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UniStar
NUCLEAR ENERGY

10 CFR 50.4
10 CFR 52.79

February 22, 2011

UN#11-085

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 145, Foundations

References:

1) Surinder Arora (NRC) to Robert Poche (UniStar Nuclear Energy), "FINAL RAI No 145 SEB 2197" email dated August 27, 2009

2) UniStar Nuclear Energy Letter UN#10-246 from Greg Gibson to Document Control Desk, U.S. NRC, Response to Request for Additional Information for the Calvert Cliffs Nuclear Power Plant, Unit 3, RAI 145, Foundations, dated September 21, 2010

3) UniStar Nuclear Energy Letter UN#10-193 from Greg Gibson to Document Control Desk, U.S. NRC, Response to Request for Additional Information for the Calvert Cliffs Nuclear Power Plant, Unit 3, RAI No. 144, Other Seismic Category I Structures, and RAI 145, Foundations, dated July 23, 2010

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 27, 2009 (Reference 1). This RAI addresses Foundations, as discussed in Section 3.8 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 7.

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Reference 2 stated that UniStar Nuclear Energy would provide responses to Question 03.08.05-02 and Question 03.08.05-04 by March 31, 2011. This date was based on the expected schedule for seismic reconciliation of the CCNPP Unit 3 FSAR following completion of the NI finite element model (FEM) and other updates that are being prepared for the U.S. EPR FSAR.

UniStar Nuclear Energy has elected to provide response to these questions based upon the information contained in Revision 2 of the U.S. EPR FSAR and Revision 7 of the CCNPP Unit 3 COLA. It is recognized that ongoing discussions between AREVA and the NRC will likely result in new COL applicant items for FSAR Section 3.8.5.5. Those new applicant items will be addressed following AREVA issuance of Revision 3 of the U.S. EPR FSAR. The enclosure provides our response to RAI No. 145, Question 03.08.05-02 and the NI portions of Question 03.08.05-04 and includes revised COLA content. A Licensing Basis Document Change Request has been initiated to incorporate these changes into a future revision of the COLA.

A partial response addressing the Emergency Power Generation Buildings (EPGBs) as discussed in CCNPP Unit 3 COLA FSAR Section 3.8.5.5.2 and the Essential Service Water Buildings (ESWBs) as discussed in Section 3.8.5.5.3 was provided in Reference 3.

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. Wayne A. Massie at (410) 470-5503.

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

Executed on February 22, 2011

Greg Gibson

Enclosure: Response Summary for Request for Additional Information, RAI No. 145, Foundations, 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
Getachew Tesfaye, NRC Project Manager, U.S. EPR DC Application (w/o enclosure)
Charles Casto, Deputy Regional Administrator, NRC Region II (w/o enclosure)
Silas Kennedy, U.S. NRC Resident Inspector, CCNPP, Units 1 and 2
U.S. NRC Region I Office

GTG/SJS/mdf

Enclosure

Response Summary for Request for Additional Information
RAI No. 145, Foundations

Calvert Cliffs Nuclear Power Plant Unit 3

RAI No. 145

Question 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?

Response

The Calvert Cliffs site-specific settlement as discussed in Section 2.5.4.10 of Revision 7 of the CCNPP Unit 3 FSAR is less than the U.S. EPR differential settlement limit of ½ inch in 50 feet. As shown in COLA FSAR Table 2.5-69 the maximum tilt in the Nuclear Island is 0.32 inches per 50 ft. The following responses are based upon information presented in Revision 7 of the CCNPP Unit 3 COLA and Revision 2 of the U.S. EPR FSAR.

1. The U.S. EPR standard design differential settlement analysis is performed using the ANSYS finite element overall computer model of the Nuclear Island (NI) Common Basemat Structure. Modeling details of the buildings of the NI Common Basemat Structure are provided in U.S. EPR FSAR Tier 2, Sections 3.8.1.4.1, 3.8.3.4.1, 3.8.4.4.2 and 3.8.5.4.2. Site specific differential settlement values from CCNPP Unit 3 COLA FSAR Section 2.5.4.10 are reconciled to the U.S. EPR differential settlement model.

