## PMLevyCOLPEm Resource

**From:** Brian Anderson
**Sent:** Friday, April 17, 2009 11:35 AM
**To:** robert.kitchen@pgnmail.com; david.waters@pgnmail.com; tillie.wilkins@pgnmail.com; PMLevyCOLPEm Resource
**Subject:** DRAFT RAIs - 2285 - SRP section 2.5.2 - Levy County Units 1 and 2 Combined License Application
**Attachments:** LNP Draft RAI 2285 - 2.5.2.doc

**Importance:** High

The attached draft RAI is related to SRP section 2.5.2 for the Levy County Units 1 and 2 Combined License Application. Please let me know if you would like to schedule a conference call to discuss this RAI.

Thank you,
Brian

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

**Hearing Identifier:** Levy_County_COL_Public
**Email Number:** 98

**Mail Envelope Properties** (CB87FC66F95637428C5E0D066E756B6FAC7E4898CD)

**Subject:** DRAFT RAIs - 2285 - SRP section 2.5.2 - Levy County Units 1 and 2 Combined License Application
**Sent Date:** 4/17/2009 11:34:30 AM
**Received Date:** 4/17/2009 11:34:31 AM
**From:** Brian Anderson

**Created By:** Brian.Anderson@nrc.gov

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

**Post Office:** HQCLSTR01.nrc.gov

| **Files** | **Size** | **Date & Time** |
|---|---|---|
| MESSAGE | 395 | 4/17/2009 11:34:31 AM |
| LNP Draft RAI 2285 - 2.5.2.doc | 50170 | |

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

Request for Additional Information No. 2285
Levy County, Units 1 and 2
Progress Energy Florida, Inc.
Docket No. 52-029 and 52-030
SRP Section: 02.05.02 - Vibratory Ground Motion
Application Section: 2.5.2

QUESTIONS for Geosciences and Geotechnical Engineering Branch 2 (RGS2)

02.05.02-***

FSAR section 2.5.2.5.1 Dynamic Properties of the LNP Site states on page 2.5-132 that averaged shear-wave velocity measurements shown in Figures 2.5.2-247 and 2.5.2-248 demonstrate significant variability of layer structure at the Levy site (especially profile LNP 1). Seismological methods of site response calculations including Approach 2B and analyses using one-dimensional SHAKE program used by the applicant are based on the assumption of a uniform (flat) layer structure under the site.

Please justify the assumption of uniformity of layers based on available boring and shear-wave profiles in relation to applicability of Approach 2B and SHAKE to the Levy site response calculation.

02.05.02-***

FSAR section 2.5.2.1.1 Earthquake Catalog, Appendix 2AA lists the earthquakes in the updated catalog that have occurred within 320 km (200 mi.) of the LNP site. The list consists of 15 events of body-wave magnitude (mb≥3) that occurred between 1826 and January 1, 2007. The size distribution of these earthquakes consists of 13 events of magnitude 3 ≤mb ≤ 4; and 2 events of magnitude 4≤ mb ≤ 4.5.

a) Please clarify the difference between the text and the catalog in Appendix 2AA listing 15 earthquakes with body-wave magnitudes larger than 3, and Figure 2.5.2-202 that only shows 12 events within the 320 km zone.

b) Estimated seismic moments are provided for the catalog in Appendix 2AA. The values listed were estimated by first estimating moment magnitude using the three relationships described in FSAR Subsection 2.5.2.4, then computing seismic moment from each moment magnitude estimate using the Hanks and Kanamori relationship, and finally, averaging the results (Reference 2.5.2-216). Estimated seismic moments are not included in the table in Appendix 2AA. Please explain why there is a discrepancy between the statement above and the listed parameters in the Appendix 2AA table.

c) From the above statement on page 2.5-94, it appears that Appendix 2AA, the Earthquake Catalog, lists only the earthquakes that have occurred within the 320 km (200 mi.) site radius. However, Appendix 2AA contains earthquake parameters throughout the CEUS, which is more than 15 events. Please clarify the discrepancy between the statement in the text and the amount of parameters in the Earthquake Catalog (Appendix 2AA).

