



Serial: NPD-NRC-2010-007  
January 19, 2010

10CFR52.79

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

**LEVY NUCLEAR PLANT, UNITS 1 AND 2  
DOCKET NOS. 52-029 AND 52-030  
SUPPLEMENT 1 TO RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION LETTER  
NO. 009 RELATED TO STABILITY OF SUBSURFACE MATERIALS AND FOUNDATIONS**

- References:
1. Letter from Brian C. Anderson (NRC) to Garry Miller (PEF), dated February 24, 2009, "Request for Additional Information Letter No. 009 Related to SRP Section 2.5.4 for the Levy County Nuclear Plant, Units 1 and 2 Combined License Application"
  2. Letter from Garry D. Miller (PEF) to U. S. Nuclear Regulatory Commission, dated April 2, 2009, "Response to Request for Additional Information Letter No. 009 Related to Stability of Subsurface Materials and Foundations", Serial: NPD-NRC-2009-046
  3. Letter from Robert H. Kitchen (PEF) to U. S. Nuclear Regulatory Commission, dated October 14, 2009, "Supplemental Information for Response to Request for Additional Information Letter No. 009 Related to Stability of Subsurface Materials and Foundations", Serial: NPD-NRC-2009-212

Ladies and Gentlemen:

Progress Energy Florida, Inc. (PEF) hereby submits a supplemental response to the Nuclear Regulatory Commission's (NRC) request for additional information provided in Reference 1.

A supplemental 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 Nuclear Plant Units 1 and 2 application.

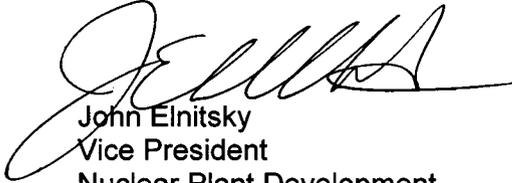
If you have any further questions, or need additional information, please contact Bob Kitchen at (919) 546-6992, or me at (727) 820-4481.

D094  
NRO

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

Executed on January 19, 2010.

Sincerely,

A handwritten signature in black ink, appearing to read 'John Elnitsky', written over a printed name and title.

John Elnitsky  
Vice President  
Nuclear Plant Development

Enclosure

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

**Levy Nuclear Plant Units 1 and 2  
Supplement 1 to Response to NRC Request for Additional Information Letter No. 009  
Related to SRP Section 2.5.4 for the Combined License Application,  
Dated February 24, 2009**

<u>NRC RAI #</u>	<u>Progress Energy RAI #</u>	<u>Progress Energy Response</u>
02.05.04-4	L-0024	April 2, 2009; NPD-NRC-2009-046
02.05.04-5	L-0025 & L-0209	April 2, 2009; NPD-NRC-2009-046 & Supplemental response enclosed – see following pages
02.05.04-6	L-0026 & L-0210	April 2, 2009; NPD-NRC-2009-046 & Supplemental response enclosed – see following pages
02.05.04-7	L-0027 & L-0211	April 2, 2009; NPD-NRC-2009-046 & Supplemental response enclosed – see following pages
02.05.04-8	L-0028 & L-0212	April 2, 2009; NPD-NRC-2009-046 & Supplemental response enclosed – see following pages
02.05.04-9	L-0029	April 2, 2009; NPD-NRC-2009-046

**NRC Letter No.:** LNP-RAI-LTR-009

**NRC Letter Date:** February 24, 2009

**NRC Review of Final Safety Analysis Report**

**NRC RAI NUMBER:** 02.05.04-5

**Text of NRC RAI:**

FSAR Section 2.5.4 states that down-hole geophysics suffered from borehole construction techniques (cased versus uncased), and/or limited capabilities of the geophysical tools. It also states that it was not always possible to correlate geophysical data to the physical data measured in the core logs. It is also noted that recovery was generally poor in certain layers, particularly below the proposed grouting zone. Because of poor recovery, the characterization of the soft zones was based on the expertise of the driller and the time it took to sample a 5 ft. core. However, the time of drilling is also a function of the downward pressure exerted on the drill rods.

