Progress Energy

Serial: NPD-NRC-2009-105
June 9, 2009

10 CFR 52.79

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555-0001

LEVY COUNTY NUCLEAR POWER PLANT, UNITS 1 AND 2
DOCKET NOS. 52-029 AND 52-030
PARTIAL RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 034
RELATED TO BASIC GEOLOGIC AND SEISMIC INFORMATION

Reference: Letter from Brian C. Anderson (NRC) to Garry Miller (PEF), dated May 8, 2009, "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"

Ladies and Gentlemen:

Progress Energy Florida, Inc. (PEF) hereby submits our response to the Nuclear Regulatory Commission's (NRC) request for additional information provided in the referenced letter.

A partial response to the NRC request is addressed in the enclosure. The enclosure also identifies changes that will be made in a future revision of the Levy County Nuclear Power Plant Units 1 and 2 application.

If you have any further questions, or need additional information, please contact Bob Kitchen at (919) 546-6992, or me at (919) 546-6107.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on June 9, 2009.

Sincerely,

Garry D. Miller
General Manager
Nuclear Plant Development

Enclosure

cc : U.S. NRC Region II, Regional Administrator
Mr. Brian Anderson, U.S. NRC Project Manager

Progress Energy Carolinas, Inc.
P.O. Box 1551
Raleigh, NC 27602

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NRO

Levy Nuclear Power Plant Units 1 and 2
Response to NRC Request for Additional Information Letter No. 034 Related to SRP Section 2.5.1 for the Combined License Application, dated May 8, 2009

NRC RAI #	Progress Energy RAI #	Progress Energy Response
02.05.01-13	L-0297	Response enclosed – see following pages
02.05.01-14	L-0298	Future Response
02.05.01-15	L-0299	Response enclosed – see following pages
02.05.01-16	L-0300	Future Response
02.05.01-17	L-0301	Future Response
02.05.01-18	L-0302	Future Response
02.05.01-19	L-0303	Future Response
02.05.01-20	L-0304	Response enclosed – see following pages
02.05.01-21	L-0305	Future Response
02.05.01-22	L-0306	Future Response
02.05.01-23	L-0307	Future Response
02.05.01-24	L-0308	Future Response
02.05.01-25	L-0309	Response enclosed – see following pages
02.05.01-26	L-0310	Response enclosed – see following pages
02.05.01-27	L-0311	Response enclosed – see following pages
02.05.01-28	L-0312	Response enclosed – see following pages

NRC Letter No.: LNP-RAI-LTR-034

NRC Letter Date: May 8, 2009

NRC Review of Final Safety Analysis Report

NRC RAI NUMBER: 02.05.01-13

Text of NRC RAI:

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.

PGN RAI ID #: L-0297

PGN Response to NRC RAI:

This description of the topography within the East Gulf Coastal Plain section addresses topographic variations due to differences in the erosional resistance of the underlying bedrock units. The term 'weak', which was used in the original reference cited, is inferred to mean 'less resistant to erosion' or 'more easily eroded'. The term 'stronger' rocks refers to bedrock units that are more resistant to erosion.

Associated LNP COL Application Revisions:
The following changes will be made to the LNP FSAR Chapter 2 in a future revision:

Revise FSAR Section 2.5.1.1.1.1.2 from:

"2.5.1.1.1.1.2 East Gulf Coastal Plain Section

The East Gulf Coastal Plain section begins near the Georgia – South Carolina boundary and continues west to Louisiana and as far north as Illinois. Although no sharp topographic boundary exists between the Sea Island section and the East Gulf Coastal Plain section, there is an increase in the number and thickness of the Cretaceous and Eocene formations, resulting in a widening of the Coastal Plain and notable variation in erosion rates. The variation in erosion rates have produced a youthful to maturely dissected, belted coastal plain that consists of a series of alternating cuestas, and lowlands, and coastwise terraces that are present along the outer margin. (Reference 2.5.1 210)

The East Gulf Coastal Plain section can be divided into two distinct types of topography. The majority of the section consists of a series of belted coastal plains that include a series of lowlands developed on weak rock (limestones and shales) bounded by cuesta scarps and dip

slopes on the stronger rocks (commonly sandstones) (Reference 2.5.1 210). The only topographic belt of the East Gulf Coastal Plain that is within the 320 km (200 mi.) radius of the LNP site is the Flatwoods belt, and it is described as a lowland that was developed on the Eocene Midway Formation (Reference 2.5.1 210). The other type of topography within the East Gulf Coastal Plain consists of a sequence of coastwise terraces that lie adjacent to the coast (Reference 2.5.1 210)."

To read:

"2.5.1.1.1.1.2 East Gulf Coastal Plain Section

The East Gulf Coastal Plain section begins near the Georgia – South Carolina boundary and continues west to Louisiana and as far north as Illinois. Although no sharp topographic boundary exists between the Sea Island section and the East Gulf Coastal Plain section, changes in the topographic characteristics between the two sections are sufficient to warrant differentiation. A westward increase in the number and thickness of the Cretaceous and Eocene formations, which results in a widening of the Coastal Plain in the East Gulf Coastal Plain section, and greater variability in the lithological characteristics and resulting erosibility of the underlying bedrock units are the primary factors responsible for the change in topography. The variation in erosibility of rocks within the East Gulf Coastal Plain have produced a youthful to maturely dissected, belted coastal plain that consists of a series of alternating cuestas, and lowlands. (Reference 2.5.1 210)

The East Gulf Coastal Plain section can be divided into two distinct types of topography. The majority of the section consists of the belted coastal plain that includes a series of lowlands developed on more easily eroded rock (limestones and shales) bounded by cuesta scarps and dip slopes on the stronger, less easily eroded rocks (commonly sandstones) (Reference 2.5.1 210). The only topographic belt of the East Gulf Coastal Plain that is within the 320 km (200 mi.) radius of the LNP site is the Flatwoods belt, and it is described as a lowland that was developed on the Eocene Midway Formation (Reference 2.5.1 210). The other type of topography within the East Gulf Coastal Plain consists of the sequence of coastwise terraces that lie adjacent to the coast (Reference 2.5.1 210)."

Attachments/Enclosures:

None

NRC Letter No.: LNP-RAI-LTR-034

NRC Letter Date: May 8, 2009

NRC Review of Final Safety Analysis Report

NRC RAI NUMBER: 02.05.01-15

Text of NRC RAI:

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.

PGN RAI ID #: L-0299

PGN Response to NRC RAI:

Before the end of the Paleogene, the Georgia Channel system, including features referred to as the "Gulf Trough" and the "Suwannee Straits") acted as a barrier to siliciclastic transport onto the Florida Platform (Reference 2.5.1-235). The Suwannee Current occupied the channel system from the Late Cretaceous until the Late Oligocene (Reference 1). A significant sea level decline in the Late Oligocene resulted in the cessation of the current and the influx of siliciclastic sediments onto the Florida Platform (Reference 2.5.1-235).This heralded the most significant deposition system change on the Florida Platform since the initiation of carbonate sedimentation in the Jurassic (Reference 2.5.1-231). Following the cessation of the Suwannee Current and the infilling of the Georgia Channel System, siliciclastic sediments encroached onto the Florida Platform. By Late Pliocene, siliciclastic sediments covered virtually the entire platform and greatly limited carbonate deposition. (Reference 2.5.1-235)

The Georgia Channel System, which included the Apalachicola Embayment and the Southeast Georgia Embayment, extended across the northern part of the study region (RAI 02.05.01-15 Figure 1). RAI 02.05.01-15 Figure 2 shows the location of the Suwannee Current relative to the Gulf Trough as defined by Huddlestun (Reference RAI 02.05.01-15 01). (see also the Response to RAI 02.05.01-18 for revised figures showing tectonic and structural features in the study region).

Reference

1) Huddlestun, 1993, A revision of the lithostratigraphic units of the Coastal Plain of Georgia – The Oligocene: Georgia Geologic Survey Bulletin 105, 152 p., 3 plates.

Associated LNP COL Application Revisions:

No COLA revisions have been identified associated with this response.

Attachments/Enclosures:

RAI 02.05.01-15 Figure 1

RAI 02.05.01-15 Figure 2

NRC Letter No.: LNP-RAI-LTR-034

NRC Letter Date: May 8, 2009

NRC Review of Final Safety Analysis Report

NRC RAI NUMBER: 02.05.01-20

Text of NRC RAI:

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.

PGN RAI ID #: L-0304

PGN Response to NRC RAI:

Figure 2.5.1-224 illustrates ages inferred for faults shown by Miller (1986) (Reference 2.5.1-240). Miller (Reference 2.5.1-240) did not recognize the postulated faults of Vernon (Reference 2.5.1-262) and therefore, these faults are not shown on Figure 2.5.1-224. The title of Figure 2.5.1-224 will be modified to clarify that this figure refers to the Miller (Reference 2.5.1-240) interpretation. Additional information regarding the existence of the postulated Vernon faults will be provided in Responses to RAI 02.05.01-19 and RAI 02.05.03-05.

