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UniStar
NUCLEAR ENERGY

10 CFR 50.4
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October 29, 2009

UN#09-444

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: UniStar Nuclear Energy, NRC Docket No. 52-016
Response Summary for Seismic Design and Analysis Requests for Additional Information for the Calvert Cliffs Nuclear Power Plant, Unit 3

The purpose of this letter is to provide current status and an updated response schedule for the remaining seismic design and analysis request for additional information (RAI) questions. These RAIs address Seismic Instrumentation, Seismic System Analysis, Seismic Design Parameters, and Seismic Subsystem Analysis as discussed in Section 3.7 of the Final Safety Analysis Report (FSAR), and Design of Category I Structures as discussed in FSAR Section 3.8, as submitted in Part 2 of the Calvert Cliffs Nuclear Power Plant (CCNPP) Unit 3 Combined License Application (COLA), Revision 6.

UniStar Nuclear Energy will provide a comprehensive update of FSAR Section 3.7 that addresses all of the FSAR Section 3.7 RAIs received to date by December 29, 2009. UniStar Nuclear Energy is also preparing a cross reference document that identifies where all of the FSAR Section 3.7 RAI questions are covered in the updated FSAR text. This cross reference will provide additional response information when necessary. This cross reference document will be provided concurrent with the FSAR 3.7 re-write or shortly thereafter.

The enclosure provides a Response Summary for RAIs encompassing all of the FSAR Sections 3.7 and 3.8 RAI questions.

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NRO

There are no regulatory commitments identified in this letter. This letter does not contain any proprietary or sensitive information.

If there are any questions regarding this transmittal, please contact me at (410) 470-4205, or Mr. Michael J. Yox at (410) 495-2436.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on October 29, 2009

Greg Gibson

Enclosure: Response Summary for Requests for Additional Information, RAI No. 19, Seismic Instrumentation; RAI No. 25, Seismic Instrumentation; RAI No. 58, Seismic Design Parameters; RAI No. 63, Seismic Subsystem Analysis; RAI No. 65, Seismic System Analysis; RAI No. 112, Seismic Design Parameters; RAI No 113, Seismic System Analysis; RAI No. 139, Seismic System Analysis; RAI No. 144, Other Seismic Category I Structures; RAI No. 145, Foundations; RAI No. 158, Seismic Design Parameters; RAI No. 159, Seismic System Analysis; RAI No. 167, Seismic System Analysis; RAI No. 168, Seismic System Analysis; RAI No. 179, Seismic Design Parameters; RAI No. 180, Seismic System Analysis; and RAI No. 181, Seismic Subsystem Analysis, Calvert Cliffs Nuclear Power Plant Unit 3

cc: Surinder Arora, NRC Project Manager, U.S. EPR Projects Branch
Laura Quinn, NRC Environmental Project Manager, U.S. EPR COL Application
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U.S. NRC Region I Office

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Enclosure

Response Summary for Requests for Additional Information,

RAI No. 19, Seismic Instrumentation;
RAI No. 25, Seismic Instrumentation;
RAI No. 58, Seismic Design Parameters;
RAI No. 63, Seismic Subsystem Analysis;
RAI No. 65, Seismic System Analysis;
RAI No. 112, Seismic Design Parameters;
RAI No. 113, Seismic System Analysis;
RAI No. 139, Seismic System Analysis;
RAI No. 144, Other Seismic Category I Structures;
RAI No. 145, Foundations;
RAI No. 158, Seismic Design Parameters;
RAI No. 159, Seismic System Analysis;
RAI No. 167, Seismic System Analysis;
RAI No. 168, Seismic System Analysis;
RAI No. 179, Seismic Design Parameters;
RAI No. 180, Seismic System Analysis; and
RAI No. 181, Seismic Subsystem Analysis
Calvert Cliffs Nuclear Power Plant Unit 3

Response Summary for Requests for Additional Information

RAI 19 Question	Description of RAI Item	Response Letter or Scheduled Response Date
03.07.04-1	In order to determine whether plant shutdown is required after an earthquake, Regulatory Position 4.1.1 of Regulatory Guide 1.166 states that "[t]he OBE [operating basis earthquake ground motion] response spectrum check is performed using the lower of: 1. The spectrum used in the certified standard design, or 2. A spectrum other than (1) used in the design of any Seismic Category I structure." Section 3.7.4.4 of the U.S. EPR FSAR states that "the application of OBE Exceedance Criteria is based on the following: "i. For the certified design portion of the plant, the OBE ground motion is one-third of the certified seismic design response spectra (CSDRS). "ii. For the safety-related noncertified design portion of the plant, the OBE ground motion is one-third of the site-specific SSE design motion response spectra, as described in Section 3.7.1. "iii. The threshold response spectrum ordinate criterion to be used in conjunction with RG 1.166 is the lowest of (i) and (ii)." Section 3.7.1.1.1 of the applicant's FSAR states that "[t]he horizontal SSE [safe-shutdown earthquake] ground motion is defined as the envelope of the GMRS [Ground Motion Response Spectra] and the set of CSDRS [Certified Seismic Design Response Spectra] curves anchored at 0.1 g peak ground acceleration. The vertical SSE spectrum is defined as the vertical GMRS." In addition, the applicant's FSAR, in Section 3.7.1.1.1, describes the design response spectra of several site-specific Category I structures (including the Ultimate Heat Sink Makeup Water Intake Structure), which differ from the SSE. The NRC staff requests the applicant to specify the OBE which would be used to determine whether shutdown would be required following a seismic event.	Response submitted See UniStar Nuclear Energy letter UN#09-372, dated September 15, 2009

Response Summary for Requests for Additional Information

RAI 25 **Question**	**Description of RAI Item**	**Response Letter or Scheduled Response Date**
03.07.04-2	Regulatory Guide (RG) 1.12 states that "free-field sensors should be located and installed so that they record the motion of the ground surface and so that the effects associated with surface features, buildings, and components on the recorded ground motion will be insignificant." In the applicant's FSAR, section 3.7.4.2.1, the applicant states that "[t]he free-field acceleration sensor is located on the base mat of the Fire Protection Building . . . . This location is sufficiently distant from nearby structures that they have no significant influence on the recorded free-field seismic motion." According to the applicant's FSAR, Figure 1.2-1, the Fire Protection building is adjacent to two Fire Protection Storage Tanks. The NRC staff is concerned that these storage tanks may be potential sources of seismic noise, and requests the applicant to provide justification to show that the effects associated with these storage tanks are insignificant.	Response submitted See UniStar Nuclear Energy letter UN#09-102, dated January 30, 2009
03.07.04-3	Regulatory Guide (RG) 1.12 states that "free-field sensors should be located and installed so that they record the motion of the ground surface and so that the effects associated with surface features, buildings, and components on the recorded ground motion will be insignificant." In the applicant's FSAR, section 3.7.4.2.1, the applicant states that "[t]he free-field acceleration sensor is located on the base mat of the Fire Protection Building . . . . This location is sufficiently distant from nearby structures that they have no significant influence on the recorded free-field seismic motion. . . . In addition, the plan dimensions of the Fire Protection Building are small enough that its base mat will not have a significant filtering effect on the free-field motion." According to the applicant's FSAR, Figure 1.2-1, the plan dimensions of the Fire Protection Building are approximately 40 ft. by 20 ft. The NRC staff requests the applicants to provide additional information to justify their assumption that seismic records obtained in the Fire Protection Building will adequately reflect "free-field" conditions. This information should also include a discussion of the embedment depth of the foundation, and a description of how the acceleration sensor will be installed within the Fire Protection Building.	Response submitted See UniStar Nuclear Energy letter UN#09-102, dated January 30, 2009

Response Summary for Requests for Additional Information

RAI Set 58 Question	Description of RAI Item	Response Letter or Scheduled Response Date
03.07.01-1	Justify assumptions of rigid basemat in SSI analysis of Nuclear Island including lower bound soil properties (where shear wave velocity is less than 1000 fps)	Response submitted See UniStar Nuclear Energy letter UN#09-388, dated September 15, 2009
	Identify impact on the SSI analysis results and on the design of the foundation mat and supported superstructure.	Response submitted See UniStar Nuclear Energy letter UN#09-388, dated September 15, 2009
03.07.01-2	Provide a figure in the FSAR depicting the soil-structure-interaction (SSI) model for the nuclear island (NI) common basemat structure including the model of the supporting subgrade. In addition, provide the following information: State whether or not embedment effects were considered in this analysis and, if not, what is the justification for not including them and what impact could this have on the analysis results? Describe the properties of the structural backfill and how the fill was modeled in the SSI analysis. As the groundwater table is close to the bottom of the basemat, how are groundwater effects treated in the SSI confirmatory analysis? Describe the computer codes used to analyze the site-specific SSI of the NI common basemat structure including a description of the code, extent of application in the analysis, and basis for computer code validation. Provide similar information for the codes used in the development of foundation input response spectra for each of the seismic Category I structures, as well as for the codes used in the seismic analysis of other SSCs covered in FSAR Sections 3.7.1, 3.7.2, and 3.7.3.	Response submitted See UniStar Nuclear Energy letter UN#09-320, dated July 15, 2009

Response Summary for Requests for Additional Information

RAI Set 58 Question	Description of RAI Item	Response Letter or Scheduled Response Date
03.07.01-3	For EPGB and ESWB, provide methodology to calculate FIRS at grade elevation computed from the GMRS which were determined at an applicable elevation 41 ft below grade.	Response submitted See UniStar Nuclear Energy letter UN#09-364, dated August 27, 2009
	Describe computer codes, soil column model, and the basis for the shear wave velocity of the structural backfill that supports both the EPGB and ESWB and the impact of this backfill on the development of the FIRS.	December 29, 2009
	Provide in the FSAR the spectra at the foundation level of each structure meeting Appendix S requirements.	December 29, 2009
	Provide in the FSAR a comparison of the FIRS at the foundation level of each structure meeting the requirements of Appendix S to the CSDRS provided in the U.S. EPR FSAR.	December 29, 2009
	Provide the basis for not performing confirmatory analysis for the EPGB and ESWB similar to that for NI.	Response submitted See UniStar Nuclear Energy letter UN#09-329, dated July 29, 2009
03.07.01-4	In FSAR Section 3.7.1.1.1, on page 3.0-32, it discusses the design response spectrum used to analyze the Ultimate Heat Sink (UHS) Makeup Water Intake Structure. The spectral comparison between the European Utility Requirements (EUR) soft soil spectrum scaled to 0.15 g, the RG 1.60 spectrum scaled to 0.1 g, and the ground motion response spectra (GMRS) shown in Fig. 3.7-38 indicates that the RG 1.60 spectrum and GMRS exceed the EUR spectrum at frequencies below 0.7 and 0.4, respectively. What is the corresponding comparison of displacements and velocities for these spectrum motions, and if the EUR displacements are exceeded, how will this be addressed in the design of piping and other appurtenances connected to these buildings including the design of buried utilities?	Response submitted See UniStar Nuclear Energy letter UN#09-320, dated July 15, 2009