Please provide information on the magnitude and location of the recorded pressures used during drilling to support the time of drilling and conclusions regarding the materials filling the karst features. If these do not exist, please indicate what other information exists (other than shear and compression wave velocities) to confirm the nature of the materials that were not recoverable.

**PGN RAI ID #:** L-0209

**PGN Response to NRC RAI:**

This RAI was previously addressed in Letter NPD-NRC-2009-046, which described an "Offset Boring Program" that would be undertaken to evaluate the properties of materials previously not recovered during core drilling, including the verification of the existence, thickness, and location of postulated beds of soft, soil-like material.

Field work associated with the Offset Boring Program was conducted between September and November 2009. During that program, a series of six (6) PQ-size, triple tube type offset core borings were drilled within a 5-foot radius of an existing A-series (Site Characterization) borehole. These A-series borings were selected because they had areas of poorer recovery or noted larger voids or soft zones.

Recovery was improved significantly in the Offset Boring Program compared to the Site Characterization (from 69 percent to 84 percent at LNP1), which is attributable to the following changes:

- Larger-sized tooling was used, which was better suited for the softer, more friable and fractured rock encountered at the site;
- A triple-tube core barrel system prevented the intrusion of drilling fluid into the inner-most barrel, containing the sample, thus causing less material to be washed out during the drilling process;
- A drill rig with mechanical feed was selected, allowing the driller to obtain more information about the strata during coring operations;

- Drilling fluid was injected at lower pressures (150 to 300 psi, compared to up to 500 psi during Site Characterization), decreasing the potential for washout of fractured material during drilling;
- When soft, poor quality, or highly fractured rock was encountered, partial core runs of less than five feet were completed, so that the harder material recovered above that zone was not allowed to deteriorate the softer rock beneath it in the core sampler;
- A technique called “airlifting” (using compressed air after boring wall cave-in occurs to lift out small rock pieces and finer grains of material) was used to prevent drilling tools from becoming locked in the boring, thus reducing the need for destructive tool removal techniques; and
- A drilling company was selected that demonstrated previous experience in the Avon Park Formation limestone.

Drilling fluid hydraulic pressure, drill rod rotational speed, drill time, and circulation loss were recorded for each core run. Additionally, rod drops, rig chatter, cave-in or rubble at the top of each run, airlift depths, instances of rods locking in the hole, and other driller notes were documented.

Several sampling methods and tests were attempted during the Offset Boring Program, including standard penetration test (SPT) sampling, Shelby tube sampling, and vane shear testing. These soil-sampling methods were determined to be ineffective for sampling the soft zones within the Avon Park Formation limestone. Shelby tubes were crushed, the vane shear apparatus was bent, and SPT sampling was unsuccessful in the softest areas encountered during the program. These methods were abandoned during the program due to this ineffectiveness, and because the material was being successfully recovered using the coring techniques described above.

Based on the recovered core samples from areas where the A-series boring data indicated the presence of soft, unrecoverable material, the Offset Boring Program has concluded that the previously postulated “soft beds” are now geologically classified as severely weathered to degraded dolomite. Based on the characteristics of the material, it was determined that the material was weathered in place, and not infilled material (karst). Additionally, while the recovery increased with the techniques that were employed, the rock quality designation (RQD) was consistent with the Site Characterization data. This suggests that the material encountered during the Offset Boring Program was the same material as that encountered during Site Characterization, as would be expected since the Offset Borings were drilled within five feet of the companion A-series borings.

The results of the Offset Boring Program, described further in the supplemental response to RAI 02.05.04-8, indicate that significant conservatism is associated with the studies and analyses conducted to date, which are based on data obtained during Site Characterization.

**Associated LNP COL Application Revisions:**

The following change will be made to the LNP FSAR in a future revision:

Boring logs from the Offset Boring Program will be added to FSAR Appendix 2BB.

