FPL.

L-2011-511
10 CFR 52.3

November 30, 2011

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

Re: Florida Power & Light Company
Proposed Turkey Point Units 6 and 7
Docket Nos. 52-040 and 52-041
Response and Revised Response Schedule to NRC Request for Additional Information
Letter No. 037 (eRAI 5896) SRP Section - 02.05.02 Vibratory Ground Motion

Reference:

1. NRC Letter to FPL dated September 29, 2011, Request for Additional Information Letter No.037 Related to SRP Section 02.05.02 - Vibratory Ground Motion for the Turkey Point Nuclear Plant Units 6 and 7 Combined License Application
2. FPL Letter to NRC dated October 31, 2011, Response and Response Schedule to NRC Request for Additional Information Letter No. 037 (eRAI 5896) SRP Section - 02.05.02 Vibratory Ground Motion

Florida Power & Light Company (FPL) provides, as attachments to this letter, its responses to the Nuclear Regulatory Commission's (NRC) Request for Additional Information (RAI) 02.05.02-7, and RAI 02.05.02-12 provided in Reference 1. FPL provided a schedule for the responses to RAI 02.05.02-7, and RAI 02.05.02-12 in Reference 2. The attachment identifies changes that will be made in a future revision of the Turkey Point Units 6 and 7 Combined License Application (if applicable).

In Reference 2, FPL also provided November 30, 2011 as the schedule for the response to RAI 02.05.02-4. The revised schedule for the response to RAI 02.05.02-4 is January 10, 2012.

If you have any questions, or need additional information, please contact me at 561-691-7490.

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

Executed on November 30, 2011

Sincerely,

William Maher
Senior Licensing Director – New Nuclear Projects

WDM/RFB

D097
NRO

Attachment 1: FPL Response to NRC RAI No. 02.05.02-7 (eRAI 5896)
Attachment 2: FPL Response to NRC RAI No. 02.05.02-12 (eRAI 5896)

cc:
PTN 6 & 7 Project Manager, AP1000 Projects Branch 1, USNRC DNRL/NRO
Regional Administrator, Region II, USNRC
Senior Resident Inspector, USNRC, Turkey Point Plant 3 & 4

NRC RAI Letter No. PTN-RAI-LTR-037

SRP Section: 02.05.02 - Vibratory Ground Motion

Question for Geosciences and Geotechnical Engineering Branch 1 (RGS1)

NRC RAI Number: 02.05.02-7 (eRAI 5896)

FSAR Subsection 2.5.2.3 discusses the correlation of seismicity with only the EPRI seismic source models. In accordance with NUREG-0800, Standard Review Plan, Chapter 2.5.2, "Vibratory Ground Motion," please provide a thorough, detailed, description in the FSAR that discusses the correlation of seismicity with all of the seismic sources used in the Turkey Point PSHA study.

FPL RESPONSE:

Seismic sources used in the Turkey Point Units 6 & 7 probabilistic seismic hazard analysis (PSHA) include updated EPRI seismic sources (FSAR Subsection 2.5.2.4.3.2), supplemental seismic sources (FSAR Subsection 2.5.2.4.4.1), Charleston, South Carolina seismic sources (FSAR Subsection 2.5.2.4.4.2), and Cuba and northern Caribbean seismic sources (FSAR Subsection 2.5.2.4.4.3). This RAI response includes descriptions of the correlation of earthquake epicenters with these seismic sources.

EPRI Seismic Sources

FSAR Figures 2.5.2-203 through 2.5.2-209 show the EPRI (FSAR Reference 2.5.2-243) seismic sources located within the site region and epicenters from the project Phase 1 earthquake catalog. Following are descriptions of the correlation of earthquakes with each EPRI seismic source.