Response Summary for Requests for Additional Information

RAI Set 58 Question	Description of RAI Item	Response Letter or Scheduled Response Date
03.07.01-5	For Ultimate Heat Sink Electrical Building, provide and include in the FSAR the horizontal and vertical spectra depicting design spectra and applicable envelope.	Response submitted See UniStar Nuclear Energy letter UN#09-364, dated August 27, 2009
	Provide in the FSAR a reconciliation of the design response spectrum with the horizontal foundation input response spectra (FIRS) for this structure which meets the minimum requirements of 10 CFR Part 50, Appendix S.	December 29, 2009
	Include a description of how the FIRS are developed including the soil model, soil properties, backfill properties, computer programs and analysis assumptions.	December 29, 2009
03.07.01-6	Provide in the FSAR how the design response spectrum and assumed soil properties used in the analysis of the UHS MWIS will be reconciled with the FIRS that meets the requirements of Appendix S and the final soil properties determined from the site final geotechnical studies.	Response submitted See UniStar Nuclear Energy letter UN#09-371, dated September 14, 2009
	Include in the FSAR a comparison of the FIRS with the design response spectra used in the analysis.	December 29, 2009
	Include a description of how the FIRS are developed including the soil model, soil properties, computer programs, and analysis assumptions.	December 29, 2009
03.07.01-7	Provide in the FSAR a discussion of the site-specific spectra that were considered for buried utilities.	December 29, 2009
	Provide justification for the use of the EUR soft soil spectrum including possible displacement and velocity differences that may exist with the use of this spectrum as opposed to using a site specific spectrum.	December 29, 2009
	Provide a comparison of the EUR soft soil spectrum with appropriate site specific spectra that are applicable to buried utilities.	December 29, 2009

Response Summary for Requests for Additional Information

RAI Set 58 Question	Description of RAI Item	Response Letter or Scheduled Response Date
03.07.01-8	In FSAR Section 3.7.1.2 (Percentage of Critical Damping Values) provide in the FSAR the structural damping values to be used in the analysis of site-specific Seismic Category I, Seismic Category II-SSE, and Seismic Category II structures and provide the justification for the values selected.	Response submitted See UniStar Nuclear Energy letter UN#09-228, dated May 1, 2009
03.07.01-9	FSAR Section 3.7.1.1.1, page 3.0-32 characterizes the geotechnical data as preliminary. In general, noted throughout FSAR Section 3.7 there are issues that are to be resolved in the final detailed design. It is not clear how the site-specific structures will meet the requirements of GDC 2. Provide a table that lists the items to be resolved in the final detailed design, how the items will be closed, and how these are to be incorporated into the final version of the FSAR.	Response submitted See UniStar Nuclear Energy letter UN#09-291, dated June 12, 2009
03.07.01-10	State explicitly or by reference design ground motion time histories for Nuclear Island, EPGB and ESWB structures.	Response submitted See UniStar Nuclear Energy letter UN#09-388, dated September 15, 2009
	What are the site specific design ground motions and their bases that apply to these structures? Provide this information in Section 3.7.1.1.2 of the FSAR.	December 29, 2009

Response Summary for Requests for Additional Information

RAI 63 **Question**	**Description of RAI Item**	**Response Letter or Scheduled Response Date**
03.07.03-1	FSAR Section 3.7.3.12 starting on page 3.0-45 describes the analysis for buried Seismic Category I piping, conduits and tunnels. For the analysis of these buried utilities, provide the following information: • Describe any computer codes used for the analysis and their application to the analysis and design of buried utilities. • Provide the soil properties used in the analysis and explain how differences in soil properties were accommodated in the analysis. • Provide the design codes and acceptance criteria for each category of buried utilities. • Describe the missile protection provided for safety-related buried utilities. • Describe how ground water effects were considered in the analysis. • For utility runs that are both above and below ground, describe how above ground inertial effects were combined with below ground seismic wave effects. • Describe how the wave velocities were determined for calculating the maximum axial strain. • Provide the basis for determining the maximum friction force per unit length of pipe. • Describe how the building anchor point displacements were determined and how these were combined with seismic wave effects and soil loads.	Response submitted See UniStar Nuclear Energy letter UN#09-320 dated July 15, 2009

Response Summary for Requests for Additional Information

RAI Set 65 Question	Description of RAI Item	Response Letter or Scheduled Response Date
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?	Response submitted See UniStar Nuclear Energy letter UN#09-228, dated May 1, 2009
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.	Response submitted See UniStar Nuclear Energy letter UN#09-291, dated June 12, 2009
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?	Response submitted See UniStar Nuclear Energy letter UN#09-291, dated June 12, 2009.
03.07.02-4	Provide results of SSI analysis for Ultimate Heat Sink Electrical Building that meet the acceptance criteria 4.A.vii of SRP 3.7.1 and acceptance criteria 4 of SRP 3.7.2 using subgrade model of final soil and backfill properties or justify alternative. Include SSSI effects from UHS MWIS. Reconcile with the results of assumed seismic response and ISRS.	December 29, 2009

Response Summary for Requests for Additional Information

RAI Set 65 Question	Description of RAI Item	Response Letter or Scheduled Response Date
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/ft2) 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.	Response submitted See UniStar Nuclear Energy letter UN#09-291, dated June 12, 2009.
03.07.02-6	Describe how the SSI analysis performed for Ultimate Heat Sink Makeup Water Intake Structure (UHS MWIS) meets the acceptance criteria and 4.A.vii of SRP 3.7.1 or justify alternative. Provide a figure depicting the soil-structure model used for the seismic analysis.	December 29, 2009
	Provide the basis for the assumed soil properties and profile used to calculate the frequency independent impedance functions.	Response submitted See UniStar Nuclear Energy letter UN#09-339, dated August 13, 2009

Response Summary for Requests for Additional Information

RAI Set 65 Question	Description of RAI Item	Response Letter or Scheduled Response Date
03.07.02-6 (continued)	Provide 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 effects.	Response submitted See UniStar Nuclear Energy letter UN#09-339, dated August 13, 2009
	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.	Response submitted See UniStar Nuclear Energy letter UN#09-339, dated August 13, 2009
	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.	Response submitted See UniStar Nuclear Energy letter UN#09-339, dated August 13, 2009
	Confirm that the control motion is applied at the base of the soil structure analysis model.	Response submitted See UniStar Nuclear Energy letter UN#09-339, dated August 13, 2009
	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.	December 29, 2009
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.	Response submitted See UniStar Nuclear Energy letter UN#09-291, dated June 12, 2009

Response Summary for Requests for Additional Information

RAI Set 65 Question	Description of RAI Item	Response Letter or Scheduled Response Date
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.	Response submitted See UniStar Nuclear Energy letter UN#09-291, dated June 12, 2009.
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.	Response submitted See UniStar Nuclear Energy letter UN#09-126, dated March 19, 2009
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.	Response submitted See UniStar Nuclear Energy letter UN#09-228, dated May 1, 2009
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?	Response submitted See UniStar Nuclear Energy letter UN#09-291, dated June 12, 2009
03.07.02-12	Provide results of a structure-to-structure interaction analysis between UHS MWIS and EB.	December 29, 2009

Response Summary for Requests for Additional Information

RAI Set 65 Question	Description of RAI Item	Response Letter or Scheduled Response Date
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?	Response submitted See UniStar Nuclear Energy letter UN#09-291, dated June 12, 2009
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.	Response submitted See UniStar Nuclear Energy letter UN#09-228, dated May 1, 2009
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?	Response submitted See See UniStar Nuclear Energy letter UN#09-320, dated July 15, 2009
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.	Response submitted See UniStar Nuclear Energy letter UN#09-126, dated March 19, 2009

Response Summary for Requests for Additional Information

RAI Set 65 Question	Description of RAI Item	Response Letter or Scheduled Response Date
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.	December 29, 2009

Response Summary for Requests for Additional Information

RAI Set 65 Question	Description of RAI Item	Response Letter or Scheduled Response Date
03.07.02-18	Clarify the seismic classification of fire protection tank and building.	Response submitted See UniStar Nuclear Energy letter UN#09-329, dated July 29, 2009
	Reconcile the U.S. EPR seismic analysis for NAB with the site-specific soil properties and foundation input response spectra (FIRS)	Response submitted See UniStar Nuclear Energy letter UN#09-388, dated September 15, 2009
	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.	Response submitted See UniStar Nuclear Energy letter UN#09-388, dated September 15, 2009
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.	December 29, 2009
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?	Response submitted See UniStar Nuclear Energy letter UN#09-291, dated June 12, 2009

Response Summary for Requests for Additional Information

RAI Set 65 Question	Description of RAI Item	Response Letter or Scheduled Response Date
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?	Response submitted See UniStar Nuclear Energy letter UN#09-228, dated May 1, 2009
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?	Response submitted See UniStar Nuclear Energy letter UN#09-126, dated March 19, 2009
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.	Response submitted See UniStar Nuclear Energy letter UN#09-291, dated June 12, 2009
03.07.02-24	Per COLA item 3.7-1, address that the seismic response of the nuclear island common base mat structures, seismic Category II structures, the Nuclear Auxiliary Building and the Radioactive Waste Processing Building is within the parameters of Section 3.7 of U.S. EPR FSAR.	Response submitted See UniStar Nuclear Energy letter UN#09-388, dated September 15, 2009
	Provide a summary for each structure, either directly or by reference, which describes how the COL item is met.	Response submitted See See UniStar Nuclear Energy letter UN#09-388, dated September 15, 2009

