ArevaEPRDCPEm Resource

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Sent:	Friday, June 15, 2012 2:45 AM
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Subject:	U.S. EPR Design Certification Application RAI No. 547 (6499, 6359), FSAR Ch. 3 - NEW PHASE 4 RAI
Attachments:	RAI_547_LB1_6499_SEB2_6359.doc

Attached please find the subject request for additional information (RAI). A draft of the RAI was provided to you on May 17, 2012, and June 12, 2012, you informed us that the RAI is clear and no further clarification is needed. As a result, no change is made to the draft RAI. The schedule we have established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs. For any RAIs that cannot be answered within 30 days, it is expected that a date for receipt of this information will be provided to the staff within the 30 day period so that the staff can assess how this information will impact the published schedule.

Thanks,
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U. S. EPR Standard Design Certification
AREVA NP Inc.
Docket No. 52-020
SRP Section: 03.06.01 - Plant Design for Protection Against Postulated Piping Failures in Fluid Systems Outside Containment
SRP Section: 03.07.02 - Seismic System Analysis

Application Section: Tier 2 Table 1.8-2

QUESTIONS for EPR Projects Branch (NARP)
QUESTIONS for Structural Engineering Branch 2 (ESBWR/ABWR Projects) (SEB2)

03.06.01-14

Open Item

Follow-up RAI to RAI 533, Question 3.6.1-13

Following the issuance of RAI 533, Question 3.6.1-13 on COL Information Items (I/Is) 3.6-1 and 3.6-2, it was identified by the staff that there are a number of similar COL I/Is in FSAR Tier 2 Table 1.8-2 that cannot theoretically be completed by the COL applicants prior to issuance of a COL license. This issue was discussed with the AREVA and COL applicants in an EPR DCWG public meeting. In their response to RAI 533 Question 3.6.1-13, AREVA chose to only respond to address that specific instance, versus the generic problem.

Generally, the proposed FSAR Tier 2 Table 1.8-2 COL I/Is are technically appropriate, however, as currently worded some present a design certification legal issue. As written, they cannot be completed prior to the issuance of a COLA. For example, the COL I/I may require: 1) as-built information to be provided, 2) completion of examinations, or 3) other information that has to be provided prior to fuel load. These COL I/Is may be revised in several different ways depending on how they are currently worded as follows:

a. COL I/Is that can be reworded in an acceptable manner so they can be completed by the COL applicant.

b. COL I/Is that duplicate, to some extent, an existing ITAAC, can be reworded to limit the scope of the COL I/I while retaining the ITAAC.

c. COL I/Is that entirely duplicate an existing ITAAC can be deleted

d. COL I/Is that can be deleted, and a new ITAAC be created, or the scope of an existing ITAAC be expanded.

The applicant is requested to review the entire COL I/Is and any associated ITAAC with the above concepts and situations in mind, and make the appropriate changes to both the FSAR Tier 2 Table 1.8-2 COL I/Is, and to the various Tier 1 ITAAC tables.

03.07.02-76

Open Item

Follow-up RAI 371, Question 03-07-02-67 (Supplement 24 Response)

In RAI 371, Question 03.07.02-67, the staff asked the applicant to provide a comparison of NI Common Basemat Structure ISRS computed from a fixed base ANSYS model with that of ISRS computed from a fixed base SASSI model. Since the ANSYS 3D Finite Element Model (FEM) used for static analysis serves as the basis for the SASSI FEM, the comparison was requested to determine if the SASSI model is dynamically equivalent to the more detailed ANSYS model. In its response the applicant provided comparisons of ISRS for a number of locations on the NI. Most of the ISRS comparisons show only slight differences between the two models. However there were a number of cases in which the ANSYS result was noticeably higher than the SASSI result. These are discussed below:

