CCNPP3COLA PEmails

From: John Rycyna
Sent: Tuesday, February 03, 2009 3:59 PM
To: Poche, Robert; McQueeney, Jennifer
Cc: CCNPP3COL Resource; Samir Chakrabarti; Sujit Samaddar; Michael Miernicki; Joseph Colaccino; Meena Khanna; James Biggins; Adam Gendelman
Subject: Draft RAI No 65 SEB2 1971.doc (PUBLIC)
Attachments: Draft RAI No 65 SEB2 1971.doc

Rob,

Attached is DRAFT RAI No. 65. You have until February 17, 2009 to review it and to decide whether you need a conference call to discuss it. After the call or after February 17, 2009 the RAI will be finalized and sent to you. You then have 30 days to respond.

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Request for Additional Information No. 65
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2/3/2009

Calvert Cliffs Unit 3
UniStar
Docket No. 52-016
SRP Section: 03.07.02 - Seismic System Analysis
Application Section: 3.7.2

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

03.07.02-1

In FSAR Section 3.7.2.1.1 (Time History Analysis Method) on page 3.0-34, it states that the Ultimate Heat Sink (UHS) Electrical Building (EB) is fully embedded and relatively rigid compared to the soil stiffness, and consequently there is no significant amplification above the ground surface input motion. The UHS Makeup Water Intake Structure (MWIS) is similar to the UHS EB in that it is relatively rigid and almost entirely embedded. The zero period acceleration (ZPA) input to the UHS MWIS is 0.15 g and the structural response at grade is approximately 0.35 g in the North-South direction. This equates to an amplification of approximately 2.33 over the input motion ZPA. Why wouldn't a similar result occur for the UHS EB, and what is the technical basis for stating that there is no significant amplification above the ground surface input motion for this structure?

03.07.02-2

In FSAR Section 3.7.2.1.4 (Equivalent Static Load Method of Analysis) on page 3.0-35, it states that the equivalent static load method is used for the UHS EB by applying 0.5 g acceleration in all directions. Assuming the zero period acceleration (ZPA) of the design input ground motion is .35 g, provide the justification for the amplification of ground acceleration used for this structure, i.e. .5/.35, or 1.43. In addition, an assumption is made that the walls and slabs are stiff. This is used as the basis for assuming there is no additional amplification of the seismic response of the structure due to local flexibility of the structural elements. While it may be true the in-plane stiffness of the walls and slabs exceed 33 Hz, it may not be true that this is the case for their out-of-plane response. Provide the results of an analysis that demonstrates that the out-of-plane response for walls and slabs exceeds 33 Hz. Include in this analysis technical consideration of whether the walls and slabs are cracked or uncracked under the applied design loads.

03.07.02-3

As shown in the applicant's FSAR, no specific dynamic analysis has been performed for the Ultimate Heat Sink Electrical Building. How are the building displacements calculated which are needed as inputs for the analysis of buried conduit, duct banks, and piping that interface with this structure?

03.07.02-4

In FSAR Section 3.7.2.4, there is no description of a soil-structure-interaction (SSI) analysis for the Ultimate Heat Sink (UHS) Electrical Building (EB). Appendix S of 10 CFR Part 50 states that for Safe Shutdown Earthquake (SSE) ground motion SSCs will remain functional and that required safety functions must be assured during and after the vibratory ground motion. It also states that the evaluation of SSCs must take into account SSI effects and the expected duration of the vibratory ground motion. SRP 3.7.1, SRP Acceptance Criteria 4.A.vii. provides SSI analysis acceptance criteria for a COL application referencing a certified design. Provide in this section of the FSAR, the results of an SSI analysis for the UHS EB that meets SRP Acceptance Criteria 4.A.vii. of SRP 3.7.1 as well as SRP Acceptance Criteria 4 of SRP 3.7.2 using a subgrade model based on the final soil properties and properties of the compacted backfill used below the building, or justify an alternative. Include the effects of structure-to-structure interaction and reconcile the results of this analysis with the assumed seismic response of the building and with the In-Structure Response Spectra used to qualify the electrical equipment.