**Attachments/Enclosures:**

None.

**NRC Letter No.:** LNP-RAI-LTR-009

**NRC Letter Date:** February 24, 2009

**NRC Review of Final Safety Analysis Report**

**NRC RAI NUMBER:** 02.05.04-6

**Text of NRC RAI:**

The FSAR and supplements state that the lateral extent of karst features was determined based on grout takes, where that information was available. Grout takes, however, may not help identify soft, soil-filled karst features as the existence of soil will limit the grout take. The result is an underestimation of the volume of the soft zone.

Since boring spacing was 100 feet on average, and down-hole geophysical investigations (natural gamma, neutron, gamma-gamma, P-S suspension logging) have lateral extent limitations, please describe how you confirmed that large soft zones do not exist well beyond the lateral dimension estimated from grout take.

**PGN RAI ID #:** L-0210

**PGN Response to NRC RAI:**

This RAI was previously addressed in Letter NPD-NRC-2009-046, which described an "Offset Boring Program" that would be undertaken to evaluate the properties of materials previously not recovered during core drilling.

As described in the supplemental response to RAI 02.05.04-5, the low recovery zones associated with Site Characterization consist of severely weathered or degraded dolomite. The nature of this material, recovered during the Offset Boring Program, confirms that the material has been weathered-in-place, and is not infilled material (karst).

As such, the analyses that considered grout data to determine the lateral extent of postulated karst features are regarded as conservative. The nature of the Avon Park Formation has been observed to be fractured and severely weathered in the zones of previously low recovery. The Offset Boring Program indicated that soil-filled karst features do not exist. Thus the size of postulated voids calculated using the approach described in Section I, Subpart IV of the Supplement (Letter NPD-NRC-2008-031) is conservative.

As described in the response to RAI 02.05.04-8, soil-like material was modeled to exist continuously along bedding planes at multiple elevations beneath the entire LNP site. As described in the supplemental response to RAI 02.05.04-8, the use of soil properties, for the material existing continuously along bedding planes, is conservative.

**Associated LNP COL Application Revisions:**

The following change will be made to the LNP FSAR in a future revision:

The following text will be added at the end of FSAR Section 2.5.4.2.2.2.

Based on the results of the Offset Boring Program, it is concluded that postulated infilled features are severely weathered or degraded dolomite with properties consistent with the Avon Park Formation.

**Attachments/Enclosures:**

None.

**NRC Letter No.:** LNP-RAI-LTR-009

**NRC Letter Date:** February 24, 2009

**NRC Review of Final Safety Analysis Report**

**NRC RAI NUMBER:** 02.05.04-7

**Text of NRC RAI:**

The Mohr-Coulomb strength parameters for the rock mass were based on Hoek-Brown methodology and incorporate among other factors, the intact rock compressive strength and a factor, GSI, to account for geologic features within the mass rock. FSAR Section 2.5.4 shows that great variability exists in the measured uniaxial compressive strength on intact samples (one standard deviation being as great as the average compressive strength in most cases), and the availability of intact rock samples was limited because of low recovery.

Please describe how you determined the GSI factor. Include a discussion on how the joint sets and bedding planes and low or no recovery zones were factored into the derivation of the GSI. Please describe any sensitivity analyses you may have performed to determine the influence of lower bound assumptions of the compressive strength and stiffness of intact rock and lower bound GSI factors on stability (bearing capacity and settlement) and stress calculations in the foundation rock.

**PGN RAI ID #:** L-0211

**PGN Response to NRC RAI:**

This RAI was previously addressed in Letter NPD-NRC-2009-046, which described an "Offset Boring Program" that would be undertaken to evaluate the properties of materials previously not recovered during core drilling.

Based on the data obtained during the Offset Boring Program, the mass property analysis presented in the response to RAI 02.05.04-7 is conservative. As described in the supplemental response to RAI 02.05.04-8, the rock mass modulus range used in these bearing capacity and settlement analyses is bounding.