1. The applicant has noted that there is a discrepancy in the dome ISRS of the Shield Building. At a frequency of approximately 15 Hz the static model results exceed the dynamic model results by about 23 percent. Although the applicant claims this is due to a small deviation in the ANSYS model from the perfect dome geometry around the apex of the dome and due to irregularities in the dome surface geometry, it is not clear why this would lead to a difference of over 20 percent in the results for the two models. In addition the ZPA for the static model exceeds that of the dynamic model by about 14 percent.
2. A comparison of ISRS for the Reactor Building Internal Structure (RBIS) at elevation 63 feet, 11 ¾ inches for the Z or vertical direction (Figure 03.07.02-67-36) shows the static model result at a frequency of about 15 Hz to be 31 percent higher than the dynamic model result. In addition, at 15 Hz both results exceed the ISRS envelope shown on FSAR Figure 3.7.2-79 (Revision 3). At this same elevation a similar result is observed for the X direction (Figure 03.07.02-67-34) where the static model result at a frequency of about 10 Hz is 44 percent higher than the dynamic model result. At 10 Hz, both results exceed the ISRS envelope shown on FSAR Figure 3.7.2-79 (Revision 3). The ZPA for the static model in the X direction is 20 percent higher than that of the dynamic model. Since the ISRS envelope includes soil case 5ae which has a shear wave velocity of 13,123 ft/sec and in effect provides a rigid support for the NI, it is not clear why the fixed base SASSI result exceeds the results for case 5ae.
3. A comparison of ISRS for the RBIS at elevation 16 feet, 10 ¾ inches for the Y direction (Figure 03.07.02-67-38) shows the static model result at about 15 Hz is 24 percent higher than the dynamic model result. At 15 Hz, both results exceed the ISRS shown on FSAR Figure 3.7.2-75 (Revision 3). For the Z direction at about the same frequency the static model result exceeds the dynamic model result by about 14 percent.

4. A comparison of ISRS for the Fuel Building at elevation 23 feet, 7 ½ inches for the Z direction (Figure 03.07.02-67-27) shows the static model result at a frequency of about 7 Hz to be 15 percent higher than the dynamic model result.
5. A comparison of Y-direction ISRS for Safeguard Building 1 (Figure 03.07.02-67-8) and X-direction ISRS for Safeguard Building 2/3 (Figure 03.07.02-67-19) at an elevation of 26 feet 3 inches shows that the static model results at frequencies less than 10 Hz to be 21 and 24 percent higher, respectively, than the dynamic model results. The envelope of the ISRS shown on FSAR Figures 3.7.2-81(Revision 3) for Safeguard Building 1 is about 5 percent lower than the static result at a frequency of about 7.5 Hz. For Safeguard building 2/3 the envelope of ISRS shown on FSAR Figure 3.7.2-87 (Revision 3) exceeds both the static model and dynamic results. This might suggest that the comparison of static and dynamic results for the Safeguard Building at elevation 26 feet 3 inches are acceptable because the envelope of ISRS is approximately equal to or exceeds the static model result. However at frequencies below 10 Hz, the CSDRS for the EUR medium and soft soil cases exceed the CSDRS for the EUR hard soil case upon which the examples provided with the response are based. If the EUR medium or EUR soft time histories were used for the fixed base analyses it is likely the results at frequencies below 10 Hz would be higher than that provided with the response and might possibly exceed the envelope of the ISRS shown on FSAR Figures 3.7.2-81 and 87.

Because there are significant differences in the ISRS and ZPA's between the static model and dynamic model results as detailed in items 1 through 5 above, it cannot be concluded that the SASSI model is dynamically equivalent to the static ANSYS model. Based on its review, the staff has a concern that for certain locations on the NI the SASSI model may be under-predicting both the ZPA's used for building design and the ISRS used for the design of equipment and suspended systems. Of particular concern are the results for the RBIS which supports the reactor coolant system (RCS). The fundamental horizontal frequencies for the RCS components as reported in the response to RAI 201, Question 03.07.02-35 (Supplement 5) are:

- Reactor Vessel ≈ 10 Hz
- Steam Generator ≈ 6.5 Hz
- Reactor Coolant Pumps ≈ 14 Hz
- Pressurizer ≈ 14.5 Hz

As the difference in horizontal response between the static and dynamic models noted in item 2 above occurred at a frequency of 10 Hz and in item 3 at 15 Hz, it is possible that the seismic response for the RCS has been under-predicted. As a result, AREVA is requested to provide additional information to address the differences in the model results and provide a technical basis as to why the SASSI model and seismic results from that model are acceptable. The applicant should also identify and address other locations in the NI where the analysis results show similar differences between the ANSYS and SASSI models as noted above and address the consequences of these differences in its response. Lastly, the staff requests that AREVA provide an explanation as to why the ISRS results for case 5ae are exceeded by the results of the fixed base SASSI analysis.