03.07.02-5

In FSAR Section 3.7.2.3.2 (Seismic Category I Structures - Not on Nuclear Island Common Base Mat) on page 3.0-36, it describes the finite element model used in the analysis of the Ultimate Heat Sink (UHS) Makeup Water Intake Structure (MWIS).

- · SRP 3.7.2, SRP Acceptance Criteria 3.C.ii. states the element mesh size should be selected on the basis that further refinement has only a negligible effect on the solution results. Describe any sensitivity studies that were implemented in determining the mesh size for the UHS MWIS, and if no sensitivity study was performed provide justification for not doing so.

- · SRP 3.7.2, SRP Acceptance Criteria 3.D. states that in addition to the structural mass, a floor load of 244.64 kg/m2 (50 pounds/ft^2) should be included to represent miscellaneous dead weights and a mass equivalent to 25 percent of the floor design live load and 75 percent of the roof design snow load should be included in the model. Describe how this acceptance criterion has been addressed in the model of the UHS MWIS, and if no additional mass was added provide the justification for not doing so.

03.07.02-6

FSAR Section 3.7.2.4 (Soil-Structure Interaction) starting on page 3.0-37 describes soil-structure-interaction (SSI) for the Ultimate Heat Sink (UHS) Makeup Water Intake

Structure (MWIS). The basis for this analysis is ASCE 4-98 which has not been endorsed by the staff for performing SSI analysis. Describe how the analysis performed meets the guidance provided in SRP 3.7.1, SRP Acceptance Criteria 4.A.vii. for performing SSI analysis or provide justification for an alternative. Also for the analysis described, provide in the FSAR the following information:

- A figure depicting the soil-structure model used for the seismic analysis.
- The basis for the assumed soil properties and profile used to calculate the frequency independent impedance functions.
- · The method and formulas used to calculate the values of the soil springs under the foundation as well as the lateral soil springs that represent the embedment effect.
- · State whether the soil properties used in the analysis are strain dependent or simply the low strain values. If these are low strain values, justify their use and quantify the impact of not using strain dependent properties on the results of the analysis. If the soil properties are strain dependent, describe how the final soil properties are determined in the analysis.
- · For large values of Poisson's ratio, the dynamic stiffness and damping are frequency dependent. Provide justification for assuming that the impedance functions of the supporting foundation are frequency independent.
- · FSAR Section 3.7.2.4 on page 3.0-37 indicates that the control motion is applied at the bottom of the basemat. Confirm that this is intended to state that the control motion is applied at the base of the soil structure analysis model and revise the FSAR accordingly.
- · Provide a reconciliation of the final soil properties and the foundation input response spectra (FIRS) that are based on these properties with the seismic analysis results described in the FSAR.

03.07.02-7

In FSAR Section 3.7.1.1 (pg 3.0-29), it indicates that the Category I makeup water intake structure (MWIS) is founded below sea level. The description of the soil-structure-interaction (SSI) analysis for this structure does not describe how the ground water effects were included in the analysis. Describe how the SSI calculations included these effects, and if they did not, provide justification for not doing so and address the impact.

03.07.02-8

FSAR Section 3.7.2.3.2 states that the Ultimate Heat Sink Makeup Water Intake Structure is analyzed in GTSTRUDL. It further states that the walls "are not anticipated" to crack. Provide the basis for this statement including numerical results for typical concrete sections using the applicable wall design loads.

03.07.02-9

The reference for ASCE 4-98 in Section 3.7.2.4 on page 3.0-38 and elsewhere in the text is listed as ASCE, 1986. State which code revision is being used and correct the revision dates stated in the FSAR.