Associated LNP COL Application Revisions:

No text revisions.

Figure 2.5.1-224 will be revised (see Attachment 02.05.01-20A) as follows:

The title of the figure will be changed from: "Ages of Rocks Affected by Cenozoic Faults (320-km [200-mi.] Radius)" to "Ages of Rocks Affected by Cenozoic Faults (Miller, 1986)."
In addition, the legend will be revised to show the faults in chronological order from youngest to oldest and to remove the word "surface" from fault descriptors.

Attachments/Enclosures:

Attachment 02.05.01-20A Revised Figure 2.5.1-224

NRC Letter No.: LNP-RAI-LTR-034

NRC Letter Date: May 8, 2009

NRC Review of Final Safety Analysis Report

NRC RAI NUMBER: 02.05.01-25

Text of NRC RAI:

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.

PGN RAI ID #: L-0309

PGN Response to NRC RAI:

Figure 2.5.1-201 provides a regional perspective on physiographic provinces. County lines are not appropriate at the scale of the map. The Central Highlands geomorphic province is shown on revised Figure 2.5.1-201 (see Attachment 02.05.01-25A) for cross reference to the more detailed Figures 2.5.1-233 and 2.5.1-234 showing the county lines with respect to local geomorphic units. The paragraph in FSAR Section 2.5.1.2.1 that states that Levy, Citrus, and Marion Counties lie within the site vicinity, and that these three counties lie within the central (midpeninsular) physiographic zone will be modified in a future amendment to delete reference to the counties with respect to Figure 2.5.1-201.

Associated LNP COL Application Revisions:
The following changes will be made to the LNP FSAR Chapter 2 in a future revision:

Figure 2.5.1-201 will be revised as follows: Legend will be revised for clarification.

Revise FSAR Section 2.5.1.2.1 from:

"The LNP site, located within southwestern Levy County, lies approximately 16 km (10 mi.) east of the Gulf of Mexico and approximately 12.8 km (8 mi.) north of the Withlacoochee River. A geomorphic map of the site vicinity (40 km [25 mi.] radius) and site area (8 km [5 mi.] radius) is shown on Figure 2.5.1 233. The western portion of Levy County is a poorly drained, low relief region that is characterized by extensive swamps, marshes, and terraces formed by ancient sea level high stands (Reference 2.5.1 307). Within the 40 km (25 mi.) radius of the site, two other counties border the LNP site: Citrus County located south of the site and Marion County located east of the site. As shown on Figure 2.5.1 201, all three counties fall within the central (midpeninsular) physiographic zone. (Reference 2.5.1 212) Levy County lies near the northern edge of the midpeninsular zone. This zone spans the Florida peninsula from the lower edge of the Northern Highlands southward to approximately the Caloosahatchee River, and is

characterized by ridges, valleys, and terraced coastal plains. The midpeninsular zone is subdivided into a series of elevationally differentiated geomorphic provinces. Two of these geomorphic provinces occur within the 40 km (25 mi.) radius of the site — the Central Highlands, and the Gulf Coastal Lowlands. (Reference 2.5.1 308) The site lies within the Gulf Coastal Lowlands. These geomorphic provinces and their respective subzones that fall within the 40 km (25 mi.) radius of the site are shown on Figure 2.5.1 233."

To read:

"The LNP site, located within southwestern Levy County, lies approximately 16 km (10 mi.) east of the Gulf of Mexico and approximately 12.8 km (8 mi.) north of the Withlacoochee River. Within the 40 km (25 mi.) radius of the site, two other counties border the LNP site: Citrus County located south of the site and Marion County located east of the site. A geomorphic map of the site vicinity (40 km [25 mi.] radius) and site area (8 km [5 mi.] radius) is shown on Figure 2.5.1 233. The western portion of Levy County is a poorly drained, low relief region that is characterized by extensive swamps, marshes, and terraces formed by ancient sea level high stands (Reference 2.5.1 307). As shown on Figure 2.5.1 201, the site lies within the central (midpeninsular) physiographic zone. (Reference 2.5.1 212) Levy County lies near the northern edge of the midpeninsular zone. This zone spans the Florida peninsula from the lower edge of the Northern Highlands southward to approximately the Caloosahatchee River, and is characterized by ridges, valleys, and terraced coastal plains. The midpeninsular zone is subdivided into a series of elevationally differentiated geomorphic provinces. Two of these geomorphic provinces occur within the 40 km (25 mi.) radius of the site — the Central Highlands, and the Gulf Coastal Lowlands. (Reference 2.5.1 308) The site lies within the Gulf Coastal Lowlands. These geomorphic provinces and their respective subzones that fall within the 40 km (25 mi.) radius of the site are shown on Figure 2.5.1 233."

Attachments/Enclosures:

Attachment 02.05.01-25A Revised Figure 2.5.1-201

NRC Letter No.: LNP-RAI-LTR-034

NRC Letter Date: May 8, 2009

NRC Review of Final Safety Analysis Report

NRC RAI NUMBER: 02.05.01-26

Text of NRC RAI:

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.

PGN RAI ID #: L-0310

PGN Response to NRC RAI:

Figure 2.5.1-201 shows the location of the site with respect to the regional physiographic provinces (Reference 2.5.1-209) (i.e., the three sections of the Coastal Plain Province), the state of Florida transpeninsular physiographic divisions (Reference 2.5.1-212) and the Central Highlands geomorphic province (Reference 2.5.1-216), thus illustrating the relationship between the physiographic and geomorphic provinces. For clarification, the legend of Figure 2.5.1-201 (see Attachment 02.05.01-25A) will be modified in a future revision to include the Central Highlands under the heading geomorphic provinces. Additionally, the text will be modified in a future revision to refer to both the Central Highlands and Gulf Coastal Lowlands correctly as geomorphic provinces.

Associated LNP COL Application Revisions:
The following changes will be made to the LNP FSAR Chapter 2 in a future revision:

Figure 2.5.1-201: Legend will be modified to include the Central Highlands under the heading geomorphic provinces.

Revise the 5th paragraph of FSAR Section 2.5.1.1.1.1.3 from:

"The Florida peninsula is divided into three generalized physiographic zones separated by roughly east-west boundaries. From north to south, these are the northern (or proximal) zone, the central (or midpeninsular) zone, and the southern (or distal) zone. Superimposed onto these subdivisions is a Central Highlands area trending north-northwest to south-southeast through the center of the peninsula border. It is surrounded to the east, south, and west by plains and coastal lowlands (Figure 2.5.1-201). (Reference 2.5.1-212) The following descriptions of the three physiographic zones are from Bryant et al. (Reference 2.5.1-216)."

To read:

"The Florida peninsula is divided into three generalized physiographic zones separated by roughly east-west boundaries. From north to south, these are the northern (or proximal) zone, the central (or midpeninsular) zone, and the southern (or distal) zone. Superimposed onto these subdivisions is the Central Highlands geomorphic province trending north-northwest to south-southeast through the center of the peninsula border. It is surrounded to the east, south, and west by plains and coastal lowlands (Figure 2.5.1-201). (Reference 2.5.1-212) The following descriptions of the three physiographic zones are from Bryant et al. (Reference 2.5.1-216)."

Revise the 2nd paragraph of FSAR Section 2.5.1.2.1.3 from:

"The LNP site, located within the Gulf Coastal Lowlands physiographic province, is characterized by both depositional and erosional features. Broad plains underlain by a series of late Tertiary and Quaternary surfaces and shorelines are pitted with karstic depressions within the limestone at or near the present land surface in the site area. The Gulf Coastal Lowlands represent a typical mature karst terrain overlain by a thin mantle of permeable terrace deposits (i.e., a mantled epikarstic subsurface as described below in FSAR Subsection 2.5.1.2.1.3.1). (Reference 2.5.1-316)"

To read:

"The LNP site, located within the Gulf Coastal Lowlands geomorphic province, is characterized by both depositional and erosional features. Broad plains underlain by a series of late Tertiary and Quaternary surfaces and shorelines are pitted with karstic depressions within the limestone at or near the present land surface in the site area. The Gulf Coastal Lowlands represent a typical mature karst terrain overlain by a thin mantle of permeable terrace deposits (i.e., a mantled epikarstic subsurface as described below in FSAR Subsection 2.5.1.2.1.3.1). (Reference 2.5.1-316)"

Revise the 1st paragraph of FSAR Section 2.5.0.1.2 from:

"The LNP site, located within southern Levy County, lies approximately 16 km (10 mi.) west of the Gulf of Mexico and approximately 12.8 km (8 mi.) north of the Withlacoochee River. The site area, located within the Gulf Coastal Lowlands physiographic province, is characterized by both depositional and erosional features. Broad plains underlain by a series of late Tertiary and Quaternary surfaces and shorelines are pitted with karstic depressions within the limestone at or near the present land surface in the site area. The LNP site is located within the Limestone Shelf and Hammocks subzone, a zone that is characterized as a karstic, erosional limestone plain overlain by sand dunes, ridges, and coast-parallel paleoshore sand belts associated with the Pleistocene-age marine terraces."