**Associated LNP COL Application Revisions:**

No COLA revisions have been identified associated with this response.

**Attachments/Enclosures:**

None.

**NRC Letter No.:** LNP-RAI-LTR-009

**NRC Letter Date:** February 24, 2009

**NRC Review of Final Safety Analysis Report**

**NRC RAI NUMBER:** 02.05.04-8

**Text of NRC RAI:**

The description of the finite element analysis presented does not clearly indicate if or how soil filled joints and soft bedding layers were incorporated into the evaluation.

Please describe how joint patterns and soil filled bedding planes were modeled in the finite element analysis for evaluation of settlement and bearing capacity.

**PGN RAI ID #:** L-0212

**PGN Response to NRC RAI:**

This RAI was previously addressed in Letter NPD-NRC-2009-046, which described the sensitivity studies that were performed using conservatively assumed properties for the bedding planes postulated to exist in the LNP subsurface. The sensitivity studies considered thirteen (13) one-foot thick zones of "infilled/weathered-in-place material" present continuously beneath the entire LNP site. The elastic modulus of this material was considered to be 16.5 ksi (comparable to material with a shear wave velocity of 480 feet per second), which corresponds to 3 percent of the elastic modulus of the Avon Park Formation in NAV-1 (547 ksi). An Offset Boring Program was conducted to determine whether these sensitivity studies were adequately conservative.

As described in the supplemental response to RAI 02.05.04-5, the Offset Boring Program indicated that the zones previously postulated to be infilled material (due to low recovery) were instead weathered Avon Park Formation limestone. The Offset Boring Program specifically targeted zones of postulated soft material at the approximate depth ranges associated with those identified as "bedding plane" features in the response to RAI 02.05.04-8. In each of the six offset borings, the classification and properties of the material recovered from those depths were consistent with the properties of the Avon Park Formation limestone found elsewhere at the LNP site.

In previous sensitivity analyses, soil properties were used to approximate the elastic modulus and Poisson's ratio. Based on the nature of the recovered material (weathered rock), the use of soil properties is conservative. Table RAI 02.05.04-8-02 compares the conservative properties assumed during previous sensitivity analyses with the properties conservatively estimated based on the results of the Offset Boring Program.

**TABLE RAI 02.05.04-8-2  
BEDDING PLANE FEATURE MATERIAL PROPERTIES  
SENSITIVITY ANALYSES VERSUS BEST ESTIMATE**

<b>ENGINEERING PROPERTY</b>	<b>VALUE USED IN SENSITIVITY ANALYSES</b>	<b>CONSERVATIVE ESTIMATE BASED ON OFFSET BORING PROGRAM RECOVERY</b>
Elastic Modulus	16.5 ksi	82 ksi
Poisson's Ratio	0.27	0.30
Unit Weight	130 pcf	136 pcf

This elastic modulus (82 ksi) conservatively represents the single minimum Young's modulus value calculated from shear wave velocity measurements taken during Site Characterization, reduced by 50 percent to reflect strain degradation effects (as described in responses to RAI 02.05.04-2 and RAI 02.05.04-3).

Additionally, the rock mass properties used in previous analyses were based on methods that consider the interactions between intact rock and discontinuities (such as joints and bedding planes). By determining that the softer zones are dolomitic limestone, it has added additional conservatism to separately model these bedding plane features with lower strength properties than the surrounding material, since the properties of the surrounding material have already accounted for the presence of these features through the Rock Mass Rating (RMR) and Geologic Strength Index (GSI) determinations (see the response to RAI 02.05.04-7).

The Offset Boring Program has determined that the "soft zones," previously postulated to be infilled material with soil-like properties, are dolomitic in nature and weathered-in-place. By modeling these bedding plane features as discrete, continuous layers of soil-like material with an elastic modulus of 16.5 ksi, previous sensitivity studies are conservative.

**Associated LNP COL Application Revisions:**

No COLA revisions have been identified associated with this response.

**Attachments/Enclosures:**

None.