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FEB 25 1982

Docket Nos: 50-522
and 50-523

Mr. Frank Spangenberg
Assistant Project Manager - Nuclear
Northwest Energy Services Company
2820 Northup Way
Bellevue, Washington 98004

Dear Mr. Spangenberg:

Subject: Request for Additional Information - Skagit/Hanford Nuclear Project

In order that we may continue our review of your application for permits to construct the Skagit/Hanford Nuclear Project, Units 1 and 2, your response to the enclosed request for additional information is required. The items marked with an asterisk in the enclosure reflect NRC staff positions in the revised Standard Review Plan NUREG-0800. These are provided to inform you of the current SRP criteria. The Skagit/Hanford Operating License application will eventually be reviewed against the revised SRP. We encourage you to carefully consider the responses to the asterisked items.

To maintain our licensing review schedule we require a completely adequate response to the enclosed request by March 5, 1982. Please inform us within 7 days after receipt of this letter whether or not you will be able to respond by March 5, 1982.

Please contact the licensing project manager, Mike Mallory, at (301) 492-4449 if you desire additional discussion or clarification of the information requested.

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:
A. Schwencer
for
Robert L. Tedesco, Assistant Director
for Licensing
Division of Licensing

RECEIVED
FEB 26 1982

Enclosure:
As stated

cc: See next page

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PDR ADOCK 05000522
A PDR

*NOTE: SEE PREVIOUS WHITE FOR CONCURRENCE

OFFICE	DL:LB #4	LA:DL:LB #4	SEB	DL:LB #4	AD:L/DL		
SURNAME	*MMallory/hmc	*MDuncan	*FSchauer	EAdensam	RTedesco		
DATE	2/19/82	2/19/82	2/23/82	2/ /82	2/ /82		

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Sincerely,

Robert L. Tedesco, Assistant Director
for Licensing
Division of Licensing

Enclosure:
As stated

cc: See next page

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SURNAME	MMallory/hmc	MDuncan	FSchauer	EAdensam	RTedesco		
DATE	2/19/82	2/19/82	2/23/82	2/ /82	2/ /82		

SKAGIT

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1450 Maria Lane, Suite 210
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REQUEST FOR ADDITIONAL INFORMATION

SKAGIT/HANFORD NUCLEAR PROJECT

STRUCTURAL ENGINEERING BRANCH

220.0 STRUCTURAL ENGINEERING

* 220.01 (3.5.3) With respect to PSAR Section 3.5.4, missile barriers are designed as described in BC-TOP-9A, which shows the ductility ratio 20 for flexture in steel barriers. The staff had approved BC-TOP-9 in 1974 taking exception for ductility ratio over 10. The current staff position is included in SRP Section 3.5.3 Appendix "A" (Attachment 1). Confirm that you have not used ductility ratio more than 10 or justify deviation from above mentioned SRP criteria.

Also, for columns with slenderness ratio more than 10, the current SRP requires ductility ratio less than or equal to 1.0 while BC-TOP-9A mentions 1.3. Confirm that you will use all the ductility ratios per SRP criteria or justify the deviation, and revise the PSAR sections accordingly.

220.02 (3.7.1) Figure 3.7-3 and 3.7-4 show that more than 8 points of the time history response spectra fall below the design response spectra for 1%, 2%, 5%, and 7% damping. SRP Section 3.7.1 subsection II.1.b requires that no more than 5 points should fall below the design response spectra. Justify your deviation from the SRP position.

220.03 (3.7.1) With respect to PSAR Section 3.7.1.2 you did not demonstrate that the frequency interval for calculation of response spectra are small enough that further reduction does not result in more than 10% change in computed spectra. This is one of the requirements of SRP Section 3.7.1. Confirm that you will meet the SRP criteria and revise the PSAR accordingly.

