CCNPP3eRAIPEm Resource

From: Takacs, Michael
Sent: Monday, November 18, 2013 10:03 AM
To: CCNPP3eRAIPEm Resource
Cc: Arora, Surinder
Subject: FW: Response to Request for Additional Information for the Calvert Cliffs Nuclear Power Plant, Unit 3, RAI 396, Seismic System Analysis.
Attachments: RAI 396 7202 response CCNPP.pdf

From: Takacs, Michael
Sent: Tuesday, November 12, 2013 12:55 PM
To: Chakrabarti, Samir
Cc: CCNPP3eRAIPEm Resource; Xu, Jim; Arora, Surinder; Segala, John; McLellan, Judith; Miernicki, Michael
Subject: Response to Request for Additional Information for the Calvert Cliffs Nuclear Power Plant, Unit 3, RAI 396, Seismic System Analysis.

Samir,

UniStar's letter with ADAMs ML13309A808 dated November 1, 2013, provides a response to RAI 396-7202, question 03.07.02-76 & 77. The response also includes a markup of the proposed changes to the applicable sections of the COLA.

Please review the RAI response and the associated COLA changes and appropriately status the question in eRAI system.

The response can be accessed by link below:

Open ADAMS P8 Document(Response to Request for Additional Information for the Calvert Cliffs Nuclear Power Plant, Unit 3, RAI 396, Seismic System Analysis.)

Thanks,

Mike Takacs
Bell Bend Lead Project Manager, Licensing Branch 1
Office of New Reactors
U.S. Nuclear Regulatory Commission
(301) 415-7871

Hearing Identifier: CalvertCliffs_Unit3Col_RAI
Email Number: 340

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Subject: FW: Response to Request for Additional Information for the Calvert Cliffs Nuclear Power Plant, Unit 3, RAI 396, Seismic System Analysis.
Sent Date: 11/18/2013 10:03:07 AM
Received Date: 11/18/2013 10:04:03 AM
From: Takacs, Michael

Created By: Michael.Takacs@nrc.gov

Recipients:
"Arora, Surinder" <Surinder.Arora@nrc.gov>
Tracking Status: None
"CCNPP3eRAIPEm Resource" <CCNPP3eRAIPEm.Resource@nrc.gov>
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MESSAGE	1228	11/18/2013 10:04:03 AM
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Recipients Received:

Paul Infanger
Manager, Regulatory Affairs & Engineering

750 East Pratt Street, Suite 1400
Baltimore, Maryland 21202

UniStar
NUCLEAR ENERGY

10 CFR 50.4
10 CFR 52.79

November 1, 2013

UN#13-138

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

Subject: UniStar Nuclear Energy, NRC Docket No. 52-016
Response to Request for Additional Information for the Calvert Cliffs Nuclear Power Plant, Unit 3,
RAI 396, Seismic System Analysis

References:
1) Surinder Arora (NRC) to Paul Infanger (UniStar Nuclear Energy), "CCNPP3 - Final RAI 396 SEB2 7202," dated August 26, 2013

2) UniStar Nuclear Energy Letter UN#13-137, from Mark T. Finley to Document Control Desk, U.S. NRC, Response to Request for Additional Information for the Calvert Cliffs Nuclear Power Plant, Unit 3, RAI 396, Seismic System Analysis, dated October 25, 2013

3) UniStar Nuclear Energy Letter UN#13-031, from Mark T. Finley to Document Control Desk, U.S. NRC, Response to Request for Additional Information for the Calvert Cliffs Nuclear Power Plant, Unit 3, RAI 378, Seismic System Analysis, dated March 29, 2013

The purpose of this letter is to respond to the request for additional information (RAI) identified in the NRC e-mail correspondence to UniStar Nuclear Energy, dated August 26, 2013 (Reference 1). This RAI addresses Seismic System Analysis, as discussed in Section 3.7.2 of the Final Safety Analysis Report (FSAR), as submitted in Part 2 of the Calvert Cliffs Nuclear Power Plant (CCNPP) Unit 3 Combined License Application (COLA), Revision 9.

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NRO

Reference 2 indicated that a response to RAI 396 would be provided to the NRC by November 1, 2013. Enclosure 1 provides our response to RAI 396, Questions 03.07.02-76 and 03.07.02-77, and includes revised COLA content. Enclosure 2 provides the COLA impact from the response to RAI 396, Questions 03.07.02-76 and 03.07.02-77. Enclosure 2 includes a markup to FSAR Table 3.2-1. The FSAR Table 3.2-1 markups are shown on a version of FSAR Table 3.2-1 which reflects the COLA changes made in the response to RAI 378 Question 03.07.02-75 (Reference 3). A Licensing Basis Document Change Request has been initiated to incorporate these changes into a future revision of the COLA.

Enclosure 3 provides a table of changes to the CCNPP Unit 3 COLA associated with the RAI 396, Questions 03.07.02-76 and 03.07.02-77. As identified in the Enclosure 3 Table of Changes, this response modifies previously submitted RAI responses.

Our response does not include any new regulatory commitments. This letter and its enclosures do not contain any sensitive or proprietary information.

If there are any questions regarding this transmittal, please contact me at (410) 369-1987 or Mr. Mark Finley at (410) 369-1907.

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

Executed on November 1, 2013

Paul Infanger

Enclosures:

1) Response to NRC Request for Additional Information RAI 396, Questions 03.07.02-76 and 03.07.02-77, Seismic Design Parameters, Calvert Cliffs Nuclear Power Plant, Unit 3

2) Changes to CCNPP Unit 3 COLA Associated with the Response to RAI 396, Questions 03.07.02-76 and 03.07.02-77, Calvert Cliffs Nuclear Power Plant, Unit 3

3) Table of Changes to CCNPP Unit 3 COLA Associated with the Response to RAI 396, Questions 03.07.02-76 and 03.07.02-77, Calvert Cliffs Nuclear Power Plant, Unit 3

cc: Surinder Arora, NRC Project Manager, U.S. EPR Projects Branch
Tomeka Terry, NRC Environmental Project Manager, U.S. EPR COL Application
Laura Quinn-Willingham, NRC Environmental Project Manager, U.S. EPR COL Application
Amy Snyder, NRC Project Manager, U.S. EPR DC Application, (w/o enclosures)
Patricia Holahan, Acting Deputy Regional Administrator, NRC Region II, (w/o enclosures)
Silas Kennedy, U.S. NRC Resident Inspector, CCNPP, Units 1 and 2
David Lew, Deputy Regional Administrator, NRC Region I (w/o enclosures)

bcc: Antonio Fernandez, Regulatory Affairs & Engineering
Jon Kirkwood, Bell Bend Licensing
Robert Randall, Regulatory Affairs & Engineering

UN#13-138

Enclosure 1

Response to NRC Request for Additional Information
RAI 396, Questions 03.07.02-76 and 03.07.02-77,
Seismic Design Parameters,
Calvert Cliffs Nuclear Power Plant, Unit 3

RAI No. 396

03.07.02-76

Follow Up Question to RAI 304, Question 03.07.02-56

In RAI 304, Question 03.07.02-56, the staff had asked the applicant for additional details regarding analyses for the hydrodynamic effects of the water contained within the basins of the Common Basemat Intake Structure (CBIS).

In part 7 of its response the applicant provided information regarding the basis for the calculation of the sloshing effect of the enclosed water within the basins of the CBIS. To calculate the wave height, the applicant has used the equations of ACI 350.3-06 and a water height of 26.84 feet. This water depth was based on a maximum water level of 3.67 ft. above mean sea level. However, based on information in FSAR Section 2.4.5.2.2.1 the maximum water level is 4.4 ft. NGVD. As the normal mean sea level is at 0.64 ft. NGVD, the maximum water level becomes 3.76 ft. above mean seal level not 3.67 ft. This results in a maximum depth of water equal to 26.93 ft. The applicant states that the result of the sloshing is a calculated wave height of 0.95 ft. in the forebay and a remaining freeboard of 9.05 ft. According to Figure 2 of the response the height of the forebay wall is 32.50 ft. Subtracting a water height of 26.93 ft. and a calculated wave height of 0.95 ft. the remaining freeboard is 4.62 ft. not the 9.05 ft. reported in the response. The applicant is requested to address these discrepancies identified in its response.

In selecting the spectral response to be used in determining the wave height, the applicant stated that it used as input the site-specific Foundation Input Response Spectra (FIRS). However, the seismic analysis of the CBIS is based on the site SSE not the FIRS. In addition, the staff believes the basemat ISRS should be used to calculate the wave height and not the spectra in the free field. The applicant is requested to provide the technical basis for its response and why the CBIS foundation basemat ISRS was not used to determine the sloshing effect of enclosed water. In addition the applicant is requested to explain why the higher water level of 4.4 ft. NGVD 29 was not used as the basis for determining the impulsive and convective water masses for the CBIS analysis since this higher water level is based on an anticipated increase over time of the water level in the Chesapeake Bay as documented in FSAR Section 2.4.5.2.2.1.

TID 7024 provides equations that calculate the heights at which the impulsive and convective water masses are considered to act in order to determine the overturning effect of the water on a structure's basemat foundation. The heights thus determined are greater than the heights that are used to determine the hydrodynamic effects of the impulsive and convective water on the portions of the structure that are above the basemat. The applicant is requested to confirm how the overturning effect was addressed in the stability analysis of the CBIS and if it was not addressed, provide the technical justification for not doing so.

