PMBelCOL PEmails

From: Ravindra Joshi
Sent: Monday, July 21, 2008 8:24 AM
To: Ray, Phillip M; Eddie R Grant; bob Hirman
Cc: Clifford Munson; Yong Li; BelCol Resource
Subject: Draft RAIs related to SRP Section 2.5.4 ---Bellefonte Units 3 and 4.
Attachments: RAI 690.doc

To All,
Attached are the Draft RAIs related to SRP section 2.5.4. Please let me know if you would like to discuss the RAIs before they are made official.
Ravi Joshi
415-6191

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Subject: Draft RAIs related to SRP Section 2.5.4 ---Bellefonte Units 3 and 4.
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Request for Additional Information No. 690

Bellefonte Units 3 and 4
TVA
Docket No. 52-014 and 52-015
SRP Section: 02.05.04 - Stability of Subsurface Materials and Foundations
Application Section: 2.5.4

QUESTIONS FROM Geosciences and Geotechnical Engineering Branch 2 (RGS2)

02.05.04-1***

FSAR Section 2.5.4.1.3.1 describes cavities encountered in the borings at the Bellefonte Units 3 and 4 site. The largest cavity discontinuity encountered in the borings within the construction zone is 4 feet while the largest cavity discontinuity encountered in all borings is 8 feet. Please explain the control level on the physical dimension of those cavities outside the bore holes and any potential impact on the stability of the foundation and structure.

02.05.04-2***

FSAR Section 2.5.4 states that the bottom of the foundation basemat is located at an elevation of 588.6 ft. Please describe the minimum dimension of a cavity that could adversely impact both static and dynamic design for the basemat and the intersecting walls, and describe the possibility of encountering this kind of cavity beneath the basemat. In addition, please describe what procedures are to be used during excavation and construction to ensure that any cavities with potentially adverse impact to reactor safety do not exist below the foundation to ensure that the design of the basemat and intersecting walls will not be adversely impacted.

02.05.04-3***

FSAR Section 2.5.4.1.3.2 indicates boring rod drops as much as 12 to 14 ft during the boring process. Please explain if such drops were related to cavities. Please also describe if any of the soft zones described in this Section extend to depths below the basemat.

02.05.04-4***

FSAR Section 2.5.4.1.3.3 describes the irregularity of the rock surfaces and contacts within the construction zone and ascribes this irregularity to the variability of the dissolution weathering front created by the slow downward movement of erosive water through the soil and rock. Please explain how the irregularity of the rock surface beneath the foundation compares to the uniformity criteria presented in the AP1000 DCD.

02.05.04-5***

AP1000 DCD (Rev.16) has site criteria for the lateral variability of the foundation supporting soils. Geologic units inside the Middle Stones River Formation demonstrate different geotechnical properties. For example, FSAR Figure 2.5-299 shows a sharp contrast between Units C and D in terms of their shear wave velocities. Due to the inclining layering at the site, different geologic units will appear beneath the same reactor foundation. For example, Middle Stones River Unit C will support the eastern part of the Unit 3 foundation and Unit D will support the western half of the foundation. Please explain if this subsurface lateral variability meets the minimum requirement of the AP 1000 DCD site criteria on lateral variability. Furthermore, please explain if the inclined geologic boundaries beneath the foundation basemat will affect the surface ground motion estimates and possibly introduce a seismic force concentration.

02.05.04-6***

Based on seismic reflection profiles, FSAR Section 2.5.4.1.3.3 presents P-wave velocity (Vp) contours for two surfaces at 6000 and 14000 ft/sec, respectively (in FSAR Figures 2.5-312 and 313). You also implemented P-S suspension logging to measure the P wave velocity profiles at various borehole locations. Please provide a comparison of the wave velocity profiles obtained from these two different methods. Are these methods consistent in terms of P wave velocity measurements? FSAR Figure 2.5-339 shows a site stratigraphic profile across the site, including borehole locations and corresponding shear wave velocity profiles, as well as Units 3 and 4 foundation profiles. The figure demonstrates that the Unit 3 foundation excavation is located inside the bedrock with a shear wave velocity about 9000 fps and a P wave velocity of about 16000 fps. FSAR Figure 2.5-314, however, shows a large area underneath Unit 3 where the top of the 14000 fps (Vp) layer is below elevation 588.6 ft. Please explain the discrepancy.