Response Summary for Requests for Additional Information

RAI Set 65 **Question**	**Description of RAI Item**	**Response Letter or Scheduled Response Date**
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.	Response submitted See UniStar Nuclear Energy letter UN#09-228, dated May 1, 2009
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.	Response submitted See UniStar Nuclear Energy letter UN#09-291, dated June 12, 2009

Response Summary for Requests for Additional Information

RAI Set 112 Question	Description of RAI Item	Response Letter or Scheduled Response Date
03.07.01-11	Provide a definition of site SSE and explain how it meets regulation requirements.	Response submitted See UniStar Nuclear Energy letter UN#09-388, dated September 15, 2009
	Consistent with the site SSE, provide the FIRS in the free field at the foundation level of each structure meeting the requirements of Appendix S, and describe how each is determined.	NI Response submitted See UniStar Nuclear Energy letter UN#09-388, dated September 15, 2009 for NI -------------------------- EPGB, ESWB December 29, 2009
	For the U.S. EPR Certified Design structures, provide a comparison of the results of the site seismic analyses using the FIRS input motion defined at the foundation level of each structure, with the analyses results documented in the U.S. EPR FSAR.	NI Response submitted See UniStar Nuclear Energy letter UN#09-388, dated September 15, 2009 -------------------------- EPGB, ESWB December 29 2009
	For the EPGS and ESWS, describe how the effect of structure-soil-structure interaction has been accounted for in the analysis of these buildings.	December 29, 2009

Response Summary for Requests for Additional Information

RAI Set 113 Question	Description of RAI Item	Response Letter or Scheduled Response Date
03.07.02-27	Please clarify how locations are selected within the Ultimate Heat Sink (UHS) Make-up Water Intake Structure (MWIS) floors, or within the UHS Electrical Building (EB) for the development of in-structure response spectra (ISRS) which are required for the qualification of equipment, components, and piping. In addition, it was stated during the structural audit that the ISRS developed as part of the U.S.EPR certified design would be used to qualify piping systems located within EPR standard design structures for Calvert Cliffs. COL Information Item 3.9-10 of the U.S. EPR FSAR states that pipe stress and support analysis will be performed by a COL applicant that references the U.S. EPR design certification. Please clarify the source of the input structure response spectra for this analysis. In addition to providing information on how locations within the UHS MWIS and UHS EB are selected for the generation of ISRS, please provide additional information confirming that the Certified Design ISRS documented in the U.S. EPR FSAR are used for the qualification of piping and pipe supports within the buildings of the U.S. EPR Certified Design. Please also address the same question for seismic Category I equipment and components.	Response submitted See UniStar Nuclear Energy letter UN#09-285, dated June 18, 2009

Response Summary for Requests for Additional Information

RAI Set 139 Question	Description of RAI Item	Response Letter or Scheduled Response Date
03.07.02-28	Follow-up 1 to Question 03.07.02-16 (RAI No. 65) The staff reviewed the response to RAI No. 65, Question 03.07.02-16 and the proposed change to the CCNPP Unit 3 FSAR (UniStar letter No. UN#09-126, dated March 19, 2009) for the Ultimate Heat Sink (UHS) Makeup Water Intake Structure, and found them acceptable based on the fact that the time history method used meets the guidance provided in Regulatory Guide (RG) 1.92. However, in the March 19 RAI response, the proposed revision to FSAR Section 3.7.2.7 states that the combination of modal responses does not apply to the UHS Electrical Building (EB). Instead, because of its small cross-section size and significant stiffness, the response of the UHS EB is based on the ground motion Zero Period Acceleration (ZPA). Please include in FSAR Section 3.7.2.7 additional technical justification for the assumed seismic response of the UHS EB, or include references to other FSAR Sections where such technical justification may have been provided.	Response submitted See UniStar Nuclear Energy letter UN#09-371, dated September 14, 2009
03.07.02-29	Follow-up 1 to Question 03.07-02-22 (RAI No. 65) The staff reviewed the response to RAI No. 65, Question 03.07.02-22 (UniStar letter No. UN#09-126, dated March 19, 2009) regarding the distribution of foundation stiffness to the basemat nodes, and concluded that the response included only a concept of how the springs are calculated for the tributary areas, and did not provide enough information as to how this was accomplished for the Ultimate Heat Sink (UHS) Makeup Water Intake Structure (MWIS). Provide a specific example showing how the methodology is applied to the UHS MWIS, including how the nodes are distributed in the foundation, and how the tributary area is determined for each node. Also, the March 19 RAI response stated that the stiffness values are amplified to account for embedment effects using factors given in Table C3.3-1 of American Society of Civil Engineers (ASCE) 4-98, "Seismic Analysis of Safety-Related Nuclear Structures," which is applicable to circular foundations. In the forthcoming response to RAI No. 65, Question 03.07.02-6, which will address issues regarding the Soil Structure Interaction (SSI) analysis of this structure, provide discussion of how embedment effects are determined, including justification for the use of Table C3.3.1 for the UHS MWIS, which has a rectangular foundation and is not embedded on all sides, and how the stiffness of the soil is calculated.	Response submitted See UniStar Nuclear Energy letter UN#09-371, dated September 14, 2009

Response Summary for Requests for Additional Information

RAI 144 Question	Description of RAI Item	Response Letter or Scheduled Response Date
03.08.04-1	CCNPP Unit 3 FSAR 3.8.4.1 provided information to address the second COL item but not the first. The applicant is requested to address the first COL item as well, or state in the FSAR (as was done for the other items) that "No departures or supplements" apply. Identify whether the structural features listed below (obtained from Figure 9.2-4) are considered as Seismic Category I, and if not, explain why. a. Existing Bulkhead b. New Sheet Pile Bulkhead c. New Channel Wall d. New Dredged Intake Channel Identify where all of these items are listed in FSAR Table 3.2-1. If these items are considered as Seismic Category I or II, identify where the design and analysis descriptions are provided. FSAR Figure 9.2-4 shows that the CW Intake Structure is quite close to the UHS Makeup Water Intake Structure. According to FSAR Table 3.2-1, the CW Intake Structure is classified as Seismic Category "CS" which means Conventional Seismic. Explain why this structure isn't classified as Seismic Category II since it appears that consideration of potential seismic interaction effects with the adjacent UHS Makeup Water Intake Structure is needed. The EPR FSAR and the CCNPP Unit 3 FSAR do not provide a description of the analysis and design results for the radwaste structures consisting of the Nuclear Auxiliary Building (NAB) and the Radioactive Waste Processing Building (RWPB). Explain where this information is located. Similarly, where is the description of the analysis and design results for Seismic Category II structures?	December 29, 2009
03.08.04-2	Section 3.8.4.3.1 identifies the Severe Environmental Loads for the Standard Project Hurricane (SPH) and Extreme Environmental Loads for the Probable Maximum Hurricane (PMH). Provide the location in the FSAR where all of the specific quantitative data for these loads are developed. Describe how the hurricane parameters given in this section are used to calculate the pressures to be applied to the structures. Since the information provided in Section 3.8.4.3.1 only appears to be fluid pressure loads, explain what quantitative wind load is used in conjunction with the SPH and PMH for the site-specific structures and identify where this information is presented in the FSAR. Also, explain what wind loading identified as W is used for the other load combinations included in U.S. EPR FSAR Section 3.8.4.3.2 that do not include PMH and SPH.	December 29, 2009

Response Summary for Requests for Additional Information

RAI 144 Question	Description of RAI Item	Response Letter or Scheduled Response Date
03.08.04-2 (continued)	Section 3.8.4.3.1 states that "the UHS Makeup Water Intake Structure (MWIS) and UHS Electrical Building are designed to withstand a peak positive overpressure (due to postulated explosions) of at least 1 psi without loss of function." Provide the basis for selection of this quantitative overpressure loading and explain how this criterion is used to demonstrate that an explosion on transportation routes (e.g., railway, highway, or navigable waterway) is not likely to have an adverse effect on plant operation or to prevent a safe shutdown of the plant. Confirm whether the evaluation for explosions is performed in accordance with NRC Regulatory Guide 1.91, Rev. 1, "Evaluations of Explosions Postulated to Occur on Transportation Routes near Nuclear Power Plants."	Response Submitted See UniStar Nuclear Energy letter UN#09-390, dated September 28, 2009
	For the site-specific structures, some information is provided for hurricane loads and pressure loads due to explosions. For the site-specific structures provide a description of all the other applicable loads or explain whether the identical description and quantitative data presented in the EPR FSAR are utilized for the CCNPP Unit 3 structures as well.	December 29, 2009
03.08.04-3	Calvert Cliffs Unit 3 FSAR Sections 3.8.4.3.1, 3.8.5.5.2, and 3.8.5.5.3 identify that the EPR certified design groundwater level is exceeded in 2 instances, based on site-specific groundwater analyses. From information provided in the License Renewal application for Units 1 and 2, the staff is aware that there is an underground drain system for Units 1 and 2, whose purpose is to maintain the groundwater at a level lower than would naturally occur. The staff requests the applicant to provide the following information for Unit 3: 1. Will this existing drain system be relied on to maintain the Unit 3 groundwater at a level lower than would naturally occur? If so, describe quantitatively the estimated effect on the level of the groundwater; describe the operating experience and current condition of the drain system; describe any repairs/upgrades that will be implemented; and describe the maintenance program that will be relied on to ensure continued functioning of the existing drain system throughout the Unit 3 operating life. 2. Will a new underground drain system be installed for Unit 3, to maintain the Unit 3 groundwater at a level lower than would naturally occur? If so, describe quantitatively the estimated effect on the level of the groundwater; and describe the maintenance program that will be relied on to ensure continued functioning of the new drain system throughout the Unit 3 operating life. 3. If either existing or new underground drain system(s) are relied upon, then explain why the system(s) are not identified as safety related systems.	December 29, 2009