2. The U.S. EPR standard design differential settlement consists of tilt and flexure which are caused by elastic and consolidation settlements. The elastic settlement is captured by soil

case specific soil springs; the tilt settlement is modeled as rigid body rotation around the East-West (X) axis of the NI Common Basemat Structure, and the consolidation settlement is assumed as explained in U.S. EPR FSAR Section 3.8.5.5.1. CCNPP Unit 3 COLA FSAR Section 3.8.5.5.1 is revised as shown in the COLA markups to indicate that site-specific differential settlement is within the U.S. EPR standard design limit.

3. During development of the standard soil profile spring stiffness it was found that the displacement of the NI Common Basemat Structure is greatest toward the Fuel Building and least toward Safeguard Buildings 2 & 3. Therefore, tilt settlement was imposed in the North-South direction only. Flexural effects due to settlement are considered independently in both principal directions.

4. The total differential displacement consists of linear (rigid body tilt) and flexure. The site specific reconciliation demonstrated that there is no departure from the standard design for tilt or flexure.

5. The U.S. EPR standard design limit for differential settlement of ½ inch in 50 feet accounts for increased flexure and shear in the foundation due to elastic and consolidation settlements, and is verified for acceptance on a site-specific basis. For the CCNPP Unit 3 COLA FSAR, flexure was not increased since the site-specific flexure producing differential settlement was found to be enveloped by the softest U.S. EPR soil case.

The U.S. EPR is designed for application at sites where the foundation conditions do not have extreme variation within the foundation footprints. CCNPP Unit 3 COLA FSAR Section 2.5.4.10 evaluated the uniformity of the foundation support media. The site-specific differential settlement values along with model description and factors considered as part of the site-specific settlement calculation are provided in CCNPP Unit 3 COLA FSAR Section 2.5.4.10.

COLA Impact

CCNPP Unit 3 COLA FSAR Table 2.0-1 will be revised as shown in a future revision of the COLA:

	U.S. EPR FSAR Design Parameter Value	**CCNPP Unit 3 Site Characteristic Value**
Maximum Differential Settlement (across the basemat)	1/2 inch in 50 feet in any direction	≤ ½~~-1~~ inch in 50 ft for common Basemat. ~~(note a)~~ (See Sections 2.5.4~~ and 3.8.5.5.1~~) > ½ inch in 50 ft for both EPGB and ESWB (note a) (See Sections 2.5.4, 3.8.5.5.2, and 3.8.5.5.3)

CCNPP Unit 3 COLA FSAR Section 2.5.4.10.2.2 will be revised as shown in a future revision of the COLA:

2.5.4.10.2.2 Settlement and Heave Analysis in the CCNPP Powerblock Area

. . .

Conclusions – Settlement Analysis

. . .

The U.S. EPR FSAR Section 2.5.4.10.2 identifies differential settlement as a required parameter to be enveloped, defined as "½ inch per 50 ft in any direction across the foundation basemat of a Seismic Category I structure" and that "values larger than this may be demonstrated acceptable by performing additional site specific evaluations."

The estimated differential settlements for ESWB 1 and ESWB 2 do not meet the U.S. EPR FSAR requirement of ½ inch per 50 ft (or 1/1,200) and EPGB 1 is at ½ inch per 50 ft (see Table 2.5-69); however, additional site specific evaluations will be performed to demonstrate their acceptability, as follows.

. . .

CCNPP Unit 3 COLA FSAR Section 3.8.5.5.1 will be revised as shown in a future revision of the COLA:

3.8.5.5.1 Nuclear Island Common Basemat Structure Foundation Basemat

{No departures or supplements.}

~~{The following departure is taken from U.S. EPR FSAR Section 3.8.5.5.1. The standard design of Seismic Category I foundations for the U.S. EPR is based on a maximum differential settlement of ½ inch in 50 ft in any direction across the foundation. These standard design values are specified in the U.S. EPR FSAR Sections 2.5.4.10.2 and 3.8.5.5.1, and tabulated in U.S. EPR FSAR Tier 1 Table 5.0-1. The expected site-specific values for settlement of the CCNPP Unit 3 NI Common basemat foundation are in the range of 1/600 (1 inch in 50 ft) to 1/1200 (½ inch in 50 ft) as stated in Section 2.5.4.~~

