TurkeyPointRAIsPEm Resource

From: Comar, Manny
Sent: Tuesday, October 18, 2011 5:19 PM
To: TurkeyPointRAIsPEm Resource
Subject: REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 040 RELATED TO SRP SECTION 02.05.04 FOR THE TURKEY POINT UNITS 6 AND 7 COMBINED LICENSE APPLICATION
Attachments: PTN-RAI-LTR-040.doc

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Subject: REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 040 RELATED TO SRP SECTION 02.05.04 FOR THE TURKEY POINT UNITS 6 AND 7 COMBINED LICENSE APPLICATION
Sent Date: 10/18/2011 5:19:17 PM
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From: Comar, Manny

Created By: Manny.Comar@nrc.gov

Recipients:
"TurkeyPointRAIsPEm Resource" <TurkeyPointRAIsPEm.Resource@nrc.gov>
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October 18, 2011

Mano K. Nazar
Senior Vice President and Chief Nuclear Officer
Florida Power & Light Company
Mail Stop NNP/JB
700 Universe Blvd
Juno Beach, FL 33408-0420

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 040 RELATED TO SRP SECTION 02.05.04 STABILITY OF SUBSURFACE MATERIALS AND FOUNDATIONS FOR THE TURKEY POINT NUCLEAR PLANT UNITS 6 AND 7 COMBINED LICENSE APPLICATION

Dear Mr. Nazar:

By letter dated June 30, 2009, as supplemented by letters dated August 7, 2009, September 3, 2010 and December 21, 2010, Florida Power and Light submitted its application to the U. S. Nuclear Regulatory Commission (NRC) for a combined license (COL) for two AP1000 advanced passive pressurized water reactors pursuant to 10 CFR Part 52. The NRC staff is performing a detailed review of this application to enable the staff to reach a conclusion on the safety of the proposed application.

The NRC staff has identified that additional information is needed to continue portions of the review. The staff's request for additional information (RAI) is contained in the enclosure to this letter.

To support the review schedule, you are requested to respond within 30 days of the date of this letter. If you are unable to provide a response within 30 days, please state when you will be able to provide the response. In the event the response submitted is incomplete, please indicate in the response when the complete response will be provided. If changes are needed to the final safety analysis report, the staff requests that the RAI response include the proposed wording changes. Your response should also indicate whether any of the information provided is to be withheld as exempt from public disclosure pursuant to 10 CFR 2.390.

If you have any questions or comments concerning this matter, you may contact me at 301-415-3863 or manny.comar@nrc.gov.

Sincerely,

/**RA**/

Manny Comar, Lead Project Manager
AP1000 Projects Branch 1
Division of New Reactor Licensing
Office of New Reactors

Docket Nos. 52-040
52-041

Enclosure:
Request for Additional Information

CC: see next page

If you have any questions or comments concerning this matter, you may contact me at 301-415-3863 or manny.comar@nrc.gov.

Sincerely,

/**RA**/

Manny Comar, Lead Project Manager
AP1000 Projects Branch 1
Division of New Reactor Licensing
Office of New Reactors

Docket Nos. 52-040
52-041
eRAI Tracking No. 6006

Enclosure:
Request for Additional Information

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NRO-002

OFFICE	RGS2/BC	NWE1/PM	NWE1/L-PM
NAME	CCook*	MComar*	MComar*
DATE	9/20/11	9/21/11	10/3/11

*Approval captured electronically in the electronic RAI system.

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Request for Additional Information No. 6006

10/18/2011

Turkey Point Units 6 and 7
Florida P and L
Docket No. 52-040 and 52-041
SRP Section: 02.05.04 - Stability of Subsurface Materials and Foundations
Application Section: 2.5.4

QUESTIONS from Geosciences and Geotechnical Engineering Branch 1 (RGS1)

02.05.04-1

FSAR Section 2.5.4.1.2.1 presents a discussion on dissolution activity in the limestone formation, including potential cavities at depths. Among the data sets used to assess the potential existence of cavities is the microgravity data presented in Figures 2.5.4-224 through 231 which provide insights into the existence of potential cavities in at the site. Based on the analysis of gravity data analyses, this section concludes that there are no large cavities underneath the site. In accordance with NUREG-0800, Standard Review Plan, Chapter 2.5.4, "Stability of Subsurface Materials and Foundations," and Regulatory Guide (RG) 1.132, "Site Investigations for Foundations of Nuclear Power Plants" please provide additional discussion on the adequacy of the assumptions used in the microgravity data analyses. Since only profile measurements were made and large gaps remain between profiles throughout the site area, please justify your assumption that no large cavities exist throughout the site. Also, please provide additional references and data sources used to reach this conclusion.