220.04 (3.7.2) With respect to PSAR Section 3.7.?11, you have mentioned that torsional effects will be considered in Category I structures using 3-dimensional models, or 2-dimensional models with static factors to account for torsional accelerations. Confirm that the dynamic analysis method you use, will also have the consideration of rocking, and translational responses of the structures and their foundations.

220.05 (3.7.2) In seismic analysis methods for Category I structures you have not mentioned the effect of differential support movement. Confirm that your analysis methods will have the consideration of maximum relative displacements among supports of Category I structures, systems, and components. Also discuss the extent to which your analysis method conforms with the applicable criteria of SRP Section 3.7.2.

220.06 (3.7.2) In PSAR Section 3.7.2.4, it is stated that for soil-structure interaction elastic half space method will be used and a "simplified finite element analysis" will be performed as a confirmation. The words "simplified finite element analysis" are unclear to the staff. Describe in detail the procedures, assumptions and boundary conditions (specially affected by the site move amendment) that you intend to use in your finite element analysis. The current position of the staff about soil-structure interaction is outlined in REV 1 of SRP Section 3.7.2 issued in July 1981. Confirm that you will meet the SRP criteria, and revise the PSAR accordingly.

220.07 (3.7.2) In seismic analysis methods for Category I structures you did not address the accidental torsion. Confirm that, in your seismic analysis, you will account for accidental torsion by taking an additional eccentricity of ±5% of the maximum building dimension over and above the actual geometric eccentricity. This is the requirement of SRP Section 3.7.2 subsection II.11.

220.08 (3.7.4) PSAR Section 3.7.4 shows that triaxial response spectrum recorders and triaxial time history monitors are provided at specific locations, meeting the requirement of SRP Section 3.7.4. However, for control room operator notification you have mentioned that, whenever an acceleration time history is being or has been recorded, a visual annunciation will be made in the control room.

SRP Section 3.7.4 requires that triaxial time history monitor will readout peak acceleration in the control room and the response spectrum recorder will readout values at discrete frequencies. Just the visual annunciation is not sufficient. confirm that you will meet the SRP criteria or justify the deviation.

220.09 (3.7.4) PSAR does not mention the inservice surveillance program for seismic instruments. SRP Section 3.7.4 subsection II.5 requires that each seismic instrument be demonstrated operable by the performance of test operations at specified intervals. Revise the PSAR to meet the SRP criteria or justify the deviation from same.

* 220.10 (3.8.1) In your Amendment 23 of PSAR Section 3.8.1, concrete containment was not included. Please confirm that the site move does not affect your commitment in the PSAR including the design and analysis procedures of concrete containment, loads and loading combinations, structural acceptance procedures and the applicable codes, standards and specifications to comply with ASME Section III, Division 2 code and the related Regulatory Guides. Also, please indicate that in the containment loads and loading combinations the LOCA/SRV related hydrodynamic loads in suppression pools manifested as jet loads and/or pressure loads will be considered.

* 220.11 (3.8.1) Provide an ultimate capacity analysis of the containment responding to the internal pressure build-up due to accidents. The guideline and the staff position on this subject is enclosed (Attachment 2).

* 220.12 (3.8.1) (3.8.4) Update and expand the list of Regulatory Guides that would be applied to all Category I structures (e.g., R.G. 1.94, 1.115, 1.117, 1.122, 1.136, 1.142, ...). Address any exceptions and deviations from these Regulatory Guides and provide comments and explanations.

* 220.13 (3.8.1) In PSAR you have mentioned the use of 10 CFR 50 Appendix A, GDC 2, 4, 16, 50, etc. Why has GDC 1 been omitted? Include GDC 1 also and address its effect on your Quality Assurance Program.

* 220.14 (3.8.1) PSAR Table 3.8-1 shows load combinations and load factors. For service load at construction stage you have not included the wind loads. The current SRP refers to the Table CC-3230-1 of ASME Section III Division 2 Code for load combinations. The construction load in this table includes wind. Confirm that you will meet the SRP criteria and include the wind loads at construction stage and revise the PSAR section accordingly.