Response Summary for Requests for Additional Information

RAI 144 Question	Description of RAI Item	Response Letter or Scheduled Response Date
03.08.04-4	Describe in detail, the waterproofing system that is used for all below grade concrete structures including the buried electrical duct banks and buried piping. The description should include the type of waterproofing membrane, material composition, thickness, type of joints for the membrane, and installation process. For the installation process, explain how it is assured that the waterproofing membrane will not be damaged in any manner. Sections 3.8.4.6.1 and 3.8.5.6.1 indicate that the waterproofing system in combination with improved concrete mix design will adequately protect the below-grade foundations (walls and basemats) and buried duct banks. Reference is also made to ACI 201.2R-01 (Guide to Durable Concrete) and ACI 515.1R-79 (Guide to the Use of Waterproofing, Damp Proofing, Protective, and Decorative Barrier Systems for Concrete) (ACI, 1985). Provide more details on the specific measures that are being specified to ensure that no degradation of the concrete foundations and buried duct banks will occur over the potential 60 year design life of the plant. This should include a quantitative discussion of the aggressiveness of the soil/groundwater, the specific concrete mix design to be specified, which recommendations of ACI 201.2R and ACI 515.1R will be specified, and the construction procedures that will be followed to ensure durable and dense concrete. Will rubber water stops be utilized at all construction joints that may occur up to grade elevation? Additional questions related to the use of improved concrete mix design are contained in RAI 3.8-11(Internal). Describe the operating experience for other below grade reinforced concrete structures that currently exist at the site which contain similar waterproofing membranes and are also exposed to comparable aggressive groundwater over long periods of time. Provide vendor test data or other operating experience which demonstrates that the type of waterproofing membrane to be used has adequate water-retarding properties under aggressive saturated soil conditions for long periods of time without degrading.	December 29, 2009

Response Summary for Requests for Additional Information

RAI 144 Question	Description of RAI Item	Response Letter or Scheduled Response Date
03.08.04-5	Calvert Cliffs Unit 3 FSAR Section 3.8.4.3.2 presents two additional load combinations for the UHS MWIS and UHS Electrical Building to address the hurricane loadings SPH and PMH. The Severe Environment SPH load combination appears to correspond to one of the Service Load Combinations presented in the EPR FSAR and ACI 349, when the wind load W is replaced by the hurricane load SPH. The Extreme Environment PMH appears to correspond to one of the Factored Load Combinations that are presented in the EPR FSAR and ACI 349, when the tornado load Wt is replaced by the hurricane load PMH. Address the following items related to these load combinations: 1. Explain why these two load combinations are only applicable to the UHS MWIS and UHS Electrical Building, and not to the other Seismic Category I structures as well. 2. The load combination $U = (0.75)(1.4D + 1.4F + 1.7L + 1.7H + 1.7W + 1.7T_o + 1.7R_o)$ appears in the EPR FSAR and ACI 349. Explain why a load combination corresponding to $U = (0.75)(1.4D + 1.4F + 1.7L + 1.7H + 1.7SPH$ (replacing W) $+ 1.7T_o + 1.7R_o)$ is not considered. 3. In order to be consistent with the Factored Load Combinations in the EPR FSAR and ACI 349 that contain Wt (tornado wind), explain why the load T_o was omitted in the "Extreme Environment PMH" load combination presented in Section 3.8.4.3.2 of the CCNPP Unit 3 FSAR.	Response Submitted See UniStar Nuclear Energy letter UN#09-390, dated September 28, 2009
03.08.04-6	Calvert Cliffs Unit 3 FSAR Section 3.8.4.4.5 provides a limited description of the analysis and design procedures for buried electrical duct banks and buried Essential Service Water pipes. The first COL Item listed in Section 3.8.4.4.5 indicates that a COL applicant will describe the design and analysis procedures for the conduit and buried pipe. Section 3.8.4.4.5 refers to Section 3.7.3 for the seismic design of buried duct banks and buried pipe. Information for the analysis and design procedures for all of the other loads is lacking. Therefore, provide a description of the analysis and design procedures for all of the other loads imposed on all the buried duct banks and buried pipes. This description should include the procedures for analysis and design under vertical earth loads, permanent surface loads, surface live loads, internal pressure (for pipe), fluid transients (if applicable), buoyancy, thermal expansion (if applicable), and frost effects (e.g., heave for pipes placed above the frost line). This description should also clearly state (1) whether the approach follows the analysis and design procedures presented in EPR FSAR Section 3.8.4.4.5, including the AREVA report entitled U.S. Piping Analysis and Pipe Support Design Topical Report (Reference 37 of the EPR FSAR) for buried piping and (2) the extent to which the procedures in EPR FSAR Section 3.8.4.4.5 and EPR Reference 37 are used for buried electrical duct banks. If a different approach is used for either buried duct banks or buried pipe, provide a detailed description of the approach used. Since the ground water table is probably above the buried electrical duct banks, explain what types of joints are used and what provisions are made to prevent water intrusion.	December 29, 2009

Response Summary for Requests for Additional Information

RAI 144 Question	Description of RAI Item	Response Letter or Scheduled Response Date
03.08.04-7	Calvert Cliffs Unit 3 FSAR Sections 3.8.4.4.6 (Other Seismic Category I Structures – Design Report) and 3.8.5.4.5 (Foundations - Design Report), state "No departures or supplements." Since there are three site-specific Seismic Category I structures defined in the FSAR, a Design Report is required for each of these structures. Therefore, provide a Design Report for the UHS Makeup Water Intake Structure, UHS Electrical Building, and the buried electrical duct banks and buried piping. The Design Reports should be prepared in accordance with the guideline described in NRC SRP 3.8.4, Appendix C. The Design Reports could be separate documents referenced by the FSAR or included as part of the FSAR as an Appendix. If Appendix 3E.4 is used for the purpose of the Design Reports, then it would need to be expanded to include the other information described in SRP 3.8.4, Appendix C.	December 29, 2009
03.08.04-8	1. For the UHS Makeup Water Intake Structure: a. For determining member forces in the structure for design purposes, provide more detailed information on the finite element model (FEM) and analysis than that described in Section 3.8.4, 3.8.5, and Appendix 3E. This should include information on: (1) soil representation used in the FEM (e.g., why pinned supports rather than soil springs), (2) how equivalent static loads are determined and then applied, (3) consideration of any local dynamic amplification for slabs and walls for seismic loading, (4) seismic load application (were loads applied simultaneously in three directions or applied separately? If separately, how are the responses combined? Due to non-symmetry conditions are seismic loads considered to act in plus and minus horizontal directions?), (5) representation of water within the structure and outside the structure. b. If the same model and approach described in FSAR Section 3.7.2 is used for representation of water, simply stating that it was done in accordance with ACI 350.3-06 and Army Corps of Engineers Manual EM-1110-2-6051 is not acceptable. These standards have not been previously reviewed and endorsed by the NRC and many elements of these standards are not applicable to nuclear power plants. Provide a description of how the water contained within the structure and outside the structure was considered in the model for developing member forces. c. Explain why the concrete shear keys below the basemat are not included in the FEM and why the sloped concrete walls on the North-West side of the UHS Makeup Water Intake Structure, shown on Figure 3E.4-2, are not also sloped in the FEM on Figure 3.8-5.	December 29, 2009

Response Summary for Requests for Additional Information

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Question</th><th>Description of RAI Item</th><th>Response Letter or Scheduled Response Date</th></tr>
<tr><td>03.08.04-8 (continued)</td><td>d. Provide a description of how all the loads were determined and applied to this model. This should include soil loads from dead weight, live load, surcharge, seismic, and soil passive pressure (if relied upon for stability evaluation); water pressure within and outside the building; and the hurricane induced loadings (pressure loadings from wind, storm surge and wave run-up).
e. Section 3.8.4.4.7 states that the "results from the GT STRUDL static analysis are used to design reinforced concrete shear walls and slabs according to provisions of ACI 349-01 (ACI, 2001a) (with supplemental guidance of Regulatory Guide 1.142 (NRC, 2001)), ACI 350-06 (ACI, 2006a) and ACI 350.3-06 (ACI, 2006b)." These ACI standards have not been previously reviewed and generically endorsed by the NRC and some elements of these standards are not applicable to nuclear power plants. Furthermore, the referenced Regulatory Guide 1.142 endorses ACI 349-97, not ACI 349-01. Therefore, specifically identify which sections/provisions in the three ACI referenced standards are used for design and describe how they compare to ACI 349-97, supplemented by Regulatory Guide 1.142. Note that this item, related to the appropriate ACI Standard(s), is also applicable to the UHS Electrical Building and to the buried electrical conduit duct banks.

2. For the UHS Electrical Building:

Section 3.8.4.4.7 states "Due to its relative simplicity and treatment as a soil inclusion, the design of the embedded UHS Electrical Building is performed by manual calculations. Reinforced concrete shear walls and slabs are designed in accordance with ACI 349-01 (ACI, 2001a) (with supplemental guidance of Regulatory Guide 1.142 (NRC, 2001)), ACI 350-06 (ACI, 2006a) and ACI 350.3-06 (ACI, 2006b)."

a. Explain what is meant by the phrase "soil inclusion."

b. Since Section 3.8.4.4 is supposed to present the design and analysis procedures, provide a description of how the manual calculations were performed for the various loads.