03.07.02-77

Open Item

New Phase 4 RAI

NRC Information Notice (IN) 2011-20, dated November 18, 2011, identifies the occurrence of alkali-silica reaction (ASR)-induced concrete degradation of a seismic Category I structure at the Seabrook Station NPP. The IN indicates that ASR-induced degradation occurred even though concrete testing per ASTM standards C289 and C295 was specified in the Seabrook Station FSAR. It is explained that the tests described in ASTM C227 and C289 may not accurately predict aggregate reactivity when dealing with late or slow-expanding aggregates containing strained quartz or micro-crystalline quartz; updated ASTM testing standards C1260 and C1293 are more appropriate in this regard.

EPR, FSAR Tier 2 Section 3.8 indicates that the construction of seismic Category I structures is done in accordance with the ASME Code (2004 edition) Section III, Division 2 or ACI 349-01. The ASME Code references the 1987 edition of ASTM C289, while ACI 349-01 references the 1981 edition of ASTM C289. Neither document references ASTM C1260 or C1293.

Therefore, it appears that the EPR FSAR does not reference updated ASTM testing standards C1260 and C1293, either directly or through ACI 349-01 or the ASME code (2004 edition). The applicant is requested to explain the measures that are implemented in the FSAR to prevent the problems described in IN 2011-20. In particular, the applicant is requested to explain whether testing in accordance with updated ASTM C1260 and C1293 will be performed during construction.

03.07.02-78

Open Item

Follow-up to RAI 371, Question 03.07.02-66 and RAI 376 Question 03.08.05-28.

1. In RAI 371 Question 03.07.02-66 Item (a), the staff had asked the applicant to evaluate the impact of an analysis simplification for the seismic analysis of the Nuclear Island (NI) basemat in that zero thickness plate elements all lying in a single plane were used to represent the basemat centerline. However, the actual basemat has a thickness which varies and the centerline does not lie in a single plane. This has the potential to introduce errors in the basemat seismic loads used for design. In its response the applicant describes a revised NI 3D FEM seismic analysis model which is used to develop the basemat seismic loads. The foundation basemat is represented by five layers of solid brick elements. These elements replace the zero thickness shell elements used to represent the basemat in the SASSI model. This FEM is used to calculate moments and shears in the basemat using the ANSYS computer program. The time history inputs are the in-column motions at the level of the bottom of the basemat and are consistent with those motions used in the corresponding SASSI analysis.

Compression-only vertical soil springs support the bottom of the basemat while horizontal contact/sliding elements are used to address the potential sliding of the model. The spring parameters were obtained from the Gazetas formulation, which were found to produce displacements and base reactions similar to the SASSI results for the dynamic case. However the comparison of displacements and base reactions was not provided with the applicant's response and should be included to allow the staff to complete its evaluation and to provide assurance that the SASSI model and ANSYS model are dynamically equivalent. In addition the applicant did not provide the properties of the contact/sliding elements used in the analysis. The applicant is requested to provide these properties and their technical basis for the staff's review.

In the response it says that springs similar to the dynamic model were used in the static model. For static models the spring stiffness is normally set at about one-half the dynamic spring stiffness. However in a discussion of the static model soil springs the applicant says that the one-half of the strain compatible shear modulus was used for the seismic soil cases. This appears to be an editorial error in that it should state that one-half of the strain compatible shear modulus was used for the static soil cases. The applicant is requested to explain this discrepancy and correct the sentence if it is in error.

In FSAR Section 3.7.2.3.1.4, Revision 4 Interim, on page 3.7-106 it states that the ANSYS model is loaded statically by accelerating the lumped and distributed masses before a time history analysis is performed. Presumably the time history results then include the effect of both the dynamic and static loads. The applicant should describe how the dynamic shears and moments are then extracted from this result so that they can be combined with the results of the ANSYS static model which uses spring stiffness's based on one-half of the strain compatible shear modulus.

Lateral soil pressures along the vertical embedded walls were developed following a standard geotechnical approach. For the seismic loads, the lateral soil pressures are based on wall displacements that occur during the application of the seismic input motions. The parameters of the lateral springs were developed to yield maximum and minimum pressures defined by the Rankine passive (Kp = 3.0)/active (Ka = 0.333) pressure states with an at-rest pressure (K0) value of 0.50. The stiffness of these springs was selected to yield a displacement at full passive pressure of 0.006H (2.799 in) and for the minimum active state a displacement of 002H (0.933 in). However, the passive pressure curve appears to be different from that used in the stability analysis of the NI presented in the response to RAI 376 Question 03.07.02-69 (see Figures 03.07.02-69-15 and -16). The applicant is requested to explain why a different passive curve was used in the basemat analysis and what effect this might have on the mat design loads.

