value is the allowable yield stress listed for 304 stainless steel at 200°F in Table I-7.2 of ASME Section III. Thus, it is concluded that this is a safe stress condition. The force on the cask was considered as the SSE seismic, 0.12g, minus the 0.1 friction coefficient and averaged at one half of the remainder, or 0.01g. The 0.1 friction coefficient is low compared to the steel on steel published values of 0.8 dry to 0.16 greased. These values are from page 542, Machinery's Handbook, Nineteenth Edition. Thus, if friction between the cask and pool liner is as low as 0.1, which is unrealistic, the frame will still only be stressed to a safe yield value. With a friction coefficient higher than 0.1, which is very realistic, there will be no movement and, thus, no frame loading.

QUESTION D-11

Discuss how the walls and floor of the spent fuel pool were analyzed for the loads imparted by the storage racks and cask energy absorbing frame. Include a description of the modelling techniques used.

RESPONSE

The spent fuel pool is a very rigid concrete structure supported by vertical end-bearing piles. The amplification of the seismic response is generated basically by foundation structure interaction.

The vertical and rotational stiffnesses of the foundation were obtained from axial load deformation characteristics and configuration of piles. The horizontal stiffness of the foundation was calculated from the flexural stiffness of piles. A decrease in horizontal pile stiffness due to closer spacing was considered. Due to the major influence of steel piles on seismic response, 2% and 5% damping were considered for the OBE and SSE respectively. With this input information, a single mass model with translation and rotational springs was developed for the foundation analysis.

The bending and shear capacities of wall and floor sections were calculated based on strength design according to ACI 318-71. Moments and shears were computed for all loads at critical sections of the spent fuel pool walls and bottom slab according to the six loading combinations referenced in previous submittals. The combined moments and shears resulting from the load combinations were found to be less than the critical section strengths in all cases.

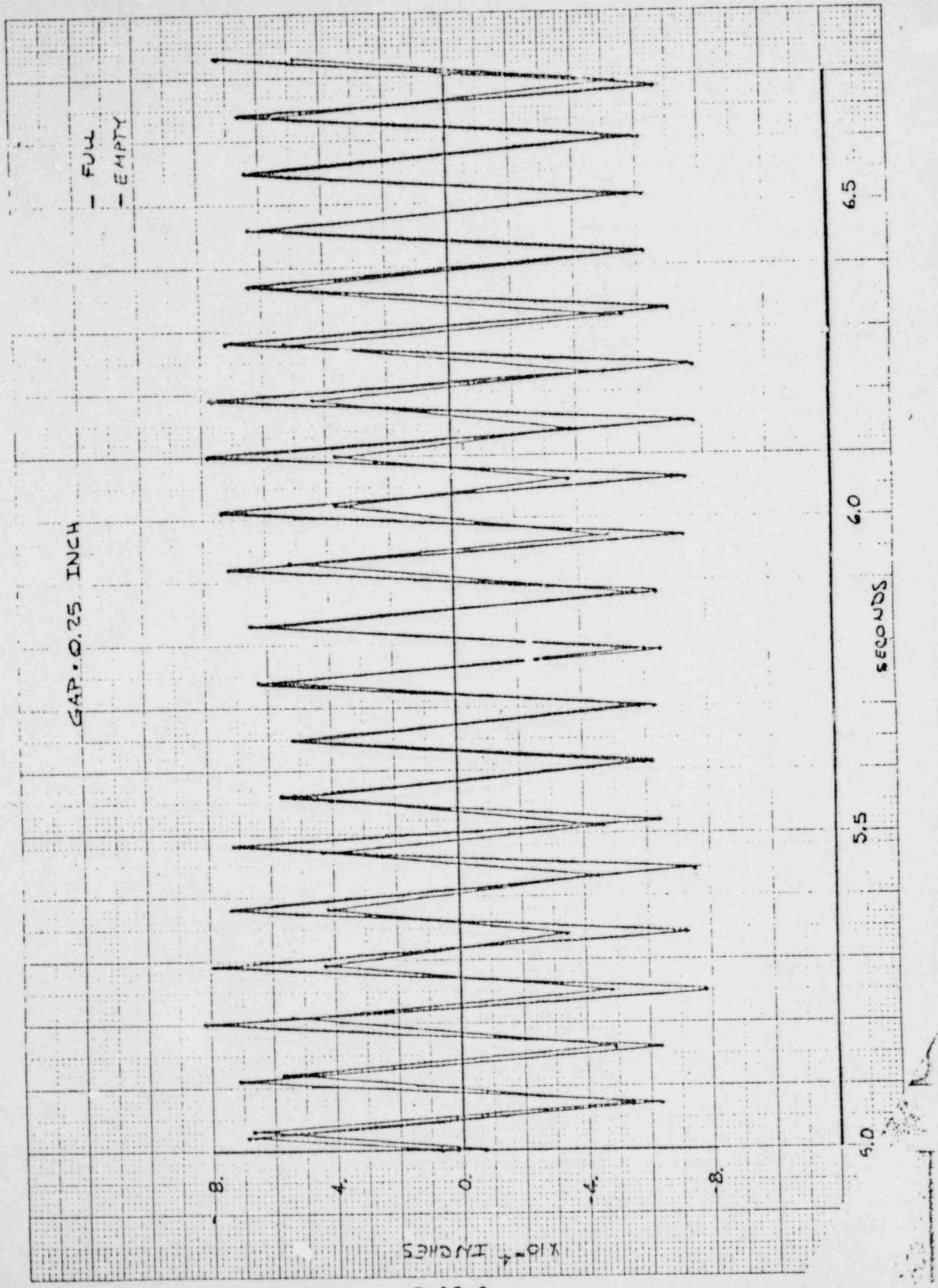
The loads imparted to the fuel pool walls from the cask energy absorbing frame is less than the design seismic loads on the wall if the cask area contained fuel storage positions. Therefore, the pool structural analysis was conservatively performed assuming that wall loads during a seismic event were equal to standard rack loads rather than the loads from the energy absorbing frame.

