PMLevyCOLPEm Resource

From: Brian Anderson
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Subject: DRAFT RAIs - 2099, 2244 - SRP section 2.5.4 - Levy County Units 1 and 2 Combined License Application
Attachments: LNP Draft RAI 2099 - 2.5.4.doc; LNP Draft RAI 2244 - 2.5.4.doc

Importance: High

Attached are two draft RAIs related to SRP section 2.5.4 for the Levy County Units 1 and 2 Combined License Application. Please let me know if you would like to schedule a conference call to discuss these RAIs.

Thank you,
Brian

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Request for Additional Information No. 2099
Levy County, Units 1 and 2
Progress Energy Florida, Inc.
Docket No. 52-029 and 52-030
SRP Section: 02.05.04 - Stability of Subsurface Materials and Foundations
Application Section: 2.5.4.10

QUESTIONS for Geosciences and Geotechnical Engineering Branch 1 (RGS1)

02.05.04-***

AP 1000 DCD, Revision 17, Table 2.5-1 provides the limits of acceptable settlement without additional evaluation. The table states that the total settlement for the nuclear island foundation mat is 3 inches and the differential settlement across the nuclear island foundation mat is limited to ½ inch in 50 ft. Additionally, Westinghouse response to RAI-TR85-SEB1-36 corrects Table 2.5-1 of Rev 17, to state that the differential settlement between the nuclear island and the turbine building is limited to 3 inches, and the differential settlement between the nuclear island and other buildings is also limited to 3 inches. The FSAR states that LNP1 and LNP2 nuclear island will be founded on the RCC bridging mat supported by Avon Park limestone, and the turbine building and other buildings surrounding the nuclear island on drilled piers socketed into the Avon Park limestone. The FSAR further states that the design of the drilled piers will be performed during detailed design based on borings located at each drilled pier. Estimates of settlement and monitoring plans for non-safety related structures were not provided in the FSAR, since it was submitted before the settlement criteria of Rev. 17.

Please provide estimates of non-safety related structure settlements and a description of the monitoring program that you will implement to ensure that the actual settlements and differential settlements of the structures relative to the nuclear island do not exceed the DCD settlement criteria.

02.05.04-***

The description provided of the finite element analysis of the coupled RCC bridging mat and rock/void materials does not provide information on the sensitivity of the computed responses (stresses developed in and around the rock mass) to uncertainties and variability in material properties.

Please provide information on sensitivity of calculated stresses and displacements in the Avon Park rock foundation to (a) variability in assumed elastic properties and uniformity of the rock material, and (b) impact of potential void sizes and shapes on calculated stresses and safety factors.

02.05.04-***

Cross-sections are not indicated on Figure 201A as stated in FSAR Section 2.5.4.1.1

Please correct this inconsistency.

DRAFT

02.05.04-***

Section 2.5.4.2.1.1.3 states that the sonic drilling "method is suitable for obtaining a nearly continuous sample for visual inspection in accordance with the requirements in Regulatory Guide 1.132 for continuous sampling."

“I” borings logs were not provided in Appendix B. Please provide the boring logs of borings I-01 to I-10. Please describe the quality of these continuous samples, and discuss how the information derived from the "I" borings were used to characterize the stratigraphic profile.

02.05.04-***

Section 2.5.4.2.1.3 states “An aquifer pumping test was performed in one well (PW-1), and the locations of the pumping and observation wells are shown on FSAR Figure 2.4.12-223.

Please note that this figure does not show the location of the pump test well and observation wells. Please correct this apparent inconsistency.

02.05.04-***

The use of unconfined compression strength results and geologic data were used as input to the empirical Hoek-Brown criteria to determine the average Mohr-Coulomb strength parameters of the Avon Park limestone for stability analyses. The Hoek-Brown method acknowledges limitations to its use, and karstic limestone is not specifically addressed. Among the limitations cited in Brown 2008, are GSI values below 30 and unconfined compressive strengths less than 15 MPa (2175 psi). Table 2.5.4.2-211 indicates a wide range in unconfined compressive strength values, with very low minimums, and presumedly a significant number of test results less than 2175 psi based on the average values and one standard deviation cited in the Table. Additionally, Table 2.5.4.2-213 shows GSI values that fall below 30. The selected value of mi (0.8) is also questioned for the Avon Park limestone, i.e., is this value truly representative of karstic limestone. The staff grants that the method may have applicability for foundations, particularly the bridging mat concept, but the staff questions the use of average values given the geologic uncertainties and great variability in measured engineering properties, and the lack of engineering data on materials filling the discontinuities. Since small changes in Mohr Coulomb strength parameters can affect large differences in computed response, it seems desirable that lower bound values of the rock strength parameters, GSI and mi would provide a stronger basis for establishing the safety of the structure.

Please provide the justification for using average properties over the selection of lower bound properties for the input parameters into the Hoek-Brown method to determine the Mohr-Coulomb strength parameters.

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02.05.04-***

Boring logs for borings E-05, E-06, E-07 and E-08 are not provided in the FSAR.

Please provide all boring logs for review.