02.05.04-2

FSAR Section 2.5.4.2.1.3.2.2 states that N60 was obtained by applying a correction factor, CE, to the energy ratio. In accordance with NUREG-0800, Standard Review Plan, Chapter 2.5.4, "Stability of Subsurface Materials and Foundations," and Regulatory Guide (RG) 1.132, "Site Investigations for Foundations of Nuclear Power Plants," please justify why other correction factors (e.g., overburden pressure, borehole diameter, rod length and sampling method) were not included in the N-value correction process. Also please describe how the recommended SPT design values in FSAR Table 2.5.4-209 were obtained and how each single value for each stratum could properly and statistically reflect the entire layer variations, as shown on Figure 2.5.4-213 and Table 2.5.4-204.

02.05.04-3

FSAR Subsection 2.5.4.2.2 indicates that adjustments are made to the subsurface investigation including changes to the field testing locations and to the types. Also, the applicant made adjustments to depths and frequencies of sampling. In accordance with NUREG-0800, Standard Review Plan, Chapter

2.5.4, "Stability of Subsurface Materials and Foundations," and Regulatory Guide (RG) 1.132, "Site Investigations for Foundations of Nuclear Power Plants," please provide further information on how and to what extent these adjustments vary from the recommendations provided in RG 1.132 and justify its acceptance for characterizing site subsurface conditions.

02.05.04-4

FSAR Table 2.5.4-205 presents a summary of general physical and chemical properties test results for each subsurface layer. The staff noticed that no results were provided for the Fort Thompson formation (Layer 4). In accordance with NUREG-0800, Standard Review Plan, Chapter 2.5.4, "Stability of Subsurface Materials and Foundations," please provide these results or justify why these results are not needed.

02.05.04-5

FSAR Section 2.5.4.2.1.3.11 states that two different relationships were used to calculate the high strain elastic modulus for fine and coarse grained soils. For fine-grained soils the first correlation is based on the use of an empirical Su and the second is based on the use of Vs. Since SPT N-values were used to calculate Su, and these were considered unreliable because of artesian conditions, and Vs obtained from small strain tests is not suitable to be used for the “high strain” case, please explain, in accordance with NUREG-0800, Standard Review Plan, Chapter 2.5.4, "Stability of Subsurface Materials and Foundations," what correlation was ultimately used to obtain the values for high strain elastic modulus included in FSAR table 2.5.4-209. Also, please explain why other test methods, such as laboratory testing as suggested by RG 1.138, were not applied given the large variability and uncertainty of SPT results.

02.05.04-6

FSAR Section 2.5.4.2.3 “Laboratory Testing” states “due to the fragility of the rock and the porosity of the limestone, attaching strain gages for determination of stress-strain characteristics is not possible for most samples”. In accordance with NUREG-0800, Standard Review Plan, Chapter 2.5.4, "Stability of Subsurface Materials and Foundations," and Regulatory Guide (RG) 1.138, "Laboratory Investigations of Soils and Rocks for Engineering Analysis and Design of Nuclear Power Plants," please justify why only two rock core samples were tested for stress-strain characteristics and why this is sufficient to characterize the Fort Thompson and Key Largo rock formations, especially since the Key Largo will be the bearing layer. Also, please explain how you validated the assumption in FSAR 2.5.4.2.1.3.11 that for rocks the elastic and shear modulus values generally remain constant at both small and large strains.

02.05.04-7

FSAR Table 2.5.4-208 shows that only one triaxial test was completed on an intact soil sample from Tamiami Formation sandy silt (Boring B-630). Also, the recommended effective cohesion and effective friction value for Lower Tamiami in FSAR Table 2.5.4-209 is solely based on the result of this sample. In accordance with NUREG-0800, Standard Review Plan, Chapter 2.5.4, "Stability of Subsurface Materials and Foundations," and Regulatory Guide (RG) 1.138, "Laboratory Investigations of Soils and Rocks for Engineering Analysis and Design of Nuclear Power Plants," please justify why additional triaxial tests are not needed to fully characterize the shear strength parameters of these soils.