- Bechtel BZ1 (Gulf Coast) – Seismicity within Bechtel source BZ1 is sparse and appears evenly distributed throughout (FSAR Figure 2.5.2-204). There is no clear association of seismicity with any known geologic structure within this source. The largest magnitude earthquake in this source from the Phase 1 earthquake catalog is Emb 5.90.
- Dames & Moore 20 (So. Coastal Margin) – Seismicity within Dames & Moore source 20 is sparse and appears evenly distributed throughout (FSAR Figure 2.5.2-205). There is no clear association of seismicity with any known geologic structure within this source. The largest magnitude earthquake in this source from the Phase 1 earthquake catalog is Emb 5.58.
- Law Engineering 126 (South Coastal Block) – Seismicity within Law Engineering source 126 is sparse and appears evenly distributed throughout (FSAR Figure 2.5.2-206). There is no clear association of seismicity with any known geologic structure within this source. The largest magnitude earthquake in this source from the Phase 1 earthquake catalog is Emb 4.96.
- Rondout Associates 51 (Gulf Coast to Bahamas Fracture Zone) – Seismicity within Rondout Associates source 51 is sparse and appears evenly distributed throughout (FSAR Figure 2.5.2-207). There is no clear association of seismicity with any known geologic structure within this source. The largest magnitude earthquake in this source from the Phase 1 earthquake catalog is Emb 5.90.

- Rondout Associates 49-05 (Appalachian Basement) – Seismicity within Rondout Associates source 49-05 is sparse and appears evenly distributed throughout (FSAR Figure 2.5.2-207). The largest magnitude earthquake in this source from the Phase 1 earthquake catalog is Emb 4.96.
- Weston Geophysical 107 (Gulf Coast Background) – Seismicity within Weston Geophysical source 107 is sparse and appears evenly distributed throughout (FSAR Figure 2.5.2-208). The largest magnitude earthquake in this source from the Phase 1 earthquake catalog is Emb 5.90.
- Woodward-Clyde BG-35 Turkey Point (Truncated) – Seismicity within truncated Woodward-Clyde source BG-35 is very sparse and appears evenly distributed throughout (FSAR Figure 2.5.2-209). The largest magnitude earthquake in this source from the Phase 1 earthquake catalog is Emb 4.09.

Supplemental Seismic Sources

FSAR Figures 2.5.2-204 through 2.5.2-208 show the supplemental seismic source zones and epicenters from the project Phase 1 earthquake catalog. These supplemental seismic source zones were developed by the Turkey Point Units 6 & 7 project to account for those portions of the site region not covered by EPRI source zones. As described in FSAR Subsection 2.5.2.4.4.1, there is one supplemental source zone for each EPRI team except Woodward-Clyde, for which no supplemental source is needed.

Seismicity within each of the supplemental sources is very sparse, with a total of just one or two earthquakes in each (FSAR Figures 2.5.2-204 through 2.5.2-208). The largest magnitude earthquake from the Phase 1 earthquake catalog in each supplemental source zone is Emb 4.09.

Charleston, South Carolina Seismic Sources

Alternate geometries representing the Charleston, South Carolina seismic source from the Updated Charleston Seismic Source (UCSS) characterization are shown in FSAR Figure 2.5.2-212. Revised FSAR Figure 2.5.2-212 (included herein in the Associated COLA Revisions section) shows these Charleston seismic sources along with epicenters from the project Phase 1 earthquake catalog. Following are descriptions of the correlation of earthquakes with each UCSS seismic source.

- Source A (Charleston) – Charleston Source A was developed in part to envelop the area of ongoing seismicity in the Middleton Place-Summerville area. The preponderance of these moderately abundant earthquakes is thought to be aftershocks of the historical 1886 Emb 6.75 event (FSAR References 2.5.2-272, 2.5.2-324, and 2.5.2-325). The largest magnitude earthquake from the Phase 1 earthquake catalog in Charleston Source A is the historical 1886 Emb 6.75 event.
- Source B (Coastal and Offshore Zone) – Charleston Source B is a coast-parallel source that includes all of Charleston Source A and extends farther to the northeast and southwest to capture more distant paleoliquefaction features, and to the southwest to include the offshore Helena Banks fault zone. Seismicity within Charleston Source B, outside of the area covered by Charleston Source A, is sparse. The largest magnitude

earthquake from the Phase 1 earthquake catalog in Charleston Source B is the historical 1886 Emb 6.75 event.