QUESTION D-12

Describe the extent to which interaction between storage racks was analyzed including the modelling techniques and boundary conditions.

RESPONSE

Interaction between two storage racks adjacent to each other was analyzed assuming that one rack was full and one rack empty. The racks were separated by a small gap and subject to the N-S 1940 El Centro time history motion. One full and one empty rack is the most severe dynamic mismatch and yet the calculated results show that the modules vibrate in phase as indicated on the attached graph. Vibrating in phase means no rack-to-rack impact. The graph does not differentiate between full and empty since the lines are so coincident that it is only academic to attempt identification which would be extremely difficult to follow.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— FULL
— EMPTY
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X10-4 INCHES
5.0
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SECONDS

QUESTION D-13

Describe how seismic forces will be transmitted across the tool storage area in the spent fuel pool.

RESPONSE

The tool storage area is a designated location in the spent fuel pool where tools are stored when they are not being used. The tools are stored in appropriately designed holders mounted up on the wall of the spent fuel pool. When in storage, the tools do not rest on the pool floor but are held with the lower end substantially above the pool floor elevation and above the elevation of the seismic restraints.

The racks adjacent to the tool storage area in the south pool will transmit seismic loads to the north wall with seismic restraints essentially identical to those used in the north pool. A special seismic support will be designed for load transfer to the west wall and will be similar to that used along the south wall of the north pool. A cover plate will be furnished for the sump, if necessary, which will serve as the floor of that area when the seismic support is installed.

QUESTION D-14

Quantify the maximum stress levels in the feet of the rack bases including the stresses in the threads of the leveling screws.

RESPONSE

The leveling screw threads carry the highest stresses and were analyzed for tension, 8733 psi, F. S. = 2.06, shear 3010 psi, F. S. = 5.31, bearing 3691 psi, F. S. = 9.75. The shoulder bushing which carries the female thread has a shear stress of 6646 psi, F. S. = 2.4. All the foregoing figures are for the SSE condition. Allowable stresses as defined in Part 1 of the AISC "Specification for Design, Fabrication, and Erection of Structural Steel for Buildings", Feb. 12, 1969, are S for tension and shear and 1.6S for bearing. The specific stress conditions are as follows, using Sy = 25,000 psi from Appendix I of ASME III BPVC:

Tension S = .45 Sy = 18,000 psi

Shear S = .40 Sy = 15,000 psi

Bearing 1.6S = 1.6 (.9Sy) = 36,000 psi

The loading condition for this analysis is that only 3 of the 4 leveling screws take the load.

QUESTION D-15

The worst postulated thermal transient in the spent fuel pool corresponds to a maximum surface temperature of 212°F resulting from boiling of the spent fuel pool water. Are all the required load combinations satisfied assuming appropriate temperatures in the boiling condition?

RESPONSE

Fuel pool water boiling was not a design condition for the spent fuel pool structure. Notwithstanding, we have reviewed the fuel pool structure with regard to pool boiling. It is the conclusion of the study that the fuel pool structure would safely withstand a postulated water boiling condition and continue to function.

For this review, seismic loads were not considered applicable, since it is not considered credible that an earthquake would occur simultaneously with pool boiling. All required loading combinations, as referenced in previous submittals were investigated. The study shows that the pool structure meets the normal design criteria as defined by the factored load equations in all combinations, except for the pool west wall for the following factored load equation: $U = 0.75 (1.4D + 1.7L + 1.7T)$. The allowable west wall moment, per ACI 318-71 using ultimate strength design procedure, is 246 ft-K/ft while the calculated moment is 248 ft-K/ft. This is less than 1% difference. The calculation of the allowable moments is based upon minimum code specified material properties. This is only a slight overload condition, and while the factored load equation is not satisfied, the resulting stresses are within realistic material strength limits for the pool structural components. This is considered acceptable for the faulted case postulated.

QUESTION D-16

Quantify the damping values used in the analysis of the racks.

RESPONSE

A damping value of 0.5 percent is included in the Spectrum Response Curves utilized for the seismic analysis. No additional damping was used in the seismic dynamic analysis and, thus, the results are considered conservative.

QUESTION D-17

Describe the load path through the seismic restraints into the racks and describe the analysis performed to ensure that the racks are capable of handling the high localized stresses at the junction of the restraints to the racks.

RESPONSE

The seismic loads are transmitted from the racks to the seismic supports (two supports on the side of each rack) through the fuel assembly module bottom plates. Each rack utilizes a width of six modules, approximately 60" of length, for this load transfer (three modules per restraint). The basic seismic support plate, which is 3/8" thick, bears against the bottom line of the module plates on an area of about 22 square inches for a bearing stress of about 1022 psi. If only one fourth of this area is actually in contact, the stress would increase to 4088 psi and the factor of safety would be about 8.75. These values are for the SSE loading condition and show that the design is more than adequate.