03.07.02-10

In FSAR Section 3.7.2.4 (Soil-Structure Interaction) on page 3.0-37, it states that in the analysis of the Ultimate Heat Sink (UHS) Makeup Water Intake Structure (MWIS) the impulsive forces of water acting on the walls of the intake structure are calculated using an acceleration of 0.5 g. What is the basis for this acceleration value? How is the impulsive weight calculated, and is the impulsive mass of water included in the soil-structure-interaction analysis of the structure? If it is not included, describe why it was not and provide the impact this will have on the natural frequencies of the structure, provided in Tables 3.7-7 thru 3.7-12, and on the building structural loads.

03.07.02-11

In FSAR Section 3.7.2.4 on page 3.0-37, it states that the convective frequencies associated with sloshing effects occur in the range where the scaled down European Utility Requirements (EUR) spectra do not exceed either the CCNPP Unit 3 spectra (zero period acceleration (ZPA) of 0.067 g) or Regulatory Guide 1.60 spectra scaled to a ZPA of 0.10 g. It goes on to say that due to the lower acceleration levels at the convective frequencies and the lower convective water mass, the convective forces are anticipated to be minimal with respect to the impulsive forces. If the foundation input response spectra (FIRS) for this structure are the scaled down EUR spectra, explain why this is an appropriate response spectra for this site when the low frequency input is less than that of the ground motion response spectra (GMRS) which has a ZPA of .067 g. What is the basis for the calculation of the convective water mass? Why was this mass not included in the analysis of the UHS MWIS? How will the difference in input response spectra be resolved in determining the proper convective design loads for the structure?

03.07.02-12

In FSAR Section 3.7.2.4 on page 3.0-38, it states that structure-to-structure interaction exists between the Ultimate Heat Sink (UHS) Makeup Water Intake Structure (MWIS) and the UHS Electrical Building (EB). It then states that as a consequence the design response spectra for the UHS EB is an envelope of half the European Utility Requirements (EUR) soft soil ground motion response spectra (zero period acceleration

(ZPA) of 0.15 g) and the In-Structure Response Spectra (ISRS) developed at the operating deck of the UHS MWIS (ZPA of .35 g). Provide the results of a structure-to-structure interaction analysis that supports this assumption.

03.07.02-13

In FSAR Section 3.7.2.6 (Three Components of Earthquake Motion) on page 3.0-40, it states for the Ultimate Heat Sink (UHS) Electrical Building that due to building symmetry cross-coupling is determined to be negligible. As no dynamic analysis was performed for this structure, what is the justification for this statement?

03.07.02-14

In FSAR Section 3.7.2.6 on page 3.0-40, it states that separate manual calculations, using the equivalent static analysis method are performed to determine the structural response of the site-specific Ultimate Heat Sink Electrical Building in each of the three directions. On page 3.0-35, it states that 0.5 g acceleration is used in all directions. Describe in the FSAR the manual calculations that were used, how the structural response was obtained, and provide examples of how the three components of earthquake motion are combined comparing the results to those of the 100-40-40 rule presented in RG 1.92, Revision 2, or justify an alternative. Also describe how the forces and moments are determined to design the individual elements (walls and slabs) of this structure, or justify an alternative.

03.07.02-15

In FSAR Section 3.7.2.6 on page 3.0-40, it states that for the Ultimate Heat Sink (UHS) Makeup Water Intake Structure (MWIS), three statistically independent time histories are applied for each of the six soil cases to determine accelerations at select locations. Describe how the accelerations obtained from this dynamic analysis are applied to the static model to obtain forces and moments for structural design and provide examples of how the three components of earthquake motion are combined and compare the results to those of the 100-40-40 rule presented in RG 1.92, Revision 2. The use of an equivalent static approach to determine forces and moments in the structure may not be conservative as dynamically computed forces and moments will retain the appropriate sign from the analysis and the static approach will not. How will this be addressed in the development of loads used in the design of the structure?