The tendon gallery acts as a shear key under seismic loads. The seismic loads need to include the effect of any localized movement of the basemat. Determining the additional loads due to movement of the basemat is accomplished by performing two separate analysis. In the first analysis, uplift and sliding of the basemat is not allowed. In the second analysis, uplift and sliding is permitted. The difference in the pressure between these two cases is a delta pressure which is added to the lateral loads determined from the SASSI SSI analysis of the NI. For the two rock cases which appear to provide the highest sidewall pressure loads on the shear key, the applicant states that the top ring of nodes of the tendon gallery are connected to the solid element basemat using ANSYS shell to solid Multi-Point Constraints (MPCs) and have no sidewall rock springs. The bottom ring (elevation) of nodes of these shell elements that are connected to the basemat have stiff sidewall rock springs that simulate partially fixed boundary conditions. These nodes experience higher pressures and moments (stress concentration effect) typically associated with fixity. For these cases, average maximum pressure values considering a full element instead of a node are presented in Table 03.07.02-66-2. As it is not clear from the applicant's explanation which nodes or elements are being described and what is meant by partially fixed boundary conditions, the applicant is requested to provide:

a. A figure depicting the boundary conditions for the shear key nodes and;

b. A figure depicting maximum pressure values and average pressure values over the complete height of the tendon gallery with a description of how the average values were calculated.

2. The response to RAI 371 Question 03.07.02-66 Item (a) indicates that FSAR Tier 2, Section 3.8.5.4.2 was revised to clarify how the seismic design loads for the NI basemat are obtained from the ANSYS 3D FEM basemat foundation model. However, a review of the FSAR Section 3.8.5.4.2 markup reveals several inconsistencies and discrepancies with the information provided in the RAI response, as well as obsolete information that is no longer applicable to the applicant's current design approach for the NI. For example, the staff notes the following:

a. Section 3.8.5.4.2, Revision 4 Interim, first paragraph. The second sentence refers to a "static model" that is incorrectly stated as being described in Sections 3.8.1.4.1 and 3.8.5.3.

b. Section 3.8.5.4.2, Revision 3, second paragraph. There remains a reference to the "NI Common Basemat Structure static analysis." There is also a reference to Figure 3.8-103 that illustrates the ANSYS NI basemat model; however, the latter only shows the NI basemat itself and not the superstructure (which is also a part of the NI basemat model as shown in Figure 3.7.2-152).

c. Section 3.8.5.4.2, Revision 3, third and subsequent paragraphs. An explanation is provided as to how the vertical soil/rock springs were developed using the Gazetas formulation and the elliptical variation of stiffness across the foundation footprint. However, specific information is only provided for the static springs (i.e., springs used in the static analysis for gravity loads, Table 3.8-13). No information is given for the dynamic springs (i.e., springs used in the time-history seismic analysis). Furthermore, there is no mention of the horizontal soil/rock springs that represent the soil/rock pressures on the embedded sidewalls (including the tendon gallery), or the fact that the ANSYS basemat model captures nonlinear effects due to sliding and uplift.

d. Section 3.8.5.4.2, Revision 3, pg. 3.8-134, bottom paragraph. References to Figures for obsolete soil cases such as 1u, 2u, 4u, 3r3u, etc., remain in the text.

e. Section 3.8.5.4.2, Revision 3, pg. 3.8-135, first paragraph. The text indicates that the results of the soil spring analyses are used in determining the acceptability of the supporting soil media under static loading conditions; however, as indicated in the response to RAI 376 Question 03.08.05-28, soil bearing pressures are computed using the SASSI 3D FEM model for both static and dynamic cases.

f. Section 3.8.5.4.2, Revision 3, pg. 3.8-135, third and subsequent paragraphs. The discussion switches from consideration of the ANSYS basemat model to the NI stability analysis, and then to the discussion of differential settlement evaluation, without a clear indication to the reader that the corresponding analytical models are different and use different computer codes. The applicant should consider using different sub-headings for each of the different discussions.

g. Although indicated in the response, the staff could not identify in Section 3.8.5.4.2, Revision 3 or 4 Interim, the explanation of how the design forces for the NI basemat (bending moments and shears) are obtained from the analysis results of the ANSYS basemat model, for all analysis cases and loading conditions.