220.15 (3.8.3) In your Amendment 23 of PSAR Section 3.8.3, concrete and steel internal structures of steel or concrete containment, were not included. Please confirm that the site move would not affect your commitment in the PSAR including the design of containment internal structures, loads and loading combinations, structural acceptance procedures and the applicable codes, standards and specifications to comply with ASME Section III Division 1 and 2, ACI 349, AISC and related Regulatory Guides. For structures or structural components subject to hydrodynamic loads resulting from LOCA and/or SRV actuation, the consideration of such loads should be included. Please refer to the Appendix to NUREG-800 SRP Section 3.8.1.

220.16 (3.8.4) With respect to PSAR Section 3.8.4.1.2, you only discussed wall separation between the Auxiliary Building and containment structure. There are other Category I structures adjacent to containment. Please indicate whether there are any wall separations between them. If any, please specify how much is the wall separation. Please provide this information and the technical bases to verify that adequate separation is provided.

220.17 (3.8.4) With respect to PSAR Section 3.8.4, you didn't indicate whether masonry construction was utilized or not. Enclosed is a copy of design criteria for safety-related masonry wall evaluation (Attachment 3). Identify any difference in requirements of materials, testing, analysis, design and construction between SKAGIT/HANFORD design, and staff position. Provide justification for these differences or indicate your compliance with them. If no Category I masonry wall construction is planned, please so indicate and neglect the technical portion of this question.

*220.18 (3.8.4) With respect to PSAR Section 3.8.4.1.3, Fuel Building, discuss, in detail, the design of spent fuel pool racks. Enclosed is a copy of staff position on the "minimum requirements for design of spent fuel pool racks" (Attachment 4). Modify your analysis and design, if necessary, to agree with this position.

*220.19 (3.8.3) (3.8.4) (3.8.5) With respect to PSAR Sections 3.8.3.2, 3.8.4.2, and 3.8.5.2 applicable codes standards and specifications, it is the staff's position that ACI 349-76 code should be used in conjunction with Regulatory Guide 1.142. Indentify any deviations of Category I structural design from the requirements of the code and the Regulatory Guide and justify your deviations.

Attachments:
As stated

ATTACHMENT 1

APPENDIX A

STANDARD REVIEW PLAN SECTION 3.5.3

PERMISSIBLE DUCTILITY RATIO
FOR OVERALL DAMAGE PREDICTION

I. INTRODUCTION

In the evaluation of overall response of reinforced concrete and steel structural elements (e.g., missile barriers, columns, slabs, etc.) subjected to impactive or impulsive loads, such as impacts due to missiles, assumption of nonlinear response (i.e., ductility ratios greater than unity) of the structural elements is generally acceptable provided that the intended safety functions of the structural elements and those of safety-related systems and components supported or protected by the elements are maintained. The following summarizes specific positions for review and acceptance of ductility ratios for reinforced concrete and steel structural elements subjected to impactive and impulsive loads.

II. SPECIFIC POSITIONS

1. Reinforced Concrete Members

The technical position of the regulatory staff with regard to permissible ductility ratios is stated in Regulatory Guide 1.142. Prior to publication of Revision 1 of Regulatory Guide 1.142, the staff position regarding ductility will be provided to applicants on a case-by-case basis.

2. Structural Steel Members

a. For tension due to flexure

$$\mu_d \leq 10.0$$

b. For columns with slenderness ratio (l/r) equal to or less than 20

$$\mu_d \leq 1.3$$

Where l = effective length of the member

r = the least radius of gyration

For columns with slenderness ratio greater than 20

$$\mu_d \leq 1.0$$

c. For members subjected to tension

$$\mu_d \leq 0.5 \frac{e_u}{e_y}$$

Where e_u = Ultimate strain

e_y = Yield strain

ATTACHMENT 2

SRP Section 3.8.1 REV. 1. JULY 1981

Subsection II.4.j

Ultimate capacity of concrete containment

An analysis should be performed to determine the ultimate capacity of the containment.