02.05.04-7***

Section 2.5.4.1.3.3 describes weathering zones (Eastern and Western Anomaly Zones) extending to great depths (as much as 90 ft) in comparison to the design depth of the basemat (40 ft). Please demonstrate the locations for the two anomalies relative to the Unit 3 and 4 nuclear islands and explain if there is any impact from the weathering zones to the GMRS calculation.

02.05.04-8***

FSAR Section 2.5.4.1.3.3 states that “most of the rock containing cavities was … removed, leaving only isolated cavities at depth. Cavities encountered at the base of the excavation were small and were grouted.” If the same procedure will be used in the construction of Units 3 and 4, please state whether such a visual inspection can guarantee that no larger cavities exist below the excavation limit. Provide a detailed description of the grouting program. In addition, please explain if the grouting procedure should be included in the ITAAC or post-COL activities. Are there any special criteria to be used for specification of dental grouting? Please explain the basis for saying “to clean all cavities down to the minimum depth of two times the width,” and provide more detail to describe the “wedging effect” mentioned in the FSAR.

02.05.04-9***

FSAR Section 2.5.4.1.3.3 also indicates that a grouting program was adopted for Units 1 and 2 which includes treatment for cracks developed during blasting. Please provide a detailed description of the blasting program and explain how you plan to ensure that unnecessary fracturing of the in-situ rock will not occur. Please explain why this program was not included as part of the ITAAC.

02.05.04-*10**

FSAR Section 2.5.4.1.5 indicates that all safety-related facilities will be located on fresh or hard rock, or on fill concrete placed over fresh or hard rock. Please describe the criteria to be used for placement of fill concrete. Specifically, explain if the concrete is to have a shear wave velocity (stiffness and strength) equivalent to that of the hard rock. Is it to be placed in lifts so as not to adversely influence its in-situ velocities?

02.05.04-*11**

FSAR Section 2.5.4.5.2.1 indicates that analysis shows that factors of safety for the excavation slope are greater than 2.0 at a 1.5:1 inclination. Please describe the slope analysis method and provide details of the slope safety factor evaluation.

02.05.04-12***

FSAR Section 2.5.4.5.2.1 states that "kinematic analyses … and an average assumed interface friction value of 35°, bedding plane failure is not a viable failure mode." Please describe your rationale for assuming a 35° interface friction value and explain why bedding failure is not a viable failure mode.

02.05.04-13***

FSAR Section 2.5.4.5.4 states that the space between the edge of the concrete basemat for the nuclear islands and the rock excavation will be filled in with backfill material consisting of lean concrete. Please specify the strength of the concrete to be used for lean concrete mixtures.

02.05.04-14***

FSAR Section 2.5.4.5.4 states that backfill soil will be placed adjacent to the exterior walls of the nuclear islands. Please provide an evaluation of compaction-induced additional loads acting on the exterior walls of nuclear islands. Please explain why this is not included as part of the ITAAC to confirm that the in-situ properties of the backfill material are acceptable after compaction.

02.05.04-15***

FSAR Section 2.5.4.6.3 describes the issues related to previous construction dewatering, related to Units 1 and 2. Please provide a detailed dewatering plan for the COLA site. Please explain why the water level reduction effort is slight and provide evidence that the reduction in the perched water will have a minimum impact on the settlement of the adjacent ground during the construction and post-construction periods.

02.05.04-16***

Please include in FSAR Section 2.5.4.7.3 a reference to the resonant column torsional shear (RCTS) results (FSAR Table 2.5-245).

