PMLevyCOLPEm Resource

From: Brian Anderson
Sent: Friday, April 24, 2009 12:04 PM
To: robert.kitchen@pgnmail.com; david.waters@pgnmail.com; tillie.wilkins@pgnmail.com; PMLevyCOLPEm Resource
Subject: DRAFT RAIs - 2474, 2495, 2514, 2516 - SRP sections 2.5.1, 2.5.2, 2.5.3, 2.5.4 - Levy County Units 1 and 2 Combined License Application
Attachments: LNP Draft RAI 2474 - 2.5.2.doc; LNP Draft RAI 2495 - 2.5.4.doc; LNP Draft RAI 2516 - 2.5.3.doc; LNP Draft RAI 2514 - 2.5.1.doc

Importance: High

Attached are four draft RAIs related to SRP sections 2.5.1, 2.5.2, 2.5.3, and 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

Brian Anderson
301-415-9967
Lead Project Manager, AP1000 Projects Branch 1
Office of New Reactors
U.S. Nuclear Regulatory Commission

Hearing Identifier: Levy_County_COL_Public
Email Number: 103

Mail Envelope Properties (CB87FC66F95637428C5E0D066E756B6FBFFFB944A6)

Subject: DRAFT RAIs - 2474, 2495, 2514, 2516 - SRP sections 2.5.1, 2.5.2, 2.5.3, 2.5.4 - Levy County Units 1 and 2 Combined License Application
Sent Date: 4/24/2009 12:03:31 PM
Received Date: 4/24/2009 12:03:34 PM
From: Brian Anderson

Created By: Brian.Anderson@nrc.gov

Recipients:
"robert.kitchen@pgnmail.com" <robert.kitchen@pgnmail.com>
Tracking Status: None
"david.waters@pgnmail.com" <david.waters@pgnmail.com>
Tracking Status: None
"tillie.wilkins@pgnmail.com" <tillie.wilkins@pgnmail.com>
Tracking Status: None
"PMLevyCOLPEm Resource" <PMLevyCOLPEm.Resource@nrc.gov>
Tracking Status: None

Post Office: HQCLSTR01.nrc.gov

Files	Size	Date & Time
MESSAGE	426	4/24/2009 12:03:34 PM
LNP Draft RAI 2474 - 2.5.2.doc	34298	
LNP Draft RAI 2495 - 2.5.4.doc	30202	
LNP Draft RAI 2516 - 2.5.3.doc	43002	
LNP Draft RAI 2514 - 2.5.1.doc	102394	

Options
Priority: High
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

Request for Additional Information No. 2474
Levy County, Units 1 and 2
Progress Energy Florida, Inc.
Docket No. 52-029 and 52-030
SRP Section: 02.05.02 - Vibratory Ground Motion
Application Section: 2.5.2

QUESTIONS for Geosciences and Geotechnical Engineering Branch 2 (RGS2)

02.05.02-***

Section 2.5.2.2.1 (p. 2.5-98 to 2.5-106) of the FSAR describes the EPRI-SOG source evaluations and the source zones that contribute to 99% of the seismic hazard at the site. Subsequent sections go on to describe how more recent seismicity was used to update these sources, specifically the maximum magnitude. Please address how recent seismicity in the Gulf of Mexico is accounted for in ESTs (earth science teams) that didn't have a source region in the Gulf (for example, Dames and Moore, Law Engineering, and Woodward-Clyde).

Please address whether or not the areas of the source regions and maximum magnitudes used by these teams should be updated.

02.05.02-***

Section 2.5.2.2.1.4 (p. 2.5-103) describes the Rondout Associates Team source zones. The Southern New York–Alabama Lineament (source 13) appears to be missing from Figure 2.5.2-207 (the figure that shows their source zones).

Please address why the source was omitted from the figure and whether the omission indicates that the Rondout Associates Team's Source 13 was or was not used in the calculation of the LNP PSHA.

02.05.02-***

Section 2.5.2.2 (beginning on p. 2.5-98) evaluates seismic sources that contribute to the seismic hazard of the LNP site. The New Madrid Seismic Zone (NMSZ) is considered a major seismic zone in the Southern U.S., however, the FSAR provides no calculation of the contribution of the NMSZ to the hazard at the LNP site. However, the Dec. 1811 New Madrid Earthquake is included in the Appendix 2AA Earthquake Catalog on page 2AA-2.

Please discuss the significance of the NMSZ to the LNP site and provide justification for not including this source zone in the seismic hazard analysis.

02.05.02-***

In Section 2.5.2.4.2.3 (p. 2.5-120 to 2.5-121), the FSAR presents three relations used to convert body wave magnitude to moment magnitude. This conversion is important to the PSHA because the magnitudes in the earthquake catalogs are high-frequency body wave magnitudes whereas the ground motion prediction equations use moment magnitude. However, the body wave magnitude scale saturates at m_b=7, but the conversion relations do not show the same behavior. For example, when magnitude is set equal to 8, then the Atkinson/Boore, Johnston, and EPRI relations give m_b=7.6, 7.4, and 7.4, respectively.

Please show plots of the three conversion relations and clarify how you are dealing with the issue of body wave magnitude saturation in the PSHA.

02.05.02-***

Section 2.5.2.5.1.3 (p. 2.5-135) discusses rock density beneath the LNP site and how it varies with depth.

Please provide a reference for a functional relationship between limestone velocity and density and then, based on this information, please provide justification for the density of 150 pcf chosen for depths below -305 msl (mean sea level).

02.05.02-***

Table 2.5.2-220 (p. 2.5-167, referenced on p. 2.5-127) gives Uniform Hazard Response Spectra for generic hard rock conditions. P. 2.5-128 describes application of Approach 2B for site response analyses to compute the effects of the LNP site sediments on the generic hard rock motions. Experience indicates that site response in karst terrains is highly variable and is difficult to predict on the basis of borehole information.

Have any site response studies been made using empirical surface-recorded seismic data? Microseisms, for example, can be used for this purpose. Please clarify if any empirical site response measurements were performed to support use of the analytical methods.

Please clarify how variability in karst terrain was accounted for in the site response analysis. Please justify the use of only one shear-wave velocity base model instead of multiple base models.

Request for Additional Information No. 2495
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-***

FSAR Section 2.5.4.1.2.1.1 (pg 2.5-190) and supplemental materials (Supplement dated 12 September 2008, Attachment 2, pg 4, Karst Discussion) describe local fracture systems observed in outcrops of the Avon Park Formation along the Waccasassa River and in the Gulf Hammock Quarry, which apparently parallel the regional fracture trends defined by Vernon (1951). The Waccasassa River outcrop is located 25 km (15.7mi) north-west of the LNP site, and the Gulf Hammock Quarry outcrop occurs19 km (11.8mi) north-northwest of the site, so both outcrops lie within the site vicinity (FSAR Section 2.5.4.1.2.1.1, pg 2.5-190).

As shown in FSAR Figure 2.5.4.1-202 in the supplemental materials dated 12 September 2008 (Attachment 2), fracture spacing of these local fractures in both outcrops is 5.8m (19 ft) for the primary fractures trending N39W and 7.7m (23.5ft) for orthogonal fractures striking N51E. FSAR Section 2.5.4.1.2.1.3 (pg 2.5-191), supplemental materials (12 September 2008 Supplement, Attachment 2, pg 18, Site Uniformity Discussion), and RAI Response 2.5.4-2 address the assumptions made regarding the occurrence of large voids at depth directly beneath the RCC bridging mat to enable the 3D FEM analysis. However, it is not clear whether these assumptions properly incorporate pertinent information on the observed local fracture systems into the 3D FEM analysis, including the potential for enhanced dissolution at intersections of fractures with bedding planes. In addition, it is not clear whether field observations at the two outcrops in the site vicinity may have revealed more closely-spaced fracture systems that should be included in the 3D model, and whether the fractures observed in the two outcrops are expected to be characteristic of the anticipated fracture sets at the site location so that the 3D model is appropriate for the site location.