Response:

- Part 1 - Basis for the sloshing height calculation

  Inconsistencies in the RAI 304, Question 03.07.02-56[1] response are due to small round off differences. The antecedent water level without round off is El. 4.34 ft NGVD 29 which is equal to the summation of the initial rise or sea level anomaly of 1.1 ft, the 10% exceedance high tide (1.53 ft MSL + 0.64 ft = 2.17 ft NGVD 29), and the long term rise (1.07 ft). In Section 2.4.5.2.2.1 of the FSAR Rev. 9, the antecedent water level is reported as El. 4.4 ft NGVD 29. However, the calculations were performed using El. 4.34 ft NGVD 29.

  As the bottom of the forebay is at El. -22.5 ft NGVD 29, the maximum water depth in the forebay is 22.5 ft + 4.34 ft = 26.84 ft.

  When calculating the freeboard of the forebay, the water depth (23.14 ft) corresponding to the normal mean sea level (MSL) was used instead of the depth (26.84 ft) corresponding to the maximum water level. Use of the normal versus maximum water level is non-conservative with respect to determining the maximum sloshing height. This discrepancy is addressed in Part 2 of this RAI response. A condition report regarding this error has been entered into the vendor's and UNE's corrective action programs for disposition. The recalculation of the freeboard considers the updated water depth in the forebay (26.84 ft) and the In-Structure Response Spectra (ISRS) as obtained from the Soil Structure Interaction (SSI) analysis of the Common Basemat Intake Structure (CBIS).

- Part 2 – Sloshing height calculation

  The RAI 304, Question 03.07.02-56[1] response incorrectly reported that the Foundation Input Response Spectra (FIRS) was used in determining the wave height calculation. The calculations actually utilized the site-specific Safe Shutdown Earthquake (SSE) motion for the horizontal acceleration response spectra. A condition report regarding this error has been entered into UNE's corrective action program for disposition.

  Using the maximum water height of 26.84 ft, instead of the mean height, the sloshing height is recalculated using the results from the SSI analysis of the CBIS. The basemat ISRS are used to calculate the maximum height of sloshing in the forebay. For this purpose, the CBIS model with the SSE motion and best estimate (BE) soil condition is used. Figure 1 shows the CBIS basemat and the location of the selected nodes in the forebay for the calculation of the basemat ISRS in N-S (X) and E-W (Y) directions.

  The calculation of the basemat ISRS, for one particular direction, is in accordance with the following process:

  1. Response accelerations are calculated at the selected nodes in the basemat, in a particular direction, as the algebraic summation of the acceleration time histories in that direction due to input motions in N-S (X), E-W (Y) and Vertical (Z) directions.

[1] UniStar Nuclear Energy Letter UN#13-008, from Mark T. Finley to Document Control Desk, U.S. NRC, Response to Request for Additional Information for the Calvert Cliffs Nuclear Power Plant, Unit 3, RAI No. 304, Seismic System Analysis, dated January 23, 2013

2. Response accelerations in a particular direction, due to input motions in X, Y and Z directions, are used to calculate response spectra for each selected node for 0.5% of critical damping.

3. Response spectra in a particular direction are enveloped, widened and smoothed to obtain the basemat ISRS in that direction. A widening factor of 0.15 is used for the frequency of each peak, as stated in U.S. NRC R.G. 1.122.

The maximum sloshing height (d_{max}) in the forebay is calculated for N-S (X) and E-W (Y) directions, using equation 1 (ACI 350.3-06):

$$d_{max} = \frac{L}{2} C_c I \qquad \text{(Equation 1)}$$

The seismic response coefficient, C_c, is given by 2/3 of the maximum spectral acceleration calculated from the basemat ISRS and for the natural period of the first convective mode of sloshing. The term *"I"* is the Importance Factor.

Based on the above, the maximum height of sloshing is calculated as 3.45 ft. The results are presented in Table 1. The freeboard of the forebay is obtained by subtracting the maximum water depth (26.84 ft) and the calculated maximum sloshing wave depth of 3.45 ft from the height of the forebay wall (32.5 ft). The resulting freeboard is 2.24 ft. Therefore, the tank top head is adequate.

Consistent with the design load combinations, the operating water level in the Forebay is used in the seismic and static analyses of the CBIS. The operating water level in the Forebay is the normal mean sea level (MSL), since the water level inside the forebay follows the water levels in the Chesapeake Bay. Therefore, the MSL was used to calculate the impulsive and convective masses in the SSI seismic analysis of the CBIS.

However, the maximum water level of El. 4.34 ft NGVD29 was also considered as part of the sensitivity analysis for the stability of the CBIS. For this purpose, an SSI analysis considering SSE motion and BE soil condition was performed with convective and impulsive masses corresponding to the maximum water level of El. 4.34 ft NGVD29. The overturning moment calculation and results are explained in Part 3 of this RAI Response.

The results from the maximum water level model were also used for checking the CBIS design. This review indicated that the CBIS capacity is adequate.

- Part 3 – Overturning effect of water on the basemat

For the SSI analysis of the CBIS, the water depths were calculated in order to determine the effects of the impulsive and convective water on the structure; that is, excluding bottom pressure (EBP). The stability analysis of the CBIS is updated in this RAI response by considering the additional overturning moment caused by the hydrodynamic forces in the basemat; that is, including bottom pressure (IBP). For this purpose, the CBIS model with the maximum water depth of 26.84 ft, SSE motion and BE soil condition is used. Hydrodynamic masses and spring constants are calculated based on ACI 350.3-06.

According to the Technical Information Document (TID) 0724, Chapter 6, the total overturning moment in the basemat, IBP, is calculated by increasing the water heights from the EBP condition, H_{EBP}, to the IBP condition, H_{IBP}. The additional water height to be considered is:

$$H_{add} = H_{IBP} - H_{EBP} \qquad \text{(Equation 2)}$$

The impulsive and convective water heights IBP are calculated with the equations in TID 7024 or their ACI 350.3-06 counterparts.

Considering a rectangular tank with a hydrodynamic water force, *F*, the total overturning moment, *M*, at the base of the tank is calculated as (TID 0724):

$$M = F \times H_{IBP}$$

Including Equation 2:

$$M = F \times H_{EBP} + F \times H_{add}$$

Where:
$F \times H_{EBP}$ is the overturning moment EBP and,
$F \times H_{add}$ is the additional overturning moment to take into account

The EBP overturning moment, $F \times H_{EBP}$, was included in the stability analysis of the CBIS. An additional overturning moment, $F \times H_{add}$, is incorporated into the stability analysis.
The convective and impulsive water forces, *F*, are calculated from the SSI analysis of the CBIS model with the maximum water level, SSE motion and BE soil condition, in the following way.

The convective water forces are calculated directly from the convective spring forces. The convective spring force in one particular direction is obtained by algebraic summation of the spring force in that direction due to input motions in X, Y, and Z directions. Resultant spring forces in X and Y directions are then multiplied by the corresponding additional heights (*Equation 2*) to obtain the additional overturning moment time histories in X and Y directions, respectively.

The impulsive water forces are calculated by multiplying the acceleration of the nodes, where the impulsive masses are distributed, by the corresponding impulsive mass. The acceleration of the impulsive mass in one particular direction is obtained by algebraic summation of the accelerations in that direction due to input motions in X, Y, and Z directions. Resultant accelerations in X and Y directions are then multiplied by the corresponding masses and additional heights (*Equation 2*) to obtain the additional overturning moment time histories in X and Y directions, respectively.

Convective and impulsive additional overturning moment time histories in X and Y directions are added to the driving forces in the overturning analysis of the CBIS.

The additional convective and impulsive overturning moments are significantly lower than the moments associated with seismic driving forces and lower than the lateral earth pressure related moments. The factors of safety for the maximum pool case with and without additional convective and impulsive overturning moments are 1.73 and 1.74, respectively. Therefore, the maximum pool case does not govern the stability of the CBIS.

During incorporation of the additional convective and impulsive overturning moments, an error was found in the overturning factors of safety calculated as part of the response to RAI 343 Question 03.07.02-73[2]. This error impacted the factors of safety reported in *Table 1* of the RAI 343 response, and in Table 3.8-2 of the FSAR. The corrected table is provided below as *Table 2.* A condition report regarding this error has been entered into UNE's corrective action program for disposition.

TABLE 1
MAXIMUM VERTICAL DISPLACEMENT OF WATER DURING WAVE OSCILLATION

DIRECTION	L (ft)	T_C (s)	S_{CM} (g)	C_C	d_{MAX} (ft)
NS	100	7.5	0.083	0.055	3.45
EW	80	6.3	0.058	0.039	1.94

[2]UniStar Nuclear Energy Letter UN#13-058, from Mark T. Finley to Document Control Desk, U.S. NRC, Response to Request for Additional Information for the Calvert Cliffs Nuclear Power Plant, Unit 3, RAI 343, Seismic System Analyses, dated April 30, 2013.

TABLE 2
STABILITY EVALUATION RESULTS FOR THE CBIS

LOAD COMBINATION (LC)	FACTORS OF SAFETY (FOS)		
	SLIDING	OVERTURNING	FLOTATION
D + H + W	106	2.1	-
D + H + Wt	11.9	1.6	-
D+H+E	1.1	1.2	-
D+F'[(1)]	-	-	1.33
D + H + PMH	28.1	1.2	-
D + H + SPH	66.4	1.5	

Notes:

(1) The factor of safety against flotation (D+F') is governed by the PMH draw-down condition

D: Dead load

H: Earth pressure

W: Wind load.

Wt: Tornado load.