The pressure-retaining capacity of localized areas as well as of the overall containment structure should be determined.

The analysis should be made on the basis of the allowable material strength specified in the Code. However, if the actual material properties such as concrete cylinder compressive strength, mill test results of reinforcing steel and liner plate, strength variations indicated by mill test certificates and other uncertainties are available, the lower and upper bounds of the containment capacity may be established statistically.

The details of the analysis and the results should be submitted in a report form with the following identifiable information.

(1) The original design pressure, P_a, as defined in the Code,

(2) Calculated static pressure capacity,

(3) Equivalent static pressure response calculated from dynamic pressure,

(4) The associated failure mode,

(5) The stress-strain relation of the liner steel and reinforcing and/or prestressing steel and the behavior of the liner under the postulated loading conditions in relation to that of the reinforcing and/or prestressing steel,

(6) The criteria governing the original design and the criteria used to establish failure;

(7) Analysis details and general results, and

(8) Appropriate engineering drawings adequate to allow verification of modeling and evaluation of analyses employed for the containment structure.

APPENDIX A TO SRP SECTION 3.8.4

INTERIM CRITERIA FOR SAFETY-RELATED MASONRY WALL EVALUATION

The purpose of this appendix is to provide minimum design considerations and criteria for the review of safety-related masonry walls which will meet the design standards specified in subsection II of this SRP section.

1. General Requirements

The materials, testing, analysis, design, construction, and inspection related to the design and construction of safety-related concrete masonry walls should conform to the applicable requirements contained in Uniform Building Code - 1979, unless specified otherwise, by the provisions to this criteria.

The use of other industrial codes, such as ACI-531, ATC-3, or NCMA, is also acceptable. However, when the provisions of these codes are less conservative than the corresponding provisions of these interim criteria, their use should be justified on a case-by-case basis.

In new construction, no unreinforced masonry walls will be permitted. For operating plants, existing unreinforced walls will be evaluated by the provisions of these criteria. Plants applying for operating licenses which have already built unreinforced masonry walls will be evaluated on a case-by-case basis.

2. Loads and Load Combinations

The loads and load combinations shall include consideration of normal loads, severe environmental loads, extreme environmental load, and abnormal loads. Specifically, for operating plants, the load combinations provided in the plant's FSAR shall govern. For operating license applications, the following load combinations shall apply (for definition of load terms, see SRP Section 3.8.4, subsection II.3).

(a) Service Load Conditions

(1) D + L

(2) D + L + E

(3) D + L + W

If thermal stresses due to T_o and R_o are present, they should be included in the above containment, as follows:

(1a) $D + L + T_o + R_o$

(1b) $D + L + T_o + R_o + E$

(1c) $D + L + T_o + R_o + W$

Check load combination for controlling condition for maximum 'L' and for no 'L'.

(b) Extreme Environmental, Abnormal, Abnormal/Severe Environmental, and Abnormal/Extreme Enviromental Conditions

(4) $D + L + T_o + R_o + E'$

(5) $D + L + T_o + R_o + W_t$

(6) $D + L + T_a + R_a + 1.5\ P_a$

(7) $D + L + T_a + R_a + 1.25\ P_a + 1.0\ (Y_r + Y_j + Y_m) + 1.25\ E$

(8) $D + L + T_a + R_a + 1.0\ P_a + 1.0\ (Y_r + Y_j + Y_m) + 1.0\ E'$

In combinations (6), (7), and (8), the maximum values of P_a, T_a, R_a, Y_j, Y_r, and Y_m, including an appropriate dynamic load factor, should be used unless a time-history analysis is performed to justify otherwise. Combinations (5), (7), and (8) and the corresponding structural acceptance criteria of should be satisfied first without the tornado missile load in (5) and without Y_r, Y_j, and Y_m in (7) and (8). When considering these loads, local section strength capacities may be exceeded under these concentrated loads, provided there will be no loss of function of any safety-related system.