Address the same question raised under Item 1.e above, regarding the use of the three ACI standards, as it applies to the UHS Electrical Building.</td><td></td></tr>
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Response Summary for Requests for Additional Information

RAI 144 Question	Description of RAI Item	Response Letter or Scheduled Response Date
03.08.04-9	Calvert Cliffs Unit 3 FSAR Section 3.8.4.5 indicates that Section 3E.4 of Appendix 3E provides the details for the design of the basemat and typical wall for the UHS Makeup Water Intake Structure and the UHS Electrical Building. What is the technical basis for only selecting a typical wall for each structure? Explain why other concrete walls and slabs were not considered. Since the buried electrical duct banks and buried piping are also site-specific Seismic Category I structures, provide corresponding analysis and design information for critical sections of electrical duct banks and buried piping to represent this group of structures/components.	December 29, 2009
03.08.04-10	Calvert Cliffs Unit 3 FSAR Sections 3.8.4.6.1 and 3.8.5.6.1 refer to "the use of dense concrete with a low water cement ratio and improved concrete mixture design." According to Section 3.8.5.6.1, the compressive strength of the concrete for the foundation of the UHS Makeup Water Intake Structure and UHS Electrical Building is f'c = 5,000 psi. Provide information to address the following related items: 1. FSAR Sections 3.8.1 through 3.8.5 should identify any specific water cement ratios needed for the concrete mix for all Seismic Category I structures. The tables in Part 10, Section 2.4 (ITAAC) specify that the acceptance criterion is a maximum water cement ratio of 0.45 for all below grade concrete sections. Explain how this value was selected considering that usually a lower value of the water cement ratio, high compressive strength f'c, and large concrete cover over steel reinforcement are recommended for aggressive concrete surface conditions. As an example, ACI 350-01 recommends a water cement ratio of 0.40 and f'c = 5,000 psi for severe aggressive conditions. Also, clarify where in the FSAR the water cement ratios for Seismic Category II and II-SSE structures are specified. 2. In view of the aggressiveness of the soil conditions at CCNPP Unit 3, explain why the concrete compressive strength for most of the other Seismic Category I structures is less than 5,000 psi, which is the value used for the UHS Makeup Water Intake Structure and UHS Electrical Building. EPR FSAR Sections 3.8.4.6.1 and 3.8.5.6.1 indicate that 4,000 psi is specified for the foundations of Seismic Category I structures including the buried electrical duct banks. Also clarify where in the FSAR the compressive strength for the Seismic Category II and II-SSE structures is specified and address this issue for these structures as well.	December 29, 2009
03.08.04-11	U.S. EPR FSAR Sections 3.8.4.6.1 and 3.8.5.6.1 require a COL applicant that references the U.S. EPR design certification to evaluate the use of waterproofing membranes and epoxy coated rebar based on site-specific groundwater conditions. Describe the evaluation performed to determine whether epoxy coated rebar is needed in accordance with the referenced COL item.	December 29, 2009

Response Summary for Requests for Additional Information

RAI 144 Question	Description of RAI Item	Response Letter or Scheduled Response Date
03.08.04-12	The staff notes that the approach to limit the in-service inspection program to examination of exposed portions of below-grade concrete for signs of degradation when adjacent soil is excavated for any reason has been used and accepted at sites where the soil is not aggressive. Therefore, provide more details about this program and why is it considered adequate for below grade concrete foundations when subjected to aggressive soil conditions. The description should include a discussion of the scope, locations, schedule, parameters inspected, inspection methods, and acceptance criteria. Also provide the technical basis for assuming that the presence of a waterproof membrane is sufficient justification to follow an in-service inspection program normally used where the soil is not aggressive. Explain why the description in the FSAR refers to this as a periodic surveillance program while in a later discussion it indicates that the inspection is limited to examination of the surfaces when the adjacent soil is excavated for any reason. Provide the basis for why examination of exposed portions of below-grade concrete, when adjacent soil is excavated for any reason, is considered adequate rather than supplementing this requirement with a specified maximum time period. Explain why the FSAR does not state that such a program is also applicable to buried piping considering the aggressive soil conditions present at the site. For the waterproofing membrane beneath the foundation basemats and on the below grade walls, explain what type of inspection is to be specified to ensure that the waterproofing membrane has not been damaged or shows sign of degradation. Explain whether this inspection will be performed prior to the placement of soil backfill and during the periodic below-grade concrete degradation program. Explain whether the monitoring and maintenance of all Seismic Category I, II, and II-SSE structures, including the site-specific structures, will be performed in accordance with the requirements of 10 CFR 50.65, supplemented with the guidance in Regulatory Guide 1.160. For the UHS Makeup Water Intake Structure and CW Intake Structure explain whether the inspections will also be performed in accordance with NRC Regulatory Guide 1.127, Rev. 1, "Inspection of Water-Control Structures Associated with Nuclear Power Plants."	December 29, 2009

Response Summary for Requests for Additional Information

RAI 144 **Question**	**Description of RAI Item**	**Response Letter or Scheduled Response Date**
03.08.04-13	Calvert Cliffs Unit 3 FSAR Table 3E.4-1 presents the governing design load combinations for the UHS Makeup Water Intake Structure and UHS Electrical Building. Provide the following information related to the load definition and load combinations for these site-specific structures: a. Confirm that all of the load definitions for these site-specific structures are the same as those defined in the US EPR FSAR. b. Confirm that the methods utilized to determine the individual loads are consistent with the approach used in the US EPR FSAR and provide the magnitude of the live load and snow load for these site-specific structures. c. Explain why the load combinations in Table 3E.4-1 are considered to bound all of the other load combinations tabulated in the US EPR FSAR. d. Confirm that for every load combination, where any load reduces the effects of other loads, a load factor of zero is applied/considered for that load. e. For the stability evaluation load combinations 6 through 8, confirm that the effects due to the buoyancy force based on the maximum groundwater elevation and permanent surcharge loads (of adjacent structure(s)) are also considered.	December 29, 2009
03.08.04-14	Calvert Cliffs Unit 3 FSAR Section 3E.4 provides a description of the analysis and design of the UHS Makeup Water Intake Structure and UHS Electrical Building and some limited information about the results in terms of demand member forces for several critical sections (basemats and walls). For the most critical concrete members in the basemat and walls for the UHS Makeup Water Intake Structure and the UHS Electrical Building, provide the resulting member forces (membrane forces, shears, and moments) and comparisons to the section strengths, at least for the most critical governing load combination(s). This information would show the level of margin existing in the design. To facilitate the review, such information is usually presented in tables. Include in these tables the steel areas provided which correspond to the tabulated section strengths.	December 29, 2009

Response Summary for Request for Additional Information

RAI 145 Question	Description of RAI Item	Response Letter or Scheduled Response Date
03.08.05-1	Section 3.8.5.5 lists three bulleted items that participate in resisting sliding of the Emergency Power Generating Buildings (EPGBs) and the Essential Service Water Buildings (ESWBs). Explain why these items were listed only for the EPGBs and the ESWBs and not for the Nuclear Island (NI), or for Seismic Category II and II-SSE structures. Is the methodology used for the EPGBs and ESWBs different than that used for the NI? Explain why the list of three bulleted items does not include: (1) the resistance to sliding between the mud mat and waterproofing membrane, and (2) shear resistance within the soil. In order to achieve a coefficient of friction between the basemat and the mud mat of 0.7 will the concrete surface of the mud mat be required to be intentionally roughened in accordance with ACI 349-97 Section 11.7? If not, then demonstrate that the coefficient of friction between the basemat and the mud mat is equal to at least 0.7. Section 3.8.5.6.1 of the EPR FSAR indicates that the textured waterproofing membrane in the mud mat beneath the basemat will have a coefficient of friction of at least 0.7 and that this will be demonstrated by vendor testing. Where is this requirement stated in the Calvert Cliffs Unit 3 FSAR, and where are the vendor test data results presented? Section 3.8.5.5 of the Calvert Cliffs FSAR indicates that a coefficient of friction of 0.70 at the soil-soil interface beneath the EPGB and ESWB basemats cannot be achieved for the existing underlying soils. Therefore, during excavation of the soil at the site, additional soil material will be removed below the structures and structural backfill material will be placed. Section 3.8.5.5 further states that the coefficient of friction for the actual structural backfill material will be confirmed to meet the EPR FSAR requirement of 0.70 prior to placement of the structural backfill. Based on the information in Sections 3.8.5.5, 2.5.4.5.2 and Figures 2.5-130 through 2.5-134, there appears to be only 4 feet of structural backfill material that will be used under several of the structures (e.g., Reactor Containment Building, Safeguards Building, and Fuel Building). Explain how this depth is determined and why is this considered to be sufficient to preclude sliding/soil failure beneath the 4 foot structural backfill layer. Explain how it will be determined that the required coefficient of friction is met for the critical soil layer prior to placement of the structural backfill. What type of testing will be performed to determine the coefficient of friction at both the soil-soil and soil-concrete interfaces? When will this be performed? Also, the ITAAC in Application Part 10, Table 2.4-1, related to demonstrating the coefficient of friction for the various structures do not clearly state that the coefficient of friction of 0.70 will be demonstrated for the soil-soil and soil-concrete interfaces. The last paragraph of Section 3.8.5.5 states "Coefficients of friction at the soil-soil and soil-concrete interfaces are consistent with the values in Section 2.5.4.10.2, including Table 2.5-36." Explain the meaning of this sentence. Are there test data at this time which demonstrate that the coefficients of friction at the soil-soil and soil-concrete interfaces will be at least 0.70 as required? Why is Section 2.5.4.10.2 referenced since it addresses settlement with no discussion about coefficients of friction? Although Table 2.5-36 provides coefficients of sliding, the coefficients correspond to values far below the requirement of 0.70.	December 29, 2009

Response Summary for Request for Additional Information

RAI 145 Question	Description of RAI Item	Response Letter or Scheduled Response Date
03.08.05-2	Calvert Cliffs Unit 3 FSAR Section 3.8.5.5.1 states that the site-specific differential settlements of the NI foundation basemat are expected to be up to 1 inch in 50 feet. This exceeds the ½ inch in 50 feet considered in the standard design for the EPR. Some limited information was provided on the evaluation for the higher site-specific differential settlements; however, a more detailed description is needed. Provide the information requested below: 1. Identify and describe the specific structural model(s) used for the NI settlement analysis. 2. Explain how the site-specific differential settlement of 1 inch in 50 feet was applied to or considered in the model. How does the approach used relate to the statement in FSAR Section 3.8.5.5.1 which states that the "NI is subjected to structural eccentricities associated with a 7 inch basemat differential displacement representing a settlement value of 1 inch in 50 feet." 3. Explain whether the differential settlement values were included in both N-S and E-W directions simultaneously. 4. Was a purely linear displacement distribution assumed and applied to the model? 5. FSAR Section 3.8.5.5.1 states "The evaluation assumed no changes in the soil stiffness or increased flexure due to differential settlement consistent with the design analysis for the standard U.S. EPR Design." Explain why the evaluation did not include the potential increase in flexure due to differential settlement. If no increase in flexure is assumed then how can the effect of differential settlement on member forces be determined? What considerations were given to the effects of horizontal variations in soil properties that could lead to increased loadings (flexure and shear) on the structures?	December 29, 2009

