From: Christian Araguas
Sent: Monday, July 14, 2008 12:26 PM
To: jtdavis@southernco.com
Subject: Draft Questions
Attachments: Draft Questions.doc

Jim,

Attached are the draft question.

Christian

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"jtdavis@southernco.com" <jtdavis@southernco.com>
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Draft Requests for Additional Information Regarding the Southern Nuclear Operating Company Vogtle ESP/LWA Application

<u>RAI 2.4.12-4</u>

Provide input and output files for the following model runs; Model 3, run 305; Model 5, run 504; Model 6, run 612; and Model 7, run 708. Review of these files will enable NRC staff (1) to check the improved modeling effort achieved by Southern (e.g., mass balance, convergence), (2) to better understand the modeling assumptions associated with key regions of the model domain, and (3) to evaluate the key elements of the conceptual model identified by Southern, (e.g., the high hydraulic conductivity region upgradient of Mallard Pond, the low hydraulic conductivity region in the southwest model quadrant, the five recharge zones).

<u>RAI 2.4.12-5</u>

Provide a version of the baseline groundwater model (i.e., the model of the existing water table aquifer) that better honors the field data concerning both (1) the known groundwater high (which lies below the proposed cooling towers) and (2) the topography and flow within the tributary to Daniels Branch (which is to the west of the cooling tower area proposed for Units 3 and 4). A key question before the NRC is whether changes in the hydrology necessary to cause a shift in the groundwater flow path are plausible. Key to addressing that question is to begin with a plausible conservative representation of the existing system.

The plausibility of a groundwater pathway to the west from the power block relies on whether the groundwater high could conceivably shift from its present day location toward, if not into, the proposed power block area. The magnitude of change to the model, (i.e., hydraulic conductivity of engineered backfill, infiltration rate throughout the area disturbed by construction), need only be sufficient to move the hydraulic high of the model from the cooling tower area toward the power block area. Model 7 places the hydraulic high substantially south of the cooling towers, roughly doubling the distance that the groundwater high would need to move. Changes made to the model to represent the future conditions are in the vicinity of the power block and cooling tower areas (i.e., construction zone), and, hence, in the immediate vicinity of the present-day groundwater high. With the simulated present-day groundwater high removed from this region, the model changes can not directly impact the simulated groundwater high.

The fidelity of the model with respect to simulation of the tributary to the Daniels Branch is also of concern. According to the wetland report submitted by Southern (see January 2007 submittal), the tributary to Daniels Branch that lies to the west of the cooling tower area includes segments of ephemeral stream (adjacent to OW-1007), and wetland and perennial stream. The perennial stream is upstream of Lower Debris Basin 2. The baseline model could exhibit groundwater flow toward each of these segments of the stream during the wetter period of the year, (e.g., March), and should do so for the perennial stream segment. In the real setting based on groundwater observations, groundwater flow occurs from the proposed cooling tower area to the tributary to Daniels Branch; however in the simulated setting it does not. Furthermore, the potentiometric surface shown for Model 7 (see Figure 50) suggests that groundwater flow occurs across or through the streambed and continues in a northerly direction even though the topographic data suggests the streambed is below the groundwater level in this vicinity. For some reason the groundwater does not appear to acknowledge the presence of the streambed. The perennial stream segment may be better represented by a constant head boundary condition rather than a “drain.”

RAI 2.4.12-6

Provide a further review of the assignment of infiltration rates with special attention to the potential for higher infiltration in the immediate vicinity of the groundwater high which occurs beneath and adjacent to the proposed cooling towers for Units 3 and 4. The presence of highs or lows in the potentiometric surface of an aquifer suggests sources or sinks of groundwater, respectively. In the case of a broad region of uniform hydraulic conductivity, the presence of a groundwater high suggests a topographic high or a greater amount of infiltration. The region of interest is an area that was reshaped during construction of the existing units, and as a result it is relatively flat and may present an opportunity for minimal runoff and maximum recharge. In addition, the presence of asphalt roadways and concrete pads may contribute to runoff to areas prone to infiltration (unlined ditches, water retention basins) with infiltration rates locally approaching if not exceeding precipitation because of the collection area aspect of ditches and basins.