Both cases of L having its full value or being completely absent should be checked.

3. Allowable Stresses

Allowable stresses provided in ACI-531-79, as supplemented by the following modifications/exceptions, shall apply.

(a) When wind or seismic loads (OBE) are considered in the loading combinations, no increase in the allowable stresses is permitted.

(b) Use of allowable stresses corresponding to special inspection category shall be substantiated by demonstration of compliance with the inspection requirements of the NRC criteria.

(c) When tension perpendicular to bed joints is used in qualifying the unreinforced masonry walls, the allowable value will be justified by test program or other means pertinent to the plant and loading conditions. For reinforced masonry walls, all the tensile stresses will be resisted by reinforcement.

(d) For load conditions which represent extreme environmental, abnormal, abnormal/severe environmental, and abnormal/extreme environmental conditions, the allowable working stress may be multiplied by the factors shown in the following table:

Type of Stress	Factor
Axial or Flexural Compression[1]	2.5
Bearing	2.5
Reinforcement stress except shear	2.0 but not to exceed 0.9 fy
Shear reinforcement and/or bolts	1.5
Masonry tension parallel to bed joint	1.5
Shear carried by masonry	1.3
Masonry tension perpendicular to bed joint	
for reinforced masonry	0
for unreinforced masonry[2]	1.3

Notes

(1) When anchor bolts are used, design should prevent facial spalling of masonry unit.

(2) See 3(c).

4. Design and Analysis Considerations

(a) The analysis should follow established principles of engineering mechanics and take into account sound engineering practices.

(b) Assumptions and modeling techniques used shall give proper considerations to boundary conditions, cracking of sections, if any, and the dynamic behavior of masonry walls.

(c) Damping values to be used for dynamic analysis shall be those for reinforced concrete given in Regulatory Guide 1.61.

(d) In general, for operating plants, the seismic analysis and Category I structural requirements of FSAR shall apply. For other plants, corresponding SRP requirements shall apply. The seismic analysis shall account for the variations and uncertainties in mass, materials, and other pertinent parameters used.

(e) The analysis should consider both in-plane and out-of-plane loads.

(f) Interstory drift effects should be considered.

(g) In new construction, no unreinforced masonry wall is permitted; also, all grout in concrete masonry walls shall be compared by vibration.

(h) For masonry shear walls, the minimum reinforcement requirements of ACI-531 shall apply.

(i) Special construction (e.g., multiwythe, composite) or other items not covered by the code shall be reviewed on a case-by-case basis for their acceptance.

(j) Licensees or applicants shall submit QA/QC information, if available, for staff review.

In the event QA/QC information is not available, a field survey and a test program reviewed and approved by the staff shall be implemented to ascertain the conformance of masonry construction to design drawings and specificiations (e.g., rebar and grouting).

(k) For masonry walls requiring protection from spalling and scabbing due to accident pipe reaction (Y_r), jet impingement (Y_j), and missile impact (Y_m), the requirements of SRP Section 3.5.3 shall apply. Any deviation from SRP Section 3.5.3 shall be reviewed and approved on a case-by-case basis.

5. Revision of Criteria

The criteria will be revised, as appropriate, based on:

(a) Design review meetings with the selected licensees and their A/Es.

(b) Experience gained during review.

(c) Additional information developed through testing and researches.

6. References

(a) Uniform Building Code - 1979 Edition.

(b) Building Code Requirements for Concrete Masonry Structures ACI-531-79 and Commentary ACI-531R-79.

(c) Tentative Provisions for the Development of Seismic Regulations for Buildings-Applied Technology Council ATC 3-06.

