Progress Energy

Serial: NPD-NRC-2009-133
July 1, 2009

10CFR52.79

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

LEVY NUCLEAR POWER PLANT, UNITS 1 AND 2
DOCKET NOS. 52-029 AND 52-030
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 032 RELATED TO VIBRATORY GROUND MOTION

Reference: Letter from Brian C. Anderson (NRC) to Garry Miller (PEF), dated May 8, 2009, "Request for Additional Information Letter No. 032 Related to SRP Section 2.5.2 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 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 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 July 1, 2009.

Sincerely,

Garry D. Miller
General Manager
Nuclear Plant Development

Enclosure

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

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Levy Nuclear Power Plant Units 1 and 2
Response to NRC Request for Additional Information Letter No. 032 Related to SRP Section 2.5.2 for the Combined License Application, dated May 8, 2009

NRC RAI #	Progress Energy RAI #	Progress Energy Response
02.05.02-16	L-0285	Response enclosed – see following pages
02.05.02-17	L-0286	Response enclosed – see following pages
02.05.02-18	L-0287	Response enclosed – see following pages
02.05.02-19	L-0288	Response enclosed – see following pages
02.05.02-20	L-0289	Response enclosed – see following pages
02.05.02-21	L-0290	Response enclosed – see following pages

NRC Letter No.: LNP-RAI-LTR-032

NRC Letter Date: May 8, 2009

NRC Review of Final Safety Analysis Report

NRC RAI #: 02.05.02-16

Text of NRC RAI:

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

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

PGN RAI ID #: L-285

PGN Response to NRC RAI:

The principal effect of the Gulf of Mexico earthquakes is on the assessment of maximum magnitude. The process used was to update the maximum magnitude distributions for each of the EPRI-SOG teams to reflect the largest earthquake observed to have occurred in each source. These updates are documented in FSAR Table 2.5.2-209.

The seismic source models for the three teams indicated did not include the oceanic crust where the September 2006 M ~6 event occurred. For Dames & Moore and Law, their sources are restricted to the continental shelf and include, or nearly include, the location of the February 2006 ~**M** 5.5 event; the maximum-magnitude distributions for these sources were updated to reflect this event. The Woodward-Clyde source did not extend to this event, so it was not modified.

Seismicity in the oceanic crust outside of the Dames & Moore, Law, and Woodward-Clyde sources is at such a large distance and low rate that it is not expected to have a significant contribution to the site hazard. Examination of the deaggregated hazard from the Rondout team source 51, which encompasses the Gulf of Mexico seismicity, shows that seismicity in this area contributes well below one percent to the site hazard.

Associated LNP COL Application Revisions:

No COLA revisions have been identified associated with this response.

Attachments / Enclosures:

None.

NRC Letter No.: LNP-RAI-LTR-032

NRC Letter Date: May 8, 2009

NRC Review of Final Safety Analysis Report

NRC RAI #: 02.05.02-17

Text of NRC RAI:

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

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

PGN RAI ID #: L-286

PGN Response to NRC RAI:

As indicated in Table 2.5.2-205 of the FSAR, Rondout Associates source 13 was not included in the PSHA for the LNP site. It was tested and found to contribute less than one percent to the total hazard. The source was incorrectly included in the description of the Rondout sources implying that it was included in the EPRI (1989, Reference 2.5.1-203) calculations for the Crystal River site. The FSAR text will be revised to remove reference to this source from Section 2.5.2.2.1.4 and Table 2.5.2-205.

Associated LNP COL Application Revisions:

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

1. Section 2.5.2.2.1.4 will be modified from:

"Section 2.5.2.2.1.4 Rondout Associates Team

Six seismic sources defined by the Rondout Associates team (Reference 2.5.2-235) are included in the PSHA calculation for the LNP site (Figure 2.5.2-207). These sources are listed in Table 2.5.2-205 and described briefly below.

- Southern New York – Alabama Lineament (Source 13): A striking change in the regional magnetic anomaly pattern in basement rocks is the basis for defining this seismic source zone. Seismicity is associated with the linear anomaly pattern in eastern Tennessee and to a lesser extent in northern Georgia and Alabama (Reference 2.5.2-235).
- Charleston (Source 24): The Charleston seismic zone includes the Ashley River fault and Woodstock fault (Reference 2.5.2-235)."