03.07.02-16

In FSAR Section 3.7.2.7 (Combination of Modal Responses) on page 3.0-40, it states that modal combination is not applicable to the time history analysis performed for the Ultimate Heat Sink (UHS) Makeup Water Intake Structure (MWIS). Since it is not clear from the text of FSAR Section 3.7.2, describe the method of time history analysis that was performed for this structure and, if time history integration was used, provide the time steps used in the analysis.

03.07.02-17

The interaction of non-seismic Category I structures with Seismic Category I systems is described in FSAR Section 3.7.2.8. In this section on page 3.0-41, it states that fire protection SSCs are categorized as either Seismic Category II-SSE, meaning the SSC must remain functional during and after a Safe Shutdown Earthquake (SSE), or Seismic Category II, meaning the SSC must remain intact after an SSE without deleterious interaction with a Seismic Category I or Seismic Category II-SSE SSC. In the U.S. EPR FSAR on page 3.7-95, it states that Seismic Category II is designed to the same criteria as Seismic Category I structures. In SRP 3.7.2, SRP Acceptance Criteria 8, which addresses the interaction of non-Category I structures with Category I SSCs, it states that when non-Category I structures are designed to prevent failure under SSE conditions; the margin of safety shall be equivalent to that of the Seismic Category I structure.

- · Describe how this margin of safety is achieved for the Seismic Category II-SSE and Seismic Category II portions of the fire protection system. Include in your response the seismic inputs, loading combinations, codes and acceptance criteria. What are the differences in the method of design for these two seismic categories?
- · Describe the basis and provide figures in the FSAR of the design response spectra used to analyze above ground seismic Category II and seismic Category II-SSE fire protection SSCs including the fire protection tanks.
- · What are the methods of analysis and acceptance criteria for both the buried and above ground portions of the fire protection system that are Seismic Category II-SSE that will ensure that these portions of the system will remain functional following an SSE event?
- · What are the modeling and analysis methods used for the fire protection tanks and to what extent do the fire protection tanks meet the acceptance criteria of SRP 3.7.3, SRP Acceptance Criteria 14.A. thru J.? When the tank analysis does not meet the acceptance criteria, provide the technical justification for not doing so.

03.07.02-18

In FSAR Section 3.7.2.8 on page 3.0-42, it states the U.S.EPR FSAR Section 3.7.2.8 addresses the interaction of certain Non-Seismic Category I structures with Seismic Category I structures These structures are the Vent Stack, Nuclear Auxiliary Building (NAB), Access Building (AB), Turbine Building (TB), Radioactive Waste Processing Building (RWPB) and the Firewater Storage Tanks and Fire Protection Building.

- · The Fire Protection Tanks and Fire Protection Building are classified as Seismic Category II-SSE in the CCNPP Unit 3 FSAR. This is an exception to the U.S. EPR FSAR which classifies them as conventional seismic. Please revise this section of the CCNPP FSAR to identify and clarify this difference.

- · A seismic analysis was performed for the NAB in the U.S. EPR FSAR. Since this structure could potentially interact with Seismic Category I structures, the CCNPP FSAR needs to reconcile the U.S. EPR analysis with the site-specific soil properties and foundation input response spectra (FIRS) for the NAB. Also demonstrate in the FSAR that the displacement of this structure relative to the nuclear island common basemat structure is enveloped by the results of the U.S. EPR analysis.

03.07.02-19

In FSAR Section 3.7.2.8 on page 3.0-42 it states that the conventional seismic switchgear building, conventional seismic grids systems control building, the conventional seismic circulating water intake structure and the Seismic Category II retaining wall surrounding the CCNPP Unit 3 intake channel could potentially interact with Seismic Category I SSCs. For each of the above structures, describe in the FSAR how the seismic interaction acceptance criteria of SRP 3.7.2, SRP Acceptance Criteria 8 are met, or justify an alternative. If they are intended to meet criterion B, provide the technical basis for the determination that the collapse of the non-Category I structure is acceptable. For criterion C, confirm that the structure will be analyzed and designed to have a margin of safety equivalent to that of a Category I structure and state how this will be accomplished.