(d) Specification for the Design and Construction of Load-Bearing Concrete Masonry - NCMA August, 1979.

(e) Trojan Nuclear Plant Concrete Masonry Design Criteria Safety Evaluation Report Supplement - November, 1980.

(f) Regulatory Guide 1.61, "Damping Values for Seismic Design of Nuclear Power Plants."

ATTACHMENT 4

APPENDIX D TO SRP SECTION 3.8.4

TECHNICAL POSITION ON SPENT FUEL POOL RACKS

Introduction

The purpose of this appendix is to provide minimum requirements and criteria for review of spent fuel pool racks and the associated structures which would meet the design standards specified in subsection II of this SRP section.

(1) Description of the Spent Fuel Pool and Racks

Descriptive information including plants and sections showing the spent fuel pool in relation to other plant structures shall be provided in order to define the primary structural aspects and elements relied upon to perform the safety-related functions of the pool, the spent pool liner fuel, and the racks. The main safety function of the spent fuel pool, including the liner, and the racks is to maintain the spent fuel assemblies in a safe configuration through all environmental and abnormal loadings such as earthquake, and impact due to spent fuel cask drop, drop of a spent fuel assembly, or drop of any other heavy object during routine spent fuel handling.

The major structural elements reviewed and the extent of the descriptive information required are indicated below.

(a) Support of the Spent Fuel Racks: The general arrangements and principal features of the horizontal and the vertical supports to the spent fuel racks should be provided indicating the methods of transferring the loads on the racks to the fuel pool wall and the foundation slab. All gaps (clearance or expansion allowance) and sliding contacts should be indicated. The extent of interfacing between the new rack system and the old fuel pool walls and base slab should be discussed, i.e., interface loads, response spectra, etc.

If connections of the racks are made to the base and to the side walls of the pool such that the pool liner may be perforated, the provisions for avoiding leakage of radioactive water of the pool should be indicated.

(b) Fuel Handling: Postulation of a drop accident, and quantification of the drop parameters are reviewed by the Accident Evaluation Branch (AEB); Structural Engineering Branch accepts the findings of the AEB review for the purpose of review of the integrity of the racks and the fuel pool including the fuel pool lines due to a postulated fuel handling accident. Sketches and sufficient details of the fuel handling system should be provided to facilitate this review.

(2) Applicable Codes, Standards, and Specifications

Construction materials should conform to Section III, Subsection NF of Ref. 3.1. All materials should be selected to be compatible with the fuel pool environment to minimize corrosion and galvanic effects.

Design, fabrication, and installation of spent fuel racks of stainless steel material may be performed based upon Subsection NF requirements of Ref. 3.1 for Class 3 component supports.

(3) Seismic and Impact Loads

For plants where dynamic input data such as floor responses spectra or ground response spectra are not available, necessary dynamic analyses may be performed using the criteria described in SRP Section 3.7. The ground response spectra and damping values should correspond to Regulatory Guides 1.60 and 1.61, respectively. For plants where dynamic data are available, e.g., ground response spectra for a fuel pool supported by the ground, floor response spectra for fuel pools supported on soil where soil-structure interaction was considered in the pool design or a floor response spectra for a fuel pool supported by the reactor building, the design and analysis of the new rack system may be performed by using either the existing input parameters including the old damping values or new parameters in accordance with Regulatory Guides 1.60 and 1.61. The use of existing input with new damping values in Regulatory Guide 1.61 is not acceptable.

Seismic excitation along three orthogonal directions should be imposed simultaneously for the design of the new rack system.

The peak response from each direction should be combined by square root of the sum of the squares in accordance with Regulatory Guide 1.92. If response spectra are available for a vertical and horizontal directions only, the same horizontal response spectra may be applied along the other horizontal direction.

Submergence in water may be taken into account. The effects of submergence are considered on case-by-case basis.