RAI 2.4.12-7

Based on the improved baseline model incorporating the further review of infiltration rate assignments – this would be the most plausible conservative conceptual model of today’s site - provide an analysis of (1) the magnitude of change in hydraulic conductivity, if any, that would cause a groundwater flow path to exist to the west or southwest from the power block area, (2) the spatial distribution and magnitude of infiltration rate changes, if any, that would cause a groundwater flow path to exist to the west or southwest of the power block area, and (3) combinations of the above. These results would form the basis for a suite of post-construction simulations.

RAI 2.5.2-25

The staff’s review of Subsection 2.5.2.9.2 of the Vogtle ESP application, Revision 4, and Westinghouse Report SV0-1000-S2C-802 found that the difference between the site amplification from the 2D SASSI site response analysis (with the “Bath-tub” effect) and the site amplification from the 1D SHAKE results for the same set of input motion and soil properties (without “bath-tub” effect) is insignificant as shown in Figures 2.5.2-55 through 2.5.2-57. Our review also found that the comparison of floor response spectra from the analyses based on the Vogtle "bathtub" 2D SASSI NI model with those based on the 2D SASSI SSI model with horizontal soil layers shows that the differences are very small (Figures 2.5.2-59 through 2.5.2-64). These review findings are quite different from our past review experience of other licensing review. Please provide the following, as appropriate, to support your technical basis:

(a) At some reference locations, a comparison of transfer functions from 2D SASSI (“bath-tub” effect of backfill soil with no structures included in the model) analyses with those from 1D SHAKE analyses, and

(b) At some reference locations in the structural model, a comparison of transfer functions from 2D SASSI (“bath-tub” effect of backfill soil with structures included in the model) analyses with those based on the assumption of uniform layer of backfill (without “bath-tub” effect included).

RAI Appendix 2.5E-1

From our review of Appendix 2.5E, “AP1000 Vogtle Site Specific Seismic Evaluation Report,” to Vogtle ESP Application, Revision 4, Appendix 3G,”Nuclear Island Seismic Analysis,” to AP1000 DCD Section 3.7, and Westinghouse Vogtle Seismic Analysis Report SV0-1000-S2C-802 (at the on-site meeting), “Soil-Structure Analysis of Vogtle site,” the staff identified the following two concerns:

(a) The Zero Period Accelerations (ZPAs) of floor response spectra (at various locations) for the soft-to-medium soil are much higher (a factor of 1.6 to 3.2) than those for the soft soil (AP1000 DCD Figures 3G.3-2 through 3G.3-11). However, the ZPAs of floor response spectra (at various locations) for the ESP soil case (equivalent to the DCD soft soil case) are about the same (slightly higher or lower) as those based on the sensitivity soil case (equivalent to DCD soft-to-medium soil case).

(b) As shown in DCD Figures 3G.3-2 through 3G.3-11, the ZPAs of floor response spectra (at various locations) increase when the floor elevation increases. The range of amplification factor is about 2 to 5.3. However, some deamplification of the ZPAs of floor response spectra were observed.

Please provide justification for these two issues.

<u>RAI Appendix 2.5E-2</u>

During your presentation of Phase 2 of the test backfill program, you stated that the purpose of the MSE wall section construction is to demonstrate the effectiveness of the fill placement and compaction techniques using small-sized compactors within the zone immediately behind the MSE wall in compacting each of the soil types to the required degree of compaction. This description and discussion of the effect of backfill adjacent to the MSE walls on SSI analysis results should be provided in Appendix 2.5E to the ESP SAR in order to support the staffs’ evaluation relative to safety.