In order for the staff to thoroughly assess the input data for and results of the 3D FEM analysis, please explain how information related to the observed local fracture systems was incorporated into this analysis for the Levy LNP1 and LNP2 sites, including possible interactions between fractures and intersecting bedding planes which may have a strong influence on development of dissolution voids at depth. To ensure that the 3D FEM model is appropriate for the site location, please clarify whether more closely-spaced fractures also occur in the two outcrops and whether the fractures observed in the two outcrops are thought to be characteristic of fracture sets at the site location. Please explain how the design analyses account for settlement due to movement permitted by joint sets and bedding planes.

Request for Additional Information No. 2516
Levy County, Units 1 and 2
Progress Energy Florida, Inc.
Docket No. 52-029 and 52-030
SRP Section: 02.05.03 - Surface Faulting
Application Section: 2.5.3

QUESTIONS for Geosciences and Geotechnical Engineering Branch 2 (RGS2)

02.05.03-***

FSAR Section 2.5.3-1 (pg 2.5-176) indicates that discussions were held with researchers familiar with the structural and tectonic framework of the region, as well as carbonate stratigraphy and post-Cretaceous faulting of the carbonate platform. Only two researchers (T. Scott and R. Randazzo) are specifically mentioned, however, and there is no documentation for other experts who may have been contacted. In addition, there is no summary of the information provided by these researchers which bear on surface faulting at the site.

In order for the staff to determine that current interpretations were incorporated for drawing conclusions regarding surface faulting at the LNP site, please specify all researchers who were contacted, along with their technical expertise. Please also summarize the pertinent information provided by these researchers which enable the conclusion that surface faulting does not exist at the site.

02.05.03-***

FSAR Section 2.5.3.2 (pg 2.5-177) states that T. Scott provided personal communications to the effect that slickensides and tilted bedding which Vernon (1951) ascribed to surface faulting were related to karst collapse rather than tectonic deformation. Such features identified by T. Scott are also referred to in FSAR Section 2.5.1.2.4 (pg 2.5-78). There is no map provided to show locations and orientations of the slickensides or tilted bedding, and the logic applied by T. Scott is not summarized.

In order for the staff to determine whether slickensides and tilted bedding may be related to surface faulting, please locate the sites where these features were observed on a map, indicate their measured orientations, and summarize the logic proposed by T. Scott that they resulted from dissolution collapse rather than having a tectonic origin.

02.05.03-***

FSAR Section 2.5.3.2.1.1 (pg 2.5-180) states that erosion and channel development are enhanced in “zones of weakness caused by upward propagation of lineaments through unconsolidated sediments.” However, the mechanism for this upward propagation of lineaments, which commonly reflect fracture systems or faults, is not discussed to indicate whether it is non-tectonic in nature.

In order for the staff to assess the importance of a mechanism that would cause a lineament to propagate upward through unconsolidated sediments, please explain why this upward propagation occurs in regard to whether the mechanism is non-tectonic in character.

02.05.03-***

FSAR Section 2.5.3.2.1.2 (pgs 2.5-180 and 2.5-181) discusses the evaluation of faults postulated by Vernon (1951). This evaluation is based primarily on imagery (Landsat data from 2000, 1949 aerial photograph mosaics, 10-m USGS DEM data, and high-resolution DEM developed from LIDAR data acquired in 2007). FSAR Section 2.5.3.2 (pg 2.5-177) concludes that the faults postulated by Vernon (1951) could not be identified at the surface from any of these data sets, and (pg 2.5.1-178) that identification of subsurface faults based on apparent displacement of stratigraphic units is highly speculative. However, the staff notes that a cross section from Arthur (2001), presented in FSAR Figure 2.5.1-245, shows a part of the Ocala Limestone stratigraphic section to be missing in Well Number W-6903 at a location in the cross section that may lie near one of the three faults postulated by Vernon (1951) to occur within the site area (i.e., the Inverness fault and Unnamed Faults A and B). It is not clear whether the missing stratigraphy is related to displacement along a subsurface fault rather than erosion, non-deposition, or dissolution of the limestone.

In order for the staff to assess whether one of the faults postulated by Vernon (1951) may exist in the subsurface within the site area, please discuss implications of the cross section data from Arthur (2001), as illustrated in Figure 2.5.1-245, in regard to whether subsurface faulting, rather than dissolution, non-deposition, or erosion, could be responsible for the missing limestone unit.

02.05.03-***

FSAR Section 2.5.3.4 (pg 2.5-182) addresses ages of the most recent deformations, but does not present information on suggested ages for the faults which were postulated by Vernon (1951) to displace units of Eocene (54.8 to 33.7 mya) age. This FSAR section does state that more recent studies have not confirmed this relative age relationship, and FSAR Section 2.5.3.1(pg 2.5-176) indicates that no well-documented evidence exists for these faults. There is no summary of the ages suggested by Vernon (1951). FSAR Section 2.5.3.2 (pg 2.5-178) indicates that these postulated faults project across marine terraces which range in age from as young as Late Pleistocene (i.e., Quaternary) to possibly Pliocene without any geomorphic expression.

In order for the staff to assess information related to the faults postulated by Vernon (1951) in regard to their suggested age(s), please summarize existing information on possible age constraints for these faults, particularly in regard to data which may indicate that, if they exist, they are older than Quaternary.

02.05.03-***

FSAR Section 2.5.3.4 (pg 2.5-182) states that there are no pronounced lineaments trending across the site location that suggest either a through-going fault or a major fracture system. However, maps of the site location (e.g., Figures 2.5.3-216, 2.5.3-218, and 2.5.3-220) appear to illustrate a northwest-trending lineament that, while discontinuous, could define part of a regional fracture system along which possible paleosinkholes occur. FSAR Section 2.5.3.2.1.3 (pg 2.5-182) states that the LNP1 and LNP2 sites are located between zones of prominent northwest-trending lineaments, while a zone of northeast-trending lineaments lies between the two units.

In order for the staff to assess whether regional fracture trends cross-cut the site location, please discuss lineaments illustrated in Figures 2.5.3-216, 2.5.3-218, and 2.5.3-220 in regard to whether they may represent geologic structures.

02.05.03-***

FSAR Section 2.5.3.7 (pg 2.5-183) states that review of available data and subsurface investigations performed for the FSAR did not identify any evidence of tectonic deformation in the site area. There is no summary of results from subsurface investigations which were performed for drawing this conclusion.

In order for the staff to assess information used to determine that no evidence exists for tectonic deformation in the site area, please summarize the data derived from subsurface investigations that enable this conclusion to be made.

02.05.03-***

FSAR Figure 2.5.3-201 shows the following stratigraphic units in the legend which do not appear on the figure: Cypresshead Formation, Hawthorn Group – Coosawhatchie, and Suwannee Limestone. This figure also shows a northeast-trending linear feature which intersects Unnamed Fault A which is not identified in the legend.

In order for the staff to interpret the geologic map of the site area shown in Figure 2.5.3-201, please show the Cypresshead Formation, Hawthorn Group – Coosawhatchie, and Suwannee Limestone on the map and add the northeast-trending linear feature to the legend, or explain why these units do not belong in this figure.