02.05.04-8

Section 2.5.4.2.1.3.8 discusses the computation of effective (drained) friction angle in each sand stratum from corrected SPT, CPT and laboratory direct shear test results. However, previous discussion in the FSAR Section 2.5.4.2.1.3.2.1 indicates that the SPT data is suspect due to anomalies of sampling, only 4 CPT profiles are available for use and no direct shear testing results were provided. Correlations of these data to generate typical soil properties are expected to have a high degree of uncertainty. Laboratory tests of these material samples can be expected to be extremely disturbed considering the depth and behavior of materials. In accordance with NUREG-0800, Standard Review Plan, Chapter 2.5.4, "Stability of Subsurface Materials and Foundations," please justify the adequacy of the friction angle. Also, provide detailed information regarding your laboratory direct-shear test program and test results.

02.05.04-9

In accordance with NUREG-0800, Standard Review Plan, Chapter 2.5.4, "Stability of Subsurface Materials and Foundations," please describe how shear and compressive wave velocity values are selected for design in Table 2.5.4-209. Provide correlations for shear and compressive wave velocity between Table 2.5.4-209 and Table 2.5.4-215 to indicate what percentile is used for recommended values. Given the large deviations, especially on Key Largo and Fort Thompson formations (see Figures 2.5.4-218 and 2.5.4-19 and Table 2.5.4-215), explain how the selected single value for each stratum statistically reflects the entire layer.

02.05.04-10

FSAR Figures 203 through 209 indicate one boring for each of the two Units extending to a depth of about 450'. Most other borings taken at the site extend to depths of only about 150'. Figure 2.5.4-220 presents information on shear wave velocity, including best estimate (BE) and upper/lower bound (UB/LB) values down to a depth of about 600'. In accordance with NUREG-0800, Standard Review Plan, Chapter 2.5.4, "Stability of Subsurface Materials and Foundations,"

please indicate how you estimated variations in shear wave velocity based on only two readings over the deeper portion of the profile.

02.05.04-11

Figure 2.5.4-218 presents a plot of shear wave velocity measurements. Below the Fort Thompson formation, the soils are variously described as silty sands or silts and clays. However, the velocities do not show any change with depth. In accordance with NUREG-0800, Standard Review Plan, Chapter 2.5.4, "Stability of Subsurface Materials and Foundations," please indicate the data that was used to construct this figure and explain the uniformity in shear wave velocity below the Fort Thompson formation.

02.05.04-12

Section 2.5.4.5.2 “Extent of Excavations, Fills, and Slopes”, states that the TPNPP Units 6 and 7 nuclear islands will be founded directly on a 20 ft thick lean-concrete layer above a competent rock stratum (Key Largo Formation). In accordance with NUREG-0800, Standard Review Plan, Chapter 2.5.4, "Stability of Subsurface Materials and Foundations," please address the following:

a. Define “Lean Concrete” and clarify if CLSM is used. Also specify which ACI standard(s) will be followed.

b. Given the load path, how is the potential for cracking of the lean concrete evaluated? Also discuss your plan to control thermal cracking of the fill materials.

c. Describe the load transfer mechanism between the base of the NI structures and the lean fill concrete as well as the load transfer between the lean concrete and the surrounding supporting soils.

d. Your chemical tests of soil and rock indicated that that the chemistry of soil and rock is considered to be aggressive towards cementitious materials. Please provide test results on groundwater chemistry including pH, chlorides, and sulfates. Evaluate the potential aging effects and address the concrete durability for lean concrete backfill and sub-foundation due to aggressive soil and groundwater conditions. Also provide a description on how potential settlement and differential settlement due to erosion of cement from porous lean concrete backfill will be addressed.

02.05.04-13

Page 2.5.4-46 mentions an MSE wall that will be use around the perimeter of the plant area. It was stated in the FSAR that this wall is designed to retain the soil mass and resist loading resulting from the probable maximum hurricane. In

accordance with NUREG-0800, Standard Review Plan, Chapter 2.5.4, "Stability of Subsurface Materials and Foundations," please indicate whether the safety of any Seismic category 1 structures is dependent on the MSE wall. Also, please provide a description of this wall's design in the FSAR.

