LevyCountyRAIsPEm Resource

From: Brian Anderson
Sent: Friday, May 08, 2009 12:04 PM
To: LevyCountyRAIsPEm Resource
Subject: REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 034 RELATED TO SRP SECTION 2.5.1 FOR THE LEVY COUNTY UNITS 1 AND 2 COMBINED LICENSE APPLICATION
Attachments: LNP-RAI-LTR-034.doc

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May 8, 2009

Mr. Garry Miller
General Manager, Nuclear Plant Development
Progress Energy Florida, Inc.
PO Box 1551
411 Fayetteville Street Mall
Raleigh, NC 27602

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 034 RELATED TO SRP SECTION 2.5.1 FOR THE LEVY COUNTY NUCLEAR PLANT, UNITS 1 and 2 COMBINED LICENSE APPLICATION

Dear Mr. Miller:

By letter dated July 28, 2008, as supplemented by a letter dated September 12, 2008, Progress Energy Florida, Inc. 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 changes are needed to the final safety analysis report, the staff requests that the RAI response include the proposed wording changes.

If you have any questions or comments concerning this matter, you may contact me at 301-415-9967.

Sincerely,

/**RA**/

Brian C. Anderson, Lead Project Manager
AP1000 Projects Branch 1
Division of New Reactor Licensing
Office of New Reactors

Docket Nos. 52-029
52-030

eRAI Tracking No. 2514

Enclosure:
Request for Additional Information

If you have any questions or comments concerning this matter, you may contact me at 301-415-9967.

Sincerely,

/**RA**/

Brian C. Anderson, Lead Project Manager
AP1000 Projects Branch 1
Division of New Reactor Licensing
Office of New Reactors

Docket Nos. 52-029
52-030

eRAI Tracking No. 2514

Enclosure:
Request for Additional Information

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NAME	CMunson *	BAnderson *	JMartin*	BAnderson*
DATE	04/03/09	04/03/09	04/21/09	05/08/09

*Approval captured electronically in the electronic RAI system.

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Request for Additional Information
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)

02.05.01-8

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.

02.05.01-9

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 and to assess the thickness of Quaternary sands as a potential indicator of paleochannels or paleosinkholes, 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.

02.05.01-10

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 indicates that a local orthogonal fracture set exhibits a dominant N39W strike parallel to the trend of primary fractures in the regional orthogonal fracture set defined by Vernon (1951), and suggests that a secondary local fracture set also exists parallel to the secondary regional fracture set. 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. There is no discussion related to why one set is labeled as “primary” and the other as “secondary”, and the FSAR does not illustrate orientations of these local fracture sets (e.g., as contoured maxima on stereonet plots).

In light of the description provided by Vernon (1951), two fracture sets oriented at about 90 degrees to each other comprise the local fracture system as well as the regional orthogonal fracture system. Therefore, the label of “an orthogonal fracture set” as expressed in the FSAR seems inaccurate for referring to the two orthogonal sets comprising the local and regional 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 characteristics of these fractures was not discussed.

In addition, FSAR Section 2.5.1.2.7.2 (pg 2.5-85) states that televiewer records provide information on fractures in boreholes at the LNP site, 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. It is also not clear why both “fractures” (a more general term including joints and faults) and “joints” are reported in the televiewer logs.

In order for the staff to assess characteristics of the local fracture sets observed at the quarry and riverbank locations and understand how they are related to fractures at the site location, please address the following questions:

(a) Were all fractures in the two outcrops observed and measured to determine spacing of the “local” fracture sets?

(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) 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 appear to exercise any control on karst development?

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

(e) What is the basis for distinguishing one set of fractures as “primary” and the other as “secondary” in relation to both local and regional fracture sets for the LNP site?

(f) Can any data in the televiewer logs be used to determine whether orientation and spacing of fractures at the site are similar to those same characteristics for fractures observed in outcrops at the Gulf Hammock Quarry and along the Waccasassa River?

(g) Is the more general term “fracture” used in reference to features observed in the televiewer logs because some features cannot be distinguished as either a fault or a joint?

02.05.01-11

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 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 which control stream drainages and sinkhole alignments. Considering orientation of the two regional fracture sets in relation to the axis of the arch as defined by Vernon (1951), these features could be 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 of these two orthogonal fracture sets (e.g., as contoured maxima on stereonet plots), but a relationship to the Ocala arch as interpreted by Vernon (1951) suggests an origin related to bending of rock units across the arch.

The response to RAI 2.5.1-2 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 a tectonic 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 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 comments:

(a) Define orientations 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) Discuss the mechanism(s) for generation of regional and local fractures sets, including a possible association with development of the Ocala Arch and the relationship between regional and local fracture sets.

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

(d) Discuss the logic for concluding that origin of the Ocala arch/platform is the result of sedimentary processes when reported dips of bedding in the sedimentary units suggest that a broad uplift has affected these units.

(e) 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.

02.05.01-12

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.

02.05.01-13

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.

02.05.01-14

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.

02.05.01-15

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.

02.05.01-16

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.

02.05.01-17

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.

02.05.01-18

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.

02.05.01-19

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.

02.05.01-20

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.

02.05.01-21

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.

02.05.01-22

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.

02.05.01-23

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 address the following, or explain why such information is not necessary:

(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 microseismic 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.

02.05.01-24

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 indicate 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.

02.05.01-25

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.

02.05.01-26

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 regards to representing it as a geomorphic province.

02.05.01-27

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.

02.05.01-28

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 specify 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.

02.05.01-29

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.

02.05.01-30

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 develop. 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.

02.05.01-31

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 the 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 the location of these features relative to the LNP site.

02.05.01-32

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.

02.05.01-33

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 the 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.

02.05.01-34

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).

02.05.01-35

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.

02.05.01-36

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.

02.05.01-37

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.

02.05.01-38

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.

02.05.01-39

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, implying that these features are shear fractures. However, this FSAR section defines orientations for these 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.

In addition, 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 relate 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 address the following comments:

(a) Discuss the relationship of fractures mapped at the Crystal River plant to regional fracture patterns which control stream drainages and sinkhole alignment and to fractures which are expected to occur at the LNP site.

(b) Compare spacing of regional fracture sets with spacing of fractures measured at the Crystal River plant site and those fractures anticipated to occur at the LNP site.

(c) Explain why fracture sets which appear to be orthogonal are interpreted as conjugate fracture systems.

(d) What were the criteria used to distinguish between major (primary) and minor (secondary) fractures observed at the Crystal River plant site? Were these same criteria applied to distinguish primary and secondary local and regional fractures for the LNP site?

02.05.01-40

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 this 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.

02.05.01-41

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.

02.05.01-42

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, or explain why these maps are not necessary.

02.05.01-43

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, or explain why graphs or maps are not necessary.

02.05.01-44

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 the 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.

02.05.01-45

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.