- Source B' (Coastal Zone) – Charleston Source B' also includes all of Charleston Source A and extends to the northeast and southwest to capture more distant paleoliquefaction features, but does not include the offshore Helena Banks fault zone. Seismicity within Charleston Source B', outside of the area covered by Charleston Source A, is sparse. The largest magnitude earthquake from the Phase 1 earthquake catalog in Charleston Source B' is the historical 1886 Emb 6.75 event.
- Source C (East Coast Fault System-South) – Charleston Source C represents the southern segment of Marple and Talwani's (FSAR Reference 2.5.2-278) East Coast fault system. There is partial overlap between Charleston Sources A and C. Within the area of overlap, seismicity is moderately abundant and likely represents aftershocks of the 1886 earthquake. Outside the area of overlap, seismicity in Charleston Source C is very sparse. The largest magnitude earthquake from the Phase 1 earthquake catalog in Charleston Source C is the 1959 Emb 4.31 event. The location of the 1886 Emb 6.75 earthquake from the Phase 1 earthquake catalog plots just outside of Geometry C, but, given the uncertainty in the location of this earthquake, it is considered to have possibly occurred within Geometry C.

<u>Cuba and Northern Caribbean Seismic Sources</u>

Seismic sources for Cuba and the northern Caribbean region are shown in FSAR Figure 2.5.2-217. FSAR Figure 2.5.2-214 and Table 2.5.2-221 show significant earthquakes in this region. Revised FSAR Figure 2.5.2-217 (included herein in the Associated COLA Revisions section) shows the Cuba and northern Caribbean seismic sources along with epicenters from the project Phase 2 earthquake catalog. Following are descriptions of the correlation of earthquakes with each of the Cuba and northern Caribbean seismic sources.

- Cuba Areal Source – The Cuba areal source is associated with moderately abundant seismicity that is distributed throughout the source. There appears to be higher concentration of epicenters in the southeastern portion of the Cuba areal source, near the active plate boundary and the eastern and western Oriente fault sources. Also, there appears to be a higher concentration of epicenters distributed along the northern coast and near-shore portions of Cuba within the Cuba areal source. The largest earthquakes from the Phase 2 catalog associated with this source are the 1551 M_w 5.98 event in southeastern Cuba, the 1880 M_w 6.13 event in western Cuba, and the 1914 M_w 6.29 event offshore northeastern Cuba.
- Oriente Fault-Western – The Oriente Fault-Western source is associated with abundant seismicity along its length, with an apparent concentration of epicenters at its western end near the Cayman trough. Seismicity also appears concentrated near its eastern end near where the western and eastern segments of the Oriente fault form a transtensional step-over. The largest earthquakes from the Phase 2 catalog associated with this source are the 1917 M_w 7.20 and 1992 M_w 6.80 events.
- Oriente Fault-Eastern – The Oriente Fault-Eastern source is associated with abundant seismicity along its length, with an apparent concentration of epicenters along its west-central portion, just offshore of southernmost Cuba near the city of Santiago de Cuba.

The largest earthquake from the Phase 2 catalog associated with this source is the historical 1766 M_w 7.53 event.