In light of the above, it appears that the changes made to FSAR Tier 2, Section 3.8.5.4.2, from Revision 0 through Revision 3, have resulted in a text that could be confusing to a reader who is not familiar with the various modifications made to the applicant's initial design approach. Therefore, the applicant is requested to provide a complete revision of FSAR Tier 2, Section 3.8.5.4.2 that clearly explains the ANSYS 3D FEM Basemat Foundation Model: its description, characteristics, purpose, limitations, and difference with the ANSYS Fixed Base 3D FEM Superstructure Model. This revision should be consistent with the information provided in the RAI response and with the new FSAR Tier 2, Section 3.7.2.3.1.4. This revision should also include a clear explanation of how the design forces for the NI basemat (moments and shears) are obtained from the analysis results of the ANSYS basemat model, for all analysis cases and loading conditions.

In addition, the applicant is requested to review FSAR Tier 2, Sections 3.8.1 through 3.8.5 and identify all references to the "NI Common Basemat Structure model" or to the "static model." For each identified reference, determine whether it applies to the ANSYS 3D FEM Basemat Foundation Model or to the ANSYS Fixed Base 3D FEM Superstructure Model. A clear differentiation between these two models should be evident in the text; otherwise, provide a revision to the text.

3. The response to RAI 371 Question 03.07.02-66 Item (a) indicates that soil pressures used for designing embedded walls due to seismic loading are obtained from the SSI analysis. It is also indicated that these loads are scaled up such that their magnitude is at least equal to the corresponding Rankine passive pressures (Kp = 3.0) for the corresponding soil case. These pressures are then applied to the ANSYS Fixed Base 3D FEM Superstructure Model to perform the design of the embedded walls. This is consistent with FSAR Tier 2, Section 3.8.5.4.2, Revision 4 Interim.

   On the other hand, the response to RAI 376 Question 03.08.05-28 Item 3 indicates that wall pressures calculated from SSI analysis, elastic solution by Wood, and those required for sliding stability are considered in the design of embedded walls. It adds that each soil case is analyzed, dynamically and statically, and design loads and controlling loads for each wall are used in the design. This is consistent with FSAR Tier 2, Section 3.8.5.4.1, Revision 3, but appears to be inconsistent with FSAR Tier 2, Section 3.8.5.4.2, Revision 4 Interim.

   The response to RAI 376 Question 03.08.05-28 also provides Figures 03.08.05-28-4 through 03.08.05-28-41, and Figures 03.08.05-28-60 through 03.08.05-28-97, which compare the total soil pressures applied to the ANSYS Fixed Base 3D FEM Superstructure Model (scaled SSI pressure profiles) to the passive pressures developed for the stability analysis and to Wood's solution. The applicant indicates that, for each soil case, the passive pressures from the stability analysis are always bounded by the scaled SSI pressure profiles. The staff also notes that Wood's solution is always bounded by the scaled SSI pressure profiles. This appears to address the inconsistency noted in the two preceding paragraphs. However, since the results of the comparative study are required to ensure the adequacy of the embedded wall design, in accordance with the guidance in SRP 3.8.4 and 3.8.5, the applicant is requested to provide the following additional information:

(a) To ensure that the referenced figures in RAI 376 Question 03.08.05-28 provide a consistent comparison, confirm that all the pressure profiles shown represent the combined effect of static plus surcharge plus seismic loads, including the profiles identified as Wood's solution. How are the static and surcharge loads combined with the scaled SSI pressures and to the passive pressures from the stability analysis?

(b) Provide a graphical explanation of the scaling of the SSI pressure profiles. Clarify whether this scaling is done at each depth so that the scaled SSI pressure profiles always bound the linear Kp=3.0 pressure profile, or whether the scaling is done at one depth only using a single scaling factor applied to the entire profile. (It is stated that the maximum pressure on each wall is at least equal to the passive earth pressure of Kp=3.0).

(c) A review of the referenced figures indicates that, for a given wall, soil, and analysis case, it does not appear to be always true that the scaled SSI pressure profile always bounds the pressures required by the sliding stability analysis. For example, in Figure 03.08.05-28-5 (Wall 2, "cracked" analysis) the vertical "4ue Stability Kp" profile (blue line) is greater than the "4ue" profile (magenta line) at depths between approx. 5 ft and 25 ft. A similar situation is observed in Figure 03.08.05-28-61 (Wall 2, "uncracked" analysis). This is due to the difference in the relative shape of the two pressure profiles. Since the applicant indicates that it is not using an envelope of all soil cases (such as the ones shown in Figures 03.08.05-28-42 through 03.08.05-28-59 and Figures 03.08.05-28-98 through 03.08.05-28-115), but is considering each soil case independently, explain how it is ensured that the scaled SSI pressure profile used in wall design always bounds the pressures required by the sliding stability analysis for each soil case.