To read:

"The LNP site, located within southern Levy County, lies approximately 16 km (10 mi.) west of the Gulf of Mexico and approximately 12.8 km (8 mi.) north of the Withlacoochee River. The site area, located within the Gulf Coastal Lowlands geomorphic province, is characterized by both depositional and erosional features. Broad plains underlain by a series of late Tertiary and Quaternary surfaces and shorelines are pitted with karstic depressions within the limestone at or near the present land surface in the site area. The LNP site is located within the Limestone Shelf and Hammocks subzone, a zone that is characterized as a karstic, erosional limestone plain overlain by sand dunes, ridges, and coast-parallel paleoshore sand belts associated with the Pleistocene-age marine terraces."

Attachments/Enclosures:

Attachment 02.05.01-25A Revised Figure 2.5.1-201

NRC Letter No.: LNP-RAI-LTR-034

NRC Letter Date: May 8, 2009

NRC Review of Final Safety Analysis Report

NRC RAI NUMBER: 02.05.01-27

Text of NRC RAI:

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.

PGN RAI ID #: L-0311

PGN Response to NRC RAI:

FSAR Section 2.5.1.2.1 has been changed to Geomorphic Provinces with two subdivisions: the Central Highlands and Gulf Coastal Lowlands provinces.

Associated LNP COL Application Revisions:

The following changes will be made to the LNP FSAR Chapter 2 in a future revision:

Revise FSAR Section 2.5.1.2.1.1 from:

"2.5.1.2.1.1 Central Highlands Geomorphic Province

The Central Highlands geomorphic province comprises the eastern third of Levy County, two thirds of Citrus County, and all of Marion County (Figure 2.5.1 233). The Central Highlands include a series of localized highlands and ridges punctuated by topographically lower valleys, all of which trend generally coast parallel down the central Florida peninsula. The Central Highlands province is further subdivided into the Western Valley and the Brooksville Ridge. (Reference 2.5.1 308) The Tsala Apopka Plain is part of the Western Valley subzone in Citrus County. (Reference 2.5.1 307) In Marion County, there are 12 different subzones within the Central Highlands. Only seven of these subzones lie within the 40 km (25 mi.) radius of the LNP site; these are the Brooksville Ridge, Western Valley, Cotton Plant Ridge, Martel Hill, Sumter Upland, Fairfield Hills, and the Central Valley (Figure 2.5.1 233). Sumter Upland, Fairfield Hills, Martel Hill, and Cotton Plant Ridge together form a north south series of topographic highs that separate the Western Valley from the Central Valley. These ridges are thought to be relict coastal features and are largely composed of thick sand and clayey sand deposits. Surface elevations within these four subdivisions are as follows: Sumter Upland elevation is 23 to 30 m (75 to 100 ft.) amsl; Fairfield Hills elevation is 24 to 64 m (80 to 210 ft.) amsl; Martel Hill is

considered an outlier of the Fairfield Hills; and Cotton Plant Ridge has a maximum elevation of 51 m (168 ft.) amsl. Immediately to the west of Cotton Plant Ridge and the Sumter Upland lies the Western Valley and west of the Western Valley lies the Brooksville Ridge, a large, linear high that is described below. (Reference 2.5.1 309)

Western Valley. In Levy County, the Western Valley extends both east and south into Marion County and is bounded on the west by the Brooksville Ridge (see Figure 2.5.1 233). Along the eastern edge of Levy County, the Western Valley encompasses the Williston Limestone Plain, a well developed, gently rolling limestone plain with surface elevations ranging from 18 to 30 m (60 to 100 ft.) amsl. Covering the limestone is a thin layer of Pleistocene sand and clayey sands that contain localized pockets of phosphatic Alachua formation sediments. (Reference 2.5.1 308) Vernon (Reference 2.5.1 262) hypothesized that the Williston Limestone Plain was a relict erosional limestone shelf of Eocene sediments that represented the seaward extension of the ancient Wicomico Sea. (Reference 2.5.1 310)

In Citrus County, the Western Valley extends the length of the county and is bounded on the west by the Brooksville Ridge and on the east by the Withlacoochee River. The Western Valley encompasses the Tsala Apopka Plain, which consists of a number of interconnected lakes partially separated by peninsulas and islands. Sands and clayey sands of variable thickness cover the limestone surface. Land surface elevations range from 18 to 24 m (60 to 80 ft.) amsl, whereas water surface elevations vary from 11 to 14 m (35 to 45 ft.) amsl. (Reference 2.5.1 307)

Brooksville Ridge. The Brooksville Ridge is a topographic highland extending from northeastern Gilchrist County southward through eastern Levy County, terminating 177 km (110 mi.) to the south in Pasco County. (Reference 2.5.1 308) It is bounded to the east by the Western Valley subzone and to the west by the Gulf coastal lowlands. In Levy County, it is present as a thin unit on the eastern third of the county, and is only present in an isolated region in the northwest corner of Marion County. In Citrus County, it occupies the central part of the county. From north to south, the width of the ridge increases as well as surface elevations.

The Brooksville Ridge has an irregular surface due to karst activity, and elevations may vary over 30 m (100 ft.) in short distances. (Reference 2.5.1 307) The core of the ridge, overlying Eocene limestone, is composed of varying thicknesses of Pleistocene siliciclastics and is capped by a depression pocked rolling plain of Pleistocene marine terrace sands. (Reference 2.5.1 308) These clastic sediments restrict the downward percolation of water, thereby reducing dissolution of the underlying limestone. (Reference 2.5.1 311) In Levy County, the Brooksville Ridge is more than 46 m (150 ft.) amsl, significantly higher than the surrounding plains. Vernon (Reference 2.5.1 262) named this feature the Coharie – Okefenokee Sand Ridge. (Reference 2.5.1 310)

Gulf Coastal Lowlands Geomorphic Province. The Gulf coastal lowlands geomorphic province occupies more than two thirds of Levy County and approximately one third of Citrus County; it is not present in Marion County (Figure 2.5.1 233). It parallels the present Gulf coast of Florida from Ft. Myers northward, then westward to the Alabama line. In Levy and Citrus counties, the Gulf coastal lowlands extend inland from the modern Gulf of Mexico shoreline, terminating at the western edge of the Brooksville Ridge. The Gulf coastal lowlands are characterized by broad, flat marine erosional plains, underlain by Eocene limestones, and covered by thin Pleistocene sands deposited by the regressing Gulf of Mexico. (Reference 2.5.1

308) The geomorphic setting is a low energy, salt or freshwater environment with insufficient sand to build beaches. The marine terraces located within this geomorphic province are gently sloping features with seaward facing escarpments. These features formed when sedimentary materials were alternatively deposited and eroded as sea levels rose and fell. (Reference 2.5.1 307)

In Levy County, the Gulf coastal lowlands are subdivided into several subzones that are differentiated based on topography (Figure 2.5.1 234). These subzones include the Waccasassa Flats, the Limestone Shelf and Hammocks, the Chiefland Limestone Plain, the Suwannee River Valley Lowlands, and the Coastal Marsh Belt. (Reference 2.5.1 308)

Waccasassa Flats. The Waccasassa Flats, located in central Levy County is a low swampy area that extends from the Santa Fe River in Gilchrist County southeast into Levy County. Land surface elevations average 17 m (55 ft.) amsl, although isolated sand hills, possibly associated with the Wicomico marine terrace deposits and the Brooksville Ridge, reach elevations as high as 22 m (70 ft.) amsl. At the southern edge of the Waccasassa Flats, the zone broadens to approximately 22.5 km (14 mi.) wide and elevations decrease to 9 m (30 ft.) amsl as the flats merge into the hammocks of southwestern Levy County. The Waccasassa River, which originates as a poorly defined channel in the swamps, lakes, and ponds of northern Levy County, drains the lower reaches of the Waccasassa Flats. The river flows to the southwest and empties into the Gulf of Mexico. A narrow Holocene floodplain of muds and sand occurs near the coast where the river merges with the coastal swamps. (Reference 2.5.1 308)