02.05.03-***

FSAR Figure 2.5.3-202 shows a possible post-Paleozoic graben fault boundary from Applin which is labeled as “D/U.” There appears to be no description of this feature in the FSAR and no reference cited for Applin.

In order for the staff to interpret the fracture pattern map of the Florida Peninsula shown in Figure 2.5.3-202 and to understand the character of this possible post-Paleozoic graben structure which occurs within the site region, please provide a reference for Applin who apparently defined the feature and describe this feature.

02.05.03-***

FSAR Figures 2.5.3-206, 2.5.3-209, 2.5.3-212, 2. 2.5.3-206, 5.3-218, and 2.5.3-220 show lineaments within the site area or site location. There is no designation in the legends of these figures to indicate whether they are interpreted as fractures or faults, although the FSAR text generally states they are not interpreted as faults. It is known that such planar structures can exercise strong control on dissolution.

In order for the staff to understand information related to possible density of regional fracture patterns within the site area and at the site location which may exercise strong controls on dissolution, please indicate in the figure legends whether the lineaments are generally interpreted as fractures or faults or some other type of geomorphic feature.

Request for Additional Information No. 2514
Levy County, Units 1 and 2
Progress Energy Florida, Inc.
Docket No. 52-029 and 52-030
SRP Section: 02.05.01 - Basic Geologic and Seismic Information
Application Section: 2.5.1

QUESTIONS for Geosciences and Geotechnical Engineering Branch 2 (RGS2)

02.05.01-***

FSAR Figure 2.5.1-250 illustrates that soil layer S-1 is composed of surficial Quaternary sands which overlie calcareous silts (i.e., layers S-2 and S-3) derived from weathered Avon Park Limestone. FSAR Section 2.5.1.2.3.10 (pg 2.5-74) states that surficial Quaternary deposits are thickest where sediment accumulation is related to infilling of karst features (i.e., paleosinkholes produced by dissolution of limestone) in the site vicinity. FSAR Section 2.5.1.2.5.2.1 (pg 2.5-82) also indicates that thicker deposits of S-1 encountered in LNP borings are interpreted to represent infilling of paleosinkholes or paleochannels.

In the cross-section of FSAR Figure 2.5.4.2-203A, soil layer S-1 is at least 80 ft thick in Borehole B-07 which is located at the northern end of the turbine building for LNP Unit 2. Thickness of S-1 in other boreholes in that cross-section varies from about 60 ft (Boreholes B-06 and GSC-04) to 10 ft. Thickness of Quaternary deposits in Borehole B-07 and other boreholes shown in FSAR Figure 2.5.4.2-203A, as well as Figure 2.5.4.2-202A (specifically Borehole B-22 at the northern end of the turbine building for LNP Unit 1, with a thickness of about 40 ft for layer S-1), suggests that areas of lower surface topography allowed thicker Quaternary deposits to accumulate locally at the site location. It is not clear whether these areas of lower surface topography may have developed in response to collapse of overlying materials into subsurface dissolution cavities with vertical dimensions roughly equivalent to the thickness of the overlying Quaternary deposits.

In order for the staff to assess the potential for dissolution voids in the subsurface at the site location, as possibly suggested by aerial distribution of thicker surficial Quaternary deposits, please address the possibility that the areas of lower surface topography may reflect local collapse above dissolution cavities at depth to permit deposition of thicker surficial Quaternary deposits. Please also discuss possible constraints on the vertical dimension of such potential subsurface dissolution cavities at the site location.

02.05.01-***

Details related to classification of the unconsolidated Quaternary deposits making up soil layer S-1 by USCS terminology, shown in Figure 2.5.4.2-203A, indicates that these deposits comprise interlayered poorly-graded sand (SP), silty sand (SM), clay (CL), and fat clay (CH). Layers S-2 and S-3, labeled as calcareous silts developed from weathered Avon Park Limestone in FSAR Figure 2.5.1-250, show similar unconsolidated materials in Figure 2.5.4.2-203A which indicates these two layers comprise interlayered clayey sand (SC), silt (ML), silty sand (SM), clay (CL), and fat clay (CH). FSAR Section 2.5.1.2.5.2.1 (pg 2.5-82) states that Quaternary sediments of layer S-1 are differentiated from the top of underlying calcareous silts (layer S-2) by a lack of reaction to hydrochloric acid for the Quaternary sediments. It is not clear why Quaternary sediments could not contain some calcareous material since, as stated in FSAR Section 2.5.1.2.5.2.1 (pg 2.5-81), some of the materials were likely deposited in a near-shore beach environment and such a depositional environment could contain calcareous shell fragments.

In order for the staff to understand the stratigraphic sequence which exists at the site location, please discuss whether the acid test alone is sufficient to distinguish unconsolidated Quaternary deposits from weathered Avon Park Limestone in boreholes drilled for LNP Unit 1 and LNP Unit 2, or whether other criteria have also been used to make this distinction.

02.05.01-***

The response to RAI 2.5.1-2, FSAR Section 2.5.4.1.2.1.1 (pg 2.5-190), and Attachment 2 of the supplemental information dated 12 September 2008 (pg 4) discusses local fractures observed in outcrops at the Gulf Hammock Quarry and along the Waccasassa River. These outcrops occur 19 km (11.8 mi) and 25 km (15.7 mi) north-northwest of the LNP site, respectively, so they lie within the site vicinity (FSAR Section 2.5.4.1.2.1.1, pg 2.5-190). The response to RAI 2.5.1-2 also indicates that a “local orthogonal fracture set” exhibits a dominant strike of N39W parallel to the primary fracture orientation in the “regional orthogonal fracture set” defined by Vernon (1951), and suggests that a secondary local fracture set parallel to the secondary regional fracture set also exits. The secondary fracture set is not discussed in the response to RAI 2.5.1-2, although FSAR Figure 2.5.4.1-202 in the supplemental materials dated 12 September 2008 (Attachment 2) illustrates the local N39W fracture set as well as the secondary fracture set which apparently strikes N51E. This figure shows that spacing of the local fractures in both outcrops is 5.8m (19 ft) for the primary fractures trending N39W and 7.7m (23.5ft) for the secondary fractures striking N51E. As explained in the FSAR (Section 2.5.1.2.4, pg 2.5-76), Vernon (1951) indicated that the two sets of regional fractures are orthogonal and spaced 30-50 km (20-30 mi) apart.

In light of the description provided by Vernon (1951), two fracture sets oriented at about 90 degrees to each other comprise the regional orthogonal fracture system as well as the local fracture system. Therefore, the label of “an orthogonal fracture set” expressed in the FSAR seems inaccurate for referring to the two orthogonal sets comprising both the regional and local fracture systems observed in the site vicinity. FSAR Section 2.5.4.1.2.1.1 (pg 2.5-190) also states that orthogonal vertical fractures trending north-south and east-west were observed at the Gulf Hammock Quarry and along the Waccasassa River, in addition to high-angle joints, but neither characteristics nor spacing of these fractures was discussed.

In order for the staff to assess characteristics of the local fracture sets and understand how they may relate to potential fractures at the site location since the presence of fractures may enhance dissolution, please address the following questions:

(a) Were all fractures occurring in the two outcrops observed and measured to determine spacing of the “local” (i.e., presumably mesoscopic outcrop-scale) fracture sets?

(b) What are the characteristics of the north-south and east-west fracture sets and the high-angle joints, and what mechanism is suggested for their origin? Do they exercise any control on karst development?