E: Seismic

PMH: Probable maximum hurricane

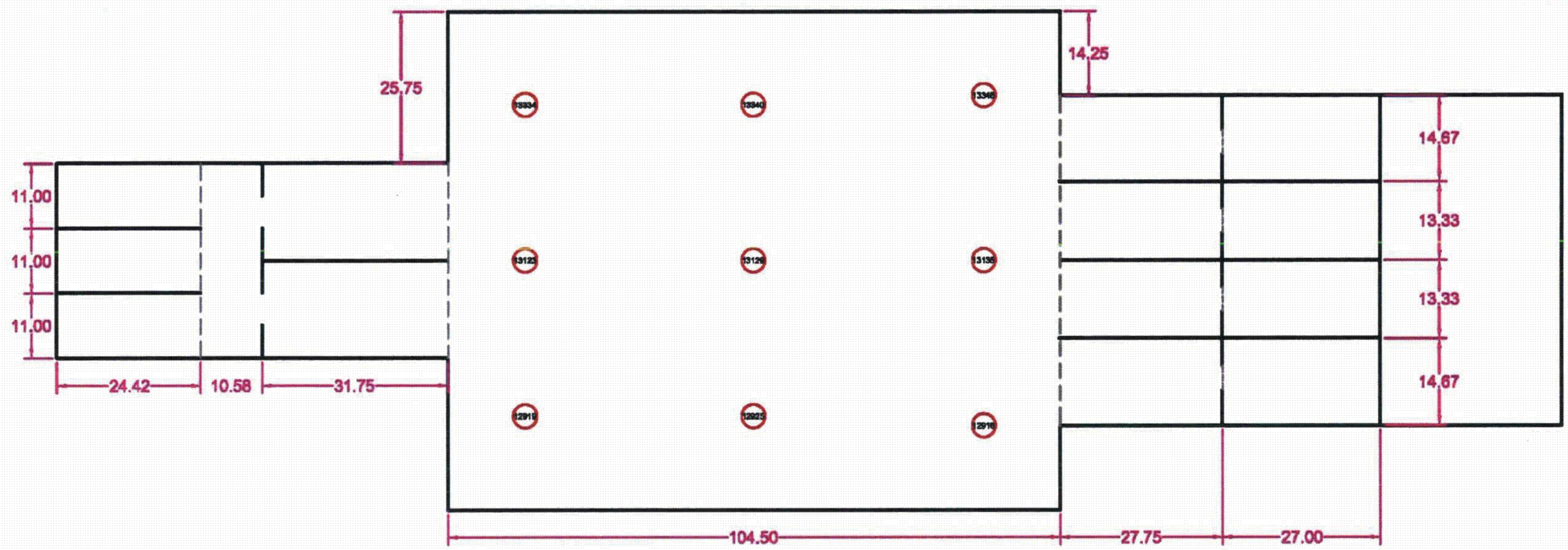

FIGURE 1
SELECTED POINTS FOR THE CALCULATION OF THE BASEMAT ISRS (DIMENSIONS IN FEET)

COLA Impact

Enclosure 2 provides the COLA impact of the response to RAI 396, Questions 03.07.02-76 and 03.07.02-77.

Question 03.07.02-77

Follow Up Question to RAI 378, Question 03.07.02-75

In RAI 378, Question 03.07.02-75, the applicant was asked to explain the seismic categories and their technical requirements for the Fire Protection System (FPS).

- In Part b, the applicant was asked to identify the additional design requirements imposed on the Fire Protection Building (FPB) and Fire Water Storage Tanks (FWSTs) that are over and above those of the IBC or other building codes. In its response, the applicant stated that the FPB and FWSTs are components that must remain functional during and following an SSE and are therefore designated as Conventional Seismic-I (CS-I). The design of the FPB and FWSTs will be equivalent to that of an SC I structure in that they will be analyzed to SSE load conditions using the same codes and standards and the same margin of safety that apply to an SC-I structure.

  The FPB will be analyzed as a fixed-base structure using a seismic load that is 1.5 times the maximum spectral acceleration of the SSE. As FPB is a one story structure and the peak spectral acceleration times a factor of 1.5 is applied to the total superstructure weight concentrated at the roof, the staff believes this approach is conservative and therefore adequate for the design of the structure. However, the applicant is requested to confirm that the SSE is as identified on Figure 3.7-1, Revision 9 of the FSAR or otherwise provide the SSE to be used, and provide justification for its application to the FPB which is located nearly at grade level. One concern the staff has regarding the proposed method of analysis is that it does not provide the anchor movement of FPS CS-I piping that is interconnected between the FPB and other structures. The applicant is requested to address how these anchor movements will be determined. Regarding the design codes for this building, the markup of FSAR Table 3.2-1 does not list any concrete codes yet the superstructure rests on a concrete foundation. The applicant is requested to add the appropriate concrete design code to Table 3.2-1. Also, the markup of FSAR Table 3.2-1 lists ASCE 43 as one of the applicable codes for the FPB. Since the building analysis and design will be equivalent to that of a SC I structure, the applicant is requested to explain what portions of ASCE 43 apply to this structure with appropriate technical justification. Regarding the design codes for the FWST, FSAR Table 3.2-1 lists ASCE 43 and both ASCE 4 and ASCE 4-98. The applicant is requested to explain why ASCE 43 is applicable for design of FWSTs, and why ASCE 4 is listed. The applicant is also requested to update the FSAR with the information and clarifications mentioned above.

  In Part b of the response, the applicant states that for CS-I SSCs located on the foundation basemat of the FPB, the In-Structure Response Spectra (ISRS) will be the envelope of the CCNPP Unit 3 SSE and Foundation Input Response Spectra (FIRS). The applicant is requested to describe how the FIRS for this structure are determined. Since the basemat ISRS may be amplified at certain frequencies above that of the input ground spectra, the applicant is requested to provide justification that using an envelope of the SSE-FIRS spectra is a conservative estimate of the basemat ISRS. For CS-I equipment above the basemat, the applicant states that the ISRS will be determined by performing an elastic single degree of freedom response time history or by scaling the base ISRS by a ratio of maximum acceleration response obtained with a modal analysis. As this description provides insufficient information for the staff to evaluate, the applicant is requested to provide the technical detail and technical basis for what it is proposing. The applicant should also describe how the different damping levels for equipment as defined in R.G. 1.61.will be accommodated with these approaches.

For the FWSTs, the applicant states that the seismic forces will be based on the American Water Works Association (AWWA) D-100 Standard and TID 7024. The applicant is requested to describe any differences between the two standards as they relate to the seismic analysis for the FWSTs. Where they are different, the applicant should explain which of the two documents will be used and the technical basis for this selection. The applicant is also requested to confirm that of SRP 3.7.3 Acceptance Criteria (AC) 14 is being met for the analysis and design of these tanks, or provide justification for not doing so. The applicant should also identify the basis of the assumed water height within the tanks.

The applicant states that to determine the acceleration of the impulsive component of the water, the maximum spectral acceleration (0.45g) of the SSE will be used. The applicant is requested to confirm that the damping value to be used for the FWSTs complies with R.G. 1.61 for metal atmospheric storage tanks, i.e. 3 percent for the impulsive component and 0.5 percent for the sloshing component, or provide justification for not doing so. The applicant is also requested to provide the design response spectra for both of these damping values and state how the forces on the tank associated with sloshing component are determined.

- In Part d, the applicant was asked to revise the FSAR to include the fact that SSCs categorized as CS would comply with SRP 3.7.2 AC 8A. This states that the collapse of a non-category I structure will not cause the non-category I structure to strike a Category I structure. In addition, the applicant was requested to include the methodology that would be followed to assure that SSCs classified as CS meet the SRP acceptance criteria. In its response the applicant stated that it would revise CCNPP FSAR Section 3.7.2.8 to include SRP 3.7.2 AC 8A for structures designated as CS-I and provide the criteria to be invoked to assure CS-I structures meet this SRP guidance. However, those portions of the FPS classified as CS-I must remain functional during and after a seismic event. They also have design requirements which are similar to SC-I requirements. Therefore, the staff believes that SRP 3.7.2 AC 8A is not applicable to the CS-I classification. The applicant is requested to revise its response and update the FSAR to make it clear that SRP 3.7.2 AC 8A is only applicable to the CS seismic category and to make clear the distinction between CS and CS-I. The applicant should also include the methodology that will be followed to assure that SSCs classified as CS meet the SRP acceptance criteria 8A, i.e., SSCs classified as CS will not strike a Category I structure if they collapse.

- In Part g the applicant was asked to revise the FSAR to make the designation and requirements for SCII structures consistent throughout the FSAR. The applicant in its response states that the Access Building, Turbine Building, and Switchgear Building will be designed using the same codes and standards as Category I structures. The applicant went on to state that the write-up in CCNPP Unit 3 FSAR Section 3.7.2.3.3, "Seismic Category II Structures," would be revised to incorporate other buildings and make the requirements equivalent to those specified for Category II structures in the US EPR FSAR. However, FSAR mark-up provided with the response did not include the proposed revision of FSAR Section 3.7.2.3.3. The applicant is requested to revise FSAR Section 3.7.2.3.3 as stated in the response.

- On page 20 of Enclosure 2, additional structures are identified as being capable of potentially interacting with SC I SSCs and on page 24 a reference is made to FSAR Table 3.7-11 which identifies those buildings that have the potential for structure-to-structure interaction with a SC I building. In FSAR Revision 9, this table lists the AB, TB, and SB as SC II structures. Two other structures are also listed. These are the Grid Systems Control Building (GSCB) and the Circulating Water Intake Structure (CWIS). The seismic category for the CWIS is SC II. The design code for the CWIS is inconsistent with that of the AB, TB, and SB in that it will be designed according to the IBC code. If the CWIS is designated as a SC II structure, it seems that the design approach should be similar to other SC II structures. The seismic category for the GSCB is CS; the design code listed is IBC; and non-nuclear codes are used for steel and concrete. If no interaction is allowed with a SC I structure the applicant is requested to explain why the design basis for these two structures is different from that of the AB, TB, and AB and why the seismic category for the GSCB is not SC II. Also listed in the FSAR markup on page 20 of Enclosure 2 as having the potential to interact with a SC I SSC, is the Conventional Seismic Sheet Pile Wall and Existing Baffle Wall. However, no further discussion of these two structures appears in this section of the FSAR. The applicant is requested to include a discussion of these two structures and address how the potential for interaction is addressed in the site-specific design of CCNPP Unit 3.