Limestone Shelf and Hammocks. The LNP site is located within the Limestone Shelf and Hammocks subzone, a zone that is characterized as a highly karstic, erosional limestone plain overlain by sand dunes, ridges, and coast parallel paleoshore sand belts associated with the Pleistocene age Pamlico marine terrace. The irregular, highly solutioned Eocene limestone underlying this subzone is covered by a blanket of Pleistocene sands of varying thickness. Near the modern coast, the limestone shelf is drowned by the coastal marshes. Inland, the limestone is heavily forested. Numerous artesian springs flow from the near surface limestone, and during heavy rain events much of the zone is prone to flooding, producing shallow swamps. Drainage from the coastal hammocks occurs through numerous small creeks and sloughs, which empty into the coastal marshes. (Reference 2.5.1 308)

Chiefland Limestone Plain. The Chiefland Limestone Plain, located in northwestern Levy County, is a flat, karstic limestone shelf that extends from Gilchrist County southward into Levy County. The Eocene limestone plain is generally flat to rolling, covered by a veneer of well drained Pleistocene sands, generally less than 9 m (30 ft.) thick. Elevations range from 8 m (25 ft.) amsl at the southern edge of the plain to nearly 15 m (50 ft.) amsl at the Levy – Gilchrist county line. (Reference 2.5.1 308)

Suwannee River Valley Lowlands. The Suwannee River Valley Lowlands house the Suwannee River, which flows southwest and empties into the Gulf of Mexico. The river, which forms the northwestern boundary of Levy County, flows in a solution valley, formed in the near surface Eocene limestones. The lowlands adjacent to the river are made up of a thin veneer of Holocene alluvium and exposed limestone. In the lower reaches, the river valley is drowned and obscured by marshes of the Coastal Marsh Belt subzone. The broadly meandering valley is less than 1.6 km (1 mi.) wide over most of its course, broadening to about 4 km (2.5 mi.) wide just

northwest of the Chiefland Limestone Plain. Elevations of the valley floor average 1.5 m (5 ft.) amsl. (Reference 2.5.1 308)

Coastal Marsh Belt. The Coastal Marsh Belt subzone is located on the drowned, seaward edge of the Eocene limestone shelf underlying Levy County. Elevations are less than 1.5 m (5 ft.) amsl. The gentle slope of the limestone plain results in a very broad, shallow continental shelf off the coast of Florida. Sediments are predominantly muds, and alluvial sand beaches are virtually absent due to the zero energy nature of the shoreline and lack of adequate sand supply. Instead, marshes of Juncus and Spartina grasses fringe the modern coastline, and a series of small islets or keys, comprised of limestone pinnacles or alluvial sand, are common offshore of the modern coast. (Reference 2.5.1 308)

Davis et al. (Reference 2.5.1 213) refer to the low wave energy coastline from the Appalachicola River delta to Anclote Key (just north of Tampa Bay) as the Big Bend Coast (or area). This part of the coastline, which includes the LNP site vicinity, is morphologically complex due to variations in underlying limestone bedrock topography, and the presence of actively discharging freshwater springs, large oyster bioherms, a modern river delta, and possible paleoshorelines. The Suwannee River, which lies approximately 138 km (86 mi.) northwest of the LNP site, is the only coastal plain river that discharges along this coast. Other rivers emanate from springs fed by the Floridan aquifer and travel only a few kilometers (miles) across the coastal plain before reaching the Gulf of Mexico."

To read:

"2.5.1.2.1.1 Geomorphic Provinces

2.5.1.2.1.1.1 Central Highlands Geomorphic Province

The Central Highlands geomorphic province comprises the eastern third of Levy County, two thirds of Citrus County, and all of Marion County (Figure 2.5.1 233). The Central Highlands include a series of localized highlands and ridges punctuated by topographically lower valleys, all of which trend generally coast parallel down the central Florida peninsula. The Central Highlands province is further subdivided into the Western Valley and the Brooksville Ridge. (Reference 2.5.1 308) The Tsala Apopka Plain is part of the Western Valley subzone in Citrus County. (Reference 2.5.1 307) In Marion County, there are 12 different subzones within the Central Highlands. Only seven of these subzones lie within the 40 km (25 mi.) radius of the LNP site; these are the Brooksville Ridge, Western Valley, Cotton Plant Ridge, Martel Hill, Sumter Upland, Fairfield Hills, and the Central Valley (Figure 2.5.1 233). Sumter Upland, Fairfield Hills, Martel Hill, and Cotton Plant Ridge together form a north south series of topographic highs that separate the Western Valley from the Central Valley. These ridges are thought to be relict coastal features and are largely composed of thick sand and clayey sand deposits. Surface elevations within these four subdivisions are as follows: Sumter Upland elevation is 23 to 30 m (75 to 100 ft.) amsl; Fairfield Hills elevation is 24 to 64 m (80 to 210 ft.) amsl; Martel Hill is considered an outlier of the Fairfield Hills; and Cotton Plant Ridge has a maximum elevation of 51 m (168 ft.) amsl. Immediately to the west of Cotton Plant Ridge and the Sumter Upland lies the Western Valley and west of the Western Valley lies the Brooksville Ridge, a large, linear high that is described below. (Reference 2.5.1 309)

Western Valley. In Levy County, the Western Valley extends both east and south into Marion County and is bounded on the west by the Brooksville Ridge (see Figure 2.5.1 233). Along the eastern edge of Levy County, the Western Valley encompasses the Williston Limestone Plain, a

well developed, gently rolling limestone plain with surface elevations ranging from 18 to 30 m (60 to 100 ft.) amsl. Covering the limestone is a thin layer of Pleistocene sand and clayey sands that contain localized pockets of phosphatic Alachua formation sediments. (Reference 2.5.1 308) Vernon (Reference 2.5.1 262) hypothesized that the Williston Limestone Plain was a relict erosional limestone shelf of Eocene sediments that represented the seaward extension of the ancient Wicomico Sea. (Reference 2.5.1 310)

In Citrus County, the Western Valley extends the length of the county and is bounded on the west by the Brooksville Ridge and on the east by the Withlacoochee River. The Western Valley encompasses the Tsala Apopka Plain, which consists of a number of interconnected lakes partially separated by peninsulas and islands. Sands and clayey sands of variable thickness cover the limestone surface. Land surface elevations range from 18 to 24 m (60 to 80 ft.) amsl, whereas water surface elevations vary from 11 to 14 m (35 to 45 ft.) amsl. (Reference 2.5.1 307)

Brooksville Ridge. The Brooksville Ridge is a topographic highland extending from northeastern Gilchrist County southward through eastern Levy County, terminating 177 km (110 mi.) to the south in Pasco County. (Reference 2.5.1 308) It is bounded to the east by the Western Valley subzone and to the west by the Gulf coastal lowlands. In Levy County, it is present as a thin unit on the eastern third of the county, and is only present in an isolated region in the northwest corner of Marion County. In Citrus County, it occupies the central part of the county. From north to south, the width of the ridge increases as well as surface elevations.

The Brooksville Ridge has an irregular surface due to karst activity, and elevations may vary over 30 m (100 ft.) in short distances. (Reference 2.5.1 307) The core of the ridge, overlying Eocene limestone, is composed of varying thicknesses of Pleistocene siliciclastics and is capped by a depression pocked rolling plain of Pleistocene marine terrace sands. (Reference 2.5.1 308) These clastic sediments restrict the downward percolation of water, thereby reducing dissolution of the underlying limestone. (Reference 2.5.1 311) In Levy County, the Brooksville Ridge is more than 46 m (150 ft.) amsl, significantly higher than the surrounding plains. Vernon (Reference 2.5.1 262) named this feature the Coharie – Okefenokee Sand Ridge. (Reference 2.5.1 310)

2.5.1.2.1.1.2 Gulf Coastal Lowlands Geomorphic Province.

The Gulf coastal lowlands geomorphic province occupies more than two thirds of Levy County and approximately one third of Citrus County; it is not present in Marion County (Figure 2.5.1 233). It parallels the present Gulf coast of Florida from Ft. Myers northward, then westward to the Alabama line. In Levy and Citrus counties, the Gulf coastal lowlands extend inland from the modern Gulf of Mexico shoreline, terminating at the western edge of the Brooksville Ridge. The Gulf coastal lowlands are characterized by broad, flat marine erosional plains, underlain by Eocene limestones, and covered by thin Pleistocene sands deposited by the regressing Gulf of Mexico. (Reference 2.5.1 308) The geomorphic setting is a low energy, salt or freshwater environment with insufficient sand to build beaches. The marine terraces located within this geomorphic province are gently sloping features with seaward facing escarpments. These features formed when sedimentary materials were alternatively deposited and eroded as sea levels rose and fell. (Reference 2.5.1 307)

In Levy County, the Gulf coastal lowlands are subdivided into several subzones that are differentiated based on topography (Figure 2.5.1 234). These subzones include the

Waccasassa Flats, the Limestone Shelf and Hammocks, the Chiefland Limestone Plain, the Suwannee River Valley Lowlands, and the Coastal Marsh Belt. (Reference 2.5.1 308)