03.07.02-20

In FSAR Section 3.7.2.8 on page 3.0-42, it states that the existing non-seismic bulkhead could potentially interact with the Ultimate Heat Sink (UHS) Makeup Water Intake Structure and UHS Electrical Building. Identify and describe the methods used to determine that this structure will not have any unacceptable interaction with either of the Seismic Category I structures?

03.07.02-21

For FSAR Section 3.7.2.11 (Method Used to Account for Torsional Effects) covered on page 3.0-43, describe how the methods used meet SRP 3.7.2, SRP Acceptance Criteria 11. How are the seismic forces due to torsional effects calculated and how are they combined with the other seismic forces of the structure?

03.07.02-22

In FSAR Section 3.7.2.15 (Analysis Procedure for Damping) on page 3.0-44, for the Ultimate Heat Sink (UHS) Makeup Water Intake Structure, it states that calculated stiffness is lumped for the whole foundation and that subsequently the stiffness is distributed based on tributary area. What equations are used to calculate the stiffness for the whole foundation and how is this stiffness distributed to tributary areas?

03.07.02-23

At the end of FSAR Section 3.7.2.15, on page 3.0-44, there is a description of a comparison of an analysis result using ANSYS to solve the complex eigen-value solution of the non-classical damping formulation with an analysis result using GT STRUDL to solve the real eigen-value solution of the classical damping formulation in which the off-diagonal terms of the damping matrix are neglected. It is not clear from the discussion which of the damping methods was used in the seismic analysis of the Ultimate Heat Sink (UHS) Makeup Water Intake Structure (MWIS). In addition, no comparison of the results using the two methods cited has been provided. Provide the method used to account for damping in the seismic analysis of the UHS MWIS and provide in the FSAR the results of the study comparing the non-classical damping formulation with the classical damping formulation.

03.07.02-24

U.S. EPR COL Information Item 3.7-1 states that a COL applicant that references the U.S. EPR design certification will confirm that the site-specific seismic response is within the parameters of Section 3.7 of the U.S. EPR standard design. In its response, the applicant has not addressed, the nuclear island common basemat structures, seismic Category II structures, the Nuclear Auxiliary Building and the Radioactive Waste Processing Building, and should do so to fully respond to this information item. The applicant is requested to provide a summary for each structure, either directly or by reference, which describes how the COL item is met.

03.07.02-25

FSAR Section 3.7.2.9 (Effect of Parameter Variation on Floor Response Spectra) on page 3.0-43 describes the effects of parameter variations on floor response spectra. It states that to account for uncertainties or variations in parameters, In-Structure Response Spectra (ISRS) for the Ultimate Heat Sink (UHS) Makeup Water Intake Structure (MWIS) are broadened +/- 15 percent in accordance with ASCE 4-98 and RG 1.122. Since ASCE 4-98 has not been accepted for use by the staff to develop ISRS and as it describes methods to account for uncertainties and parameter variations that are not included in RG 1.122, the applicant is requested to confirm that only the guidance provided in the RG is used for peak broadening or provide justification for not doing so.

03.07.02-26

SRP 3.7.2, SRP Acceptance Criteria 14 states that the determination of seismic overturning moments and sliding forces should include three components of input motion and conservative consideration of the simultaneous action of the vertical and horizontal seismic forces. How overturning moments and sliding forces are determined has not been provided in either FSAR Section 3.7.2, 3.8.5 or in Section 3E.4. The applicant is requested to provide this information in Section 3.7.2 and describe how this information is used in determining the overturning and sliding stability of the Ultimate Heat Sink (UHS) Makeup Water Intake Structure and UHS Electrical Building.