- Septentrional Fault – The Septentrional Fault source is associated with abundant seismicity along its entire length. The largest earthquakes from the Phase 2 catalog associated with this source are the historical 1842 M_w 8.23 and 1887 M_w 7.93 events.
- Northern Hispaniola Fault-Western – The Northern Hispaniola Fault-Western source is associated with abundant seismicity along its entire length, with an especially high concentration of epicenters along its central and eastern portions. The largest earthquake from the Phase 2 catalog associated with this source is the 1953 M_w 6.93 event.
- Northern Hispaniola Fault-Eastern – The Northern Hispaniola Fault-Eastern source is associated with abundant seismicity along its entire length, much of which appears in map view to the south of the surface trace of this south-dipping fault. The largest earthquake from the Phase 2 catalog associated with this source is the 1946 M_w 7.90 event.
- Swan Islands Fault-Western – The Swan Islands Fault-Western source is associated with abundant seismicity along its entire length. The largest earthquake from the Phase 2 catalog associated with this source is the historical 1856 M_w 7.69 event.
- Swan Islands Fault-Eastern – The Swan Islands Fault-Eastern source is associated with abundant seismicity along its entire length, with an apparent concentration of epicenters located near its eastern end near the Cayman trough. No earthquakes from the Phase 2 catalog greater than or equal to M_w 6.75 are associated with this source.
- Walton-Duanvale Fault – The Walton-Duanvale Fault source is associated with moderately abundant seismicity along its length, with an apparent concentration of epicenters located near its western end near the Cayman trough. Seismicity also appears concentrated at the eastern end of this source near Jamaica, where the left-lateral Walton-Duanvale and Enriquillo-Plantain Garden faults form a restraining bend. The largest earthquakes from the Phase 2 catalog associated with this source are the two approximately M_w 6.6 events that occurred in 1907 and 1957.
- Enriquillo-Plantain Garden Fault – The Enriquillo-Plantain Garden Fault source is associated with abundant seismicity along its length, with apparent concentrations of epicenters at its western and eastern ends. Multiple large historical earthquakes have ruptured along the Enriquillo-Plantain Garden fault (FSAR Reference 2.5.2-282), including from the Phase 2 catalog the 1692 M_w 7.78 earthquake near Jamaica and the 1751 M_w 7.28 and 1770 M_w 7.53 earthquakes near Port-au-Prince, Haiti.

FSAR Subsection 2.5.2.4.6 provides a discussion of PSHA results.

This response is PLANT SPECIFIC.

References:

None

ASSOCIATED COLA REVISIONS:

The text in FSAR Subsection 2.5.2.3 will be revised as follows in a future update of the FSAR:

2.5.2.3 Correlation of Seismicity with Geologic Structures and ~~EPRI~~ **Seismic** Sources

Seismic sources used in the Turkey Point Units 6 & 7 PSHA include updated EPRI seismic sources (Subsection 2.5.2.4.3.2), supplemental seismic sources (Subsection 2.5.2.4.4.1), Charleston, South Carolina seismic sources (Subsection 2.5.2.4.4.2), and Cuba and northern Caribbean seismic sources (Subsection 2.5.2.4.4.3). The EPRI earthquake catalog covers earthquakes in the CEUS through 1984, as described in Subsection 2.5.2.1. Figures 2.5.2-203 through 2.5.2-209 show the distribution of earthquake epicenters from both the EPRI (pre-1985) and Phase 1 update (through mid-February 2008) earthquake catalogs in comparison to the seismic sources identified by each of the EPRI ESTs. **Seismicity is sparse and appears evenly distributed throughout each EPRI source zone that is located within the site region. There is no clear association of seismicity with any known geologic structure in these sources.**

Comparison of the additional events of the updated **Phase 1** earthquake catalog~~s~~ to the EPRI earthquake catalog shows:

- There are no new earthquakes within the site region that can be associated with a known geologic structure.
- There are no unique clusters of seismicity that suggest a new seismic source not captured by the EPRI seismic source model.
- The updated earthquake catalog does not show a pattern of seismicity that requires revision to the geometry of any of the EPRI seismic sources. ~~The updated catalog extends farther south than the original EPRI earthquake catalog to include seismicity in the Cuba area and the North America-Caribbean plate boundary region.~~
- ~~Subsection 2.5.2.4.4.3 describes the Cuba and northern Caribbean seismic source model.~~
- The ~~updated~~ **Phase 1** earthquake catalog does not imply a significant change in seismicity parameters (rate of activity, b-value) for any of the EPRI seismic sources.

The ~~updated~~ **Phase 1** earthquake catalog ~~does~~ indicate**s** that Mmax updates are required for most of EPRI seismic sources located ~~at least partially~~ within the site region. Subsection 2.5.2.4.3 describes these Mmax updates.