(c) Is the spacing and orientations of local fracture sets at the site location anticipated to be the same as that observed for local fractures in the two outcrops?

02.05.01-***

The response to RAI 2.5.1-2 indicates that Vernon (1951) attributed the regional orthogonal fracture sets to tensional stresses associated with formation of the Ocala Arch. FSAR Section 2.5.1.2.4 (pg 2.5-76) states that Vernon (1951) interpreted the arch as a plunging anticlinal fold, with the primary fracture set parallel to the axis of this structure and the secondary set perpendicular to the primary set. FSAR Section 2.5.1.2.4 (pg 2.5-76) also states that this regional fracture system is expressed at the surface by lineaments. Vernon (1951) defines the regional fracture system more concisely as two orthogonal fracture sets, spaced 30-50 km (20-30 mi) apart, which are parallel and perpendicular to the axis of the Ocala Arch and control stream drainages and sinkhole alignments. Considering the orientation of the two regional fracture sets in relation to the axis of the arch as defined by Vernon (1951), these features could reflect a genesis as release (i.e., parallel to the axis of the Arch) and extension (perpendicular to the axis) fractures developed across the uplift. The FSAR does not clearly define orientations (i.e., strike and dip) of these two orthogonal fracture sets (e.g., as contoured maxima on stereonet plots), but the interpretation of a relationship to the Ocala arch (or platform) as stated by Vernon (1951) suggests an origin related to bending of rock units across the Ocala arch (i.e., extension and release fractures).

The response to RAI 2.5.1-2 also points out that Lafrenz (2003) suggested two episodes of uplift occurred to create the Ocala Arch, the first during Late Oligocene-Early Miocene time (i.e., mid-Tertiary) and the second in Early Pliocene-Early Pleistocene time (i.e., post-Miocene neotectonic uplift during Late Tertiary-Early Quaternary). In addition, FSAR Section 2.5.1.2.1.3.1 (pg 2.5-62) states that Early Miocene "structural adjustments" of the crust associated with formation of the Ocala feature continued, with regional fracturing significantly affecting karst activity. Consequently, information presented in the FSAR suggests that tectonic uplift may have produced the Ocala Arch and the associated regional joint patterns, with deformation extending into Quaternary time. FSAR Section 2.5.1.1.4.3.5 (pg 2.5-43) discusses Quaternary tectonic structures, but does not address the interpretation of Lafrenz (2003) which suggests that Quaternary tectonic deformation was involved in development of the arch.

In contrast to the interpretation stated above for genesis of the Ocala Arch, FSAR Section 2.5.1.1.4.3.4 (pg 2.5-39) refers to the Ocala Arch as the "Ocala platform" to avoid any connotation of a structural feature generated by uplift. This FSAR section states that the platform does not warp sedimentary units older than Middle Miocene and appears to have been produced by sedimentation processes (i.e., specifically, anomalous buildup of Middle Eocene carbonates or differential compaction of carbonates of that age shortly after deposition). The interpretation that the Ocala arch, or platform, is related to sedimentation processes is quite different from the suggestion that this feature developed as a result of two episodes of uplift and the regional orthogonal fracture sets are release and extension fractures associated with the uplift.

Because fractures provide potential pathways for dissolution of limestone in the site region and at the site location, a suggestion of Quaternary deformation which could further enhance development of fractures is of potential concern.

FSAR Section 2.5.1.2.4 (pg 2.5-76) also states that the Ocala platform was produced by sedimentary processes rather than uplift as Vernon (1951) suggested. However, this section further indicates that bedding in Tertiary units at the location of the platform dips southwest and northeast along the flanks of the feature and northwest and southeast along its plunge, suggesting uplift with deformation of bedding. It is not clear why, if development of the feature is related strictly to sedimentary processes, dips of bedding on the limbs and along the hinge line of the feature show variations which suggest at least a gentle uplift (i.e., a broad doming) of the sedimentary units.

In order for the staff to understand origin of the Ocala Arch (or platform) and the regional fracture sets which occur at and near the site location and control stream drainages and locations of sinkholes, please address the following points:

(a) Define orientations (strike and dip) of the two orthogonal fracture sets which comprise the regional fracture system on stereonet plots (if a sufficient number of orientations have been measured).

(b) Define orientations of the two orthogonal fracture sets which comprise the local fracture system on stereonet plots (if a sufficient number of orientations have been measured).

(c) Discuss the mechanism for generation of the regional and local fractures sets, including their possible association with development of the Ocala Arch.

(d) Discuss the two apparently contradictory interpretations of the genesis of the Ocala arch/platform (i.e., a tectonic versus a non-tectonic origin).

(e) Discuss the logic for concluding that origin of the Ocala arch, or platform, is strictly the result of sedimentary processes when the reported dip of bedding in the sedimentary units suggest that a broad uplift has affected these units.

(f) In light of the interpretation of Lafrenz (2003) that the Ocala Arch was created during two episodes of uplift, one of which was proposed to be early Quaternary in age, justify the conclusion that Quaternary uplift is not occurring to enhance development of fractures at the site location.

02.05.01-***

Considering a spacing of the primary fracture set of 19 ft, the response to RAI 2.5.1-5 states that, if two 10-ft diameter voids developed at adjacent local fractures (interpreted as the worst-case scenario), then the voids would be separated by approximately 9 ft of undissolved Avon Park limestone because the “plus-sign morphology” which controls karst development would govern lateral extent of a void 5 ft in each direction from the intersection point of the two vertical fracture planes (i.e., the intersection point of the “plus sign” morphology). This assumption would seem to be true if and only if dissolution were symmetrical about the “plus-sign” intersection point of the two local fracture trends. Asymmetrical dissolution from the fracture intersection point, possibly influenced by enhanced dissolution along horizontal bedding planes, could effectively result in little to no undissolved limestone between the two voids. Their coalescence could produce a dissolution cavity up to 19 ft in diameter. The response to RAI 2.5.1-5 indicates that the potential effect of voids in the subsurface produced by coalescence of 10-ft cavities on the RCC bridging mat has been evaluated. The response to RAI 2.5.1-7 also indicated that the maximum lateral dimension of subsurface voids was determined by "a conservative analysis".

Regarding the size of coalesced sinkholes, however, FSAR Section 2.5.1.2.5.3 (pg 2.5-83) states that the LNP site is characterized by probable coalescing karstic depressions of varying size. That FSAR section (pg 2.5-84) indicates that no sinkholes were observed at the land surface during site investigations and reconnaissance, although paleosinks were. In addition, FSAR Section 2.5.1.2.5.1 (pg 2.5-79) states that surface morphology of the site is characterized by shallow depressions developed above sinks or paleosinks which vary in size at the present ground surface from small (i.e., < 50m (164ft) in diameter) well-defined circular features to large (600m (2000ft) in diameter) irregular features. This surface morphology is clearly shown within the site area by the LIDAR data presented in FSAR Figure 2.5.1-248. It is not clear what the lateral dimension of dissolution voids in the subsurface would need to be to produce this observed surface morphology, but it is clear that the ground surface is characterized by shallow depressions which have a lateral dimension considerably greater than 10 ft.

In order for the staff to assess the possibility of dissolution voids in the subsurface which may exceed 10 or 20 ft in diameter, please discuss what the scale of observed surficial features thought to be related to sinks or paleosinks may suggest for a maximum lateral dimension of dissolution voids in the subsurface. If these subsurface voids are interpreted to be larger than 10-20 ft in lateral dimension, please also discuss potential effects of such larger subsurface voids on the RCC bridging mat.