- In part n, the applicant was asked to provide a table which identifies the seismic classification for each portion of the FPS to include safety classification, seismic category, applicable design codes, and seismic requirements. In its response, the applicant provided the requested information for the systems and components that makeup the FPS in Table 1 of Enclosure 1. The first item listed on page 15 of the response is the Fire Water Distribution System, Conventional Area (Safe Shutdown Equipment Protection). The table indicates that the safety classification, seismic category, codes, and design requirements for this portion of the FPS are incorporated by reference to the U.S EPR FSAR. As this portion of the Fire Water Distribution System provides safe shutdown equipment protection, it should be classified as seismic category CS-I. However the U.S. EPR FSAR in FSAR Table 3.2.2-1 lists the seismic category as SC II. As the design requirements for SC II are not the same as those for CS-I, the applicant is requested to make the appropriate change to Table 1.

- In part o, the applicant was asked to provide and include in the FSAR the seismic inputs, seismic models, methods of analysis and acceptance criteria for each SSC which must remain structurally intact under an SSE or which must remain functional during and after an SSE while maintaining its pressure boundary. Table 2 of Enclosure 1 provides by reference for the major elements of the FPS (buried piping, HVAC ducts, mechanical and electrical equipment, and aboveground piping) the information requested by the staff. The applicant has also provided this information in FSAR Table 3.8-6. As part of the response, the applicant states that site-specific SSE or appropriate ISRS created from site specific SSE is used for seismic analysis and design of site-specific CS-I FPS SSCs. The applicant is requested to clearly describe in Section 3.7 the seismic input used for the CS-1 SSCs listed in Table 3.8-6 with supporting technical justification where the site specific SSE may be used as input for the seismic analysis of the FPS. In addition, the applicant is also requested to describe how appropriate ISRS are created from the site-specific SSE for cases where ISRS are used as seismic input. Table 3.8-6 should also be revised to reflect the appropriate seismic input being used.

Response:

- Bullet 1 Part b)

  The Safe Shutdown Earthquake (SSE) of the Calvert Cliffs Nuclear Power is provided in Figure 3.7-1 of Revision 9 of the CCNPP3 Unit 3 Final Safety Analysis Report (FSAR). However, the SSE has been recently updated as part of the response to RAI 314 Question 03.07.01-16[3]. The SSE was increased in the low frequency range as a consequence of the updated seismic hazard analysis that utilized the 2012 Central and Eastern United States (CEUS) Seismic Source Characterization (SSC). The SSE for the design of the Fire Protection Building is the CCNPP Unit 3 SSE as updated in the response to RAI 314 Question 03.07.01-16[3]. It is worth noting that the soil profile beneath the FPB is similar to that of the Emergency Power Generation Building (EPGB). The EPGB is a SC1 structure located nearly at grade level. The Site SSE envelops the Adjusted FIRS for the EPGB. Since both the FPB and EPGB are surface founded structures with a similar soil profile, the FIRS for the FPB will also be close to that obtained for the EPGB and the SSE will envelope the FIRS. Thus the CCNPP Site SSE can be used as the design response spectrum for the FPB and its adequacy will be confirmed during detailed design.

  Where buried piping enters a structure, the seismic anchor movements of the structure must be accounted for in the design of the piping. The anchor movement of the Fire Protection System (FPS) CS-1 piping that is interconnected between the FPB and other structures will be evaluated by conducting a seismic anchor movement (SAM) analysis according to AREVA Topical Report U.S. EPR Piping Analysis and Pipe Support Design (ANP-10264NP Revision 1). As discussed in later portions of this response, in addition to the equivalent static lateral load approach for the design of the civil/structural components of the FPB, additional dynamic analyses will be performed to support the design of Systems and Components, including piping support.

  The concrete portions of the FPB, in particular its foundation mat, will be designed according to ACI 349-01/349-R01, Code Requirements for Nuclear Safety-Related Concrete Structures and Commentary on Code Requirements for Nuclear Safety-Related Concrete Structures. Table 3.2-1 will be revised to remove the reference to ASCE 43.

  For the Fire Water Storage Tanks (FWSTs), the references to ASCE 43 and ASCE 4 provided in Table 3.2-1 are removed. The remaining codes listed for the FWSTs provide the required seismic design criteria.

  The civil/structural components of the FPB will be designed with the use of the equivalent lateral procedure as described in the original response to RAI 378 Question 03.07.02-75[4]. However, loads for the design of Systems Structures and Components (SSC) including piping anchors will be determined with the procedures and methodologies used for the analysis and design of Seismic Category I structures.

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[3] UniStar Nuclear Energy Letter UN#13-092, from Mark T. Finley to Document Control Desk, U.S. NRC, Response to Request for Additional Information for the Calvert Cliffs Nuclear Power Plant, Unit 3, RAI 314, Seismic Design Parameters, RAI 315, Seismic System Analysis, dated July 31, 2013

[4] UniStar Nuclear Energy Letter UN#13-031, from Mark T. Finley to Document Control Desk, U.S. NRC, Response to Request for Additional Information for the Calvert Cliffs Nuclear Power Plant, Unit 3, RAI 378, Seismic System Analysis, dated March 29, 2013

The FIRS for the FPB will be developed in accordance with Regulatory Guide (RG) 1.208 by conducting a seismic site response analysis using the rock motion spectra presented in Section 2.5.2.5.1.4 and the soil profile properties described in the response to RAI 378 Question 03.07.02-75[4]. The FPB will be treated as a surface founded structure, thus the FIRS will be calculated at the ground surface. The FIRS for the FPB will be determined using the procedures and methodologies described in Section 3.7.1.1 of the CCNPP Unit 3 FSAR.

The calculation of in-structure response spectra (ISRS), including basemat ISRS for CS-I equipment above the basemat will not be performed as originally proposed in the response to RAI 378 Question 03.07.02-75[4]. The ISRS for the FPB will be based on SSE structural damping values defined in RG 1.61 (NRC, 2007). ISRS for the FPB will be defined at key locations, yet to be determined, inclusive of the basemat, roof, and other relevant points of attachment. The ISRS will be developed using site-specific dynamic Soil Structure Interaction (SSI) analyses as performed for the Seismic Category I structures. Input to the SSI analysis will be based in strain compatible soil profiles and SSI input histories consistent with the CCNPP Unit 3 SSE, as described in the response to RAI 314 Question 03.07.01-16[3]. A three dimensional Finite Element Method (FEM) model of the FPB will be generated to perform the SSI analysis.

For the FWSTs, as requested, Figure 1 provides the 0.5% and 3% damping response spectra. For comparison purposes, the 0.5% damping spectra include the AWWA criteria of 1.5 times the 5% damping (Figure 1a). Figure 1b shows the design response spectra for 3% and 0.5% damping consistent with the SSE.

In order to point out the differences between AWWA and TID and to establish the criteria that will be used for the design of the FWSTs, a hypothetical example analysis, using a tank diameter of 40 ft and a water height of 35 ft is provided in Table 1.

Differences between AWWA and TID are:

- TID 7024 assumes the tank is rigid, while AWWA D-100 considers both flexible and rigid tank models,
- TID 7024 combines the impulsive and convective forces using absolute sum, while AWWA D-100 combines the impulsive and convective forces using the SRSS (square root of sum of square).
- TID 7024 applies to circular and rectangular tanks. AWWA D-100 applies only to circular welded steel tanks.
- AWWA D-100 incorporates a response modification factor, R_i (impulsive) and R_c (convective), in determining horizontal design accelerations.
- AWWA D-100 considers a ground motion design factor (U) and the seismic importance factor (I_E). Note the importance factor depends on the utility of the tank and the damage consequences.

As previously stated in the response to RAI 378, Question 03.07.02-75[4], a bounding approach will be considered for the design of tanks. As shown in Table 1, the AWWA methodology is more conservative for the calculation of forces. The design of the tanks will use a 3% damping and 0.5% damping broadened spectra as shown in Line Items 2 and 3 of Table 1. With the AWWA approach, a flexible component of the impulsive mode is included in order to meet SRP 3.7.3 Acceptance Criteria (AC) 14. The Items of SRP AC14 will be met for the analysis and design of the FWSTs.

As far as the basis of the assumed water height within the tanks, the design will incorporate a tank top head located at an elevation higher than the increase due to sloshing height. The sloshing height will be determined using a bounding approach between AWWA and TID. Table 1 indicates that the AWWA approach of multiplying the 5% damping SSE times 1.5 to obtain the 0.5% damping spectra is un-conservative. Therefore, the convective acceleration will be calculated from the SSE based, broadened spectrum shown in line item 3 of Table 1.

In conclusion:

- The impulsive acceleration will be determined from the 3% damping broadened SSE curve, using the AWWA equations with a ductility factor (R_i) of 1.0 and importance factor (I_E) of 1.5;
- The convective acceleration will be determined from the 0.5% damping broadened SSE curve, using the AWWA equations with a ductility factor (R_c) of 1.0 and importance factor (I_E) of 1.5; since the AWWA criteria results in lower demand than the broadened SSE, the AWWA criteria used to calculate the 0.5% damping spectra of 1.5 times the 5% damping SSE will not be used for the calculation of the 0.5% response spectra;
- Forces will be determined using the previous accelerations and the AWWA impulsive and convective weights combined with the SRSS method; this approach will result in higher, more conservative forces;
- The sloshing height will be determined using a bounding approach between AWWA and TID.