~~To account for the Calvert Cliffs site-specific expected differential settlement values, an evaluation of differential settlements up to 1 inch in 50 ft was performed. A static analysis was performed of the foundation structures assuming this site-specific differential settlement value. The static analysis was performed using the same finite element model developed by AREVA for the standard plant differential settlement criteria of ½ inch in 50 ft. The finite element model is analyzed using the QA verified software ANSYS V10.0 SP1.~~

~~The evaluation consisted of a static finite element analysis of the foundation structures which considered the effects of the higher expected displacement (tilt) on the foundation bearing pressures and basemat stress due to structural eccentricities resulting from a uniform rotation of the foundation mat along the axis of the NI Common basemat. 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. The evaluation considered Soil Case SC15, from the U.S. EPR FSAR standard design, which represented the softest soil condition used in the U.S. EPR standard plant design and exhibits the largest differential displacements of the basemat.~~

~~The displacement is defined per length of the structure, 1 inch in 50 ft. The displacement of the NI common basemat is greatest along the North/South axis at the Fuel Building (FB) and least along this axis at Safeguard Building 2 and 3 (SB 2/3). Therefore, the NI model is rotated around the X-axis (West/East axis). The overall length of the NI basemat from the North end to the South end is approximately 344 ft (105 m). Since an initial settlement of 1 inch in 50 ft is considered, the NI structure has an initial displacement of approximately 7.0 inches (17.8 cm), or approximately 0.1 degrees.~~

~~Results from the evaluation indicate there is negligible difference in both the soil bearing pressures and the stresses in the concrete basemat structure when the NI is subjected to an initial settlement of 1 inch in 50 ft as compared to an initial settlement of ½ inch in 50 ft established in the U.S. EPR standard plant.~~

~~There is a negligible difference in both the bearing pressures and the stresses in the basemat when the NI is subjected to structural eccentricities associated with a 7 inch (17.8 cm) basemat differential displacement representing a settlement value of 1 inch in 50 ft. Therefore, the site-specific departure in differential settlement values is structurally acceptable.}~~

CCNPP Unit 3 COLA Part 7, Departures and Exemption Requests Section 1.1.1 and 1.2.1 will be revised as shown in a future revision of the COLA:

1.1.1 MAXIMUM DIFFERENTIAL SETTLEMENT (ACROSS THE BASEMAT)

Affected U.S. EPR FSAR Sections: Tier 1 Table 5.0-1, Tier 2 Table 2.1-1, Tier 2 Section 2.5.4.10.2

Summary of Departure:

The U.S. EPR FSAR identifies a maximum differential settlement of 1/2 inch in 50 feet (i.e., 1/1200) in any direction across the basemat. The estimated settlement values for ~~the Nuclear Island common basemat,~~ Emergency Generating Building foundations~~,~~ and Essential Service Water System Cooling Tower foundations exceed the U.S. EPR FSAR value.

Extent/Scope of Departure:

This Departure is identified in CCNPP Unit 3 FSAR Table 2.0-1 and Section 2.5.4.10.2.

Departure Justification:

~~The estimated site-specific values for settlement of the CCNPP Unit 3 Nuclear Island common basemat foundation are in the range of 1/600 (1 inch in 50 feet) to 1/1200 (1/2 inch in 50 feet) as stated in FSAR Section 2.5.4.10.2.~~

~~As described in FSAR Section 3.8.5.5.1, to account for the Calvert Cliffs site-specific expected differential settlement values, an evaluation of differential settlements up to 1/600 (1 inch in 50 feet) was performed. The evaluation consisted of a static finite element analysis of the foundation structures which considered the effects of the higher expected displacement (tilt) on the foundation bearing pressures and basemat stress due to structural eccentricities resulting from a uniform rotation of the foundation mat along the axis of the nuclear island common basemat. 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. The evaluation considered Soil Case SC15, from the U.S. EPR FSAR standard design, which represented the softest soil condition used in the U.S. EPR standard plant design and exhibits the largest differential displacements of the basemat. Results from the evaluation indicate there is negligible difference in both the soil bearing pressures and the stresses in the concrete basemat structure when the Nuclear Island is subjected to an initial settlement of 1/600 (1 inch in 50 feet) as compared to the U.S. EPR standard plant analysis results that were based on an initial settlement of 1/1200 (1/2 inch in 50 feet). Therefore, the site specific departure in differential settlement values is structurally acceptable.~~

The estimated site-specific differential settlement for the Emergency Power Generating Buildings and Essential Service Water System Cooling Towers (based on a fully flexible basemat) are 1/1166 and 1/845 (approximately ½ and ¾ inch in 50 ft), respectively, as stated in FSAR Section 2.5.4.10.2.