02.05.04-14

FSAR Figure 2.5.4-222 shows a general conceptual excavation cross-section. In accordance with NUREG-0800, Standard Review Plan, Chapter 2.5.4, "Stability of Subsurface Materials and Foundations," please describe the procedures that will be followed during site excavation and construction activity to ensure that the appropriate strata for the proposed foundation locations are confirmed through objective measures and the exposed foundation laying surface is uniform. Also, please provide the vertical and horizontal extent of all seismic categories I excavations, fills, and slopes, including the locations and limits of excavations, fills, and backfills on plot plans and geologic sections and profiles.

02.05.04-15

FSAR Section 2.5.4.7.3.4 provides a justification for use of generic curves for the dynamic properties of the crushed limestone backfill. The nature of this material is unique and potentially not conducive to dynamic testing. In accordance with NUREG-0800, Standard Review Plan, Chapter 2.5.4, "Stability of Subsurface Materials and Foundations," and Regulatory Guide (RG) 1.138, "Laboratory Investigations of Soils and Rocks for Engineering Analysis and Design of Nuclear Power Plants" and in order for the staff to review this issue, please provide additional evaluations, possibly through other types of testing, to justify the use of these generic curves.

02.05.04-16

Section 2.5.4.7.3.3 "Shear modulus and Damping for Rock", indicates that the damping for rock is taken as 1%. The damping shown in Figure 2.5.2-249, which describes the soil properties used to develop the GMRS, indicates that a damping value of 0.5% was used in the analyses. In accordance with NUREG-0800, Standard Review Plan, Chapter 2.5.4, "Stability of Subsurface Materials and Foundations," please provide clarification as to the actual level of damping used in the analyses and provide a basis for its selection considering the large variability in RQD shown in Figure 2.5.4-215.

02.05.04-17

The calculation for "Site Response and Strain Compatible Properties Calculation" Rev. 001 describes the procedure used to calculate stresses in the liquefaction analysis. In accordance with NUREG-0800, Standard Review Plan, Chapter 2.5.4, "Stability of Subsurface Materials and Foundations," and Regulatory Guide

(RG) 1.198, "Procedures and Criteria for Assessing Seismic Soil Liquefaction at Nuclear Power Plant Sites" please clarify the following regarding the methodology used to calculate the CSR (cyclic stress ratio):

a. Clarify how the method used for determining SR_{DRS} meets the ground motion level requirements for liquefaction analysis per 10 CFR 50, Appendix S. The *GRMS* initially resulted in a *PGA* of less than 0.1g and was scaled upwards per RG 1.208. Since the method used for determining the SR_{DRS} is the same as the *GRMS*, describe how this method provides stress ratio values that are comparable to those calculated using a *PGA* value of at least 0.1g.

b. Describe how the amplitude ratio $A_R(f)$, defined by $(ARS_{10\text{-}5})/(ARS_{10\text{-}4})$ and used in the determination of the weighting factor w, correlates to the ratio of the in-situ *stress ratios* resulting from site response analysis using the $ARS_{10\text{-}5}$ and $ARS_{10\text{-}4}$ as input spectrums.

c. The weighting factor *w* applied to the stress ratios $SR_{10\text{-}4}$ and $SR_{10\text{-}5}$ for the determination of SR_{DRS} is based on the average of the weighting factor *W(f).* Justify using an average value of *W(f)* over all frequencies, and describe how this is a conservative approach.

d. Describe how $ARS_{10\text{-}5}$ and $ARS_{10\text{-}4}$ are used as input to the *RVT* for site response, and how this approach correctly accounts for duration effects as compared to time series inputs for the determination of Cyclic Stress Ratio (*CSR)*. Please justify and provide the technical basis of this approach, including any assumptions.

e. Justify use of equations (77) and (78) from Idriss and Boulanger (2008) for determining q_{c1Ncs} values, and how the resulting values are conservative compared to the methods outlined in RG 1.198 using your calculated I_c values.

02.05.04-18

FSAR Section 2.5.4.10.2 describes bearing capacity calculations for the nuclear island foundation. This section states that FSAR Equation 2.5.4-15 was used to calculate the ultimate bearing capacity of the reactor and auxiliary buildings. Also the calculation for COL bearing capacity and settlement analyses states that 20 % of the unconfined compressive strength was used instead. In accordance with NUREG-0800, Standard Review Plan, Chapter 2.5.4, "Stability of Subsurface Materials and Foundations," please clarify on the actual methodology used to calculate the ultimate bearing capacity and justify its applicability. Also, please explain how the unconfined compressive strength parameter values in Table 2.5.4-209 were selected given the large range of values presented in FSAR Figure 2.5.4-217 and Table 2.5.4-207.