To read:

"Section 2.5.2.2.1.4 Rondout Associates Team

Five seismic sources defined by the Rondout Associates team (Reference 2.5.2-235) are included in the PSHA calculation for the LNP site (Figure 2.5.2-207). These sources are listed in Table 2.5.2-205 and described briefly below.

- Charleston (Source 24): The Charleston seismic zone includes the Ashley River fault and Woodstock fault (Reference 2.5.2-235)."

2. FSAR Table 2.5.2-205 will be modified from:

"Table 2.5.2-205

Rondout Team Seismic Sources

Source	P*	Closest Distance to LNP Site (km)	EPRI (1989) Maximum Magnitude Distribution (m_b)	Maximum Magnitude Distribution Used in PSHA for LNP Site (m_b)
49 (C01) Appalachian Crust	1.0	0	4.8 [0.2], 5.5 [0.6], 5.8 [0.2]	5.01 [0.2], 5.5 [0.6], 5.8 [0.2]
51 Gulf Coast to Bahamas Fracture Zone	1.0	84.5	4.8 [0.2], 5.5 [0.6], 5.8 [0.2]	6.11 [0.3], 6.3 [0.55], 6.5 [0.15]
24 Charleston	1.0	410.1	6.6 [0.2], 6.8 [0.6], 7.0 [0.2]	6.6 [1.0]
26 South Carolina Zone	1.0	314.4	5.8 [0.15], 6.5 [0.6], 6.8 [0.25]	5.8 [0.15], 6.5 [0.6], 6.8 [0.25]
13 Southern NY-Alabama Lineament	1.0	578	5.2 [0.3], 6.3 [0.55], 6.5 [0.15]	Not Included
25 Southern Appalachians	0.985	626.6	6.6 [0.3], 6.8 [0.6], 7.0 [0.1]	6.6 [0.3], 6.8 [0.6], 7.0 [0.1]

Notes:

km = kilometer
Mb = body-wave magnitude
P* = probability an EPRI-SOG seismic source is active"

To read:

"Table 2.5.2-205

Rondout Team Seismic Sources

Source	P*	Closest Distance to LNP Site (km)	EPRI (1989) Maximum Magnitude Distribution (m_b)	Maximum Magnitude Distribution Used in PSHA for LNP Site (m_b)
49 (C01) Appalachian Crust	1.0	0	4.8 [0.2], 5.5 [0.6], 5.8 [0.2]	5.01 [0.2], 5.5 [0.6], 5.8 [0.2]
51 Gulf Coast to Bahamas Fracture Zone	1.0	84.5	4.8 [0.2], 5.5 [0.6], 5.8 [0.2]	6.11 [0.3], 6.3 [0.55], 6.5 [0.15]
24 Charleston	1.0	410.1	6.6 [0.2], 6.8 [0.6], 7.0 [0.2]	6.6 [1.0]
26 South Carolina Zone	1.0	314.4	5.8 [0.15], 6.5 [0.6], 6.8 [0.25]	5.8 [0.15], 6.5 [0.6], 6.8 [0.25]
25 Southern Appalachians	0.985	626.6	6.6 [0.3], 6.8 [0.6], 7.0 [0.1]	6.6 [0.3], 6.8 [0.6], 7.0 [0.1]

Notes:

km = kilometer
Mb = body-wave magnitude
P* = probability an EPRI-SOG seismic source is active "

Attachments/Enclosures:

None.

NRC Letter No.: LNP-RAI-LTR-032

NRC Letter Date: May 8, 2009

NRC Review of Final Safety Analysis Report

NRC RAI #: 02.05.02-18

Text of NRC RAI:

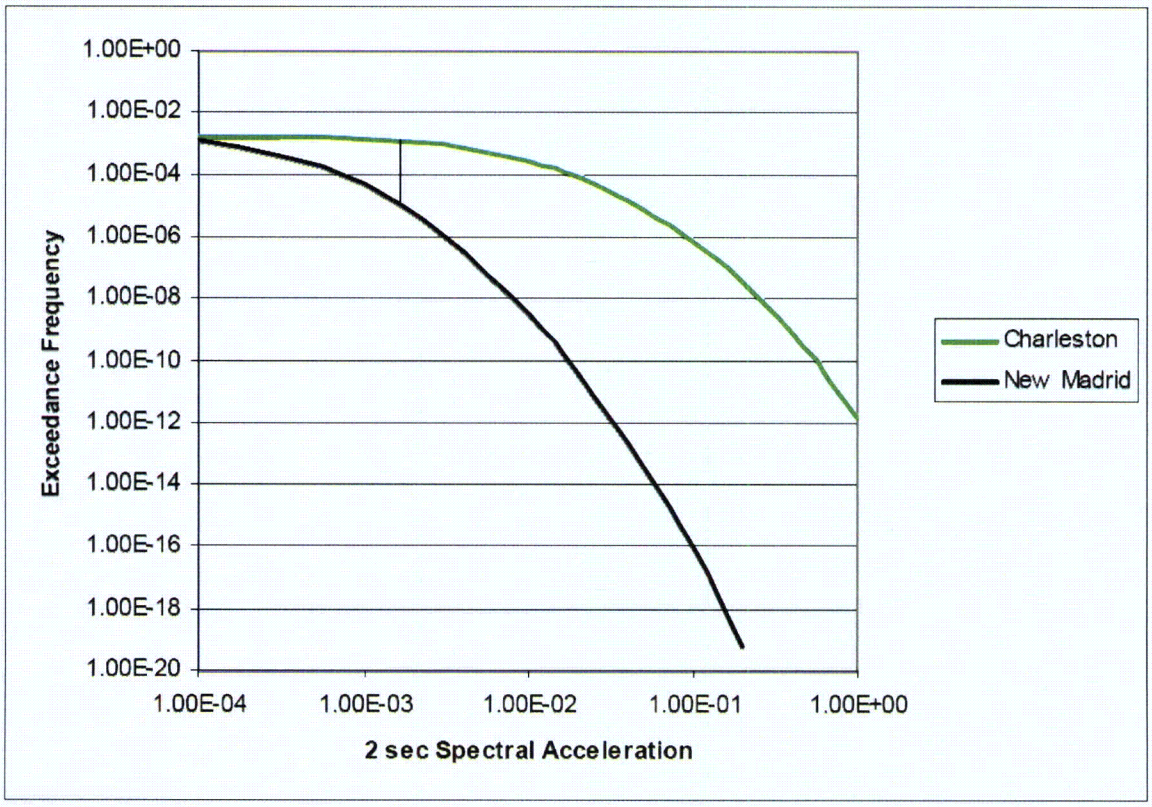
Section 2.5.2.2 (beginning on p. 2.5-98) evaluates seismic sources that contribute to the seismic hazard of the LNP site. The New Madrid Seismic Zone (NMSZ) is considered a major seismic zone in the Southern U.S., however, the FSAR provides no calculation of the contribution of the NMSZ to the hazard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

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

PGN RAI ID #: L-287

PGN Response to NRC RAI:

The significance of the New Madrid seismic source to the hazard at the LNP site was evaluated as part of the assessment of the appropriate set of seismic sources to include in the PSHA. The tests were conducted using the characterization of repeated large earthquakes at New Madrid defined in Enercon Services (2004) (Reference RAI 02.05.02-18 01). As can be seen on Figure 2.5.2-201, the travel path from the New Madrid region to the LNP site is primarily through the Gulf Coast attenuation region defined by EPRI (1993, Reference 2.5.2-260). Therefore, the Gulf Coast set of ground motion models defined by EPRI (2004, Reference 2.5.2-253) were used to test the significance of the New Madrid seismic source. RAI 02.05.02-18 Figure 1 compares the mean 2.0 second spectral acceleration hazard computed for the New Madrid source to that computed for the Charleston source of repeated large earthquakes. The Charleston source was included in the PSHA for the LNP site. As indicated on the figure, the hazard contribution from the New Madrid source is much less than 1 percent of the hazard from the Charleston source at ground motion levels of importance in defining the GMRS for the LNP site. Tests were also performed for 1 second spectral acceleration using both the Gulf Coast and Mid-Continent EPRI (2004,Reference 2.5.2-253) ground motion models. Again, the New Madrid source was found to have a hazard level at the LNP site that was less than 1 percent of that for the Charleston source at ground motion levels of importance in defining the GMRS.