The correlation of seismicity from the Phase 1 earthquake catalog with supplemental seismic sources is described in Subsection 2.5.2.4.4.1. The correlation of seismicity from the Phase 1 earthquake catalog with the Charleston, South Carolina seismic source is described in Subsection 2.5.2.4.4.2. The correlation of seismicity from the Phase 2 earthquake catalog with Cuba and northern Caribbean seismic sources is described in Subsection 2.5.2.4.4.3.

The following text will be inserted after the last bullet of the sixth paragraph of FSAR Subsection 2.5.2.4.4.1 in a future update of the FSAR:

- Assess Mmax distributions and weights for five new source zones based on the updated earthquake catalog. These five new source zones are largely devoid of historical seismicity (Table 2.5.2-211), thus Mmax distributions are based on Mmax estimates for their respective updated EPRI EST Gulf Coast zones (Table 2.5.2-207). Due to the similarity of the crust between the supplemental source zones and the original EPRI Gulf Coast source zones, the new zones reflect the same Mmax distributions as their updated Gulf Coast source zone counterpart for each EST.

Figures 2.5.2-204 through 2.5.2-208 show the supplemental seismic source zones and epicenters from the Phase 1 earthquake catalog. Seismicity within each of the supplemental sources is very sparse, with a total of just one or two earthquakes in each (Figures 2.5.2-204 through 2.5.2-208). The largest magnitude earthquake from the Phase 1 earthquake catalog in each supplemental source zone is Emb 4.09.

The following text will be inserted at the end of the third paragraph of FSAR Subsection 2.5.2.4.4.2.1 in a future update of the FSAR:

Geometry A also excludes outlying liquefaction features because liquefaction occurs as a result of strong ground shaking that may extend well beyond the areal extent of the tectonic source. Geometry A also envelops instrumentally located earthquakes spatially associated with the Middleton Place-Summerville Seismic Zone (MPSSZ), which is located in the meizoseismal zone of the 1886 Charleston earthquake (References 272, 324, and 325). **The preponderance of these moderately abundant earthquakes is thought to be aftershocks of the historical 1886 Emb 6.75 event (References 272, 324, and 325). The largest magnitude earthquake from the Phase 1 earthquake catalog in Geometry A is the historical 1886 Emb 6.75 event.**

The text in the eighth paragraph of FSAR Subsection 2.5.2.4.4.2.1 will be revised as follows in a future update of the FSAR:

Geometry B — Coastal and Offshore Zone

Geometry B is a coast-parallel, approximately 260 x 100 kilometers source area that (a) incorporates all of Geometry A, (b) is elongated to the northeast and southwest to capture other, more distant liquefaction features in coastal South Carolina (References 207, 208, and 323), and (c) extends to the southeast to include the offshore Helena Banks fault zone (Reference 213) (Figure 2.5.2-212). **Seismicity within Geometry B, outside of the area of overlap with Geometry A, is sparse. The largest magnitude earthquake from the Phase 1 earthquake catalog in Geometry B is the historical 1886 Emb 6.75 event (Figure 2.5.2-212).** The elongation and orientation of Geometry B is roughly parallel to the regional structural grain as well as roughly parallel to the elongation of 1886 isoseismals. The mapped extent of paleoliquefaction features (References 207, 208, and 323) defines the northeastern and southwestern extents of Geometry B.

The following text will be added to the end of the twelfth paragraph of FSAR Subsection 2.5.2.4.4.2.1 in a future update of the FSAR:

Geometry B' — Coastal Zone

Geometry B' is a coast-parallel, approximately 260 x 50 kilometers source area that incorporates all of Geometry A, as well as the majority of reported paleoliquefaction features (References 207, 208, and 323). Unlike Geometry B, however, Geometry B' does not include the offshore Helena Banks fault zone (Figure 2.5.2-212). **Seismicity within Geometry B', outside of the area of overlap with Geometry A, is sparse. The largest magnitude earthquake from the Phase 1 earthquake catalog in Geometry B' is the historical 1886 Emb 6.75 event.**