(d) It appears that the additional pressures due to the localized sliding/uplift of the basemat (i.e., the "delta pressures" described in the response to RAI 371 Question 03.07.02-66, listed in Tables 03.07.02-66-1 and 03.07.02-66-2) were not included in the referenced figures in RAI 376 Question 03.08.05-28. It therefore does not provide the staff with an accurate representation of the total soil pressures acting on the walls, which was the intent of the original RAI. Therefore, the applicant should provide a revised version of the figures in RAI 376 Question 03.08.05-28 that includes the SSI pressures, the delta pressures, and the combination of the two for all embedded walls including the tendon gallery. The information provided should be consistent with the information requested under Question (1) of this RAI.

(e) The response to RAI 371 Question 03.07.02-66 Item (a) indicates that static soil pressures corresponding to at-rest conditions (K_0=0.5) are applied separately to the ANSYS Fixed Base 3D FEM Superstructure Model. Since the soil pressures shown in the referenced figures in RAI 376 Question 03.08.05-28 represent the combined effect of static plus surcharge plus seismic loads, and it is indicated that they are applied separately to the ANSYS model, clarify how the static soil pressures are differentiated from the seismic soil pressures for the purposes of design load combinations.

(f) Clarify the apparent inconsistency between FSAR Tier 2, Section 3.8.5.4.1, Revision 3 and FSAR Tier 2, Section 3.8.5.4.2, Revision 4 Interim identified in the first two paragraphs of Question (3) above.

4. The response to RAI 376 Question 03.08.05-28 Attachment 1 indicates that, for rock case 5ae, the methodology for designing embedded sidewalls due to seismic loading deviates from the methodology used for all other soil cases. Instead of soil pressures applied directly to the ANSYS Fixed Base 3D FEM Superstructure Model, this model is modified with additional nodal constraints applied to the out-of-plane X and Y directions of sidewall nodes that are in contact with the excavation, and the seismic loads are applied statically to the model. It is indicated that these additional constraints simulate the contact of the sidewalls with the surrounding hard rock, while at the same time, allowing for vertical movement of these walls to adequately represent overturning effects.

(a) The above statements imply that the critical member forces for sidewall design occur at an elevation immediately above the top of rock, and that member forces computed by the analytical model below the top of rock, which could be locally very high, are ignored. Clarify whether this is the case, and if so, clarify whether the portions of the sidewalls below the top of rock are uniformly designed for the same member forces as the portions immediately above the top of rock.

(b) Attachment 1 of the RAI response also indicates that inward (away from the rock) movement of the sidewalls is only expected to occur under hydrostatic or seismic (on the side of the building opposite of the earthquake direction) loading, and that this will be considered in local design. The applicant should explain how this effect is accounted for in local design. For seismic loading and global design, explain why the additional nodal constraints on the analytical model are not removed from the side of the building opposite of the earthquake direction since the wall would move away from the rock foundation.

(c) In light of the deviation from the methodology used for all other soil cases and to ensure the adequacy of the design approach for rock case 5ae, provide a comparison of wall member forces obtained using the alternate approach for rock case 5ae to the wall member forces obtained by applying the following pressure profiles to the ANSYS Fixed Base 3D FEM Superstructure Model (without additional nodal constraints below the top of rock): (i) pressures obtained from the SASSI analysis and (ii) pressures considered in the sliding stability analysis. This comparison may be performed for a set of critical walls.

(d) Update the FSAR to indicate that rock case 5ae is treated as a special case and to describe the alternate methodology.

5. The response to RAI 371 Question 03.07.02-66 Item (a) indicates that the tendon gallery is designed to resist maximum shear obtained by imposing the corresponding envelope pressure from the SASSI analysis, Wood's solution, and hydrostatic pressure.