Waccasassa Flats. The Waccasassa Flats, located in central Levy County is a low swampy area that extends from the Santa Fe River in Gilchrist County southeast into Levy County. Land surface elevations average 17 m (55 ft.) amsl, although isolated sand hills, possibly associated with the Wicomico marine terrace deposits and the Brooksville Ridge, reach elevations as high as 22 m (70 ft.) amsl. At the southern edge of the Waccasassa Flats, the zone broadens to approximately 22.5 km (14 mi.) wide and elevations decrease to 9 m (30 ft.) amsl as the flats merge into the hammocks of southwestern Levy County. The Waccasassa River, which originates as a poorly defined channel in the swamps, lakes, and ponds of northern Levy County, drains the lower reaches of the Waccasassa Flats. The river flows to the southwest and empties into the Gulf of Mexico. A narrow Holocene floodplain of muds and sand occurs near the coast where the river merges with the coastal swamps. (Reference 2.5.1 308)

Limestone Shelf and Hammocks. The LNP site is located within the Limestone Shelf and Hammocks subzone, a zone that is characterized as a highly karstic, erosional limestone plain overlain by sand dunes, ridges, and coast parallel paleoshore sand belts associated with the Pleistocene age Pamlico marine terrace. The irregular, highly solutioned Eocene limestone underlying this subzone is covered by a blanket of Pleistocene sands of varying thickness. Near the modern coast, the limestone shelf is drowned by the coastal marshes. Inland, the limestone is heavily forested. Numerous artesian springs flow from the near surface limestone, and during heavy rain events much of the zone is prone to flooding, producing shallow swamps. Drainage from the coastal hammocks occurs through numerous small creeks and sloughs, which empty into the coastal marshes. (Reference 2.5.1 308)

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Suwannee River Valley Lowlands. The Suwannee River Valley Lowlands house the Suwannee River, which flows southwest and empties into the Gulf of Mexico. The river, which forms the northwestern boundary of Levy County, flows in a solution valley, formed in the near surface Eocene limestones. The lowlands adjacent to the river are made up of a thin veneer of Holocene alluvium and exposed limestone. In the lower reaches, the river valley is drowned and obscured by marshes of the Coastal Marsh Belt subzone. The broadly meandering valley is less than 1.6 km (1 mi.) wide over most of its course, broadening to about 4 km (2.5 mi.) wide just northwest of the Chiefland Limestone Plain. Elevations of the valley floor average 1.5 m (5 ft.) amsl. (Reference 2.5.1 308)

Coastal Marsh Belt. The Coastal Marsh Belt subzone is located on the drowned, seaward edge of the Eocene limestone shelf underlying Levy County. Elevations are less than 1.5 m (5 ft.) amsl. The gentle slope of the limestone plain results in a very broad, shallow continental shelf off the coast of Florida. Sediments are predominantly muds, and alluvial sand beaches are virtually absent due to the zero energy nature of the shoreline and lack of adequate sand supply. Instead, marshes of Juncus and Spartina grasses fringe the modern coastline, and a

series of small islets or keys, comprised of limestone pinnacles or alluvial sand, are common offshore of the modern coast. (Reference 2.5.1 308)

Davis et al. (Reference 2.5.1 213) refer to the low wave energy coastline from the Appalachicola River delta to Anclote Key (just north of Tampa Bay) as the Big Bend Coast (or area). This part of the coastline, which includes the LNP site vicinity, is morphologically complex due to variations in underlying limestone bedrock topography, and the presence of actively discharging freshwater springs, large oyster bioherms, a modern river delta, and possible paleoshorelines. The Suwannee River, which lies approximately 138 km (86 mi.) northwest of the LNP site, is the only coastal plain river that discharges along this coast. Other rivers emanate from springs fed by the Floridan aquifer and travel only a few kilometers (miles) across the coastal plain before reaching the Gulf of Mexico."

Attachments/Enclosures:

None

NRC Letter No.: LNP-RAI-LTR-034

NRC Letter Date: May 8, 2009

NRC Review of Final Safety Analysis Report

NRC RAI NUMBER: 02.05.01-28

Text of NRC RAI:

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.

PGN RAI ID #: L-0312

PGN Response to NRC RAI:

The Limestone Shelf and Hammocks subzone is primarily underlain by the Ocala Group and to a lesser degree the Avon Park Formation (Figure 2.5.1-244). Karst development is greater in the limestone units of the Ocala Group relative to the more dolomitic Avon Park Formation, which underlies the site. The text will be modified in a future revision to clarify that the both Eocene bedrock units are present and that karst development is not as great in the more dolomitic Avon Park Formation.

Figure 2.5.1-244 will be revised to show locations of springs and well locations (well locations are being added in response to RAI 02.05.01-34).

Associated LNP COL Application Revisions:
The following changes will be made to the LNP FSAR Chapter 2 in a future revision:

Figure 2.5.1-244 will be revised to show spring locations that support the revised text outlined below (see Attachment 02.05.01-28A). Figure 2.5.1-244 is also being revised in response to RAI 02.05.01-34 to show well locations.

Revise the summary paragraph describing the Limestone and Hammocks subzone (p. 2.5-57) in FSAR Section 2.5.1.2.1 from:

"Limestone Shelf and Hammocks. The LNP site is located within the Limestone Shelf and Hammocks subzone, a zone that is characterized as a highly karstic, erosional limestone plain overlain by sand dunes, ridges, and coast parallel paleoshore sand belts associated with the Pleistocene age Pamlico marine terrace. The irregular, highly solutioned Eocene limestone underlying this subzone is covered by a blanket of Pleistocene sands of varying thickness. Near

the modern coast, the limestone shelf is drowned by the coastal marshes. Inland, the limestone is heavily forested. Numerous artesian springs flow from the near surface limestone, and during heavy rain events much of the zone is prone to flooding, producing shallow swamps. Drainage from the coastal hammocks occurs through numerous small creeks and sloughs, which empty into the coastal marshes. (Reference 2.5.1 308)"

To read:

"Limestone Shelf and Hammocks. The LNP site is located within the Limestone Shelf and Hammocks subzone, a zone that is characterized as a highly karstic, erosional limestone plain overlain by sand dunes, ridges, and coast parallel paleoshore sand belts associated with the Pleistocene age Pamlico marine terrace. The irregular, highly solutioned Eocene limestone underlying this subzone (primarily Ocala Group, excepting limited areas including the LNP site where Avon Park formation occurs) is covered by a blanket of Pleistocene sands of varying thickness. (Reference 2.5.1-308) The erosional plain developed on the Avon Park Formation, which is present at the LNP site and underlies portions of the eastern part of this subzone, also is karstified, but to a lesser degree given the more dolomitic nature of this unit. Cover collapse sinkholes are uncommon in the area of the LNP site due to the dolomitized nature of the Avon Park Formation carbonates. In this area, cover subsidence sinkholes occur where dissolution of the top of the carbonate section occurs. This slowly lowers the land surface over long periods of time. (Reference RAI 02.05.01-28 01 and Reference RAI 02.05.01-28 02) Near the modern coast, the limestone shelf is drowned by the coastal marshes. Inland, the limestone is heavily forested. Locally, artesian springs flow from the near surface limestone, and during heavy rain events much of the zone is prone to flooding, producing shallow swamps. In the area where Ocala Group limestone is absent and Avon Park Formation underlies the sands there are very few springs (Revised Figure 2.5.1-244). There are very few springs that issue from the Avon Park carbonates. Drainage from the coastal hammocks occurs through numerous small creeks and sloughs, which empty into the coastal marshes. (Reference 2.5.1 308)"

Attachments/Enclosures:

Attachment 02.05.01-28A	Revised Figure 2.5.1-244
Attachment 02.05.01-28B	Harley Means, personal communication, May 27, 2009
Attachment 02.05.01-28C	Sam Upchurch, personal communication, May 27, 2009

List of Attachments:

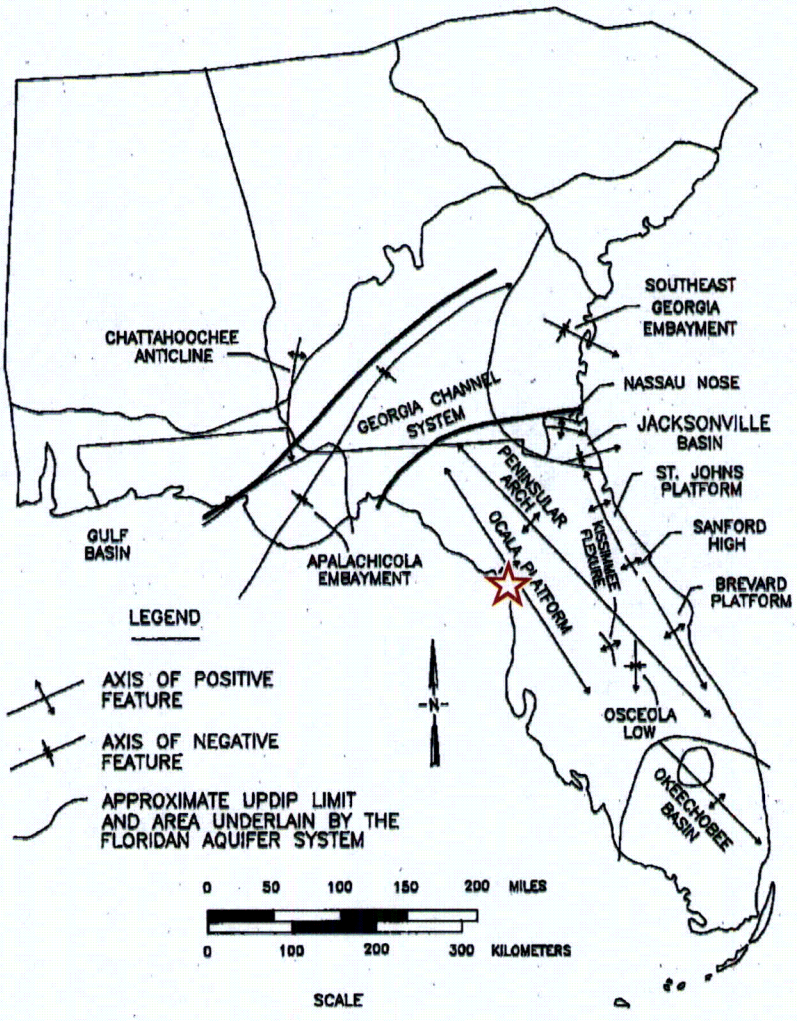
1. NRC RAI # 02.05.01-15 (PGN RAI ID # L-299):
   RAI 02.05.01-15 Figure 1 [1 page]
   RAI 02.05.01-15 Figure 2 [1 page]

2. NRC RAI # 02.05.01-20 (PGN RAI ID # L-0304)
   Attachment 02.05.01-20A, Figure 2.5.1-224 (Revised) [1 page]

3. NRC RAI # 02.05.01-25 (PGN RAI ID # L-0309):
   Attachment 02.05.01-25A, Figure 2.5.1-201 (Revised) [1 page]

4. NRC RAI # 02.05.01-26 (PGN RAI ID # L-0310):
   Attachment 02.05.01-25A, Figure 2.5.1-201 (Revised) [1 page]

5. NRC RAI#02.05.01-28 (PGN RAI ID# L-0312):
   Attachment 02.05.01-28A, Figure 2.5.1-244 (Revised) [1 page]
   Attachment 02.05.01-28B, Harley Means, personal communication, May 27, 2009 [2 pages]
   Attachment 02.05.01-28C, Sam Upchurch, personal communication, May 27, 2009 [2 pages]



Source: Scott (1997).

LEGEND

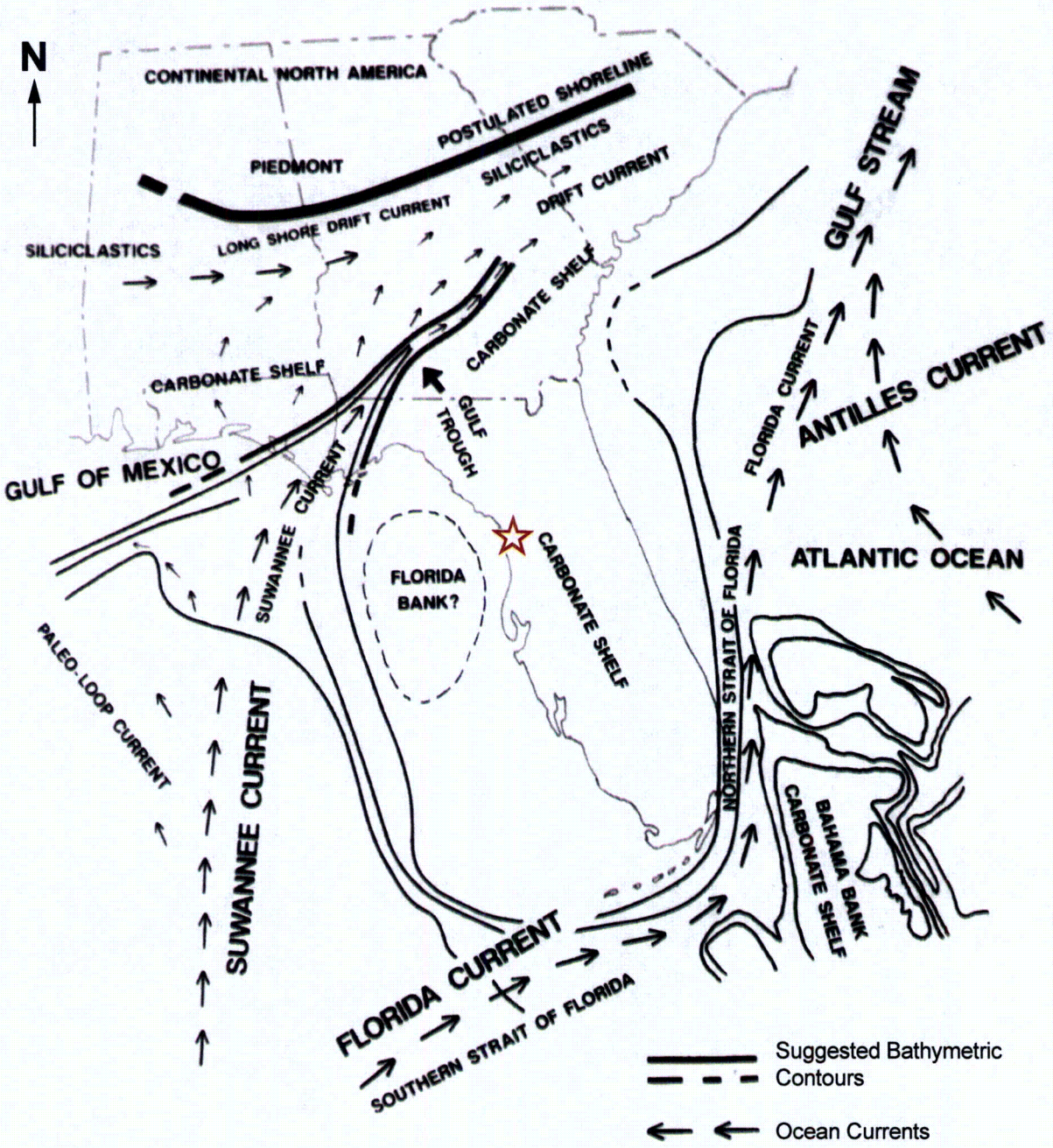
☆ LNP Site

Progress Energy Florida

Levy Nuclear Plant
Units 1 and 2
Part 2, Final Safety Analysis Report

Cenozoic Structural Features of Florida

RAI 02.05.01-15 Figure 1



Source: Huddlestun (1993).