<u>RAI 3.8.5-3</u>

Section 3.8.5.1.1, Waterproof Membrane, states that the purpose of the waterproof membrane is to protect the seismic Category I structures from external flooding. Section 3.8.5.1.1 also states that the waterproof membrane to be used at Vogtle is a departure from the DCD, both in material and in location. The waterproof membrane will be located in the middle of the mud mat instead of being at the bottom of the DCD base mat. Due to the change of the location of the waterproof membrane for the mud mat, it is necessary to ensure that the interfaces between the waterproof membrane and the upper and lower mud mats will posses a sufficient coefficient of friction so that the upper portion of the mud mat will not move relative to the lower portion of the mud mat during earthquakes. Section 3.8.5.1.1 also states that a qualification program will be used to demonstrate that the waterproof membrane meet the waterproofing and friction requirements, and the program includes tests simulating field conditions to demonstrate that a minimum 0.7 coefficient of friction is achieved by the mud mad waterproof membrane structural interface. However, there is no discussion on the material properties of the waterproof membrane nor is there any discussion and or data on how it has been used in other structures in which a minimum 0.7 coefficient of friction has been achieved. There is also no discussion on why this type of waterproof membrane can protect the seismic Category I structures from external flooding. Therefore, the staff requests the applicant provide the following:

(a) Provide chemical and structural (mechanical) properties of the waterproof membrane.

(b) Describe whether the waterproof membrane has been used in structures in which a minimum 0.7 coefficient of friction between the waterproof membrane and concrete was achieved.

(c) If no data indicating that a minimum 0.7 coefficient of friction between the waterproof membrane and concrete exist, provide basis for the adequacy of the design assumption that the upper portion of the mud mat will not move relative to the lower portion of the mud mat during earthquakes.

(d) Describe the qualification and test programs and how they can be used to demonstrate that the waterproof membrane meets the waterproofing and friction requirements, as stated in Section 3.8.5.1.1.

RAI 3.8.5-4

Section 3.8.5.1.1 states "For Vogtle Electric Generating Plant (VEGP) Unit 3 and 4 an alternate waterproofing system is presented as a departure from the DCD design." The staff learned that the soils at the bottom of the mud mat are capable of producing only a coefficient of friction of 0.45 instead of 0.7 as stated in DCD Revision 16. Due to the mud mat design departure from the DCD and the decrease of the value of the coefficient of friction, and absence of a description of the impact of these departures on the adequacy of the mud mat and the stability of the nuclear island structure during earthquakes in Section 3.8.5, the staff requests the following:

(a) For stability analysis during earthquakes, state whether the bottom of the mud mat is allowed to move relative to the supporting soils or not. If relative movement is predicted, state the maximum value of the horizontal movement during the SSE and the basis for accepting that amount of movement. If relative movement is not predicted, state the maximum magnitude of the horizontal force generated in the nuclear island structure during the SSE, and the magnitude of frictional force provided at the interface between the mud mat and the supporting soils.

(b) If the magnitude of frictional force provided at the interface between the mud mat and the supporting soils is less than the maximum magnitude of the horizontal force generated in the nuclear island structure during the SSE, state the magnitude of forces due to the passive earth pressure on one side and the active earth pressure on the opposite side of the embedded nuclear island walls generated through the rotation of the nuclear island structure, and describe how these horizontal forces are in equilibrium so that the bottom of the mud mat will not move relative to its supporting soils. At that equilibrium stage, state (1) the rotational angle of the nuclear island structure and the horizontal displacement at the top surface of the soils adjacent to the nuclear island structure during the SSE, and (2) whether or not buoyancy force due to ground water and vertical seismic forces were subtracted from the total weight of the nuclear island.

(c) Describe how the shear loads (or stresses) in different regions of the upper portion of the mud mat are transferred through the waterproof membrane to the lower portion of the mud mat. State the maximum shear load (or stress) in the mud mat and the shear capacity of the waterproof membrane and the mud mat, and describe how these values were derived or obtained.