Response Summary for Request for Additional Information

RAI 145 Question	Description of RAI Item	Response Letter or Scheduled Response Date
03.08.05-3	Calvert Cliffs Unit 3 FSAR Table 3.8-1 provides a summary table for evaluation of the UHS Makeup Water Intake Structure basemat for soil bearing pressure and stability evaluation (sliding and overturning). Provide the information requested below related to this table. 1. Define the various load combinations applicable to all of the entries in FSAR Table 3.8-1. How do these load combinations compare with those in NRC SRP 3.8.5? 2. For the site-specific UHS Makeup Water Intake Structure, provide a description and the results of the evaluation performed to demonstrate that the sliding, overturning, and flotation load combinations meet the acceptance criteria presented in NRC SRP 3.8.5. Include an explanation of how the demand (applied) SSE loading was developed for horizontal shear force and overturning moment, how the resisting forces for shear and overturning were determined, whether two sets of two-dimensional (2-D) calculations were performed (i.e., evaluations performed for NS and vertical, and then EW and vertical), whether upward vertical SSE force was assumed to reduce dead weight, and whether buoyancy was considered. 3. What was the governing coefficient of friction that was used in these stability evaluations (basemat to mud mat, mud mat to waterproofing membrane, mud mat to soil, or soil to soil (which could vary from 0.35 to 0.7 depending on whether the soil is existing soil from the site or structural backfill)). 4. Section 3.8.5.5 indicates that passive earth pressure and shear keys are utilized to transfer shear into the soil. To develop the passive earth pressure of the soil, the foundation would need to displace sufficiently to mobilize the soil passive resistance. Thus, the dynamic coefficient of friction would be more appropriate than the static coefficient of friction (which would have a smaller value). Explain whether a dynamic coefficient of friction is utilized and the magnitude of the governing dynamic coefficient of friction, or provide the technical basis for using the static coefficient of friction. 5. Provide a complete description and results of the stability evaluation for the UHS Electrical Building. Also, provide the soil bearing, settlement, and stability evaluations for the Seismic Category II and II-SSE site-specific structures.	December 29, 2009

Response Summary for Request for Additional Information

RAI 145 Question	Description of RAI Item	Response Letter or Scheduled Response Date
03.08.05-4	Calvert Cliffs Unit 3 FSAR Section 3.8.5.5.1 for the NI, 3.8.5.5.2 for the EPGBs, and Section 3.8.5.5.3 for the ESWBs acknowledge that there are some differences from the U.S. EPR standard plant in the soil bearing pressures, stresses in the base mat, and stability evaluations due to site-specific settlements and groundwater conditions. The extent of these differences is sometimes identified as negligible, within allowable values, or less than the corresponding section capacity. For each of these structures, quantify the specific differences from the U.S. EPR standard plant discussed in FSAR Sections 3.8.5.5.1, 3.8.5.5.2 and 3.8.5.5.3 rather than using qualitative terms. FSAR Section 3.8.5.5.2 for the EPGBs includes a statement that the "Factors of safety against sliding and overturning remain within allowable values" and Section 3.8.5.5.3 for the ESWBs has a similar statement which indicates that the effects are "negligible." No such discussion is given for the NI. Due to the increased site-specific settlements and higher groundwater elevations, and changes in soil bearing pressures, coefficient of frictions, and soil properties from the values specified in the EPR FSAR, provide a description and the results of the stability evaluations for the NI, EPGBs, and ESWBs. If the differences in the responses of the structures from the U.S. EPR standard plant are truly negligible eliminating the need for any of the specific stability evaluations, provide the technical justification including the quantitative data to support the conclusion. How has the potential effect of saturated soils from groundwater been considered in (1) the calculation of the subgrade modulus/soil spring stiffness used in the various analyses, (2) all seismic soil structure interaction (SSI) analyses for development of building loads and displacements, (3) calculations for soil bearing pressure demand, (4) stability evaluations (including coefficient of friction and passive pressure), and (5) design of the basemat foundation and walls?	December 29, 2009
03.08.05-5	For the UHS Makeup Water Intake Structure finite element model, Calvert Cliffs Unit 3 FSAR Section 3E.4.1 states that "Pinned supports are placed at all nodes of the base mat. During detailed engineering, and upon completion of the Final Geotechnical Site Investigation, it will be confirmed that the use of soil springs (in lieu of pinned supports) does not adversely affect the design results." This type of statement, which relies on future geotechnical site investigations, appears in several other locations in Section 3.8 of the FSAR (e.g., Sections 3.8.4.3, 3.8.4.4.5, 3.8.4.5, 3.8.5.5.4). Explain why such assumptions are necessary rather than utilizing bounding/conservative assumptions. When would these future geotechnical site investigations be performed?	December 29, 2009

Response Summary for Request for Additional Information

RAI 145 Question	Description of RAI Item	Response Letter or Scheduled Response Date
03.08.05-6	Calvert Cliffs Unit 3 FSAR Section 3E.4.1 – Base Mat of the UHS Makeup Water Intake Structure, under the heading Results of Critical Section Design, states that: "The mat dimensions used in the seismic analysis are based on the building periphery and not the extended base mat. Thus, the maximum difference between the base mat dimension in soil contact and the corresponding mat dimension used in the dynamic analysis is 8 ft (2.4 m), or approximately 15 percent of the overall mat dimension. During detailed engineering, it will be confirmed that the mat extensions do not adversely impact the accelerations and in-structure response spectra generated via the seismic analysis." This statement indicates that the analysis and design of the site-specific structures presented in the FSAR do not correspond to the actual configuration that will be constructed. Therefore, include in the FSAR the description and results of the analysis and design of the site-specific structures that match the actual configurations that will be constructed. If this is not done, then provide a sufficient technical basis supported by quantitative data to demonstrate the adequacy of the existing analysis and design.	December 29, 2009

Response Summary for Request for Additional Information

RAI 158 **Question**	**Description of RAI Item**	**Response Letter or Scheduled Response Date**
03.07.01-12	In its response the applicant stated that RG 1.61 Safe Shutdown Earthquake (SSE) damping values are used in the seismic analysis of site-specific Seismic Category I and Seismic Category II-SSE structures. This is generally acceptable for obtaining structural design loads. However, RG 1.61 states that for the generation of In-structure Response Spectra (ISRS), it is necessary to use the damping compatible structural response. The use of Operating Basis Earthquake (OBE) damping values is acceptable without further staff review. If higher than OBE values are used, RG 1.61 states that a technical justification should be provided on a case-by-case basis. Given that the Zero Period Acceleration (ZPA) of the Ground Motion Response Spectra (GMRS) for CCNPP Unit 3 is relatively low, the stress levels in the Ultimate Heat Sink (UHS) Make-up Water Intake Structure (MWIS) and UHS Electrical Building (EB) may not justify the use of SSE damping for the generation of ISRS. The applicant is requested to provide the structural damping values used for the generation of ISRS including those shown on Figures 3.7-39 through 3-41, and if SSE structural damping values were used provide a technical justification for doing so including a comparison of the stress levels in each structure to its code allowable stresses. The applicant also stated in the response that the damping values used for site-specific Seismic Category II structures correspond to response level 3 provided in Table 3-2 of ASCE Standard 43-05. For reinforced concrete structures, the damping value from the table is 10 percent which exceeds the values provided in RG 1.61. The applicant implies in its response that the seismic Category II structure is designed to Limit State A. This appears to be in conflict with CCNPP3 FSAR Section 3.7.2.3.3. EPR FSAR Section 3.7.2.3.3 stated that "the seismic analysis and design of Seismic Category II structures and members meets the requirements for Seismic Category I structures and members." CCNPP3 FSAR Section 3.7.2.3.3 did not identify any departure from the EPR FSAR other than providing a supplemental definition of Seismic Category II-SSE structures. Therefore, it is understood that the seismic analysis and design of site-specific Seismic Category II structures would also be according to the criteria provided in this Section of the EPR FSAR. Limit State A defines a structure that is just short of collapse with large permanent distortion, and does not meet analysis and design requirements of Seismic Category I structures. Therefore, the applicant is requested to explain the apparent discrepancy and confirm that the damping values used for Seismic Category II structures are consistent with those used for Seismic Category I structures, or provide justification for not doing so.	December 29, 2009

Response Summary for Request for Additional Information

RAI 159 Question	Description of RAI Item	Response Date
03.07.02-30	Follow-up Question to RAI No. 65, Question No. 03.07.02-10: The staff reviewed the applicant's response and requests the applicant to provide the following additional information in order for the staff to complete its review: 1. The applicant stated in its response that the entire water mass was conservatively considered in determining the impulsive load acting perpendicular to each wall for the equivalent static analysis. In the next sentence of the response, the applicant stated that the impulsive masses of contained water inside each chamber of the Ultimate Heat Sink (UHS) Makeup Water Intake Structure (MWIS) are calculated in accordance with Equation (9-1) of Section 9.2.1 in ACI 350.3-06. The applicant is requested to clarify why two different methods are referred for calculation of impulsive water mass, and how the above two methods were used. 2. The applicant stated in the response that "Westergaard Added Mass" methodology was used for calculating the impulsive water mass associated with the fore bay water on the exposed side of the intake structure. The staff notes that the above methodology has limitations on its application, and may not be appropriate for intake structures having complex geometry like the UHS MWIS. Further, the added mass representation of hydrodynamic pressure ignores the effects of water compressibility and water-foundation interaction which may be significant in certain instances. The applicant is, therefore, requested to provide justification why the Westergaard Added Mass methodology is considered adequate either by comparing the results with those from a more refined analysis, or providing results of any existing comparative analysis that may be considered applicable to this case, or by any other suitable means. 3. The applicant did not provide enough information in the response about how the impulsive water mass was included in the soil-structure-interaction analysis of the UHS MWIS in order for the staff to review if the guidance provided in the SRP 3.7.3 Acceptance Criteria 14 were met. The applicant is, therefore, requested to describe how the analysis of the UHS MWIS for hydrodynamic loads meets the guidance provided in SRP 3.7.3 Acceptance Criteria 14.A through 14.J, or provide justification for not doing so.	December 29, 2009