DRAFT

d) FSAR Appendix 2AA, the Earthquake Catalog, lists two different earthquake body-wave magnitudes, mb* and Final mb, for each event. On page 2AA-1 it also says “Final mb.” Section 2.5.2.4.1.3, on page 2.5-114, lists equations for computing the “adjusted magnitude”, mb*. However, it is unclear if and where in the LNP 1 and 2 COLA that the Final mb magnitude is explained. Most but not all of the Final mb are just rounded mb*. Please provide the definition of the “Final mb” magnitude and show how it is related to the adjusted magnitude, mb*.

02.05.02-***

FSAR section 2.5.2.3, Correlation of Earthquake Activity with Seismic Sources, states on page 2.5-110:

Emb — Expected estimate of body wave magnitude. Emb values assigned to the 2006 earthquakes in the STP 3 & 4 COLA differ slightly from the LNP catalog due to different versions of magnitude conversion relationships used in the two studies.

Please clarify the reasoning behind using different versions of magnitude conversion relationships.

02.05.02-***

This question relates to FSAR Table 2.5.2-210 and Section 2.5.2.4.1.3 on page 2.5-115.

In Table 2.5.2-210, one third of the rows are labeled as “Update-EPRI AS” under the Earthquake Catalog column. However, the “Update-EPRI AS” label is not described in the text of the COLA.

What does the label “Update-EPRI AS” mean, and how do data and analyses associated with “Update-EPRI AS” fit into the completeness region analyses related to the LNP 1 and 2 sites?

02.05.02-***

FSAR section 2.5.2.4.4.2, Uniform Hazard Response Spectra for Generic CEUS Rock and Identification of Controlling Earthquakes, Page 2.5-128 and Page 2.5-168, Table 2.5.2-221, lists Reference (Controlling) Earthquakes for HF (5-10 Hz) as mb-Dist (km) 6.5 – 161 km for 10-4 and 6.0 – 34 km for 10-5 hazard.

This differs from the controlling earthquake magnitude and distance from the earlier EPRI-SOG and LLNL NUREG/CR-6606 studies. For the Crystal River site, the HF controlling earthquake is M 5.3 at a distance of 17 km (Table 2.14, page 26).

Please justify the absence of a local high frequency controlling earthquake for the Levy site.

02.05.02-***



DRAFT

FSAR section 2.5.2.4.4.3, Response Spectra for Reference and Deaggregation Earthquakes, states on
page 2.5-130:

These spectral shape models are also used to extrapolate the EPRI median ground motion model from a frequency of 0.5 Hz down to a frequency of 0.1 Hz (spectral period of 10 seconds). This extrapolation requires an assessment of the aleatory variability in spectral acceleration at frequencies less than 0.5 Hz.The EPRI models are based on empirical ground motion models developed as part of the Pacific Earthquake Engineering Research (PEER) Center's Next Generation Attenuation Project (NGA) (Reference 2.5.2-267). The NGA ground motion models available from PEER include estimates of aleatory variability for spectral frequencies between 0.1 and 100 Hz. These models indicate that the standard deviation of the natural log of spectral acceleration is, on average, 14 percent higher at a frequency of 0.1 Hz than it is at a frequency of 0.5 Hz. A linear increase in aleatory variability with decreasing log frequency from 0 percent at 0.5 Hz to 14 percent at 0.1 Hz was used to extend the EPRI (Reference 2.5.2-258) aleatory variability models down to a frequency of 0.1 Hz.

The FSAR Reference 2.5.2-267 is: Pacific Earthquake Engineering Research Center's (PEER) Next Generation Attenuation Project (NGA).

Please provide a more specific reference to the NGA models used for assessing aleatory variability for spectral frequencies between 0.1 and 100 Hz. Explain where those relations are published, and what their authorships are. Please show the dependence between variability and frequencies adopted in this report.

02.05.02-***

FSAR section 2.5.2.4.4.3, Response Spectra for Reference and Deaggregation Earthquakes, states on page 2.5-130:

As can be seen on Figures 2.5.2-243, 2.5.2-244, 2.5.2-245, and 2.5.2-246, the rock UHRS at 0.5 Hz typically lies above the LF RE spectra. Thus scaling the LF RE spectrum by the LF amplification function will underestimate the appropriate surface motions that are hazard consistent with the rock UHRS. To address this issue, the rock UHRS was extended from 0.5 Hz down to 0.1 Hz by computing a second LF RE spectrum that matches the UHRS at 0.5 Hz. This additional spectrum is denoted by the "LF Extended" spectral shape shown on Figures 2.5.2-243, 2.5.2-244, 2.5.2-245, and 2.5.2-246.