As described in Sections FSAR 3.8.5.5.2 and 3.8.5.5.3, finite element analyses were performed for the Emergency Power Generating Buildings and Essential Service Water System Cooling Towers using soil springs representing the CCNPP Unit 3 site. For each structure, the differential settlement within the confines of the building periphery is shown to be substantially less than the 1/1200 (1/2 inch in 50 feet) requirement of the U.S. EPR FSAR.

The variation of the finite element analysis differential settlement with the estimated differential settlements of Section 2.5.4.10.2 is attributed to the conventional geotechnical treatment of the foundation as a flexible plate, a condition much more conservative than the actual heavily stiffened (by deep reinforced concrete walls) 6'-0" thick reinforced concrete Emergency Power Generating Building and Essential Service Water System Cooling Tower basemats.

Finite element analyses were also performed to evaluate the effects of overall Emergency Power Generating Building and Essential Service Water System Cooling Tower tilts of L/550 and L/600, respectively, where L is the least basemat dimension. For these analyses:

- Spring stiffnesses are adjusted to achieve a tilt of L/550,
- The elliptical distribution of soil springs is maintained,
- Soil spring stiffnesses along the basemat centerline (perpendicular to the direction of tilt) are retained, and
- Adjustment is made to all other springs as a function of the distance from the

basemat centerline to the edges.

Bending moments from these finite element analyses confirm that an uncracked condition of the Emergency Power Generating Building and Essential Service Water System Cooling Tower basemats is maintained.

Departure Evaluation:

This Departure, associated with the maximum differential settlement of ~~the Nuclear Island common basemat,~~ the Emergency Power Generating Building foundations~~,~~ and Essential Service Water System Cooling Tower foundations, has been evaluated and determined to not adversely affect the safety function of these structures. Accordingly, the Departure does not:

1. Result in more than a minimal increase in the frequency of occurrence of an accident previously evaluated in the plant-specific FSAR;
2. Result in more than a minimal increase in the likelihood of occurrence of a malfunction of a structure, system, or component (SSC) important to safety and previously evaluated in the plant-specific FSAR;
3. Result in more than a minimal increase in the consequences of an accident previously evaluated in the plant-specific FSAR;
4. Result in more than a minimal increase in the consequences of a malfunction of an SSC important to safety previously evaluated in the plant-specific FSAR;
5. Create a possibility for an accident of a different type than any evaluated previously in the plant-specific FSAR;
6. Create a possibility for a malfunction of an SSC important to safety with a different result than any evaluated previously in the plant-specific FSAR;
7. Result in a design basis limit for a fission product barrier as described in the plant-specific FSAR being exceeded or altered;
8. Result in a departure from a method of evaluation described in the plant-specific; or
9. FSAR used in establishing the design bases or in the safety analyses.

This Departure does not affect resolution of a severe accident issue identified in the plant-specific FSAR.

Therefore, this Departure has no safety significance.

and

1.2.1 MAXIMUM DIFFERENTIAL SETTLEMENT (ACROSS THE BASEMAT)

Applicable Regulation: 10 CFR Part 52

The U.S. EPR FSAR Tier 1 Table 5.0-1, Tier 2 Table 2.1-1, and Tier 2 Section 2.5.4.10.2 identify a maximum differential settlement of ½ inch in 50 feet (i.e., 1/1200) in any direction across the basemat. The estimated settlement values for ~~the Nuclear Island common basemat,~~ Emergency Generating Building foundations~~,~~ and Essential Service Water System Cooling Tower foundations exceed the U.S. EPR FSAR value.

Pursuant to 10 CFR 52.7 and 10 CFR 52.93, Calvert Cliffs 3 Nuclear Project, LLC, and UniStar Nuclear Operating Services, LLC, request an exemption from compliance with the U.S. EPR FSAR Tier 1 and 2 requirements associated with the maximum differential settlement.