The following text will be added to the end of the fifteenth paragraph of FSAR Subsection 2.5.2.4.4.2.1 in a future update of the FSAR:

Geometry C — East Coast Fault System-South

Geometry C is about 200 x 30 kilometers, north-northeast-oriented source area (Figure 2.5.2-212) enveloping the southern segment of the proposed East Coast fault system shown in Figure 3 of Reference 278. The area of Geometry C is defined to envelop the original depiction of the postulated East Coast Fault System-South by Marple and Talwani in Reference 278. **The largest magnitude earthquake from the Phase 1 earthquake catalog in Geometry C is Emb 4.31. The location of the 1886 Emb 6.75 earthquake from the Phase 1 earthquake catalog plots just outside of Geometry C, but, given the uncertainty in the location of this earthquake, it is considered to have possibly occurred within Geometry C. There is partial overlap between Geometries A and C. Within the area of overlap, seismicity in Geometry C is moderately abundant. To the north, outside the area of overlap, seismicity in Geometry C is very sparse.**

The following text will be inserted after the first paragraph of FSAR Subsection 2.5.2.4.4.3.2.1 in a future FSAR update:

2.5.2.4.4.3.2.1 Cuba Areal Source Zone

The single areal source zone representing Cuba (Figure 2.5.2-217) encompasses the major tectonic elements on the island and the majority of the historical seismicity. Subsection 2.5.1.1.1.3.2.4 provides discussion of geologic, geophysical, and seismic data for Cuba. The northern and eastern boundary of the source zone is drawn near the base of the submarine escarpment that marks the location of the Nortecubana fault suture and the geologic boundary between the relatively undeformed North American crust of the Bahama Platform and the highly attenuated crust of the former leading edge of the plate boundary zone (Figures 2.5.1-210 and 2.5.1-202). To account for uncertainty in the position of the boundary, a buffer of 12.5 miles from the base of the escarpment toward the north and east was added to the Cuba areal source zone. This buffer was added to account for poorly located earthquakes that probably occurred within the Cuba island arc region and/or a zone of fractured and faulted crust beyond the suture zone that formed during early Cenozoic subduction. The western boundary of the Cuba areal source zone is based on bathymetry and the locations and density of historical seismicity. This boundary approximately follows the boundary between the Yucatan Basin and the continental shelf surrounding Cuba. The southern boundary of the Cuba source zone coincides with the southern boundary of Cuba and the steep submarine escarpment that borders the Oriente fault. At closest approach, the Cuba areal source zone is located about 140 miles from the Units 6 & 7 site.

The Cuba areal source is associated with moderately abundant seismicity that is distributed throughout the source (Figure 2.5.2-217). There appears to be higher concentration of epicenters in the southeastern portion of the Cuba areal source, near the active plate boundary and the eastern and western Oriente fault sources. Also, there appears to be a higher concentration of epicenters distributed along the northern coast and near-shore portions of Cuba within the Cuba areal source. The largest earthquakes from the Phase 2 catalog associated with this source are the 1551 M_w 5.98 event in southeastern Cuba, the 1880 M_w 6.13 event in western Cuba, and 1914 M_w 6.29 event offshore northeastern Cuba.

The first paragraph FSAR Subsection 2.5.2.4.4.3.2.2 will be divided into two paragraphs and the following text will be inserted as a new paragraph in-between in a future FSAR update:

2.5.2.4.4.3.2.2 Oriente Fault — Western

At closest approach, the western Oriente fault source is located about 420 miles from the Units 6 & 7 site (Figure 2.5.2-217). Subsection 2.5.1.1.1.1.1.2 provides discussion of the geologic, geodetic, and seismic characteristics of the Oriente fault. Table 2.5.2-217 summarizes source parameters for this fault source.