LEGEND

☆ LNP Site

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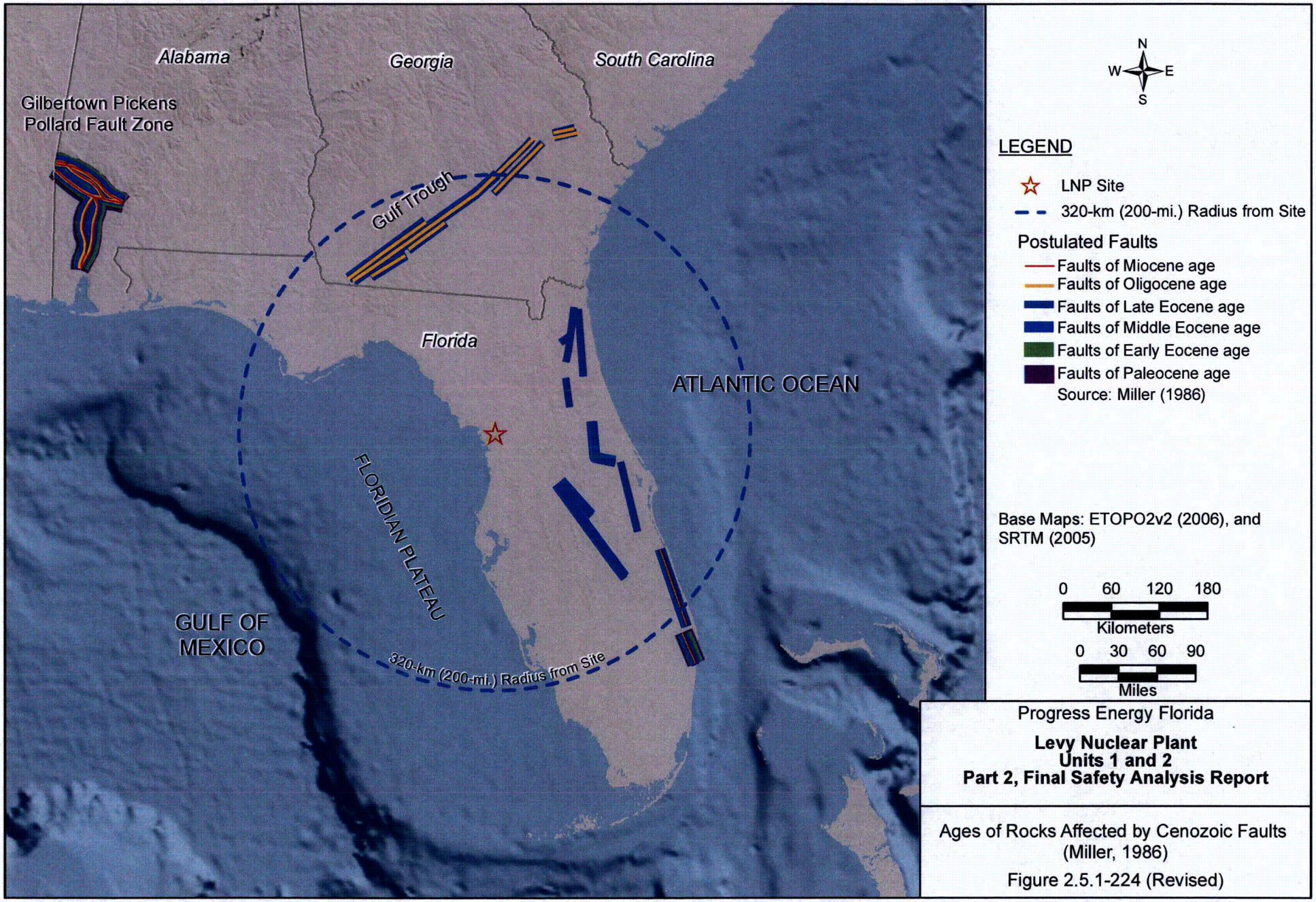
Levy Nuclear Plant
Units 1 and 2
Part 2, Final Safety Analysis Report

Map Showing the Location of the Suwannee Channel during the Late Cretaceous to Late Oligocene Time

RAI 02.05.01-15 Figure 2

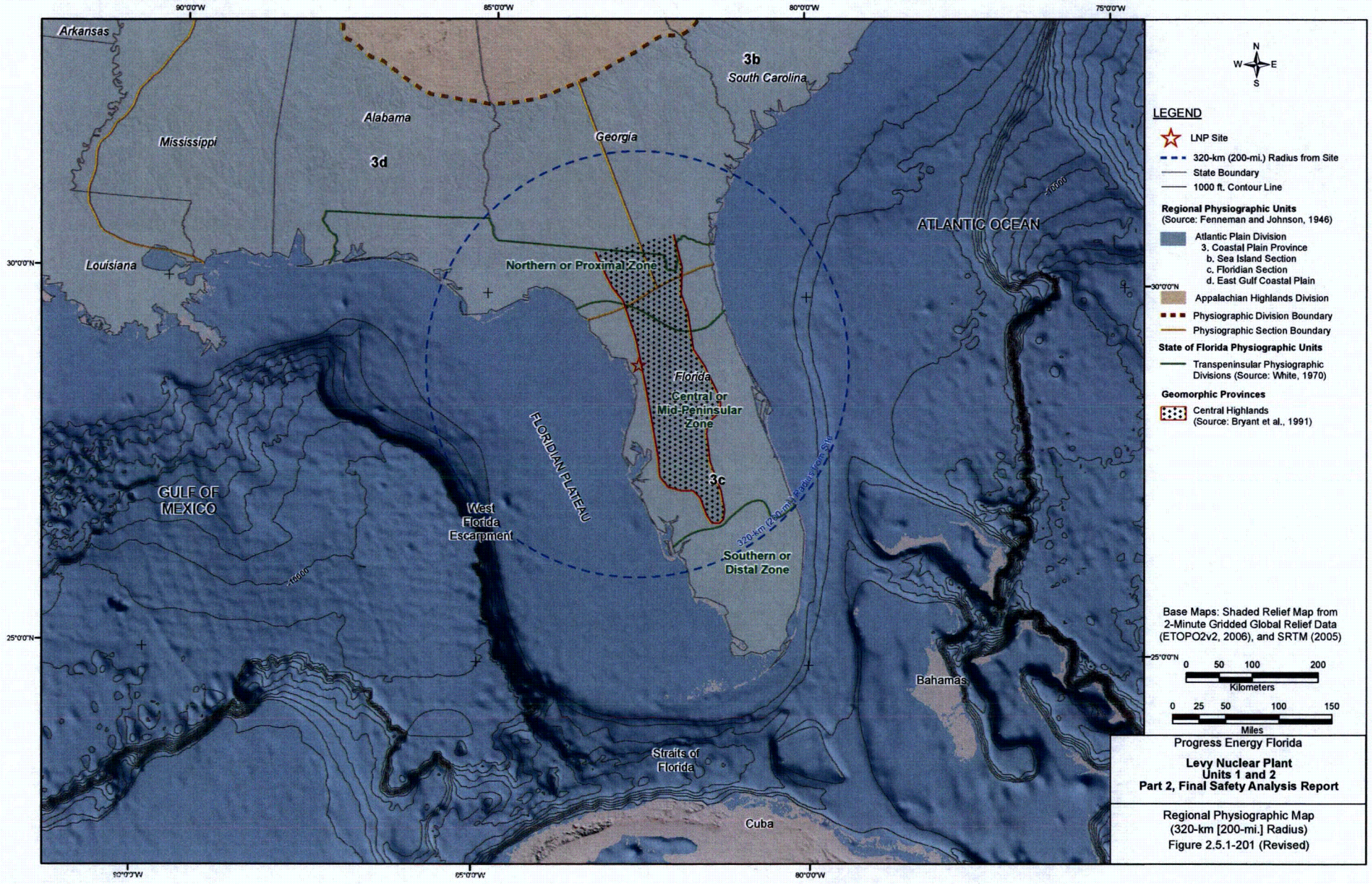


Progress Energy Florida

Levy Nuclear Plant
Units 1 and 2
Part 2, Final Safety Analysis Report

Ages of Rocks Affected by Cenozoic Faults
(Miller, 1986)

Figure 2.5.1-224 (Revised)



Progress Energy Florida

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Units 1 and 2
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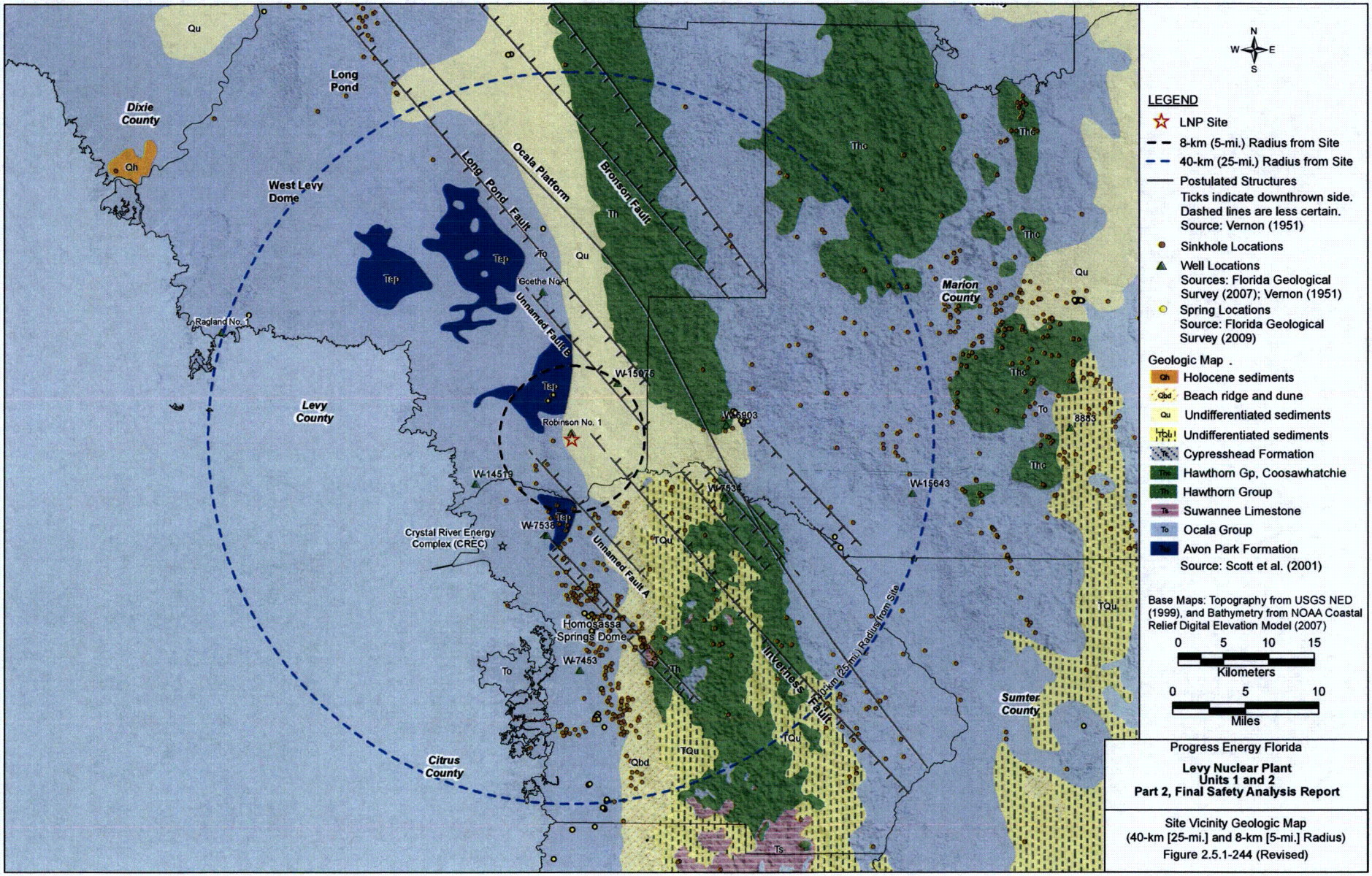
Regional Physiographic Map
(320-km [200-mi.] Radius)
Figure 2.5.1-201 (Revised)