- Bullet 2 Part d)

  The FSAR is updated to make it clear that SRP 3.7.2 AC 8A is only applicable to the CS seismic category and not to SSCs designated as CS-I. CS-I structures are designed to remain structurally sound and functional during and after an SSE. Therefore, the distance to other safety-related equipment is not relevant and SRP 3.7.2 AC 8A does not apply. The CS-I FPB and FWSTs meet SRP 3.7.2 AC 8C, which states that the SSC is analyzed and designed to prevent its failure under SSE conditions.

- Bullet 3 Part g)

  Details and COLA markups related to the design and analysis of Category II structures, including the Access Building, the Turbine Building, and the Switchgear Building were provided as part of the response to RAI 315 Question 03.07.02-64[5].

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[5] UniStar Nuclear Energy Letter UN#13-092, from Mark T. Finley to Document Control Desk, U.S. NRC, Response to Request for Additional Information for the Calvert Cliffs Nuclear Power Plant, Unit 3, RAI 314, Seismic Design Parameters, RAI 315, Seismic System Analysis, dated July 31, 2013

- Bullet 4

The Circulating Water Intake Structure (CWIS) will be designed and analyzed as a Category I structure. The structure is analyzed with the same physical model as the Category I Make-up Water Intake Structure (MWIS).

The Conventional Seismic Grid Systems Control Building (GSCB) is located in the Switchyard area, and has a minimum separation distance of approximately 700 ft (213.4 m) from the nearest Seismic Category I SSCs. Therefore, potential collapse of this building has no adverse impact on the function of Seismic Category I SSCs. This meets NUREG-0800 Section 3.7.2, AC 8.A.

The last paragraph in FSAR Section 3.7.2.8 states, "The Conventional Seismic Unit 3 Sheet Pile Wall is located approximately 30 ft (9.1 m) from the north end of the Seismic Category I Buried Intake Pipes. The layout of the Sheet Pile Wall and the separation distance between the Sheet Pile Wall and the Seismic Category I Buried Intake Pipes precludes any potential interaction between the Sheet Pile Wall and the Seismic Category I Buried Intake Pipes. The existing Baffle Wall is approximately 46 ft (14.0 m) above the bed of the intake area and is located approximately 50 ft (15.2 m) from the north end of the Seismic Category I Buried Intake Pipes. Therefore, the interaction of the Baffle Wall with the Buried Intake Pipes is not possible."

The following text is added to this section of the FSAR for clarification:

The Conventional Seismic Unit 3 Sheet Pile Wall and the Baffle Wall are both Conventional Seismic structures which meet SRP Section 3.7.2 Acceptance Criterion 8.A. SRP Section 3.7.2 Acceptance Criterion 8.A is only applicable to Conventional Seismic structures. The SRP Section 3.7.2 Acceptance Criterion 8.A is not applicable to a Conventional Seismic-I (CS-1) structure. CS-I is the designation of Conventional Seismic for an SSC which must remain functional during and after an SSE.

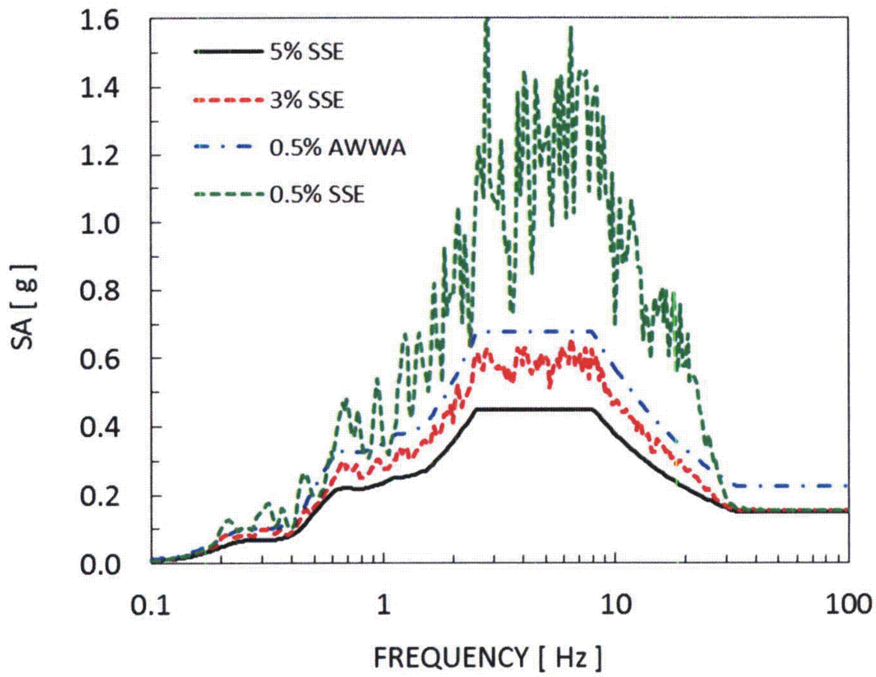
- Bullet 5 Part n)

The Table 1 as provided in the response to RAI 378 Question 03.07.02-75[4], Part n identifies the seismic classification, seismic category, applicable design codes and seismic requirements for each portion of the FPS that must remain functional during and after a site-specific SSE and designated as Conventional Seismic-I (CS-I). In that Table 1, the Fire Water Distribution System, Conventional Area (Safe Shutdown Equipment Protection) U/G Loop classifications were identified as incorporated by reference to the U.S. EPR FSAR. The Fire Water Distribution System, Conventional Area (Safe Shutdown Equipment Protection) U/G Loop is updated as seismic category CS-I as shown in the markup to FSAR Table 3.2-1 provided in Enclosure 2 of this response. The CS-I designation for an SSC requires that the SSC remain functional during and after an SSE, and therefore bounds the U.S. EPR Seismic designation of Category II.

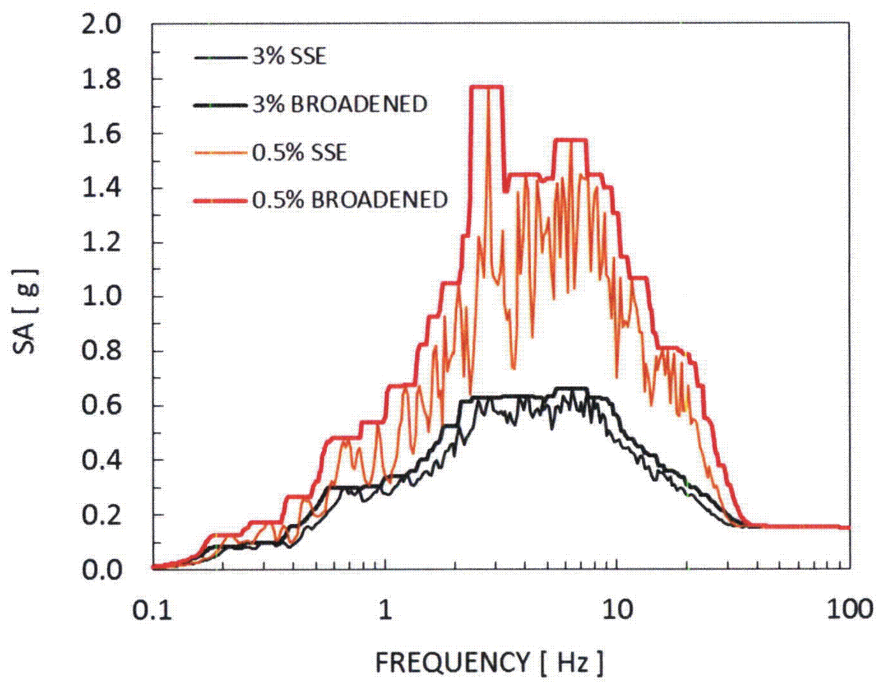
- Bullet 6 Part o)

The site-specific SSE or appropriate ISRS created from the site-specific SSE is used for seismic analysis and design of site-specific CS-I FPS SSCs. The seismic input to be used will be based on that developed and described in response to Part "b". Based on Part "b" response, the site-specific SSE or an envelope of the site-specific SSE, ISRS and FIRS will be used and will be produced later during detailed design after Combined License (COL) issuance.

FIGURE 1: DESIGN RESPONSE SPECTRA (5% SSE, 3% SSE, 0.5% SSE, and 0.5% AWWA)



(a)



(b)

TABLE 1: COMPARISON BETWEEN AWWA D-100 and TID-7024
(Page 1 of 6)

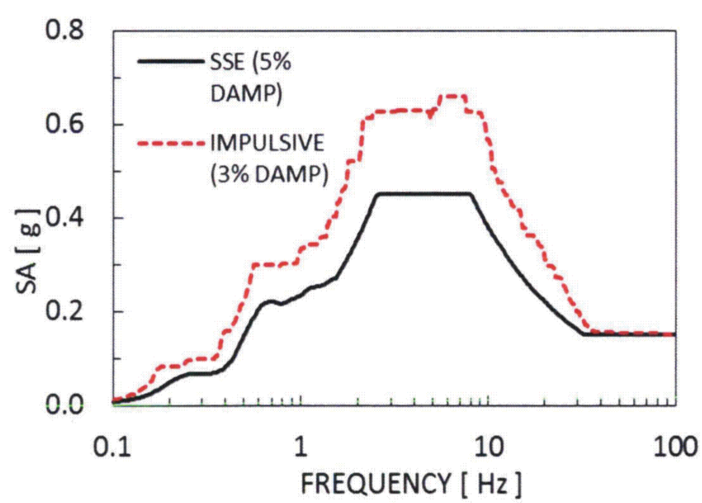
ITEM			AWWA D100	TID 7024	NOTES
1	Overall Approach		Site-specific procedure using SSE ground motion levels	SRP SSE ground motion levels	AWWA criteria of 2% probability of exceedance in 50 years dropped for SSE
2	Input Design Response Spectra (Impulsive)	DRS_i	SSE based 3% damping to comply with RG 1.161 		- 3% Damping (broadened 15%) spectra calculated from SSE time histories - 3% Damping (broadened 15%) spectra utilized for both analyses to meet intent of RG 1.161