02.05.04-17***

FSAR Section 2.5.4.8 states that the clayey and stiff nature of the native residual soil and fill exhibit a low susceptibility to liquefaction. You performed a liquefaction screening assessment in conformance with Regulatory Guide 1.198 to demonstrate the low liquefaction hazard associated with the residual soils and fill beneath the Units 3 and 4 power blocks. RG 1.198 Section C indicates that the initial phase of a site characterization program includes borings with SPT or CPT tests to determine the penetration resistance and soil characteristics for measuring classification and water content. RG 1.198 Section 1.2 provides guidance in adjustment of N values for evaluation of the liquefaction potential. Please explain the reason for not using the SPT data obtained from the soil investigations to perform the liquefaction potential assessment at the Units 3 and 4 site. In addition, provide the adjusted N data from the SPT test for the Bellefonte Nuclear (BLN) site to justify that the liquefaction threshold criteria is satisfied from the BLN site data, including the Category I structures and other non-safety related construction sites. Please describe if the shear wave velocity was used as a threshold to evaluate the liquefaction potential at the BLN site.

02.05.04-18***

FSAR Section 2.5.4.10.1 states that the bearing capacity was evaluated for each Unit using two independent methods. Method 1 uses the ultimate bearing capacity of the Terzaghi approach based on the strength of the rock mass. Due to the finite dimension of the Bellefonte Nuclear (BLN) island designs, the Terzaghi equation originally developed for infinite base needs to be modified to incorporate the correction factor for parameters Nc and Nr to take into account the footing finite geometry configuration, such as rectangular or circular, etc.. Furthermore, due to the non-symmetrical configuration of the footing of the nuclear island designs, the consequences of the eccentric loading need to be considered during the bearing capacity evaluation. Please explain whether the geometric correction factors were incorporated into your use of the Method 1 approach for the bearing capacity evaluation. If not, please update the bearing capacity values for the Method 1 approach with the correction factors. Please explain whether the effect of the eccentricity of the loading applied to the footing was considered for the bearing capacity investigation. If not, please update the bearing capacity analysis with the eccentric loading consideration.

02.05.04-19***

FSAR Section 2.5.4.10.4.1 states that estimates of post-construction settlement were calculated separately for Units 3 and 4 based on the theory of elasticity. Settlements were estimated by three methods. The maximum estimated settlement is 0.18 inches beneath Unit 3 and 0.2 inches beneath Unit 4. Please provide more details on the settlement calculations from each method, i.e. methodology, assumptions, use of settlement-time curve, etc… Please provide a comparison of the results obtained from each method.

02.05.04-20***

FSAR Section, 2.5.4.10.4.2 states that the nuclear island meets the criteria in DCD Table 2-1 for a uniform site, and that, therefore, differential settlement is not a factor. Please explain how and why these nuclear islands meet the uniformity criteria despite the fact that geologic units C and D, with a significant shear wave velocity difference, underlie the Unit 3 nuclear island.

02.05.04-21***

FSAR Section 2.5.4.10.5 states that the earth pressure coefficients for the at-rest and passive conditions determined using the methods described in Reference 462 are illustrated in FSAR Figures 2.5-360 and 2.5-361. FSAR Figure 2.5-360 shows the distribution of earth pressures from the soil backfill (at-rest condition), and, below the water table, the additional pressure caused by the hydrostatic pressure. FSAR Figure 2.5-361 shows the soil passive pressure distribution. No hydrostatic pressure is included in the passive pressure because water has no shear strength and provides no additional passive resistance. Since the hydrostatic associated pressure also contributes to the lateral pressure applied to the nuclear island walls, excluding the hydrostatic pressure from the passive, at-rest, or active earth pressure evaluation is not justified. Please include the hydrostatic pressure into passive or at-rest earth pressure evaluation and revise the contents of FSAR Figs. 2.5-360 and 2.5-361, accordingly.