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Request for Additional Information No. 2244
Levy County, Units 1 and 2
Progress Energy Florida, Inc.
Docket No. 52-029 and 52-030
SRP Section: 02.05.04 - Stability of Subsurface Materials and Foundations
Application Section: 2.5.4

QUESTIONS for Geosciences and Geotechnical Engineering Branch 1 (RGS1)

02.05.04-***

Section 2.5.4.2.4.3, Rock Elastic Modulus Properties, states that the low strain elastic modulus values were reduced by 50 percent to account for strain-related effects under static loading. Deere et al. proposed a modulus reduction factor for the purpose of reducing the seismic derived elastic modulus to account for the short duration and low stress level. Republished in Figure 3.75, Geotechnical Engineering Investigation Handbook, 2nd edition, by Roy E. Hunt, the figure shows the that a reduction factor of 0.5 would require a rock mass RQD of approximately 70%, which upon a cursory review of Figures 2.5.4.2-202A, 202B, 203A and 203B does not appear to be consistently achieved at the Levy site. Average RQD values were computed for all the A-borings at LNP1 and LNP2, between approximate El. -24 to El. -150. The RQD values ranged from 26 to 55 at LNP1, and 39 to 83 at LNP2. These averages show variability across both power blocks, and according to Figure 3.75 would support variable reduction factors, ranging from 0.1 to 0.5. Additionally, the pressuremeter tests (PMT) performed in borings B-11 and B-19 reveal very low elastic modulii in sharp contrast to the higher elastic modulii computed from the seismic shear wave velocities. It was indicated in the application that the B-11 results represented "worst case" values, however, no tests were performed in no-recovery zones, which may actually result in lower values than tests performed in the fractured rock zones of boring B-11. The application also states that the elastic modulus values derived from the UCS test results were 40% to 90% lower than those computed from the seismic measurements. It is also noted that the intact rock tested for elastic modulus is biased towards the strongest materials sampled. The lack of consistent results between various tests raises the following questions.

a. Please justify the use of a reduction modulus of 0.5 in lieu of the lower modulus suggested by the work of Deere et al described above.

b. How did the lower elastic modulus values from rock UCS testing and pressuremeter testing influence your selection of the elastic modulus values for input in the analyses performed?

c. How was site variability, as might be suggested by the RQD variability observed at the "A" borings, integrated into the analyses?

02.05.04-***

FSAR Section 2.5.4.7, Response of Soil and Rock to Dynamic Loading, states that dynamic tests were not performed as part of the site investigation because of the low seismic environment, foundation configuration and "no site specific soil structure interaction analysis for safety class structures is required".

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Please clarify or justify the statement that “no site specific soil structure interaction analysis for safety class structures is required”.

02.05.04-***

Section 2.5.4.7, “Response of Soil and Rock to Dynamic Loading” states that the materials below the bottom of the nuclear island to an elevation of -99 ft NAVD88 will be improved, and the existing karst features should be eliminated. It does not appear from the geotechnical data presented that sufficient information is known about the distribution of voids to the degree that karst features can be targeted and eliminated.

Please clarify the statement and discuss any plans for additional exploration that you will implement to identify karst features to target during the grouting phase. Please describe how you will assess whether or not the karst features have been eliminated.

02.05.04-***

FSAR Section 2.5.4.8.5, "Results of Liquefaction Analysis" states that Tables 2.5.4.8-202A and 202B contain the Factor of Safety against liquefaction. The table does state that these materials are liquefiable, but does not provide actual factors of safety as stated.

Please correct this apparent inconsistency.

02.05.04-***

FSAR Section 2.5.4.8.5 states that liquefiable zones are isolated, not continuous, and not within the passive wedge of the nuclear island considering sliding. Insufficient information is available in the FSAR to determine the acccuracy of these statements.

Please provide sufficient information for the staff to confirm that the zones are isolated, not continuous, and outside of the passive wedge zone around the nuclear island.

02.05.04-***

The supplement to the COLA identified as paragraph III., "Perimeter Diaphragm Wall Discussion" states that the bonding strength between the grout and the limestone rock is interpreted to be 200 psi based on published data.

a. Please describe how design assumptions will be confirmed during construction of the diaphragm wall.

b. How will the wall be monitored during the excavation stage?

c. Please provide a sample calcuation for the design of a tie-back anchor.

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02.05.04-***

In the supplemental materials identified as paragraph IV., "Permeation Grouting Discussion", it was noted that the uplift analysis indicated sufficient reduction of shear stresses in the grouted rock, and the computed factor of safety exceeded 1.5.

Please provide a sample calcuation of your uplift analysis with figures showing assumptions.

02.05.04-***

FSAR Section 2.5.4.10.4 indicates that the lateral earthquake load includes seismic lateral earth pressures for at-rest conditions and hydrodynamic water thrust. You state that the seismic at-rest pressure is calculated from the Woods' method and hydrodynamic pressure is calculated from the Westergaard method.

Please provide sample calculations of each. Please provide figures that aid in identifying parameters used in the equations.

02.05.04-***

FSAR Section 2.5.4.5.4, "Properties of Backfill Beneath and Adjacent to Nuclear Island" states that you propose to use a "concrete-type" fill material adjacent to the sidewalls of the nuclear islands. Table 2.5.4.5-201 summaries the anticipated engineering properties as having a 28-day compressive strength of 500 psi and a shear wave velocity of 1000 feet per second. No design criteria or standards were given for this low-strength "concrete-type" material. Since the fill material will be placed adjacent to the nuclear island, the appropriate standard is the Code Requirments for Nuclear Safety Related Concrete Structures (ACI 349). The proposed low strength concrete is currently not approved by the ACI standard for use in construction of nuclear safety related structures. Additionally, operating experinence with mud mats beneath foundations indicate leaching of cement by ground water.

Please provide justification for the use of the low strength concrete-type backfill, including the static and dynamic engineering properties, since the backfill is to be placed adjacent to the nuclear island. Please discuss your construction quality control plans for ensuring uniformity of the placement and meeting of applicable design considerations.

DRAFT