TABLE 1: COMPARISON BETWEEN AWWA D-100 and TID-7024
(Page 2 of 6)

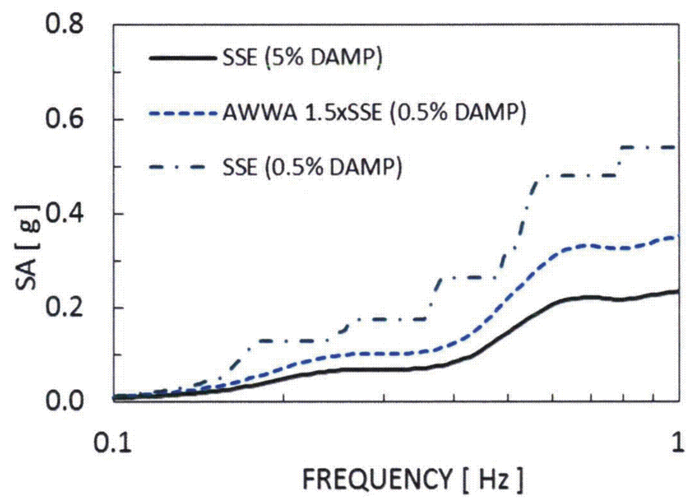
ITEM			AWWA D100	TID 7024	NOTES
3	Input Design Response Spectra (Convective)	DRS_c	0.5% Damping Spectra is 1.5 times the 5% Damped SSE	0.5% Damping calculated from SSE time histories	- SSE 0.5% (15% Broadening) (will be used for design) - AWWA is 1.5 times the 5% damping SSE (will not be used for design; shown for comparison purposes)
					
4	Fundamental Frequency of Impulsive mode	F_i [Hz]	**6.0**	**NOT USED**	AWWA value obtained from EPRI NP 6041 Appendix H (approximate value)
5	Maximum Spectral Acceleration (Impulsive)	S_{aMi} [g]	**0.658**	**NOT USED**	Using 3% damping

TABLE 1: COMPARISON BETWEEN AWWA D-100 and TID-7024
(Page 3 of 6)

ITEM			AWWA D100	TID 7024	NOTES
6	Design Factor	U	**2/3**	**NOT USED**	
7	Importance Factor	I_E	**1.5**	**NOT USED**	I_E = 1.5 for post-earthquake fire suppression
8	Ductility for Impulsive Component	R_i	**1.0**	**NOT USED**	- Selected below AWWA recommended values (D100-05, Table 28)
9	Acceleration for use in the calculation of Impulsive Forces	A_i [g]	**0.470** AWWA D100-05 Eq. 13-17 $A_i = \frac{US_{aMi}I_E}{1.4R_i}$	**0.152** Value calculated from 3% Damping SSE peak ground acceleration (PGA)	- TID 7024 assumes the tank is rigid - AWWA D100 flexible tank models - AWWA D100 allows for ductility reduction -For CCNPP Unit 3 analysis will set the AWWA product U(I_E) equal to 1.0
10	Natural Frequency of First Sloshing Mode	F_c [Hz]	**0.273** $f_c = \frac{1}{2\pi\sqrt{\frac{D}{3.68g\tanh\left(\frac{3.68H}{D}\right)}}}$ -D is the tank diameter - H is the distance from the bottom of shell to Maximum Operating Level	**0.273** Equivalent (Notation differences only)	- Both methods are equivalent

TABLE 1: COMPARISON BETWEEN AWWA D-100 and TID-7024
(Page 4 of 6)

ITEM			AWWA D100	TID 7024	NOTES
11	Maximum Spectral Acceleration (1st Convective Mode)	S_{aMc} [g]	**0.175**	**0.175**	- Values calculated from spectra in Line Item 3 - AWWA value calculated using the highest spectral coordinate from Item 3
12	Ductility for Convective Component	R_c	**1.0**	**NOT USED**	- Selected below AWWA recommended values (D100-05, Table 28)
13	Acceleration for use in the calculation of Convective Forces	A_c [g]	**0.125**	**0.175**	
			AWWA D100-05 Eq. 13-18 $A_c = \frac{US_{aMc}I_E}{1.4R_c}$	Value calculated from 0.5% Damping SSE	

TABLE 1: COMPARISON BETWEEN AWWA D-100 and TID-7024
(Page 5 of 6)

ITEM			AWWA D100	TID 7024	NOTES
14	Impulsive Weight	W_i [kips]	**2061**	**2061**	- W_T is the weight of the contents of the tank $W_T = \rho_w \pi \left(\frac{D^2}{2}\right) H$
			For D/H ≥ 1.333 $W_i = \frac{tanh\left(0.866\frac{D}{H}\right)}{0.866\frac{D}{H}} W_T$ For D/H < 1.333 $W_i = \left(1 - 0.218\frac{D}{H}\right) W_T$	Equivalent (Notation differences only)	
15	Effective Convective Weight	W_c [kips]	**719**	**497**	- Methods differ
			AWWA D100-05 Eq. 13-26	TID 7024 Eq. 6.16	
			$W_c = 0.23\frac{D}{H}\, tanh\left(\frac{3.67H}{D}\right) W_T$	$W_c = 0.159\frac{D}{H}\, tanh\left(\frac{3.68H}{D}\right) W_T$	
16	Impulsive Force	P_i [kips]	**968.6**	**313.7**	- W_{TC} (Tank components; ignored for comparison purposes)
			$P_i = A_i(W_i + W_{TC})$		

TABLE 1: COMPARISON BETWEEN AWWA D-100 and TID-7024
(Page 6 of 6)

ITEM			AWWA D100	TID 7024	NOTES
17	Convective Force	P_c [kips]	**89.8**	**86.9**	-TID calculation is based on maximum SDOF displacement. Simplified here with the use of spectral acceleration at convective mode
			$P_c = A_c W_C$		
18	Total Base Shear	V [kips]	**972.8**	**400.6**	- AWWA uses SRSS - TID 7024 uses algebraic sum
			$V = \sqrt{P_i^2 + P_c^2}$	$V = P_i + P_c$	
19	Sloshing height	d_{max} [ft]	**2.50**	**2.99**	- The design of the tanks will consider the highest value - TID method based on maximum spectral displacement. Estimated here with spectral acceleration
			$d_{max} = 0.5\ D\ A_C$	$d_{max} = \frac{0.204D * \coth\left(3.68\frac{H}{D}\right)}{\frac{2g}{(2\pi f_c)^2\theta_h D} - 1}$ $\theta_h = 1.534\frac{8gA_c(\pi f_c)^2}{D}\tanh\left(3.68\frac{H}{D}\right)$	

COLA Impact

Enclosure 2 provides the COLA impact of the response to RAI 396, Questions 03.07.02-76 and 03.07.02-77.

Enclosure 2

Changes to CCNPP Unit 3 COLA Associated with the Response to RAI 396, Questions 03.07.02-76 and 03.07.02-77, Calvert Cliffs Nuclear Power Plant, Unit 3

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Table 3.2-1— {Classification Summary for Site-Specific SSCs}
(Page 5 of 11)

KKS System or Component Code	SSC Description	Safety Classification (Note 1)	Quality Group Classification	Seismic Category (Note 2)	10CFR50 Appendix B Program (Note 5)	Location (Note 3)	Comments/ Commercial Code (Note 9)
QJ	Central Gas Supply Electrical Distribution Equipment	NS	N/A	NSC	No	UTG	(Note 8)
GK, Potable and Sanitary Water Systems							
GK	Piping	NS	E	NSC	No		ASME B31.1
GK	Valves	NS	E	NSC	No		ASME B31.1
GK	Tanks	NS	E	CS	No		AWWA D100/ASME VIII/IBC
GK	Pump	NS	E	NSC	No		ASME B31.1/ANSI (Note 8)
GK	Motors	NS	N/A	NSC	No		(Note 8)
GK	Potable Water System Electrical Distribution Equipment	NS	N/A	NSC	No		(Note 8)
SG, SGA, SGAO, SGM Fire Water Supply System							
SGA	Fire Water Distribution System Underground Piping, including valves and hydrants, Turbine Island Loop and Cooling Tower Loop (Not providing Safe Shutdown Equipment Protection following an SSE)	NS-AQ	D	NSC	No	UZT	NFPA 24 NFPA 25 NFPA 214 NFPA 804 (Note 8)
SGA	Fire Water Distribution System Underground Piping, Including valves and hydrants, to UHS Makeup Water Intake Structure (Protecting Shutdown Equipment Protection following an SSE)	NS-AQ	D	CS-I	Yes	UZT	NFPA 24 NFPA 25 NFPA 804 ANSI/ASME B31.1 ASME III (seismic qualification methodology only) ASCE 4-98 (Notes 5 & 8)
SGA, SG	Fire Water Distribution System Aboveground Piping, including valves and suppression system inside the Fire Protection Building	NS-AQ	D	CS-I	Yes	USG	NFPA 13 NFPA 25 NFPA 804 ANSI/ASME B31.1 ASME III (seismic qualification methodology only) (Notes 5 & 8)