02.05.01-***

FSAR Section 2.5.1.1.1.1.2 (pg 2.5-16) states that the East Gulf Coastal Plain section is developed on "weak" limestones and shales. A part of this Coastal Plain section lies within the site region. Limestones are not characteristically mechanically weak, although they are subject to dissolution.

In order for the staff to understand the significance of describing the limestones in the site region as "weak", suggesting in this context a strength similar to shales in the stratigraphic sequence, please clarify use of the term "weak" for the limestone units.

02.05.01-***

FSAR Section 2.5.1.1.1.1.3 (pgs 2.5-16 through 2.5-18) discusses the Floridian Coastal Plain section of the Coastal Plain physiographic province. The LNP site is located in the Central Zone of the Floridian section which encompasses the entire Florida peninsula and is made up of the Northern, Central, and Southern Zones. This FSAR section states that the Floridian section is recently emergent, and that the Northern Zone of the section reaches elevations of 60-90m (200-300ft) above mean sea level (amsl), while the

Central Zone lies 61m (200ft) amsl and the Southern Zone reaches elevations less than 10m (35ft) amsl. FSAR Section 2.5.1.1.1.1.3 does not provide a discussion of timing of "recent" emergence of the Floridian section. In addition, FSAR Section 2.5.1.1.1.1.1 (pg 2.5-15) indicates that the Sea Island Coastal Plain Section, which lies to the north of the Floridian section, exhibits a slightly submerged margin. It is not clear from the discussion presented in the FSAR whether differential emergence of the three zones of the Floridian section (as possibly suggested by differences in elevation between the zones) relative to the Sea Island section to the north may result from differential uplift of the Floridian section across a hinge line lying between these two sections, or from changes in sea level around relict topography. Uplift could imply neotectonic deformation (i.e., post-Miocene, or less than 5.3 mya in age) of the Florida peninsula.

In order for the staff to assess whether neotectonic deformation may be occurring in the Florida peninsula, and consequently in the region containing the LNP site, please discuss the mechanism for the apparent differential emergence of the Floridian Coastal Plain section in which the LNP site lies, relative to the Sea Island Coastal Plain section. Please discuss the timing of recent emergence of the Floridian section. If differential uplift is suggested, please also discuss whether there is any regional tectonic feature located in northern Florida that may represent a flexural hinge between the Floridian and Sea Island Coastal Plain sections of the Coastal Plain physiographic province.

02.05.01-***

FSAR Section 2.5.1.1.2.3 (pg 2.5-23) discusses changes in the Cenozoic depositional environment for the Florida platform on which the site is located. Tectonic features related to the Georgia Channel system, a system which represents two distinct but related sedimentological regimes of different ages, are located in FSAR Figure 2.5.1-208. However, the Suwannee current is not located on this figure and its pertinence in regard to changing Cenozoic depositional history is unclear.

In order for the staff to assess the depositional history of the Florida platform on which the site is located, please locate and discuss the pertinence of the Suwannee current in regard to changing Cenozoic depositional history.

02.05.01-***

FSAR Section 2.5.1.1.4.3.1 (pg 2.5-35) states that the Jay fault was recognized by Barnett (1975) based on truncation of northwest-trending magnetic anomalies which dominate the northern part of the Florida peninsula. FSAR Figure 2.5.1-220 shows that this fault is coincident with the Florida lineament. FSAR Figure 2.5.1-220 also illustrates that the magnetic anomalies which intersect, and appear to be truncated by, this fault trend northeast rather than northwest. The fault itself trends northwest across the Florida peninsula.

In order for the staff to assess the Jay fault, please clarify the statement that northwest-trending magnetic anomalies are truncated by this structure when Figure 2.5.1-220 does not appear to show this relationship.

02.05.01-***

FSAR Section 2.5.1.1.4.3.1 (pg 2.5-35) references Figure 2.5.1-222 which shows a fault postulated by Barnett (1975) passing through the LNP site location. There appears to be no discussion of this specific feature in the FSAR.

In order for the staff to assess the structure which Barnett (1975) postulated to pass through the site location based on Figure 2.5.1-222, please discuss data used and interpretations made by Barnett (1975) in regard to this feature. Please also address the age of this structure, and relate it to the regional fault pattern derived from Barnett (1975) which is shown on Figure 2.5.1-222.

02.05.01-***

FSAR Section 2.5.1.1.4.3 (pgs 2.5-34 through 2.5-43) describes regional tectonic structures within 320km (200mi) of the LNP site, and states that FSAR Figures 2.5.1-208 and 2.6.1-209 illustrate locations of the principal tectonic features described. However, neither of these figures appear to show locations of the Bahamas fracture zone (Figures 2.5.1-207, 2.5.1-212, and 2.5.1-222 do), the Sunniland fracture zone (Figures 2..5.1-212 and 2.5.1-222 do, and Figure 2.5.1-209 shows a Sunniland arch), the Florida Elbow fault (Figure 2.5.1-222 does), the postulated fault of Applin and Applin, the Suwannee-Wiggins suture (Figure 2.5.1-211 does, but Figure 2.5.1-208 shows a Wiggins uplift and Figure 2.5.1-209 shows a Wiggins arch), the South Georgia rift (Figure 2.5.1-204, and maybe 2.5.1-206, do), the Brevard platform, the Gulf trough (Figure 2.5.1-224 does, seemingly in the area of the South Georgia rift), the Jacksonville basin, the Nassau nose, the Okeechobee basin, the Oscelo low, the Sanford high, the St. Johns platform, and the Suwanee strait.

In order for staff to assess tectonic structures within the LNP site region, please locate all missing features on a map or maps that are correctly referenced in the FSAR, or explain why such a map is not necessary.

02.05.01-***

FSAR Section 2.5.1.1.4.3.4 (pg 2.5-40) discusses Cenozoic faulting in the study region, and states that Vernon (1951) inferred vertical fault displacements on postulated structures based on stratigraphic correlations shown in a cross section drawn across these postulated faults. This FSAR section briefly discusses the interpretations made by Vernon (1951), which are summarized in more detail in FSAR Section 2.5.1.2.4 (pgs 2.5-76 through 2.5-79), but does not show the actual cross section he used to draw his conclusions about the postulated faults, four of which are located in the site vicinity.

In order for the staff to examine the original data on which the postulated faults of Vernon (1951) are based and assess the conclusion drawn in the FSAR that these postulated structures do not exist, please provide the cross section data used by Vernon (1951) to delineate the four faults which he postulated to occur in the site vicinity, or explain why this information is not necessary.

02.05.01-***

FSAR Section 2.5.1.1.4.3.4 (pg 2.5-41) cites Figures 2.5.1-223 and 2.5.1-224 which illustrate postulated Cenozoic faults and ages of rocks affected by these postulated faults, respectively. However, only Figure 2.5.1-223 includes the faults postulated by Vernon (1951).

In order for the staff to assess Cenozoic faults postulated to occur within the site region, please explain why the postulated faults of Vernon (1951) are included only on Figure 2.5.1-223.

02.05.01-***

FSAR Section 2.5.1.1.4.4 (pg 2.5-44) refers to Table 2.5.1-201 which lists tectonic features postulated for the local Charleston area. This section discusses significant seismic sources which occur at distances greater than 320km (200mi) from the LNP site. However, it is not clear why all postulated faults which are listed in Table 2.5.1-201, specifically the eleven postulated structures shown in Figure 2.5.1-225 as local Charleston tectonic features, are not discussed in FSAR Section 2.5.1.1.4.4.