02.05.04-19

AP 1000 DCD, Revision 17, Table 2.5-1 provides the total- and differential-settlement limits. The table states that the total settlement limit for the nuclear island foundation mat is 3 inches and the differential settlement limit across the nuclear island foundation mat is 0.5 inch in 50 ft. Rev.18 revised Table 2.5-1, to state that the total settlement for the nuclear island foundation mat is limited to 6 inches; however, the differential settlement limit across the nuclear island foundation mat remained 0.5 inch in 50 ft . In accordance with NUREG-0800, Standard Review Plan, Chapter 2.5.4, "Stability of Subsurface Materials and Foundations,":

a. Please update the settlement calculations based on the DCD Rev.18 applied contact pressure for Reactor Building of 8.9 ksf instead of the 8.6 ksf stated in FSAR Rev. 2.

b. Provide additional information describing the differential settlement calculations across the nuclear island foundation mat since values appears to exceed the acceptable limits in DCD Table 2.5-1.

c. Provide a description of the monitoring program that will implemented to ensure that the actual settlements and differential settlements of the structures relative to the nuclear island do not exceed the DCD settlement criteria.

d. Provide additional explanation on why and how a dynamic shear modulus degradation curve was used to compute static unidirectional settlements.

02.05.04-20

FSAR Subsection 2.5.4.10.3 indicates that the stress distribution used for the settlement calculation was based on Boussinesq distribution. The Boussinesq distribution is based on the assumption that the soil is a homogeneous, linear elastic, isotropic half-space media. In accordance with NUREG-0800, Standard Review Plan, Chapter 2.5.4, "Stability of Subsurface Materials and Foundations," please justify how this method is applicable for the site since a considerable variation in Elastic modulus was reported in the FSAR.

02.05.04-21

The lateral earth pressure diagrams shown in Figure 2.5.4-239 and Figure 2.5.4-240 indicates that the data source is Reference 205. This reference appears to be unrelated to the subject of the figures. Please clarify.

02.05.04-22

The lateral earth pressure diagram shown in Figure 2.5.4-240 shows a plot corresponding to the dynamic lateral earth pressure. The shape of this plot appears to be consistent with the shape for dynamic pressure considering a rigid structural wall (see ASCE 4). In Section 2.5.4.10.4.2 “Seismic Lateral Earth Pressures”, the active seismic pressure was computed using the Mononobe-Okabe equation. The last sentence of the section indicates that at-rest pressure as a function of depth for below-grade walls is developed consistent with Reference 277 (ASCE-4) using the design ground motion. It is noted that the pressure developed using the ASCE-4 methodology uses the zpa value from the input motion.

Figure 2.5.2-252 shows the input motion (GMRS) developed for the site, the GMRS is located at Elevation 35. In this Figure the zpa is approximately 0.058g. However, the elevation of the GMRS is considerably lower than the surface of the soils adjacent to the basement walls that are to be evaluated for seismic lateral earth pressure. In accordance with NUREG-0800, Standard Review Plan, Chapter 2.5.4, "Stability of Subsurface Materials and Foundations," please clarify on the definition of the design ground motion, and how that motion is consistent with Appendix S to 10CFR50.

02.05.04-23

FSAR Section 2.5.4.10.4.3 states that a surcharge pressure of 500 psf was included when calculating the lateral earth pressures, however the calculation for COL static and seismic lateral earth pressures states that the adjacent building loads and the equipment loads were not considered. In accordance with NUREG-0800, Standard Review Plan, Chapter 2.5.4, "Stability of Subsurface Materials and Foundations," please describe the selection of 500 psf.

02.05.04-24

FSAR Section 2.5.4.10.4 states that the active seismic lateral earth pressures were computed using the Mononobe-Okabe methodology and ASCE Standard 4-98 was used to calculate the at-rest seismic lateral earth pressures. The calculation for COL static and seismic lateral earth pressures calculates at-rest seismic lateral earth pressures using Ostadan method. In accordance with NUREG-0800, Standard Review Plan, Chapter 2.5.4, "Stability of Subsurface Materials and Foundations," please clarify which method was ultimately used for design purposes and provide a justification regarding why ASCE Standard 4-98 was referenced in the FSAR and not Ostadan’s method.