Editors Note: See Insert for Table 3.2-1

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Table 3.2-1 Insert

KKS System or Component Code	SSC Description	Safety Classific-ation	Quality Group Classific-ation	Seismic Category (Note 2)	10CFR50 Appendix B Program (Note 5)	Location (Note 3)	Comments/ Commercial Code (Note 9)
SGA	Fire Water Distribution System, Conventional Area (Safe Shutdown Equipment Protection) Underground Loop	NA-AQ	D	CS-I	Yes	UZT	NFPA 24 NFPA 25 NFPA 804 ANSI ASME B31.1 ASME III (seismic qualification methodology only) ASCE 4-98 (Notes 5 & 8)

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Table 3.2-1— {Classification Summary for Site-Specific SSCs}

(Page 6 of 11)

KKS System or Component Code	SSC Description	Safety Classification (Note 1)	Quality Group Classification	Seismic Category (Note 2)	10CFR50 Appendix B Program (Note 5)	Location (Note 3)	Comments/ Commercial Code (Note 9)
USG	Fire Water Storage Tanks	NS-AQ	D	CS-I	Yes	USG/ UZT	NFPA 20 NFPA 22 NFPA 25 AWWA D100 ACI 349/ANSI/AISC N690/ASCE 4-98 ~~ASCE 43~~ ANSI/ASME B31.1 ~~ASCE 4~~ (Notes 5 & 8)
USQ	Fire Protection Building	NS-AQ	N/A	CS-I	Yes	USG/UZT	~~ASCE 43~~ ACI 349 (Note 5) ANSI/AISC N690
SGM	Diesel Engine Driven Fire Pumps and Drivers, subsystems, including diesel fuel oil supply piping	NS-AQ	D	CS-I	Yes	USG	NFPA 20 NFPA 25 NFPA 804 ANSI/ASME B31.1 ASME III (seismic qualification methodology only) IEEE 344 (Notes 5 & 8)
SGM	Standby Diesel Generator for Fire Protection Building Ventilation System and subsystems including diesel fuel oil supply	NS-AQ	D	CS-I	Yes	USG	NFPA 110 NFPA 804 NEMA NG-1-2003 (Note 8)
SGM	Electric Motor Driven Fire Pump and Driver	NS-AQ	D	NSC	No	USG	NFPA 20 NFPA 25 NFPA 804 IBC (Note 8)
SA	Ventilation Equipment and Ductwork, Supporting Diesel Driven Fire Pumps	NS-AQ	D	CS-I	Yes	USG	NFPA 20. NFPA 90A ASME AG-1 ASME N-509 (Notes 5 & 8)
SA	Ventilation Equipment and Ductwork, Not Supporting Diesel Driven Fire Pumps	NS-AQ	D	NSC	No	USG	NFPA 20. NFPA 90A IBC (Notes 5 & 8)
SGM	Electric Motor Driven Fire Jockey Pump and driver	NS-AQ	D	NSC	No	USG	NFPA 20 NFPA 25 NFPA 804 IBC (Note 8)

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Table 3.2-1— {Classification Summary for Site-Specific SSCs}
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KKS System or Component Code	SSC Description	Safety Classification (Note 1)	Quality Group Classification	Seismic Category (Note 2)	10CFR50 Appendix B Program (Note 5)	Location (Note 3)	Comments/ Commercial Code (Note 9)

9. Applicable Code Editions

Commercial Code	Edition
ASME III	2004
ANSI/HI 2.3	2000
ANSI/HI 9.8	1998
ACI 349	ACI 349-01/349R-01, 2001
ANSI/AISC N690	1994 (R2004)s2
IBC	2006 (w/ 2007 supplements)
ASME B31.1	2004
ASME Section VIII	2004
DOT Standard	Latest editions endorsed by DOT regulations in 10 CFR Title 49
NFPA 13	2007
NFPA 14	2007
NFPA 20	2007
NFPA 22	2003
NFPA 24	2007
NFPA 25	2002
NFPA 90A	2002 (with 2003 & 2005 errata)
NFPA 214	2005
NFPA 804	2006
ASME/ANSI N509	2002 (w/ 2003, 2005 errata)
ASME AG-1a	2003 w/ 2004 addenda
~~ASCE 43~~	~~2005~~
ASCE 4	1998, reprinted in 2000
AWWA D100	2005
AWWA	Latest editions issued as of detailed design
ANSI/AISC 341	2005
AISC 360	2005
ACI 318-05/318R-05	2005

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Editor's Note: This is the last paragraph in FSAR Section 3.7.2.8.

The Circulating Water Makeup Intake Structure above ground steel structure is designed to the same requirements as a Seismic Category I structure. Therefore, its design methodology meets SRP Section 3.7.2 Acceptance Criterion 8.C.

The Conventional Seismic Unit 3 Sheet Pile Wall is located approximately 30 ft (9.1 m) from the north end of the Seismic Category I Buried Intake Pipes. The layout of the Sheet Pile Wall and the separation distance between the Sheet Pile Wall and the Seismic Category I Buried Intake Pipes precludes any potential interaction between the Sheet Pile Wall and the Seismic Category I Buried Intake Pipes. The existing Baffle Wall is approximately 46 ft (14.0 m) above the bed of the intake area and is located approximately 50 ft (15.2 m) from the north end of the Seismic Category I Buried Intake Pipes. Therefore, the interaction of the Baffle Wall with the Buried Intake Pipes is not possible.

The Conventional Seismic Unit 3 Sheet Pile Wall and the Baffle Wall are both Conventional Seismic structures which meet SRP Section 3.7.2 Acceptance Criterion 8.A. SRP Section 3.7.2 Acceptance Criterion 8.A is only applicable to Conventional Seismic structures. The SRP Section 3.7.2 Acceptance Criterion 8.A is not applicable to a Conventional Seismic-I (CS-I) structure. CS-I is the designation of Conventional Seismic for an SSC which must remain functional during and after an SSE.

3.7.2.9 Effects of Parameter Variations on Floor Response Spectra

In-structure response spectra are smoothed and the peaks associated with each of the structural frequencies are broadened according to procedure described in RG 1.122 (NRC, 1978). This accounts for uncertainties in the structural frequencies owing to uncertainties in the material properties of the structure and soil, approximation in the modeling techniques used in the seismic analysis and the effect of potential concrete cracking.

3.7.2.10 Use of Constant Vertical Static Factors

No departures or supplements.

3.7.2.11 Method Used to Account for Torsional Effects

For the CBIS, both inherent and accidental torsional effects are accounted for in the seismic design. The inherent torsion effects are built into the 3D finite element model used for the SSI analysis.

The seismic inertia force at each story level is calculated using the maximum absolute structural accelerations in each horizontal direction, provided in Table 3.7-8, and the horizontal mass at that level. The accidental torsional moment is determined as the story inertia force times a moment arm equal to ±5 percent of the building plan dimension in the perpendicular direction, in accordance with NUREG-0800 Section 3.7.2, Acceptance Criterion 11 (NRC, 2007a). These moments are then used to calculate the in-plane shear forces in the walls, which are used for structural design. The responses from earthquakes in three orthogonal directions are combined in accordance with the co-directional response combination provisions of FSAR Section 3.7.2.6.

3.7.2.12 Comparison of Responses

As multiple seismic analysis methods are not employed for the site-specific Seismic Category I structures, a comparison of responses is not applicable.

3.7.2.13 Methods for Seismic Analysis of Category I Dams

No departures or supplements.

3.7.2.14 Determination of Dynamic Stability of Seismic Category I Structures

3.7.2.14.1 Nuclear Island Common Basemat Structures

The methodology to perform dynamic stability evaluation of the Nuclear Island Common Basemat Structures is incorporated by reference to U.S. EPR Section 3.7.2.14.

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Table 3.8-2— {Stability Evaluation Results for the CBIS}

Load Combination (LC)	Factors of Safety (FOS) Sliding	Overturning	Flotation
D + H + W	106 → ~~188~~	2.1 → ~~1.84~~	-
D + H + Wt	11.9 → ~~23.4~~	1.6 → ~~1.83~~	-
D + H + E → ~~D + H + E'(1)(2)~~	1.1 → ~~1.41~~	1.2 → ~~1.9~~ → ~~2.83~~	-
D + F'(1) → ~~D+H+E(1)(3)~~	- → ~~1.29~~	- → ~~1.26~~	1.33 → ~~—~~
D + H + PMH → ~~D+F'(4)~~	28.1 → ~~-~~	1.2 → ~~-~~	- → ~~1.83~~
D + H + SPH → ~~D + H + PMH~~	66.4 → ~~7.97~~	1.5 → ~~1.69~~	-

Notes:

1. ~~Friction (traction) between side wall and backfill is utilized.~~ ← The factor of safety against flotation (D+F') is governed by the PMH draw-down condition.

~~2. Factors of Safety computed from SASSI SSI analysis.~~

~~3. Factors of Safety computed from STAAD analysis. Due to the conservatism in the SSE accelerations applied, the SASSI analysis results will be more accurate and should be used. The STAAD values are given for comparison purposes only.~~

~~4.~~ The factor of safety against flotation (D+F') is governed by the PMH draw-down condition.

The changes shown in black boxes and in black strike through were made by the responses to RAI 315, Question 3.07.02-64, RAI 339 Questions 03.08.04-33 and -34, and RAI 343 Questions 03.07.02-71 through -74.

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Table 3.8-5— {Observed Chemical Properties of Groundwater}

Properties	Surficial aquifer	Upper Chesapeake unit
pH (average)	5.2	7.4
Sulfate (ppm, maximum)	68.6	365
Chloride (ppm, maximum)	47.4	370

Notes:
Sulfate and chloride concentrations indicate the maximum observed values at the powerblock and intake areas.
ppm = parts per million.

INSERT 6

Editor's Note: This Insert 6 was added in the response to RAI 378, Question 03.07.02-75.