RAI 02.05.02-18 Figure 1 Mean hazard curves for the New Madrid and Charleston sources of repeated large-magnitude earthquakes.

References

Reference RAI 02.05.02-18 01

Enercon Services, 2004, Entergy Grand Gulf ESP Seismic Source Characterization for Updated EPRI PSHA, Report No. ENTO002-ER-01, July.

Associated LNP COL Application Revisions:

No COLA revisions have been identified associated with this response.

Attachments/Enclosures:

None.

NRC Letter No.: LNP-RAI-LTR-032

NRC Letter Date: May 8, 2009

NRC Review of Final Safety Analysis Report

NRC RAI #: 02.05.02-19

Text of NRC RAI:

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

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

PGN RAI ID #: L-288

PGN Response to NRC RAI:

The relationships between m_b and **M** are given in the following equations given in the FSAR:

(1) by Atkinson and Boore (Reference 2.5.2-255):

$$\mathbf{M} = -0.39 + 0.98 m_b \qquad \text{for } m_b \le 5.5$$

$$\mathbf{M} = 2.715 - 0.277 m_b + 0.127 m_b^2 \qquad \text{for } m_b > 5.5$$

Equation 2.5.2-204

(2) by Johnston (Reference 2.5.2-259):

$$\mathbf{M} = 1.14 + 0.24 m_b + 0.0933 m_b^2$$

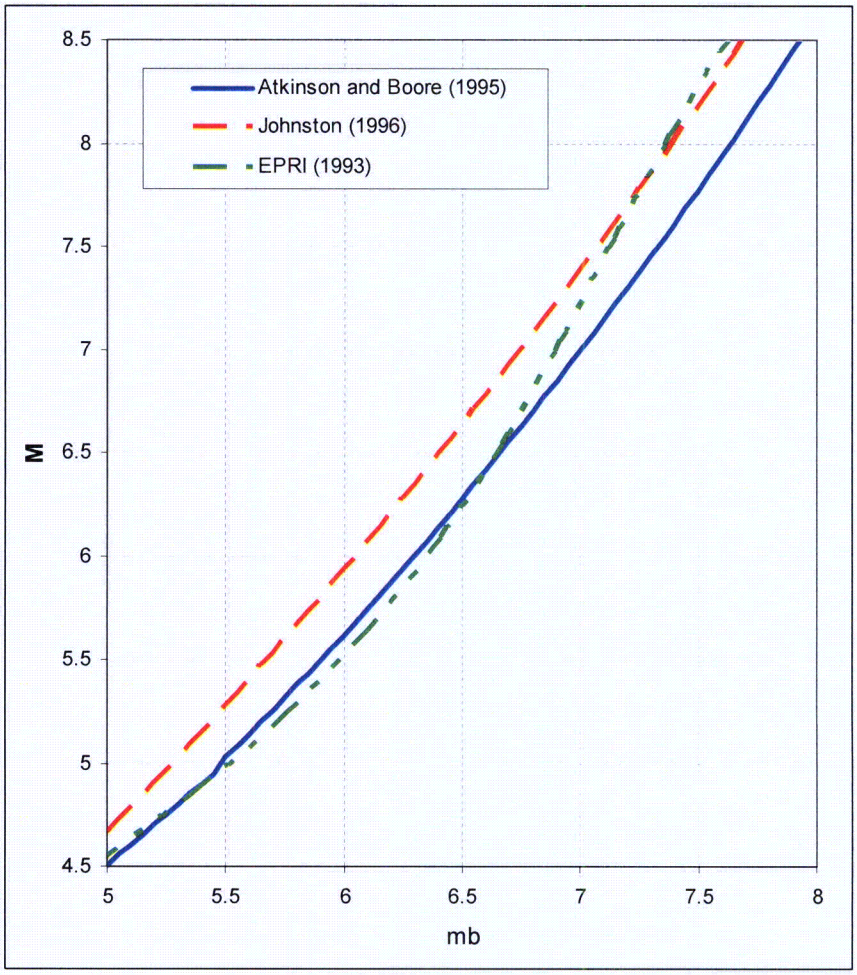
Equation 2.5.2-205

(3) by EPRI (Reference 2.5.2-260):

$$m_b = -10.23 + 6.105\mathbf{M} - 0.7632\mathbf{M}^2 + 0.03436\mathbf{M}^3$$

Equation 2.5.2-206

RAI 02.05.02-19 Figure 1 shows these three relationships.