In order for the staff to assess tectonic features postulated to occur in the Charleston area, please summarize existing information on the following faults which are located in Figure 2.5.1-225 and listed in Table 2.5.1-201 but not specifically discussed in detail in FSAR Section 2.5.1.1.4.4: Ashley River fault, Charleston fault, Cooke fault, Drayton fault, Gants fault, Woodstock fault.

02.05.01-***

FSAR Section 2.5.1.1.4.4 (pgs 2.5-44 and 2.5-45) discusses the East Coast fault system (ECFS), and states that evidence is strong for the southern section of the system but is successively weaker northward. There is no summary of the strong evidence used to support this comment, and the most recent reference cited for the researchers who proposed this fault system is 2004 (Marple and Talwani, 2004). This section also states that confidence in the existence of the ECFS is “low to moderate”, but does not indicate whether this statement applies to the entire ECFS or only the southern segment.

In order for the staff to assure that the logic applied to discount any concerns about the ECFS as a seismogenic source is based on the most recent interpretations of data related to that proposed fault system, please summarize the evidence used to conclude that there is only a low confidence that this fault system exists. Please factor in information derived from the most recent references as part of this discussion.

02.05.01-***

FSAR Section 2.5.1.1.4.4 (pg 2.5-46) states that the postulated northwest-trending Sawmill Branch fault is a segment of the longer Ashley River fault based on Talwani and Katuna (2004), and that the Sawmill Branch structure offsets the Woodstock fault in a left lateral sense. Reference is made to Figure 2.5.1-225, which appears to mislabel a northeast-trending feature as the Sawmill Branch fault. That figure, as does Figure

2.5.1, indicates that the Ashley River fault, not the Sawmill Branch feature, offsets the Woodstock fault. Figure 2.5.1-229 also shows the Sawmill Branch fault as apparently cross-cutting the Ashley River fault, rather than being a splay off the Ashley River structure. From this cross-cutting relationship, it is not obvious that the Sawmill Branch fault is a part of the Ashley River fault. No discussion of the longer Ashley River fault is provided in this FSAR section, and Figure 2.5.1-228, a map of local tectonic features, does not include the Sawmill Branch fault. .

FSAR Section 2.5.1.1.4.4 (pg 2.5-46) further states that analysis of microseismicity did not distinguish a discrete Sawmill Branch fault that is distinct from the Ashley River fault. Figure 2.5.1-229 illustrates that there is a concentration of microseismic events lying along the postulated traces of both the Sawmill Branch and Ashley River faults between the traces of the offset Woodstock fault.

In order for the staff to assess information presented in the FSAR bearing on the discussion of significant seismic sources, and potential associated faults, which occur at distances greater than 320km (200mi) from the LNP site, please accomplish the following:

(a) Clarify what data are used to conclude that the Sawmill Branch fault is a segment of the Ashley River fault when Figure 2.5.1-229 shows that the Sawmill Branch cross-cuts the Ashley River fault.

(b) Correctly label the Sawmill Branch fault in Figure 2.5.1-225, and include this structure, if it is important, on the map of local tectonic features shown in Figure 2.5.1-228.

(c) Discuss the Ashley River fault in relation to the microseimic activity which Figure 2.5.1-229 illustrates is clustered along it at a location lying between the offset traces of the Woodstock fault which is in the area where the Sawmill Branch fault is shown to cross-cut the Ashley River fault.

02.05.01-***

FSAR Section 2.5.1.1.4.4 (pgs 2.5-47 through 2.5-54) discusses indirect evidence for seismic sources outside the site region and maximum magnitude for those sources. This FSAR section states that large-magnitude earthquakes generally occur in tectonic environments characterized by Mesozoic and younger extended crust (pg 2.5-47), and that the observed maximum magnitude for these areas of extended crust is **M** 7.7 +/- 0.2. FSAR Section 2.5.1.1.4.2 (pg 2.5-33) and FSAR Figure 2.5.1-221 indicates that the site region is underlain by continental crust which was extended by Mesozoic or later rifting. Therefore, basement rocks of the site region may exhibit geologic characteristics similar to those for other regions of the east coast margin (e.g., Charleston) where large historic earthquakes have occurred. Researchers (e.g., Schulte and Mooney, 2005) have reassessed correlation of earthquakes with ancient rifts using a global database, and such information may be important for assessing earthquake hazard in areas of extended crust.

In order for the staff to ensure that current data are being considered in regard to generation of earthquakes in areas of extended crust, including the site region, please discuss the potential for large earthquakes in areas of extended crust based on interpretations presented in the current literature.

02.05.01-***

FSAR Section 2.5.1.2.1 (pg 2.5-55) on site physiography states that county lines are shown for Levy, Citrus, and Marion Counties on Figure 2.5.1-201. However, no county boundaries are illustrated on that figure.

In order for the staff to locate these three counties in relation to physiography of the site, please include county lines on Figure 2.5.1-201 or cite the figure where they are shown.

02.05.01-***

FSAR Section 2.5.1.2.1 (pg 2.5-55) on site physiography states that the site lies within the Gulf Coastal Lowlands geomorphic province and cites Figure 2.5.1-233. FSAR Section 2.5.1.1.1.1 (pg 2.5-15) on regional physiography indicates that the site is located within the Floridian section of the Coastal Plain physiographic province and cites Figure 2.5.1-201. Neither of these two figures illustrates how the geomorphic and physiographic provinces are related to enable a clear distinction between regional and site-scale physiography, geomorphology, and topography. In addition, the Gulf Coastal Lowlands province is referred to as a "physiographic" province in FSAR Section 2.5.1.2.1.3 (pg 2.5-60) rather than a geomorphic province, leading to further blurring of any pertinent distinctions, if they exist.

In order for the staff to clearly understand the relationship between regional and site-scale physiographic provinces and their characteristic geomorphology and topography, please include all physiographic and geomorphic province boundaries on one or both of the figures cited. Please also refer to the Gulf Coastal Lowlands province correctly in the text in regard to representing it as a geomorphic province.

02.05.01-***

FSAR Section 2.5.1.2.1.1 (pgs 2.5-55 through 2.5-58), titled "Central Highlands Geomorphic Province", includes discussion of the Gulf Coastal Lowlands geomorphic province under the same heading and cites Figure 2.5.1-233 and 234. These two provinces are distinct, and section titles in the FSAR should distinguish them as such since the site lies in the Limestone Shelf and Hammocks subzone of the Gulf Coastal Lowlands province.

In order for the staff to clearly understand pertinent characteristics of the two geomorphic provinces which occur within the site vicinity, please separate out the discussion of the two provinces under distinct headings in the FSAR since the site occurs in one of them.

02.05.01-***

FSAR Section 2.5.1.2.1.1 (pg 2.5-57) states that the site is located in the Limestone Shelf and Hammocks subzone of the Gulf Coastal Lowlands geomorphic province, and indicates that this zone is characterized by a “highly karstic, erosional limestone plain” overlain by Pleistocene marine terrace deposits. This FSAR section refers to an irregular, “highly-solutioned Eocene limestone” in this subzone, but does not specific whether or not this limestone unit is the Avon Park Limestone. The Avon Park is the foundation unit at the site.

In order for the staff to assess information related to the karstic character of the Avon Park Limestone, please indicate in the text whether the unit being briefly described on pg 2.5-57 of FSAR Section 2.5.1.2.1.1 is, in fact, the Avon Park foundation unit.