Response Summary for Request for Additional Information

RAI 159 **Question**	**Description of RAI Item**	**Response Date**
03.07.02-31	Follow-up Question to RAI No. 65, Question No. 03.07.02-14: The staff reviewed the applicant's response to question 03.07.02-14, and requests the applicant to provide the following additional information to complete its review: 1. In its response the applicant stated that 20 percent damping was used for soil driven modes. SRP 3.7.1, SAC-2 states that the maximum soil damping acceptable to the staff is 15 percent. In addition, no amplification factor was used in applying the maximum response from the input design spectra to the structure. However, as a soil-structure interaction (SSI) analysis using the SASSI code will be performed to confirm the design loads for the structure, this part of the response is acceptable pending the results of that analysis. Therefore, the applicant is requested to include in the FSAR a description of the proposed SASSI analysis along with a comparison of the preliminary design input used for design of the structure with the results obtained from the SASSI analysis. 2. At the end of the response the applicant stated that for the Ultimate Heat Sink (UHS) Electrical Building (EB), the design is governed by the probable maximum hurricane (PMH). According to the drawings the structure is almost completely buried. It is not readily apparent how the PMH controls the design. The applicant is requested to elaborate on how the PMH controls the design of the building.	December 29, 2009

Response Summary for Request for Additional Information

RAI 167 Question	Description of RAI Item	Response Date
03.07.02-32	Follow-up Question to RAI 65, Question 03.07.02-3 The staff reviewed the response to RAI No. 65, Question 03.07.02-3, submitted by the applicant in its letter UN#09-291 dated June 12, 2009. The staff noted that the applicant will quantify the building seismic relative displacements in a structure-soil-structure interaction (SSSI) analysis of the Ultimate Heat Sink (UHS) Makeup Water Intake Structure (MWIS) and the UHS Electrical Building (EB) after a geotechnical site investigation. Since this analysis will provide input for design of seismic category I buried commodities, please confirm that the SSSI analysis was performed and the results used for design of seismic category I buried commodities, and update the FSAR accordingly.	December 29, 2009
03.07.02-33	Follow-up Question to RAI 65, Question 03.07.02-5 The staff reviewed the response to RAI No. 65, Question 03.07.02-5, submitted by the applicant in its letter UN#09-291 dated June 12, 2009. The applicant stated in the response that GT STRUDL element type SBHQ6 was used in the finite element analysis of the Ultimate Heat Sink (UHS) Makeup Water Intake Structure (MWIS). The SBHQ6 element is a stretching and bending element appropriate for thin plates and shells. However, the foundation and some of the walls of this structure have low span-to-depth ratios such that out-of-plane shear deformations could be significant. Therefore, please provide a technical basis for using the SBHQ6 element for the static analysis of the UHS MWIS.	December 29, 2009
03.07.02-34	Follow-up Question to RAI 65, Question 03.07.02-7 The staff reviewed the response to RAI No. 65, Question 03.07.02-7, submitted by the applicant in its letter UN#09-291 dated June 12, 2009. The staff noted that the applicant's current analysis of the Ultimate Heat Sink (UHS) Makeup Water Intake Structure (MWIS) is based on preliminary soil data, and a soil-structure interaction (SSI) analysis that will include effects of ground water will be performed after further geological investigations. Therefore, please provide a detailed description of the SSI analysis of the UHS MWIS including the boundary conditions, modeling assumptions, how the dynamic input was determined, how ground water effects were accounted for, and revise the FSAR accordingly.	December 29, 2009

Response Summary for Request for Additional Information

RAI 167 Question	Description of RAI Item	Response Date
03.07.02-35	Follow-up Question to RAI 65, Question 03.07.02-8 In order for the staff to complete its review of response to RAI No. 65, Question 03.07.02-8, submitted by the applicant in its letter UN#09-291 dated June 12, 2009, please provide the following additional information: 1. Please explain the difference between the results which represent seismic and non-seismic loading combinations (north-south exterior wall) and results which represent the worst case loading condition (other structural elements) by providing the specific loading combinations used for each result, identifying the locations of the other structural elements and describing for the other structural elements how the worst case loading combination was determined. 2. FSAR Table 3E.4-2, "Demand Table for the UHS MWIS Side Walls," contains a load combination of (DL+LL+H), in which the M_{YY} moment is 418.65 kip-ft/ft. Please explain why the results for this loading combination are repeated in the bottom row of the same table. 3. Please explain why in note 1, Table 1 of Enclosure 3 of the response referred to above, the load combination of DL + LL+ H is divided by a factor of 1.5.	December 29, 2009
03.07.02-36	Follow-up Question to RAI 65, Question 03.07.02-11 In its response to RAI No. 65, Question 03.07.02-11 submitted via letter UN#09-291 dated June 12, 2009, the applicant provided reasonable assumptions regarding the preliminary design approach to account for the convective forces of sloshing water and its impact on the Ultimate Heat Sink (UHS) Makeup Water Intake Structure (MWIS). In FSAR Section 3.7.2.4 it states that during detailed design it will be confirmed that the convective forces of water sloshing have a negligible impact on both the overall design of the structure and component design. Therefore, please include in the FSAR a comparison of the results from a soil-structure interaction (SSI) analysis which includes the effect of the convective water mass with the preliminary design approach, and confirm that the convective forces on the structure are acceptable.	December 29, 2009

Response Summary for Request for Additional Information

RAI 167 Question	Description of RAI Item	Response Date
03.07.02-37	<u>Follow-up Question to RAI 65, Question 03.07.02-23</u> The staff reviewed the applicant's response to RAI No.65, Question 03.07.02-23 submitted via letter UN#09-291 dated June 12, 2009, and found the results of the comparison of modal damping ratios using composite modal damping formulation and complex eigensolution to be acceptable. The use of 7 percent structural damping for the generation of in-structure response spectra (ISRS) is justified if the stresses in the structure are near their code allowables as this implies concrete sections are cracked. The applicant in its response to Question 03.07.02-8 states that the use of uncracked section properties is justified for the seismic analysis of the Ultimate Heat Sink (UHS) Makeup Water Intake Structure (MWIS). This suggests that structural damping values used in seismic analysis to generate ISRS should be 4% not 7%. Therefore, please demonstrate the validity of the ISRS for the UHS MWIS currently shown in FSAR Figures 3.7-39 through 3.7-41 by comparing them with the ISRS obtained by soil-structure interaction (SSI) analysis using 4 percent structural damping per RG 1.61, and update the FSAR accordingly. Similarly, ISRS used for the UHS EB should be confirmed by the SSI analysis for that structure using 4 percent structural damping.	December 29, 2009
03.07.02-38	<u>Follow-up Question to RAI 65, Question 03.07.02-26</u> The staff reviewed the applicant's response to RAI No. 65, Question 03.07.02-26 submitted via letter UN#09-291 dated June 12, 2009. The approach used by the applicant to determine the sliding forces and overturning moments considered the three components of earthquake response, and is acceptable to the staff. However, in order for the staff to complete its evaluation the applicant needs to provide the following additional information: • The applicant stated that the stability of the Ultimate Heat Sink (UHS) Makeup Water Intake Structure (MWIS) for applicable loading is determined using the stability load combinations provided in SRP 3.8.5, Acceptance Criteria 3 (NRC, 2007a), which are listed as Load Combinations 6 to 9 in FSAR Table 3E.4-1. However the restoring moments apparently include (in addition to the self weight of the structure and the weight of the permanent equipment) the contained water during normal operation, 25% of the design live load and 75% of the design snow load. Please provide technical justification for including these additional loads in developing the restoring moment for the structure. • It is not clear if, in calculating the resistance to sliding, the applicant has reduced the deadweight of the structure by the effect of the structure's vertical acceleration. Please include this clarification in the FSAR. • Table 2.5-36 provides coefficients of friction for the native soils but does not provide a coefficient of friction for the structural backfill that will support the UHS MWIS foundation and the foundations of other seismic Category I structures. Please identify the coefficient of friction for structural backfill used in the sliding computation.	December 29, 2009

Response Summary for Request for Additional Information

RAI 168 Question	Description of RAI Item	Response Letter or Scheduled Response Date
03.07.02-39	Follow-up Question to RAI 113, Question 03.07.02-27 In its response to RAI No. 113, Question 03.07.02-27, sent via letter UN#09-285 dated June 18, 2009, the applicant provided the basis for selecting the locations for generation of in-structure response spectra (ISRS) for the Ultimate Heat Sink (UHS) Makeup Water Intake Structure (MWIS), which is based on two locations of safety-related pumps on the operating deck at elevation 11.5 ft. The applicant further stated in the response that as the locations of safety-related piping and components are finalized supplemental ISRS will be generated. The approach is reasonable and acceptable to the staff. However, current text in FSAR Section 3.7.2.5 does not reflect this. Therefore, please revise FSAR Section 3.7.2.5 to clarify that the ISRS provided in Figures 3.7-39 through 3.7-41 are applicable only to the pumps or other equipment at the two locations at elevation 11.5 ft (3.51M), and that supplemental ISRS at additional locations will be generated on an as-needed basis. The text in Section 3.7.2.4 states that the design response spectra for the UHS Electrical Building (EB) are envelope of half EUR soft soil ground motion response spectra with ZPA of 0.15g and ISRS developed for the operating deck of the UHS MWIS, and are used for structural design and equipment qualification purposes. However, in the response the applicant stated that SASSI analysis will be performed for development of ISRS for the EB. Therefore, please revise FSAR Section 3.7.2.4 to reflect that ISRS for the EB are developed from a SASSI analysis of the structure, and include in the FSAR the ISRS for appropriate slab elevations of the EB. The applicant, in response to a request to clarify the source of ISRS for the pipe stress and support analysis within the U.S.EPR Certified Design, has stated that the ISRS are generated from the soil cases of U.S. EPR FSAR Section 3.7.1. However the specific soil cases and design response spectra used to generate the ISRS have not been identified. Therefore, please provide this additional information, and include the ISRS applicable to the NI, ESWB and EPGB in FSAR Section 3.7.2.5.	December 29, 2009