Please clarify how "LF Extended" were obtained. What kind of principles were used to extrapolate spectrum from 0.5 Hz to 0.1 Hz?

02.05.02-***

FSAR section 2.5.2.5.1.1, Shallow Shear-Wave Velocities, states on page 2.5-133:
The general shallow stratigraphy outlined in FSAR Subsection 2.5.4.1 was subdivided into layers showing consistent patterns in the velocity, lithology, and geophysical data.

Geometric mean velocities were computed for each sublayer. Separate values were computed for the data at each unit. Separate values were also computed for the downhole and P-S suspension data. The resulting velocity profiles are shown on Figures 2.5.2-247 and 2.5.2-248. These are labeled as median profiles using the assumption that VS is lognormally distributed.

a) Please clarify why geometric means (also labeled as median velocity profiles in Figures 2.5.2-247 and 2.5.2-248) for each sublayer were computed. The existing practice (e.g., used by the USGS) of computing average shear-wave velocity in a layer is done by first computing the slowness (S-wave travel time within a layer), and second dividing the thickness of the layer by the travel time.

b) FSAR section 2.5.2.5.1.2, Deep Shear-Wave Velocities, states on page 2.5-134:

The average value of Vp/Vs for the deepest layer in the LNP P-S suspension surveys in the LNP site borings is 2.42. This ratio was used to compute a median Vs profile by multiplying the average Vp/Vs, by the median compression-wave velocities. The resulting shear-wave velocity profile is shown on Figure 2.5.2-250. This median profile was added to the base of the four shallow profiles shown on Figure 2.5.2-249 to create the initial velocity profiles for site response analysis.

Please explain why you use the median Vp instead of the velocity calculated based on slowness.

02.05.02-***

FSAR section 2.5.2.5.1.1, Shallow Shear-Wave Velocities, states on page 2.5-133:

In FSAR Figure 2.5.2-249 shows the resulting four median profiles, two for the site of each unit. The profiles labeled “P1” are based on the suspension logging data and those labeled “P2” are based on the downhole data. All four profiles are generally similar. The largest difference is between the suspension logging and the downhole data for LNP 1 (profiles LNP 1 P1 and LNP 1 P2) in the elevation range of -30 m (-100 ft.) to -67 m (-220 ft.) NAVD88. The effect of the differences in the velocity profiles shown on Figure 2.5.2-249 was examined in initial site response sensitivity analyses.

Figure 2.5.2-249 demonstrates the differences in shear-wave velocity measurements obtained based on P-S suspension logging (curve P1) and downhole methods (curve P2) especially at LNP 1 up to the elevation of about -225 ft.

Please clarify which one of the two velocity measurement methods provides more reliable data and why.

02.05.02-***

FSAR section 2.5.2.5.2 describes the use of Acceleration Time Histories for Input Rock Motions.

DRAFT

Table 2.5.2-225 only lists the bin range of the time histories. Please provide a list of the actual time histories used (earthquake and station), and describe in detail how the records were scaled. Please provide a figure(s) with an example of the 2-3 actual records with their scaling.

02.05.02-***

FSAR section 2.5.2.6.4 describes the development of the Vertical GMRS.

Please clarify why the Levy site is considered to be “intermediate” between the WUS and the CEUS, and justify the value you used for kappa.

02.05.02-***

FSAR Table 2.5.2-201 on page 2.5-146 uses two magnitudes:
Ms – surface wave magnitude and Msw – also surface wave magnitude.

Please clarify the difference between Ms and Msw.

02.05.02-***

FSAR section 2.5.2.4.3.1 describes the Selection of EPRI-SOG Seismic Sources and states that a single mb-M conversion relationship was used (Reference 2.5.2-255).

Please clarify why only a single conversion of Atkinson & Boore (1995) mb to the moment magnitude relationship was used.

DRAFT