CCNPP3eRAIPEm Resource

From: Steckel, James
Sent: Thursday, November 04, 2010 1:56 PM
To: Poche, Robert; cc3project@constellation.com; Scott, Roger D
Cc: CCNPP3eRAIPEm Resource; Cook, Christopher; Wang, Weijun; Cruz, Zahira; Colaccino, Joseph; Wilson, Anthony
Subject: FINAL RAI 268 RGS2 5120
Attachments: Final RAI 268 RGS2 5120.docx

Rob,

Attached please find the subject request for additional information (RAI) The draft of this RAI was sent to you on October 21, 2010. A clarification phone call requested by UniStar was held on November 3-4, 2010, which resulted in no changes to the draft RAI questions.

The schedule we have established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs. For any RAIs that cannot be answered within 30 days, it is expected that a schedule date for submitting your technically correct and complete response will be provided to the staff within the 30 days period so that the staff can assess how this information will impact the review schedule.

Your response letter should also include a statement confirming that the response does or does not contain any sensitive or proprietary information.

Thank you,

Jim Steckel

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Request for Additional Information No. 268 (eRAI 5120)

11/4/2010

Calvert Cliffs Unit 3
UniStar
Docket No. 52-016
SRP Section: 02.05.04 - Stability of Subsurface Materials and Foundations
Application Section: 2.5.4

QUESTIONS for Geosciences and Geotechnical Engineering Branch 2 (RGS2)

02.05.04-24

02.05.04-24 (Determining the extent of the excavation)
In response to RAI Question 02.05.04-04, you stated that to confirm that the excavation has reached the load bearing Stratum IIb-Chesapeake Cemented Sand, two methods may be used: (1) proof rolling the entire excavated area until the grade offers a relatively unyielding surface; (2) dynamic cone penetration (DCP), and/or sand-cone in-situ compaction testing methods. Since the proof rolling method may not be a practical and reliable method to identify a specific soil layer, and since one of the indications of the Stratum IIb-Chesapeake Cemented Sand is that the SPT N-value is greater than 20 for the top layer of this stratum, please provide the following information:

1. Clearly specify which method(s) will be used during excavation to ensure the excavation reaches Stratum IIb; and
2. Provide the correlation between the SPT N-values and the values obtained from the field compaction test method (DCP and/or sand cone tests); or justify why the proposed field compaction tests can identify the Stratum IIb soil.

These clarifications will assist the staff determine if the proposed methods ensure that the excavation reaches the designed load bearing layer, thus meeting the design requirement and ensuring the stability of foundations in accordance with 10 CFR 100.23.

02.05.04-25

02.05.04-25 (Bearing capacity calculation)
In response to RAI Question 02.05.04-15, you described three methods used in a static bearing capacity sensitivity analysis and compared the analysis results. In order for the staff to complete a detailed review and to ensure the stability of foundations in accordance with 10 CFR 100.23, additional details and explanation are needed. Specifically provide the following:

1. Describe how the foundation dimensions were determined and used as input in the Slope/W and Plaxis 2D analyses. Also describe if non-uniform loading condition(s) on the foundation were considered.
2. Figures 6 and 7 in the RAI response present the ultimate bearing capacity analysis results, and you stated that the ultimate bearing capacity was reached when “a significant decrease in stiffness was observed” during the Plaxis 2D

model analysis. Describe and justify the criterion that was used to determine the stiffness that corresponds to the ultimate bearing capacity.

02.05.04-26

02.05.04-26 (Settlement calculation -1)
In response to RAI Question 02.05.04-17, you provided settlement analysis results using the Soil Hardening (SH) constitutive model and the Middle Topography 2 (MT2) model. In order for staff to complete a detailed review to ensure the stability of foundations in accordance with 10 CFR 100.23, please provide the following information:

1. You state that the MT2 model is discussed in Section 2.5.4.10 of the FSAR, however the staff could not find any mention of the MT2 model in this section. Please explain this discrepancy.
2. For both the MT2 and SH models analyses, discuss a) the adequacy of finite element mesh size, which can affect the plastic model analysis results; b) the effect of distances between the edge of the foundations and the fixed boundary elements; and c) the effect of non-uniform loading conditions.
3. In Part 2 of your response, you estimated the potential for liquefaction related settlement using both Tokimantsu and Seed, and Lee methods, and presented the results in Tables 4 and 5 of this RAI response. The calculated values for t_0/s_0 and $[t_0/s_0]_M$ in Table 4, and values under "Conditional" and e_v[%] columns do not agree with the expressions for $CSR_{7.5}$ and e_c provided in this RAI response. Please explain.
4. Tables 13 and 14 in Part 3 of your response provide comparisons of building center settlements and tilts using the best estimate and the lower bound soil property parameters in the MT2 models. Although the lower bound parameters are based on the 16^{th} percentile, the approach is reasonable due to the notable variations in soil parameters. Analysis results show that the maximum total settlement will exceed 20 inches and the tilt will exceed 1.0 in/ 50 ft with the lower bound soil parameters. Since the standard design tilt differential settlement limit is 0.5 in/ 50 ft and the requested departure and exemption in this COL application is 1.0 in/ 50 ft, please discuss and justify the adequacy of the departure and the exemption of differential settlement that is requested in the CCNPP COL application
5. In Part 5 of your response, you state that the Boussinesq solution is used in a hand calculation of settlement because "both theory and experience have shown that the shape of the pressure bells (induced stress distribution) is more or less independent of the physical properties of the loaded subsurface. That is, the stress increase due to external loads is not a function of soil properties." You also state that the comparison of the two approaches (Boussinesq solution and PLAXIS 2D finite element model) indicated that the difference between the theoretical solution without any stiffness input and a layered subsurface model is marginal. Please provide additional information on the following items:

   a) Provide references that support the statement, "both theory and experience have shown that the shape of the pressure bells (induced stress distribution) is more or less independent of the physical properties

of the loaded subsurface" for layered soil since it is well known that the Boussinesq solution is an elastic solutions based on assumptions of load acting on a weightless material in a linear-elastic homogeneous isotropic half-space and not subject to initial stress. Experience has shown that the actual stresses beneath the center of shallow footing may exceed the Boussinesq values by 15 to 30 percent in clays and 20 to 30 percent in sands and that stress distribution in layered soil cannot be accurately estimated by Boussinesq solution without corrections (see Burmister, D. M 1954[1], 1963[2] and 1965[3]).

b) Provide additional details on the differences in the calculated stresses (in percentage), between the theoretical solution without any stiffness input and a layered soil finite element model (PLAXIS 2D model).

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1. Burmister, D. M. 1954. "Influence Diagram of Stresses and Displacements in a Two-Layer Soil System With a Rigid Base at a Depth H," Contract No. DA-49-129-ENG-171 with US Army Corps of Engineers, Columbia University, New York, NY. Available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.
2. Burmister, D. M. 1963. "Physical, Stress-strain, and Strength Responses of Granular Soils," Field Testing of Soils, ASTM Special Technical Publication No. 322, pp 67-97, Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.
3. Burmister, D. M. 1965. "Influence Diagrams for Stresses and Displacements in a Two-Layer Pavement System for Airfields," Department of the Navy, Washington, DC. Available from Department of the Navy, Washington, DC 20350.

02.05.04-27

02.05.04-27 (Settlement calculation -2)
Results of settlement sensitivity analyses show that:

1. Settlements computed using a non-linear Cam-Clay model calibrated to the available tri-axial stress-strain data are on the order of 4.2 ft, as compared to 1.4 ft of settlement estimated using an elastic model.
2. When using the mean consolidation test data to develop Cam-Clay model parameters, settlements of the Nuclear Island are on the order of 2.2 ft. However, if lower bound (16^{th} percentile) test data are used the computed settlements increase to about 5.5 ft.

Since the settlement sensitivity analysis results indicate that the potential differential settlements between buildings may be much greater than those estimated in the FSAR, discuss and justify the following regarding settlement of Category 1 structures and to ensure the stability of foundations at the CCNP site in accordance with 10 CFR 100.23:

1. Given the non-linear character of the soils at the site (as evidenced by the tri-axial tests results), justify the adequacy of the soil models used in predicting settlements for the CCNP site in the FSAR.

2. Given the wide range variation of consolidation properties for the tested soils and a lack of data sufficient to establish a verifiable spatial correlation of the properties, provide an assessment of how large differential settlements will be incorporated into the design of the NI structures given the relatively small differential settlement allowances in the standard design.
3. Given the expected large settlements and potential large differential settlements, sequencing of the construction process will be critical to assuring the assumptions used in the standard design are valid for the site. Provide a detailed discussion of the construction sequencing that will be used to assure that the design basis contained in the standard design is maintained based on the site specific settlement analysis.
4. Recognizing that actual settlements at this site are likely to be highly variable when compared to the settlements estimated prior to construction, settlement monitoring is essential. Please a) discuss why the proposed settlement monitoring program is sufficient; b) provide a detailed description of the actions required to evaluate measured settlements if they are inconsistent with the predictions; and c) discuss potential impacts and actions to the construction sequencing due to settlements that exceed predictions.

02.05.04-28

02.05.04-28 (Lateral earth pressure design envelope)
In response to RAI Question 02.05.04-18, you provided an updated lateral earth pressure analysis results, but did not compare the total lateral earth pressure with the standard design envelope. Clearly identify whether the estimated site-specific lateral earth pressure is enveloped by the standard design and therefore ensures the stability of foundations in accordance with 10 CFR 100.23.