Discussion:

~~The estimated site-specific values for settlement of the CCNPP Unit 3 Nuclear Island common basemat foundation are in the range of 1/600 (1 inch in 50 feet) to 1/1200 (½ inch in 50 feet) as stated in FSAR Section 2.5.4.10.2.~~

~~As described in FSAR Section 3.8.5.5.1, an evaluation of differential settlements up to 1/600 (1 inch in 50 feet) was performed. The evaluation consisted of a static finite element analysis of the foundation structures which considered the effects of the higher expected displacement (tilt) on the foundation bearing pressures and basemat stress due to structural eccentricities resulting from a uniform rotation of the foundation mat along the axis of the nuclear island common basemat. 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. The evaluation considered Soil Case SC15, from the U.S. EPR FSAR standard design, which represented the softest soil condition used in the U.S. EPR standard plant design and exhibits the largest differential displacements of the basemat. Results from the evaluation indicate there is negligible difference in both the soil bearing pressures and the stresses in the concrete basemat structure when the Nuclear Island is subjected to an initial settlement of 1/600 (1 inch in 50 feet) as compared to the U.S. EPR standard plant analysis results that were based on an initial settlement of 1/1200 (½ inch in 50 feet). Therefore, the site specific departure in differential settlement values is structurally acceptable.~~

The estimated site-specific differential settlement for the Emergency Power Generating Buildings and Essential Service Water System Cooling Towers (based on a fully flexible basemat) are 1/1166 and 1/845 (approximately ½ inch and ¾ inch in 50 ft), respectively, as stated in FSAR Section 2.5.4.10.2.

As described in Sections FSAR 3.8.5.5.2 and 3.8.5.5.3, finite element analyses were performed for the Emergency Power Generating Buildings and Essential Service Water System Cooling Towers using soil springs representing the CCNPP Unit 3 site. For each structure, the differential settlement within the confines of the building periphery is shown to be substantially less than the 1/1200 (½ inch in 50 feet) requirement of the U.S. EPR FSAR.

The variation of the finite element analysis differential settlement with the estimated differential settlements of Section 2.5.4.10.2 is attributed to the conventional geotechnical treatment of the foundation as a flexible plate, a condition much more conservative than the actual heavily stiffened (by deep reinforced concrete walls) 6'-0" thick reinforced concrete Emergency Power Generating Building and Essential Service Water System Cooling Tower basemats.

Finite element analyses were also performed to evaluate the effects of overall Emergency Power Generating Building and Essential Service Water System Cooling Tower tilts of L/550 and L/600, respectively, where L is the least basemat dimension. For these analyses:

- Spring stiffnesses are adjusted to achieve a tilt of L/550,
- The elliptical distribution of soil springs is maintained,
- Soil spring stiffnesses along the basemat centerline (perpendicular to the direction of tilt) are retained, and
- Adjustment is made to all other springs as a function of the distance from the basemat centerline to the edges.

Bending moments from these finite element analyses confirm that an uncracked condition of the Emergency Power Generating Building and Essential Service Water System Cooling Tower basemats is maintained.

This change associated with the maximum differential settlement of ~~the Nuclear Island common basemat,~~ the Emergency Power Generating Building foundations~~,~~ and Essential Service Water System Cooling Tower foundations, has been evaluated and determined to not adversely affect the safety function of these structures. Therefore, this change will not result in a significant decrease in the level of safety otherwise provided by the design described in the U.S. EPR FSAR.

The exemption is not inconsistent with the Atomic Energy Act or any other statute. As such, the requested exemption is authorized by law.

This change does not result in a departure from the design and does not require a change in the design described in the U.S. EPR FSAR. In addition, the change has been evaluated and determined to not adversely affect the safety function of the associated structures. Therefore, the requested exemption will not present an undue risk to the public health and safety.

The change does not relate to security and does not otherwise pertain to the common defense and security. Therefore, the requested exemption will not endanger the common defense and security.