Response Summary for Request for Additional Information

<table>
<tr><th>RAI 179

Question</th><th>Description of RAI Item</th><th>Response Letter or Scheduled Response Date</th></tr>
<tr><td>03.07.01-13</td><td>Follow-up Question to Partial Response to RAI 58, Question 03.07.01-3

The staff reviewed the partial response to RAI No. 58, Question 03.07.01-3 submitted by the applicant in its letter UN#09-329 dated July 29, 2009. The staff's assessment only addresses the response provided by the applicant regarding the seismic analysis of the Emergency Power Generating Building (EPGB) and the Essential Service Water Building (ESWB). The other issues addressed in the original question have future response dates. In response to the question as to why a confirmatory analysis was not performed for the EPGB and ESWB, the applicant states that a site-specific analysis based on CCNPP Unit 3 site-specific design SSE response spectrum and strain compatible soil properties, including the effects of structural fill and structure-soil-structure interaction due to the Nuclear Island (NI) will be performed for these structures. The applicant is requested to provide a description of the analysis and analysis results for the EPGB and ESWB in the CCNPP FSAR including comparisons with the results (structural accelerations and in-structure response spectra) of the analyses that served as the design basis for the U.S. EPR FSAR.</td><td>December 29, 2009</td></tr>
<tr><td>03.07.01-14</td><td>Follow-up Question to RAI No. 58, Question 03.07.01-2

As a follow-up to RAI No. 58, Question 03.07.01-2, the applicant is requested to provide the following additional information:

1. The applicant has stated that the soil-structure interaction (SSI) model used for confirmatory analysis of the NI common basemat structure is identical to the SSI model used for the US EPR FSAR (Figure 3.7.2-63 of the U.S. EPR FSAR). However, there are differences that should have been considered in the NI confirmatory analysis model for CCNPP Unit 3. These differences are:

Nodes used to determine structure-soil-structure interaction (SSSI) effects of the nuclear island (NI) on the response of the Emergency Power Generating Buildings (EPGB) and Essential Service Water Buildings (ESWB) should be located at the proper elevations of these structures and not at the same elevation as the NI foundation as was done in the U.S. EPR FSAR.

The NI is an embedded structure, not surface founded.

The subgrade layering at CCNPP is not the same as that used for the soft soil case for the U.S. EPR FSAR.

The applicant is requested to explain why the confirmatory analysis model for the CCNPP Unit 3 NI did not reflect the differences cited above and what impact these differences will have on the results of the analysis.</td><td>December 29, 2009</td></tr>
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Response Summary for Request for Additional Information

RAI 179 Question	Description of RAI Item	Response Letter or Scheduled Response Date
03.07.01-14 (continued)	2. The applicant has stated that a parametric analysis was performed to determine the effect of NI embedment on the seismic results for this structure. The applicant is requested to provide the details of the parametric analyses including the definition of input motion and how it was derived for the embedded model. The applicant should provide results from the parametric analyses and provide a comparison to results for the surface founded NI seismic model. 3. The applicant has stated that the NI common basemat structure confirmatory SSI analysis is based on undisturbed in-situ material. Discrete thin strata or localized areas of the foundation bearing soils may be encountered during construction that do not meet the COLA required soil properties. In the event substandard materials are encountered the applicant has stated they will be replaced with engineered structural fill that has characteristics comparable to the site soil properties of the undisturbed material considered in the analyses, or a site-specific validation will be performed. Unless the proposed construction methods will make use of excavation support systems considering vertical cuts with rigid vertical walls providing excavation support, it is anticipated that excavation will extend to some potentially significant area to the sides of the NI. Therefore, even if soft soils are not encountered below the foundation of the NI, fill materials will impact the SSI evaluation. If only top-down excavation methods with vertical excavation support are to be used, the CCNPP FSAR should so state. If backfill will be used to the side of the NI, the methods that will be used to assess the impact of fill on the SSI process need to be provided. If fill materials are to be used to the side of the NI, the potential impact of this fill on the seismic response of safety related structures adjacent to the NI, including potential two- and three-dimensional effects on the SSI, needs to be described. 4. In response to a question regarding how groundwater effects are treated in the SSI confirmatory analysis the applicant stated that for submerged soil layers, the water P-wave velocity (4800 fps) is used where the soil P-wave velocity is less than that of water. However, if the groundwater (GW) table is close to the foundation elevation, the soils above and below the GW elevation will be represented by different S-wave and P-wave parameters. Such a two-layer configuration was not included in the U.S. EPR site configuration profiles for the generic design. The applicant should provide an explanation of how this potential discontinuity in velocities impact the SSI evaluations and how they compare with those developed for the generic design. 5. The applicant has stated that two computer codes, SOILSIM and RVTSITE were used in the development of the FIRS for the Seismic Category I structures. The current NRC Interim Staff Guidance and NEI guidance document that summarize the processes to be used for transfer of probabilistic ground motions to different elevations in the soil column refer to the time-domain SHAKE code and not the RVTSITE apparently based on random vibration theory. The applicant should provide information on the appropriateness of using this model for site response analyses and compare its application to that of SHAKE.	

Response Summary for Request for Additional Information

RAI 179 Question	Description of RAI Item	Response Letter or Scheduled Response Date
03.07.01-14 (continued)	6. The Risk Engineering Code SOILSIM has embedded within it an assumed layer correlation model for the randomization of site soil columns from which the BE, UB and LB soil columns used in the SSI calculations are determined as well as the corresponding GMRS and FIRS spectra. The applicant should provide information on the adequacy of this correlation model for the soil conditions at the CCNPP site, provide plots of velocity versus depth for each of the randomized soil columns used to develop the GMRS and indicate whether or not the resulting site columns are appropriate for the geotechnical/geological site data available and whether this correlation model reduces the computed FIRS and GMRS spectra as compared to other correlation models that can be assumed to be appropriate.	

Response Summary for Request for Additional Information

RAI 180 Question	Description of RAI Item	Response Letter or Scheduled Response Date
03.07.02-40	**Follow-up Question to RAI No. 65, Question 03.07.02-15** Overall, the weighted average process described by the applicant in its response to RAI No. 65, Question 03.07.02-15 appears to provide a systematic method for taking the accelerations obtained from the dynamic analysis and applying them to the static model to obtain forces and moments for structural design. However, it is not clear when calculating the weighted average, if the actual sign at a particular mass point is considered in the summation. For example, it appears from the bubble plot for acceleration in the Y direction due to a Z direction earthquake that the structure is rocking about the X axis. Presumably this results in positive Y accelerations on one side of the slab and negative Y accelerations on the other side. Summing these could result in a small weighted average for the slab in the Y direction due to an earthquake in the Z direction. The applicant is requested to clarify if the absolute or signed acceleration values are used in the weighted average calculation. If the signed acceleration values are used, the applicant needs to address why this is acceptable as this could underestimate the actual slab bending forces due to the overturning effect of the earthquake. A similar situation can arise regarding accelerations in the X and Z directions when structure twists about the Y axis.	December 29, 2009
03.07.02-41	**Follow-up Question to Partial Response to RAI No. 65, Question 03.07.02-18** The staff reviewed the partial response to RAI No. 65, Question 03.07.02-18 submitted by the applicant in its letter UN#09-329 dated July 29, 2009. The staff's assessment only addresses the response regarding the seismic classification of the Fire Protection Building and Fire Protection Tanks. The other issues addressed in the original question have a future response date. In its response the applicant has provided a revision to the CCNPP FSAR which clarifies the change of seismic category for portions of the fire protection system that must remain functional from conventional seismic as stated in the U.S. EPR FSAR to Seismic Category II-SSE, and identified the fire protection systems under this category. In its response the applicant has also stated that certain portions of the fire protection system are only required to remain intact after a safe shutdown earthquake (SSE) without deleterious interaction with Seismic Category I or Seismic Category II-SSE components and classified them as Seismic Category II, but did not identify which systems fall under this category. The applicant is requested to identify and include in the FSAR the Seismic Category II portions of the fire protection structures, systems and components.	December 29, 2009

Response Summary for Request for Additional Information

RAI 181 Question	Description of RAI Item	Response Letter or Scheduled Response Date
03.07.03-2	**Follow-up Question to RAI No. 63, Question 03.07.03-1** The applicant stated in its response to RAI No. 63, Question 03.07.03-1 that if backfill material extends well below the buried commodity (more than several feet) and if its modulus degradation and damping characteristics are significantly different than the native soil properties in the surrounding area, then the backfill properties will be used to obtain the spectrum at the buried commodity elevation. The applicant also stated that most likely any such exercise will be shown to be unnecessary because the site specific safe shutdown earthquake (SSE) chosen for Calvert Cliffs will well exceed the spectrum obtained from site response analyses. The applicant is requested to describe the process used in the site response analyses and how a spectrum based on these analyses will be determined. In addition the applicant should define the site SSE and how it is derived. Regarding the selection of values for peak ground displacement (PGD) the applicant stated that the PGD value is determined directly from the constant displacement portion of the acceleration spectra. The applicant is requested to identify which acceleration spectrum is being used and why the PGD value will be conservative. For determining a value for peak ground velocity (PGV), the applicant stated that the greater of values based on: (i) Equation 5-10 in NCHRP Report No. 611 "Seismic Analysis and Design of Retaining Walls, Buried Structures, Slopes, and Embankments" (Transportation Research Board, 2008), and (ii) the empirical rule of 4 ft/sec PGV per 1.0g peak ground acceleration (PGA), is used to provide a conservative value. However, other empirical estimate values can also be used for such design in addition to the values mentioned in the response above. The applicant is requested to state why the ones identified in the response are conservative.	December 29, 2009