02.05.01-***

FSAR Section 2.5.1.2.1.2 (pgs 2.5-59 and 2.5-60) discusses five marine terraces which occur within the site vicinity (i.e., from oldest to youngest, the Sunderland/Okefenokee, Wicomico, Penholoway, Pamlico, and Silver Bluff terranes) and cites Figure 2.5.1-235. This figure shows a sixth terrace, the Talbot terrace, within the site vicinity. The Talbot terrace is not discussed in this FSAR section.

In order for the staff to understand the potential effects of late Tertiary to Quaternary sea level changes in the site vicinity, please discuss the Talbot terrace or explain why it is not discussed.

02.05.01-***

FSAR Section 2.5.1.2.1.3 (pg 2.5-61) states that Figure 2.5.1-237 shows the LNP site is located where sinkholes are few and gradually developed. For sinkhole type, the figure legend indicates that solution sinkholes dominate. However, the inset map in that same figure apparently assesses future sinkhole risk and appears to indicate that a high density of sinkholes could develop at the site, with a moderate intensity of surface collapse possible. There is no quantitative expression of the future risk of sinkhole development at the site.

In order for the staff to assess the risk of future sinkhole development at the site, please discuss information presented in the inset map of Figure 2.5.1-237 in regard to potential implications for increased hazard due to future sinkhole development at the site.

02.05.01-***

FSAR Section 2.5.1.2.1.3 (pgs 2.5-60 through 2.5-64) discusses the characteristics of karst terrain in the site region and site vicinity. Characterization of surface and subsurface features comprising a karst system commonly includes assessment of recharge and discharge areas and possible connected underground conduits that would signal the existence of caverns at depth. This FSAR section does not discuss information related to the existence of potential underground conduits (i.e., zones of potential rapid groundwater flow) connecting recharge and discharge areas in the site vicinity.

In order for the staff to assess the potential for existence of subsurface karst features at the LNP site, please discuss any available information bearing on the issue of whether underground conduits capable of accommodating rapid groundwater flow occur at or near the Levy site, including any testing that may have been conducted to define the conduits. If such features have been defined in the site region, vicinity, or area, please include maps showing location of these features relative to the LNP site.

02.05.01-***

FSAR Section 2.5.1.2.2 (pg 2.5-65) discusses geologic history of the site vicinity and cites FSAR Figures 2.5.1-208 and 2.5.1-209 as showing the South Georgia basin. However, neither figure appears to locate this feature.

In order for the staff to understand geologic history of the site vicinity, please locate the South Georgia basin on the figures cited as showing it.

02.05.01-***

FSAR Section 2.5.1.2.2 (pg 2.5-65) discusses the sedimentary sequence penetrated by Robinson Well Number 1 and cites Figure 2.5.1-243 to illustrate the stratigraphic units in the sequence penetrated. There are no Cenozoic units included in the cross section of Figure 2.5.1-243, so no assessment of thickness variations in these units can be made to enable analysis of potential faults that cut the Cenozoic layers.

In order for the staff to assess existing deep borehole information in the vicinity of the site, please provide cross-section data to include the Cenozoic section, if it was logged in any of these petroleum wells shown in FSAR Figure 2.5.1-243. If information on the Cenozoic section exists and any geologic structures are inferred, please discuss the evidence for limiting the age of the inferred structures.

02.05.01-***

FSAR Section 2.5.1.2.3 (pg 66) references FSAR Figure 2.5.1-244 which presents a site vicinity geologic map. The legend on this figure does not show the correct sequence of stratigraphic units, commonly presented with oldest at the bottom of the legend to youngest at the top, to enable interpretation of the correct stratigraphic sequence. In addition, this site vicinity geologic map appears to be based on the 1:1,000,000-scale geologic map of Florida prepared by Scott and others (2001) which may lack sufficient detail to properly portray geologic structures and stratigraphy at the scale of the site vicinity.

Figure 2.5.1-244 also shows the locations of three drillholes (W-7534, W-7538, and W-7453) which are not presented in cross sections in the FSAR. These data are potentially useful for helping to assess the presence of faults such as those proposed by Vernon (1951). The drill holes presented in the cross section shown in FSAR Figure 2.5.1-245 are not located on the geologic map of Figure 2.5.1-244.

In order for the staff to understand the stratigraphic sequence and assess all existing information regarding subsurface geology and potential structures in the site vicinity, please correct the legend of Figure 2.5.1-244 to show stratigraphic sequence from oldest at the bottom of the legend to youngest at the top since that is the standard way of presenting such geologic data. Please also justify the use of a 1:1,000,000-scale geologic map to illustrate structure and stratigraphy at the site vicinity scale. In addition, please locate drill holes W-7534, W-7538, and W-7453 on Figure 2.5.1-244 and present drillhole data in a cross section to enable assessment of the presence of faults such as those proposed by Vernon (1951).

02.05.01-***

FSAR Section 2.5.1.2.3.6 (pg 2.5-71) states that oil test wells reported by Rupert (1988) penetrated the entire Avon Park Formation under Levy County, revealing a total thickness of 243-304m (800-1000ft) for this rock which is the foundation unit at the site. Cross sections and borehole logs from this report, if they exist, could be very useful in assessing characteristics of the Avon Park in the subsurface, including the presence of paleokarst.

In order for the staff to assess subsurface characteristics of the Avon Park Formation in Levy County, including the presence of paleokarst features, please provide any cross sections, borehole logs, or other information derived from the oil test wells which Rupert (1988) examined in his analysis.

02.05.01-***

FSAR Section 2.5.1.2.3.8 (pg 2.5-73) indicates Arthur and others (2001) documented that the Lower Oligocene Suwannee Limestone is not present within the LNP site area. However, there is no summary of data used by Arthur and others (2001) to draw this conclusion.

In order for the staff to fully assess the stratigraphic units which lie within the site area, please summarize the data from Arthur and others (2001) used to document the conclusion that the Suwannee Limestone is not present.

02.05.01-***

FSAR Section 2.5.1.2.3.11 (pg 2.5-74) discusses surficial geology of the site vicinity and cites Figure 2.5.1-246, which is a 1:2,000,000-scale map prepared for the central and eastern United States by Fullerton and others (2003). This map may lack sufficient detail to properly portray surficial geology at the scale of the site vicinity.

In order for the staff to understand pertinent details of the surficial geology of the site vicinity, please justify use of a 1:2,000,000-scale map to illustrate surficial geology at the site vicinity scale.

02.05.01-***

FSAR Section 2.5.1.2.4 (pg 2.5-76) states that recent geologic maps show no faults within the site vicinity, but no specific references are cited for the maps on which this statement is based. FSAR Figure 2.5.1-244 shows multiple postulated faults (Vernon, 1951) which parallel regional fracture trends and are discussed in this FSAR section (pgs 2.5-77 through 2.5-79), with a personal communication from Scott (2007) and two references (Scott, 1988 and 1997) which indicate the faults proposed by Vernon (1951) are not likely to exist. FSAR Section 2.5.3.2.1.1 (pgs 2.5-179 and 2.5-180) is cross-referenced to document that these postulated structures are not apparent in imagery mosaics, although regional fracture trends are. There is a need for references related to the geologic maps, if they exist, and a summary of the information from these maps which is being used to conclude that none of the regional fracture traces represent faults.

In order for the staff to assess information related to interpretations of potential faults in the site vicinity, please cite appropriate references for geologic maps used to conclude that no faults occur within the site vicinity and summarize the pertinent information used to draw this conclusion. Please discuss criteria applied to distinguish regional fractures from faults in the site vicinity.