RAI 02.05.02-19 Figure 1 Comparison of m_b – **M** relationships.

The EPRI-SOG teams defined recurrence relationships and maximum magnitude distributions that extended the m_b scale to magnitudes in the range of 7.2 to 7.5. The magnitude conversions were used in the PSHA to convert these m_b values to **M** for calculation of ground motion amplitude, accounting for the tendency for saturation in the m_b scale by the curvature in the m_b-**M** relationships. The primary situation where this conversion has the most impact is in the characterization of the Charleston source of repeated large earthquakes. For that source zone the repeated large earthquakes are characterized in terms of moment magnitude and these estimates are used directly to characterize the ground motions and hazard from this source.

Associated LNP COL Application Revisions:

No COLA revisions have been identified associated with this response.

Attachments/Enclosures:

None.

NRC Letter No.: LNP-RAI-LTR-032

NRC Letter Date: May 8, 2009

NRC Review of Final Safety Analysis Report

NRC RAI #: 02.05.02-20

Text of NRC RAI:

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

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

PGN RAI ID #: L-289

PGN Response to NRC RAI:

Gardner et al. (Reference RAI 02.05.02-20 01) provide the following relationship between compression wave velocity and rock density for sedimentary rocks.

$$\rho = 0.23V_P^{0.25} \qquad \text{(RAI 02.05.02-20 Equation 1)}$$

where V_P is compression wave velocity in ft/sec and ρ is bulk density in gm/cm^3. FSAR Figure 2.5.2-250 shows the variation of V_P with depth at the LNP site. The values vary from approximately 9,000 ft/sec near the surface to values in the range of 12,000 ft/sec to 13,500 ft/sec, with a few thin layers reaching a velocity of approximately 17,500 ft/sec.

The following table lists values of ρ computed using RAI 02.05.02-20 Equation 1 and associated unit weights in lb/ft^3 based on a typical range of V_p from the LNP site.

RAI 02.05.02-20 Table 1

Relationship between V_P and ρ

V_P (ft/sec)	ρ (gm/cm^3)	Unit Weight (lb/ft^3)
9,000	**2.24**	**140**
12,000	**2.41**	**150**
13,500	**2.48**	**155**
17,500	**2.65**	**165**

The value of ρ computed for a velocity of 9,000 ft/sec is the same as the average value obtained for the lower rock layers from the site-specific data. The majority of the depth range is characterized by velocities in the range of 12,000 to 13,000 ft/sec, which is consistent with a unit weight of approximately 150 lb/ft^3.

References:

Reference RAI 02.05.02-20 01

Gardner, G.H.F., L.W. Gardner, and A.R. Gregory, 1974, Formation velocity and density—The diagnostic basics for stratigraphic traps: Geophysics, v. 39, pp. 770–780.

Associated LNP COL Application Revisions:

No COLA revisions have been identified associated with this response.

Attachments/Enclosures:

None.

NRC Letter No.: LNP-RAI-LTR-032

NRC Letter Date: May 8, 2009

NRC Review of Final Safety Analysis Report

NRC RAI #: 02.05.02-21

Text of NRC RAI:

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

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

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

PGN RAI ID #: L-290

PGN Response to NRC RAI:

Empirical site response measurements were not obtained at the LNP site.

As discussed in the response to RAI 02.05.02-03, the velocity data obtained from the site borings within the general footprint of the category I structures shows consistent trends with depth such that 1-dimensional site response methods with velocity profile randomization are appropriate for characterizing the site amplification. Variability was more pronounced between the two units and between measurement techniques. As discussed in the response to RAI 02.05.02-03, this variability was addressed by developing four base case profiles and then enveloping the site response to develop the site GMRS.

Associated LNP COL Application Revisions:

No COLA revisions have been identified associated with this response.

Attachments/Enclosures:

None.