Due to gaps between fuel assemblies and the walls of the guide tubes, additional loads will be generated by the impact of fuel assemblies during a postulated seismic excitation. Additional loads due to this impact effect may be determined by estimating the kinetic energy of the fuel assembly. The maximum velocity of the fuel assembly may be estimated to be the spectral velocity associated with the natural frequency of the submerged fuel assembly. Loads thus generated should be considered for local as well as overall effects on the walls of the rack and the supporting framework. It should be demonstrated that the consequent loads on the fuel assembly do not lead to a damage of the fuel.

Loads generated from other postulated impact events may be acceptable, if the following parameters are described: the total mass of the impacting missile, the maximum velocity at the time of impact, and the ductility ratio of the target material utilized to absorb the kinetic energy.

(4) Loads and Load Combinations:

Any change in the temperature distribution due to the proposed modification should be identified. Information pertaining to the applicable design loads and various combinations thereof should be provided indicating the thermal load due to the effect of the maximum temperature distribution through the pool walls and base slab. Temperature gradient across the rack structure due to differential heating effect between a full and an empty cell should be indicated and incorporated in the design of the rack structure. Maximum uplift forces available from the crane should be indicated including the consideration of these forces in the design of the racks and the analysis of the existing pool floor, if applicable.

The fuel pool racks, the fuel pool structure including the pool slab and fuel pool liner, should be evaluated for accident load combinations which include the impact of the spent fuel cask, the heaviest postulated load drop, and/or accidental drop of fuel assembly from maximim height.

The acceptable limits (strain or stress limits) in this case will be reviewed on a case-by-case basis but in general the applicant is required to demonstrate that the functional capability and/or the structural integrity of each component is maintained.

The specific loads and load combinations are acceptable if they are in conformity with the applicable portions of SRP Section 3.8.4, subsection II.3, and Table 1.

(5) Design and Analysis Procedures

Details of the mathematical model including a description of how the important parameters are obtained should be provided including the following: The methods used to incorporate any gaps between the support systems and gaps between the fuel bundles and the guide tubes; the methods used to lump the masses of the fuel bundles and the guide tubes; the methods used to account for the effect of sloshing water on the pool walls; and, the effect of submergence on the mass, the mass distribution and the effective damping of the fuel bundle and the fuel racks.

The design and analysis procedures in accordance with SRP Section 3.8.4, subsection II.4 are acceptable. The effect on gaps, sloshing water, and increase of effective mass and damping due to submergence in water should be quantified.

When pool walls are utilized to provide lateral restraint at higher elevations, a determination of the flexibility of the pool walls and the capability of the walls to sustain such loads should be provided. If the pool walls are flexible (having a fundamental frequency less than 33 Hertz), the floor response spectra corresponding to the lateral restraint point at the higher elevation are likely to be greater than those at the base of the pool. In such a case using the response spectrum approach, two separate analyses should be performed as indicated below:

(a) A spectrum analysis of the rack system using response spectra corresponding to the highest support elevation provided that there is not significant peak frequency shift between the response spectra at the lower and higher elevations; and

(b) A static analysis of the rack system by subjecting it to the maximum relative support displacement.

The resulting stresses from the two analyses above should be combined by the absolute sum method.

In order to determine the flexibility of the pool wall it is acceptable for the applicant to use equivalent mass and stiffness properties obtained from calculations similar to those described in Ref. 4.1. Should the fundamental frequency of the pool wall model be higher than or equal to 33 Hertz, it may be assumed that the response of the pool wall and the corresponding lateral support to the new rack system are identical to those of the base slab, for which appropriate floor response spectra or ground response spectra may already exist.

(6) Structural Acceptance Criteria

The structural acceptance criteria are those given in the Table 1. When buckling loads are considered in the design, the structural acceptance criteria shall be limited by the requirements of Appendix XVII to Reference 3.1.