Qu
Long Pond
Dixie County
Qh
West Levy Dome
Long Pond Fault
Ocala Platform
Bronson Fault
Th
Tep
To
Qu
Goethe No. 1
Unnamed Fault E
Ragland No. 1
W-15975
Levy County
Robinson No. 1
W-6803
W-14519
W-7533
W-15643
W-7538
Crystal River Energy Complex (CREC)
Unnamed Fault A
TQu
Homosassa Springs Dome
W-7453
Inverness Fault
40km (25-mi.) Radius from Site
Citrus County
Qbd
Ts
Thc
Marion County
8853
Sumter County
N
W
E
S
LEGEND
LNP Site
8-km (5-mi.) Radius from Site
40-km (25-mi.) Radius from Site
Postulated Structures
Ticks indicate downthrown side.
Dashed lines are less certain.
Source: Vernon (1951)
Sinkhole Locations
Well Locations
Sources: Florida Geological Survey (2007); Vernon (1951)
Spring Locations
Source: Florida Geological Survey (2009)
Geologic Map .
Holocene sediments
Beach ridge and dune
Undifferentiated sediments
Undifferentiated sediments
Cypresshead Formation
Hawthorn Gp, Coosawhatchie
Hawthorn Group
Suwannee Limestone
Ocala Group
Avon Park Formation
Source: Scott et al. (2001)
Base Maps: Topography from USGS NED (1999), and Bathymetry from NOAA Coastal Relief Digital Elevation Model (2007)
0 5 10 15
Kilometers
0 5 10
Miles
Progress Energy Florida
Levy Nuclear Plant
Units 1 and 2
Part 2, Final Safety Analysis Report
Site Vicinity Geologic Map
(40-km [25-mi.] and 8-km [5-mi.] Radius)
Figure 2.5.1-244 (Revised)

Tom,

Per our conversation last week, I am following up with an e-mail. I am unaware of any large springs that discharge from the Avon Park Formation in Levy County. It is possible that some of the smaller springs along the coastal region may be discharging from the Avon Park, but this has not been confirmed. Further more, I am not aware of any major cave or conduit development in the Avon Park Formation in Levy County. There may be some springs further south that have some component of their discharge that comes from the Avon Park, however this may be related to the transition from the formation being comprised primarily of limestone in this area as opposed to dolostone in Levy County.

You and I have been in some of the quarries in this area and I don't recall ever seeing much in the way of karst development in the subsurface. We have seen subsidence sinkhole development in this area, but no cover collapse that I am aware of. We have discussed, in the past, Vernon's invocation of faulting to explain what he identified as offset in cores. I have never seen any surficial expression of a fault in the Levy County area and believe that the discrepancies in Vernon's formational contacts can be explained by karst and is not the result of faulting. Further, Vernon relied heavily on biostratigraphy to define his lithostratigraphic units and I am sure that there was some guesswork on defining formational contacts. You of all people know how difficult it can be to recognize a carbonate lithostratigraphic unit without looking at the fossils!

Please let me know if I can be of further assistance.

Harley

Guy "Harley" Means, P.G.
Geologic Investigations Section
Florida Geological Survey, FDEP
903 West Tennessee Street
Tallahassee, Florida 32304-7716
850-487-9455 ext. 112

This email is in response to your request for any information available relative to karst in the Levy County area, specifically the Waccasassa Flats/Gulf Hammock area. As you know, SDII recently completed the basis documents for Minimum Flows and Levels for the Waccasassa River and its springs (the citation is Water Resource Associates, SDII Global Corporation, and Janicki Environmental, Inc., 2006. MFL Establishment for the Waccasassa River, Estuary and Levy (Bronson) Blue Spring. Technical Report, Live Oak, Florida, Suwannee River Water Management District, 258p. (Report available from the District at http://www.srwmd.state.fl.us). Section 2 of that report discusses the geology of the basin and surroundings and presents an analysis of karst and springs in the area. In addition, SDII completes about 800 sinkhole investigations a year statewide, and we have the largest sinkhole database available. It includes the results of our own investigations, the Florida Geological Survey database, and data from a number of insurance companies. The following are my conclusions relative to springs, karst, and sinkhole activity in the area.

- **The springs are limited to the edge of the outcrop belt of the Ocala Limestone. We know of no significant springs within the Avon Park Formation (there are probably some seep springs on bedding planes, but none are of sufficient magnitude to attarct attention). I beliwve that, like Glen Faulkner's interpretation of Rainbow Springs, the Levy County springs are within the Ocala Limestone where flow is forced to the surface because of the permeability contrast with the significantly less permeable Avon Park. If you refer to Figure 2-14 in the attached Section 2, Wekiva and Levy Blue Springs fall at the Ocala/Avon Park contact. There are no named springs within the outcrop area of the Avon Park.**
- **Figure 2-12 in the report shows a GIS interpretation of closed depressions in the area. These can be assumed to reflect karst features as a first approximation. Note that closed depressions are abundant and often quite large near the Brooksville Ridge and the edge of the Waccasassa Flats in Gilchrist County, but they are virtually absent in the Gulf Hammock area and the location of the Levy County power plant site.**
- **SDII's sinkhole database shows no modern (within the last 25 years) confirmed sinkholes within the area of the Avon Park outcrop area. There are three or so unconfirmed sinkholes shown on the state database, but these are or questionable quality as they were apparently not subject to rigorous QA procedures.**
- **My personal experience with the area (quarry investigations, field work for the MFLs, and sinkhole investigations and karst analysis projects) suggests that the dolostone areas of the Gulf Hammock are not prone to karst development on a magnitude sufficient to be of concern. Small depressions are common, but not of significance. They are poorly**

developed cover subsidence sinkholes or marine depressions. I would not expect sinkhole activity of sufficient scale to compromise construction of the power plant. Furthermore, I have not encountered caverns or solution-related conduits in the Avon Park that could reflect karst development. There are fractures in the dolomite, and these can sometimes lead to weight of hammer or rod strengths in SPT testing and losses of drilling fluid losses. Furthermore, fine-grained, unconsolidated "dolosilt" is sometimes encountered. This material leads to weak zones in SPT borings, but rarely in losses of drilling fluid circulation.

- **As a dolostone, the dolomitization of the Avon Park is of interest. The preservation of the plant fossils and thin laminations in many areas of the dolostone lead me to believe that at least some of the dolomitization is penecontemporaneous. This being the case, I would not expect to see large volume reductions such as occur when older limestone is dolomitized in the subsurface. The result is that the dolomitic part of the Avon Park, such as occurs in the Gulf Hammock area, normally has low porosity and permeability. It is for this reason that groundwater flow is forced up along the Ocala Limestone outcrop belt, there are no major springs in the area, and the area is characterized by large swamps and gaining streams.**

Sam B. Upchurch, Ph.D., P.G.
Vice President and Principal Geologist
SDII Global Corporation
4509 George Road
Tampa, Florida 33634