The special circumstance necessitating the request for exemption is that the CCNPP Unit 3 ~~Nuclear Island common basemat, the~~ Emergency Power Generating Building foundations~~,~~ and Essential Service Water System Cooling Tower foundations estimated settlement values exceed the U.S. EPR FSAR value. However, the CCNPP Unit 3 specific maximum differential settlement of ~~the Nuclear Island common basemat,~~ the Emergency Power Generating Building foundations~~,~~ and Essential Service Water System Cooling Tower foundations, has been evaluated and determined to not adversely affect the safety function of these structures. As such, application of the regulation for this particular circumstance would not serve the underlying purpose of the rule and is not required to achieve the underlying purpose of the rule.

This requested exemption does not require a change in the design described in the U.S. EPR FSAR. Therefore, this exemption will not result in any loss of standardization.

For these reasons, Calvert Cliffs 3 Nuclear Project, LLC, and UniStar Nuclear Operating Services, LLC, request approval of the requested exemption from compliance with the U.S. EPR FSAR Tier 1 and 2 requirements associated with maximum differential settlement.

RAI No. 145

Question 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?

Response

A partial response addressing the Emergency Power Generation Buildings (EPGBs) as discussed in CCNPP Unit 3 COLA FSAR Section 3.8.5.5.2 and the Essential Service Water Buildings (ESWBs) as discussed in Section 3.8.5.5.3 was provided in UN#10-193[1].

The following response pertains to the Nuclear Island (NI) as discussed in Section 3.8.5.5.1.

CCNPP Unit 3 COLA FSAR Section 3.8.5.5.1 is no longer a departure and will be revised as shown in the response to CCNPP Unit 3, RAI 145 Question 03.08.05-2 above.

The response to RAI 145 Question 03.08.05-1 provided in UN#10-193[1] contains a discussion on site specific stability considerations.

CCNPP Unit 3 COLA FSAR Section 2.4.12.5 states that the post-construction groundwater

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[1] UniStar Nuclear Energy Letter UN#10-193 from Greg Gibson to Document Control Desk, U.S. NRC, Response to Request for Additional Information for the Calvert Cliffs Nuclear Power Plant, Unit 3, RAI No. 144, Other Seismic Category I Structures ,and RAI No. 145, Foundations, dated July 23, 2010.

elevation at the NI is more than the 3.3 ft below grade required by the U.S. EPR FSAR. The effect of saturated soil from groundwater is considered in the following ways:

1. The subgrade modulus was determined from the settlement analysis that considered the moist unit weight for the backfill and the saturated unit weights for all soils under EL. 38 ft.

   Drained conditions were considered for the backfill, Chesapeake IIb sand, Chesapeake IIc sand, and Nanjemoy sand layers, since:

   a. backfill is placed above the groundwater table, and

   b. Chesapeake IIb, IIc, and Nanjemoy sand layers have high enough permeability to prevent generation of excess pore pressures.

   Undrained conditions were considered for the Chesapeake IIc clay layer. The subgrade modulus calculation considered both immediate settlement and consolidated settlement, which is due to the dissipation of the excess pore pressures generated under undrained conditions.

2. A parametric study was performed on the effect of groundwater on the SSI response by varying the groundwater elevation. It was found that there is no significant change in the In-Structure Response Spectrum (ISRS). For more information including quantitative results, see the response to CCNPP Unit 3, RAI 179 question 03.07.01-14, Part 4. Provided in UN#09-519[2].

3. For the bearing capacity calculations, the groundwater table is conservatively assumed at EL. 83 ft (grade elevation) outside the NI and at EL. 38 ft inside the NI. Therefore, backfill and underlying soils are considered saturated and thus effective unit weights are used in the calculations.

4. The response to RAI 145 Question 03.08.05-1 in UN#10-193[1] contains a discussion on site specific stability considerations.

5. The lateral soil pressure considered in the U.S. EPR FSAR considers a saturated soil with pressures due to the submerged unit weight. The buoyancy load due to a submerged Basemat is also taken into consideration.

COLA Impact

The COLA will not be revised as a result of this response.

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[2] UniStar Nuclear Energy Letter UN#09-519 from Greg Gibson to Document Control Desk, U.S. NRC, Update to Calvert Cliffs Nuclear Power Plant, Unit 3 FSAR Section 3.7 and response to FSAR Section 3.7 RAI sets 19, 25, 58, 63, 65, 112, 113, 139, 158,159, 167, 168, 179, 180, 181, and 193, dated December 29, 2009.