For impact loading, the ductility ratios utilized to absorb kinetic energy in the tensile, flexural, compressive, and shearing modes should be quantified. When considering the effects of seismic loads, factors of safety against gross sliding and overturning of racks and rack modulus under all probable service conditions shall be in accordance with SRP Section 3.8.5, subsection II.5. This position on factors of safety against sliding and tilting need not be met provided any one of the following conditions is met:

(a) it can be shown by detailed nonlinear dynamic analyses that the amplitudes of sliding motion are minimal, and impact between adjacent rack modules or between a rack module and the pool walls is prevented provided that the factors of safety against tilting are within the values permitted by SRP Section 3.8.5, subsection II.5.

(b) it can be shown that any sliding and tilting motion will be contained within suitable geometric constraints such as thermal clearances, and that any impact due to the clearances is incorporated.

The fuel pool structure should be designed for the increased loads due to the new and/or expanded high density racks. The fuel pool liner leak tight integrity should be maintained or the functional capability of the fuel pool should be demonstrated.

(7) Materials, Quality Control, and Special Construction Techniques

The materials, quality control procedures, and any special construction techniques should be described. The sequence of installation of the new fuel racks, and a description of the precautions to be taken to prevent damage to the stored fuel during the construction phase should be provided.

If connections between the rack and the pool liner are made by welding, the welder as well as the welding procedure for the welding assembly shall be qualified in accordance with the applicable code.

TABLE 1

LOAD COMBINATION	ACCEPTANCE LIMIT
$D + L$ $D + L + T_o$	Level A service limits
$D + L + T_o + E$ $D + L + T_a + E$ $D + L + T_o + P_f$	Level B service limits
$D + L + T_a + E'$	Level D service limits
$D + L + F_d$	The functional capability of the fuel racks should be demonstrated

Limit Analysis:

$1.7\ (D + L)$ $1.3\ (D + L + T_o)$ $1.7\ (D + L + E)$ $1.3\ (D + L + E + T_o)$ $1.3\ (D + L + E + T_a)$ $1.3\ (D + L + T_o + P_f)$ $1.1\ (D + L + T_a + E')$	XVII 4000 of ASME ASME Code Section III

Notes:

1. The abbreviations in the table above are those used in subsection II.3.a of this SRP section where each term is defined except for T_a which is defined here as the highest temperature associated with the postulated abnormal design conditions.

2. Deformation limits specified by the Design Specification limits shall be satisfied, and such deformation limits should preclude damage to the fuel assemblies.

3. The provisions of NF 3231.1 of Reference 3.1 shall be amended by the requirements of paragraphs c.2.3 and 4 of Regulatory Guide 1.124 entitled "Design Limits and Load Combinations for Class 1 Linear-Type Component Supports."

4. F_d is the force caused by the accidental drop of the heaviest load from the maximum possible height and P_f is upward force on the racks caused by postulated struck fuel assembly.

VI. REFERENCES

1. Regulatory Guides

    1.29 - Seismic Design Classification

    1.60 - Design Response Spectra for Seismic Design of Nuclear Power Plants

    1.61 - Damping Values for Seismic Design of Nuclear Power Plants

    1.76 - Design Basis Tornado for Nuclear Power Plants

    1.92 - Combining Modal Responses and Spatial Components in Seismic Response Analysis

    1.124 - Design Limits and Loading Combinations for Class 1 Linear-Type Components Supports

2. Standard Review Plan Section

    3.7 - Seismic Design

    3.8.4 - Other Category I Structures

3. Industry Codes and Standards

    1. American Society of Mechanical Engineers, Boiler and Pressure Vessel Code, Section III, Division 1

    2. American National Standards Institute, N210-76

    3. American Society of Civil Engineers, Suggested Specification for Structures of Aluminum Alloys 6061-T6 and 6067-T6

    4. The Aluminium Association, Specification for Aluminum Structures

4. Other

    1. Briggs, John M., "Introduction to Structural Dyanmics," McGraw-Hill Book Co., New York, 1964.