   On the other hand, the response to RAI 376 Question 03.08.05-28 Item 3 indicates that the results from the analysis using the ANSYS basemat model with static soil springs are used to develop design loads for the foundation mat, including the tendon gallery. The applicant is requested to clarify the inconsistency with the response to RAI 371 Question 03.07.02-66 Item (a), as well as the inconsistency between what is stated above and what is shown in Figures 3.8.5-28-34 through 3.8.5-28-41 and Figures 3.8.5-28-90 through 3.8.5-28-97 in RAI 376 Question 03.08.05-28. Also, clarify what is meant by the phrase "ANSYS basemat model with static soil springs."

   The response to RAI 376 Question 03.08.05-28 provides figures showing the lateral pressures used to design the tendon gallery sidewalls. However, Figures 3.8.5-28-34 through 3.8.5-28-41 ("cracked" seismic analysis case) only show results for soil cases 1n2ue and 2sn4ue, while Figures 3.8.5-28-90 through 3.8.5-28-97 ("uncracked" seismic analysis case) only show results for case 4ue. Provide updated figures which include all relevant soil/rock cases, including the rock cases 1n5ae and 5ae, which appear to result in the highest sidewall pressures (as described in the response to RAI 371 Question 03.07.02-66 Item (a)). Also, add the additional pressures due to the localized sliding/uplift of the basemat (i.e., the "delta pressures" described in the response to RAI 371 Question 03.07.02-66, listed in Tables 03.07.02-66-1 and 03.07.02-66-2) that were not included in the figures. The information provided should be consistent with the information requested under Question (1) of this RAI.

6. The response to RAI 376 Question 03.08.05-28 Item 5(c) indicates that the foundation static and dynamic bearing pressure demands computed for the Nuclear Island (applicable to all Seismic Category I structures) are provided in Table 3E.1-40 of FSAR Tier 2. The response also provides Figures 3.8.5-28-A through 3.8.5-28-D, which show bearing pressure contour plots for different seismic analysis cases. Since the maximum bearing pressures observed in Figures 3.8.5-28-A through 3.8.5-28-D exceed the values listed in Table 3E.1-40 of FSAR Tier 2 by a significant margin (approx. 56 ksf in Figure 3.8.5-28-C vs. 31.9 ksf maximum "edge" pressure in Table 3E.1-40), the applicant is requested to provide the following additional information:

   (a) Explain what is meant by the term "edge" used in Table 3E.1-40. Was any averaging process used to determine the reported values? Where is this explained in the FSAR?

(b) For the bearing pressure contour plots shown in Figures 3.8.5-28-A through 3.8.5-28-D, provide the technical basis for the process used to average the corner pressures, toe pressures, and any other localized pressure “hotspots.”

(c) Explain the discrepancy between the values listed in Table 3E.1-40 and the results observed in Figures 3.8.5-28-A through 3.8.5-28-D. Item 5(c) of the RAI response asserts that (i) isolated corner pressures that exceed the tabulated edge pressures are acceptable as the pressures will redistribute due to localized yielding of the soil, and (ii) there is sufficient margin in the ultimate allowable edge pressure to accommodate the redistribution increases. This explanation is not acceptable for the following reasons: (i) redistribution of pressures is already accounted for in the values shown in Figures 3.8.5-28-A through 3.8.5-28-D, and (ii) it is not acceptable to reduce the factor of safety of the design to accommodate the reported differences between the values shown in Table 3E.1-40 and those shown in Figures 3.8.5-28-A through 3.8.5-28-D.

(d) Item 5(e) of the RAI response indicates that the ANSYS 3D FEM basemat model results were compared to the SASSI FEM model results. Since the reported bearing pressures are obtained from the SASSI FEM model results, provide bearing pressure contour plots similar to those in Figures 3.8.5-28-A through 3.8.5-28-D, obtained from the ANSYS 3D FEM basemat model. Discuss the comparison between the two sets of results.

(e) Clarify the definition of “dead” load used in Figures 3.8.5-28-A through 3.8.5-28-D and Table 3E.1-40. Identify the applicable gravity loads that were considered in the estimates of static and dynamic bearing pressures, and confirm that they are consistent with FSAR Tier 2, Revision 3, Sections 2.5.4.10.1 and 3.8.5.4.1.

7. Since SSI analyses are used to compute the seismic driving forces in the sliding and overturning stability analyses, clarify whether the factors of safety reported in FSAR Tier 2, Table 3E.1-39, Revision 3, correspond to “cracked” or “uncracked” analysis cases, or to the governing (i.e., minimum) of both cases. This information should be added to the FSAR.