02.05.01-***

FSAR Section 2.5.1.2.4 (pg 2.5-76) indicates that two major and two minor near-vertical conjugate fracture systems were mapped at the Crystal River plant about 13.7 km (8.5 mi) southwest of the LNP site. However, this FSAR section defines orientations for these for fracture sets (i.e., N45W and N45E, N-S and E-W for the major sets; N60W and N30E, N30W and N60E for the minor sets) which suggest they are orthogonal rather than conjugate.

Furthermore, what is meant by “major” (primary) and “minor” (secondary) fracture sets is not clear, and there is no statement regarding spacing of fractures measured at the Crystal River plant site or how they may be related to either regional fracture systems or fracture sets anticipated to occur at the LNP site. This FSAR section does state, based on Vernon (1951), that regional fracture sets which are spaced 30-50 km (20-30 mi) apart control stream drainages and sinkhole alignments in the area, although FSAR Figure 2.5.3-205 shows fractures and postulated faults of Vernon (1951) with a spacing of 1-2 mi. There is no discussion of spacing of fractures that may occur at the LNP site relative to spacing of regional fractures or to fractures measured at the Crystal River plant site.

In order for the staff to understand the importance of fractures mapped at the Crystal River plant relative to regional fracture patterns and fractures anticipated to occur at the LNP site, please discuss their relationship to regional fracture patterns which control stream drainages and sinkhole alignment and to fractures which occur at the LNP site, including a comparison of spacing for regional fracture sets with spacing of fractures measured at the Crystal River plant site and anticipated to occur at the LNP site. Please also explain why fracture sets which appear to be orthogonal are interpreted as conjugate fracture systems.

02.05.01-***

FSAR Section 2.5.1.2.4 (pg 2.5-77) states that Vernon (1951) interpreted seven (7) northwest-trending faults in a geologic section lying along the Levy-Citrus county line, four (4) of which (as well as 2 domal structures) occurred within the LNP site vicinity. Vernon (1951) cited field evidence for his postulated faults derived from outcrop and subsurface boreholes. This FSAR section (pgs 2.5-77 and 2.5-78) summarizes the outcrop evidence used by Vernon (1951), but not that derived from boreholes. FSAR Section 2.5.3.2 (pg 2.5-177) cites Vernon (1951) in reference to wells W-874, W-1767, W1791, W-1847, and W-1848, but these boreholes are not located on a map included in the FSAR and no borehole logs are presented to illustrate data set. FSAR Section 2.5.1.2.4.1 (pg 2.5-78) indicates that Scott (2007) discounts the existence of the faults postulated by Vernon (1951).

In order for the staff to assess the information used by Vernon (1951) to postulate faults in the site vicinity and determine whether the conclusion drawn by Scott (2007) regarding their existence appears to be correct, please locate wells W-874, W-1767, W1791, W-1847, and W-1848 on an appropriate map. Please also present and discuss the pertinent data from these wells.

02.05.01-***

FSAR Section 2.5.1.2.6 (pg 2.5-84) states that the LNP site is in a location of infrequent and low seismicity. From the discussion of stratigraphic units which occur at the site in FSAR Section 2.5.1.2.5.2.1 (pgs 2.5-81 and 2.5-82), it appears that materials are present which, under saturated conditions, could develop paleoliquefaction features if any past earthquakes had produced strong ground accelerations. The FSAR does not address the topic of potential paleoliquefaction features in the site region, vicinity, or area.

In order for the staff to assess whether paleoliquefaction features may occur within the site region, vicinity, or area, please discuss any efforts undertaken to document the presence or absence of such features, or explain the logic regarding why such efforts were not thought to be necessary.

02.05.01-***

FSAR Section 2.5.1.2.5.3 (pg 2.5-83) states that surface topography at the LNP site is characterized by depressions with circular to irregular shapes which are suggestive of karstic depressions. It is not clear whether enough borehole data exist at the site location to define possible karst depressions based on structure contour maps of the tops of select subsurface stratigraphic units (including top of bedrock). If adequate data exist, such maps may be of benefit for defining possible karst at depth.

In order for the staff to assess all existing information related to the possible existence of karst depressions at depth as may be reflected by structure contours drawn on tops of select subsurface stratigraphic units, if adequate borehole data exist, please prepare structure contour maps for the tops of select stratigraphic units and discuss the morphologic patterns illustrated in regard to whether they may indicate dissolution at depth.

02.05.01-***

FSAR Section 2.5.1.2.5.3 (pg 2.5-83) states that rectilinear margins of karstic depressions, orientations of major axes of depressions and associated wetlands, and alignment of circular features suggest that these observed morphologic characteristics are influenced by joint systems in underlying rock units. However, no representation of the orientations of these morphologic characteristics is presented in the FSAR as graphs or on maps in summary form to illustrate that they parallel the linear trends of joints and fractures to document the stated relationship.

In order for the staff to determine that morphologic features related to karstic depressions (i.e., rectilinear margins, major axes of depressions and associated wetlands, and alignment of circular features) lie parallel to trends of joints and fractures, please prepare graphs or maps to clearly illustrate this relationship.

02.05.01-***

FSAR Section 2.5.1.2.5.3 (pgs 2.5-83 and 2.5-84) states that variability in elevation of the Quaternary/Tertiary (Q/T) unconformity and the contact between units S3 and AV1 at depth may be related to heterogeneous weathering and dissolution of carbonate rocks; erosion related to Neogene (i.e., Upper Tertiary) or Quaternary sea level changes; and development of a paleo-epikarstic surface that formed in upper strata of the Avon Park Formation over a period of as much as several million years. During past sea level changes, it is possible that the regional water table could have been lower than at the present time to allow dissolution to occur at depth. It is not clear whether site characterization of subsurface voids permitted a robust assessment of the potential presence of deep voids.

In order for the staff to determine whether site characterization was adequate to permit a robust assessment of deep voids at the site, please discuss how the presence or absence of deep voids was investigated, including any information bearing on the presence or absence of such voids from deep drilling for petroleum.

02.05.01-***

FSAR Section 2.5.1.2.7.2 (pg 2.5-85) states that no zones of structural weakness, such as extensive fracture zones or faults, have been identified at the LNP site. However, no bedrock outcrops were observed at the site to enable assessment of such features. This FSAR section further states that televiewer records provide some information on fractures in boreholes, and that fractures, joints, and bedding planes exist in the Avon Park Formation. It is not clear whether the televiewer records define fracture spacings at the site to determine if they may be similar to those for fracture sets observed in outcrops at the Gulf Hammock Quarry and along the Waccasassa River. The distinction made between "fractures" and "joints" is also not clear.

In order for the staff to understand the density of fractures which may occur at the LNP site, please clarify whether there is information from borehole televiewer logs that can be used to assess fracture spacing, and whether orientation and density of fractures at the site are anticipated to be similar to those observed in outcrops at the Gulf Hammock

Quarry and along the Waccasassa River. Please also clarify what distinction is being made between “fractures” and “joints”.

02.05.01-***

FSAR Figure 2.5.1-228 designates areas in the vicinity of Charleston which are interpreted by Weems and Lewis (2000) to have persistently shown relative upward movement over the last 34 my relative to the surrounding terrain. However, the importance of this information in regard to potential seismic hazard from a Charleston source is not clear.

In order for the staff to assess information presented on potential crustal movements in the vicinity of the Charleston seismic source as they may bear on seismic hazard, please explain the significance of those areas shown in Figure 2.5.1-228 which Weems and Lewis (2000) interpret as having exhibited persistent upward relative movement over the last 34 my.