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Editor's Note: This Insert 6 (Table 3.8-6 shown in black text) was added in the response to RAI 378, Question 03.07.02-75.

INSERT 6

Table 3.8-6— {Fire Protection Conventional Seismic-I SSC Seismic Design Criteria Summary}

Site-Specific FPS CS-I SSC	Seismic Input	Seismic Model	Methods of Seismic Analysis	Acceptance Criteria	Codes and Standards
Buried FPS Piping	CCNPP Unit 3 Site SSE	As described for SC I buried piping in CCNPP Unit 3 FSAR Section 3.8.4.4.5	As described for SC I buried piping in CCNPP Unit 3 FSAR Section 3.8.4.4.5	As described for SC I buried piping in CCNPP Unit 3 FSAR Section 3.8.4.4.5	As described for SC I buried piping in CCNPP Unit 3 FSAR Section 3.8.4.4.5
FPS HVAC Ducts and Supports	CCNPP Unit 3 Site SSE or appropriate ISRS created from site-specific SSE	As described for SC I HVAC Ducts and supports in CCNPP Unit 3 FSAR Appendix 3A.2	As described for SC I HVAC Ducts and supports in CCNPP Unit 3 FSAR Appendix 3A.2	As described for SC I HVAC Ducts and supports in CCNPP Unit 3 FSAR Appendix 3A.2	As described for SC I HVAC Ducts and supports in CCNPP Unit 3 FSAR Appendix 3A.2
FPS Mechanical & Electrical Equipment and supports	CCNPP Unit 3 Site SSE or appropriate ISRS created from site-specific SSE	As described for SC I mechanical & electrical equipment and supports in CCNPP Unit 3 FSAR Section 3.10 markup	As described for SC I mechanical & electrical equipment and supports in CCNPP Unit 3 FSAR Section 3.10 markup	As described for SC I mechanical & electrical equipment and supports in CCNPP Unit 3 FSAR Section 3.10 markup	As described for SC I mechanical & electrical equipment and supports in CCNPP Unit 3 FSAR Section 3.10 markup
Above Ground FPS Piping and Supports	CCNPP Unit 3 Site SSE or appropriate ISRS created from site-specific SSE	As described in CCNPP Unit 3 FSAR Section 3.9.3	As described in CCNPP Unit 3 FSAR Section 3.9.3	As described in CCNPP Unit 3 FSAR Section 3.9.3	As described in CCNPP Unit 3 FSAR Section 3.9.3

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3A CRITERIA FOR DISTRIBUTION SYSTEM ANALYSIS AND SUPPORT

This section of the U.S. EPR FSAR is incorporated by reference.

{with supplements described in the following sections}

{3A.2 Heating, Ventilation, and Air Conditioning Ducts and Supports
Fire Protection Building related HVAC ductwork and its associated support structures, designated as Conventional Seismic-I (CS-I), will follow the same seismic analysis and design methodology including seismic modeling, acceptance criteria and codes and standards, as described for Seismic Category I HVAC ductwork and its associated support structures in US EPR FSAR Appendix 3A.2, except that the seismic input will be based on site-specific SSE.}

Editor's Note: These text inserts shown in black were added in the response to RAI 378, Question 03.07.02-75

or appropriate ISRS created from site-specific SSE

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Enclosure 3

**Table of Changes to CCNPP Unit 3 COLA
Associated with the Response to
RAI 396, Questions 03.07.02-76 and 03.07.02-77,
Calvert Cliffs Nuclear Power Plant, Unit 3**

Table of Changes to CCNPP Unit 3 COLA

Associated with the Response to RAI No. 396

Change ID #	Subsection	Type of Change	Description of Change
Part 2 – FSAR			
CC3-11-0221	Table 3.2-1	Incorporate COLA markups associated with the response to RAI 253[6].	The response to RAI 253 Question 03.07.02-45 involved changing the seismic category of "II-SSE" to be "II" on Page 5 of 10 of Table 3.2-1 in the row for "Fire Water Distribution System, including valves and hydrants, Balance of Plant (Safe Shutdown Equipment Protection following SSE)."
CC3-11-0221	Table 3.2-1	Incorporate COLA markups associated with the response to RAI 253[6].	The response to RAI 253 Question 03.07.02-45 involved changing the seismic category of "II-SSE" to "CS" and the 10 CFR 50 Appendix B Program entry from "Yes" to "No" on Page 5 of 10 of Table 3.2-1, in the rows for "Fire Water Storage Tanks," "Fire Protection Building," "Diesel Engine Driven Pumps and Drivers and subsystems, including diesel fuel oil supply," and "Ventilation Equipment."
CC3-11-0221	Table 3.2-1	Incorporate COLA markups associated with the response to RAI 253[6].	The response to RAI 253 Question 03.07.02-45 involved changing the seismic category of "II-SSE" to be "II" on Page 6 of 10 of Table 3.2-1 in the rows for "Fire Suppression Systems for UHS Makeup Water Intake Structure and Fire Protection Building," and "Standpipes and Hose Stations for UHS Makeup Water Intake Structure."
CC3-11-0221	Table 3.2-1	Incorporate COLA markups associated with the response to RAI 253[6].	The response to RAI 253 Question 03.07.02-45 involved deleting the "II-SSE" definition from Note 2 of FSAR Table 3.2-1.

[6] UniStar Nuclear Energy Letter UN#12-074, from Mark T. Finley to Document Control Desk, U.S. NRC, Response to Request for Additional Information for the Calvert Cliffs Nuclear Power Plant, Unit 3, RAI 253, Seismic System Analysis, dated July 31, 2012

Change ID #	Subsection	Type of Change	Description of Change
CC3-13-0063	Table 3.2-1	Incorporate COLA markups associated with the response to RAI 378[4].	Added rows for, "Fire Water Distribution System Aboveground Piping, including valves and suppression system inside the Fire Protection Building," "Ventilation Equipment and Ductwork, Not Supporting Diesel Driven Fire Pumps," "Instrumentation and Controls in the Fire Protection Building Supporting the Fire protection System Classified as Seismic Category-I," and "Fire Protection System Electrical Distribution System" as part of the RAI 378, Question 03.07.02-75 response. Also, added the Conventional Seismic-I classification to Note 2 and made other changes under the "SG, SGA, SGAO, SGM Fire Water Supply System" and "Fire Suppression Systems" headings of the table as part of the RAI 378, Question 03.07.02-75 response
CC3-13-0134	Table 3.2-1	Incorporate COLA markups associated with the response to RAI 396, Questions 03.07.02-76 and 03.07.02-77 (this response).	Added a row for, "Fire Water Distribution System, Conventional Area (Safe Shutdown Equipment Protection) Underground Loop" as part of the response to RAI 396, Questions 03.07.02-76 and 03.07.02-77 (this response). Added ACI 349 to the Fire Protection Building Commercial Code column and also struck ASCE 43 and ASCE 4 from the Fire Water Storage Tanks Commercial Code column as part of the response to RAI 396, Questions 03.07.02-76 and 03.07.02-77 (this response).
CC3-13-0082	Table 3.8-2	Incorporate COLA markups associated with the response to RAI 315, Question 3.07.02-64 [7], the RAI 339 Questions 03.08.04-33 and -34[8], and the RAI 343 Questions 03.07.02-71 through -74 response[2].	Text, Figure, and Table changes in Sections 3.7 and 3.8 required as part of the response to RAI 315, Question 3.07.02-64, the RAI 339 Questions 03.08.04-33 and -34, and the RAI 343 Questions 03.07.02-71 through -74 response.

[7]UniStar Nuclear Energy Letter UN#13-056, from Mark T. Finley to Document Control Desk, U.S. NRC, Response to Request for Additional Information for the Calvert Cliffs Nuclear Power Plant, Unit 3, RAI 315, Seismic System Analysis, dated April 30, 2013.

Change ID #	Subsection	Type of Change	Description of Change
CC3-13-0134	Table 3.8-2	Incorporate COLA markups associated with the response to RAI 396, Questions 03.07.02-76 and 03.07.02-77 (this response).	Corrected a Factor of Safety (FOS) number as part of the response to RAI 396, Questions 03.07.02-76 and 03.07.02-77 (this response).
CC3-13-0063	Table 3.8-6	Incorporate COLA markups associated with the response to RAI 378[4].	Added new Table 3.8-6, "Fire Protection Conventional Seismic-I SSC Seismic Design Criteria Summary" as part of the RAI 378, Question 03.07.02-75 response.
CC3-13-0134	Table 3.8-6	Incorporate COLA markups associated with the response to RAI 396, Questions 03.07.02-76 and 03.07.02-77 (this response).	Added the words, "or appropriate ISRS created from site-specific SSE" to the last three entries in the "Seismic Input" column as part of the response to RAI 396, Questions 03.07.02-76 and 03.07.02-77 (this response).
CC3-13-0063	3A	Incorporate COLA markups associated with the response to RAI 378[4].	One supplement was added to Section 3A, "Criteria for Distribution System Analysis and Support" (3A.2 Heating, Ventilation, and Air Conditioning Ducts and Supports) as part of the RAI 378, Question 03.07.02-75 response.
CC3-13-0134	3A	Incorporate COLA markups associated with the response to RAI 396, Questions 03.07.02-76 and 03.07.02-77 (this response).	Added the words, "or appropriate ISRS created from site-specific SSE" to the 3A.2 paragraph as part of the response to RAI 396, Questions 03.07.02-76 and 03.07.02-77 (this response).

[8]UniStar Nuclear Energy Letter UN#13-057, from Mark T. Finley to Document Control Desk, U.S. NRC, Response to Request for Additional Information for the Calvert Cliffs Nuclear Power Plant, Unit 3, RAI 339, Other Seismic Category I Structures, dated April 30, 2013.