The western Oriente fault source is associated with abundant seismicity along its length, with an apparent concentration of epicenters at its western end near the Cayman trough (Figure 2.5.2-217). Seismicity also appears concentrated near its eastern end near where the western and eastern segments of the Oriente fault form a transtensional step-over (Figure 2.5.2-217). The largest earthquakes from the Phase 2 catalog associated with this source are the 1917 M_w 7.20 and 1992 M_w 6.80 events.

The first paragraph of FSAR Subsection 2.5.2.4.4.3.2.3 will be divided into two paragraphs and the following text will be inserted as a new paragraph in-between in a future FSAR update:

2.5.2.4.4.3.2.3 Oriente Fault — Eastern

At closest approach, the eastern Oriente fault source is located about 445 miles from the Units 6 & 7 site (Figure 2.5.2-217). Subsection 2.5.1.1.2.3.1.2 provides discussion of the geologic, geodetic, and seismic characteristics of the Oriente fault. Table 2.5.2-217 summarizes source parameters for this fault source.

The eastern Oriente fault source is associated with abundant seismicity along its length, with an apparent concentration of epicenters along its west-central portion, just offshore of southernmost Cuba near the city of Santiago de Cuba (Figure 2.5.2-217). The largest earthquake from the Phase 2 catalog associated with this source is the historical 1766 M_w 7.53 event.

The first paragraph of FSAR Subsection 2.5.2.4.4.3.2.4 will be divided into two paragraphs and the following text will be inserted as a new paragraph in-between in a future FSAR update:

2.5.2.4.4.3.2.4 Septentrional Fault

At closest approach, the Septentrional fault source is located about 545 miles from the Units 6 & 7 site (Figure 2.5.2-217). Subsection 2.5.1.1.2.3.2.1 provides discussion of the geologic, geodetic, and seismic characteristics of the Septentrional fault. Table 2.5.2-217 summarizes source parameters for this fault source.

The Septentrional fault source is associated with abundant seismicity along its entire length (Figure 2.5.2-217). The largest earthquakes from the Phase 2 catalog associated with this source are the historical 1842 M_w 8.23 and 1887 M_w 7.93 events.

The first paragraph of FSAR Subsection 2.5.2.4.4.3.2.5 will be divided into two paragraphs and the following text will be inserted as a new paragraph in-between in a future FSAR update:

2.5.2.4.4.3.2.5 Northern Hispaniola Fault — Western

At closest approach, the western Northern Hispaniola fault source is located about 550 miles from the Units 6 & 7 site (Figure 2.5.2-217). Subsection 2.5.1.1.2.3.2.2 provides discussion of the geologic, geodetic, and seismic characteristics of the Northern Hispaniola fault. Table 2.5.2-217 summarizes source parameters for this fault source.

The western Northern Hispaniola fault source is associated with abundant seismicity along its entire length, with an especially high concentration of epicenters along its central and eastern portions (Figure 2.5.2-217). The largest earthquake from the Phase 2 catalog associated with this source is the 1953 M_w 6.93 event.

The first paragraph of FSAR Subsection 2.5.2.4.4.3.2.6 will be divided into two paragraphs and the following text will be inserted as a new paragraph in-between in a future FSAR update:

2.5.2.4.4.3.2.6 Northern Hispaniola Fault — Eastern

At closest approach, the eastern Northern Hispaniola fault source is located about 760 miles from the Units 6 & 7 site (Figure 2.5.2-217). Subsection 2.5.1.1.2.3.2.2 provides discussion of the geologic, geodetic, and seismic characteristics of the Northern Hispaniola fault. Table 2.5.2-217 summarizes source parameters for this fault source.

The eastern Northern Hispaniola fault source is associated with abundant seismicity along its entire length, much of which appears in map view to the south of the surface trace of this south-dipping fault (Figure 2.5.2-217). The largest earthquake from the Phase 2 catalog associated with this source is the 1946 M_w 7.90 event.

The first paragraph of FSAR Subsection 2.5.2.4.4.3.2.7 will be divided into two paragraphs and the following text will be inserted as a new paragraph in-between in a future FSAR update:

2.5.2.4.4.3.2.7 Swan Islands Fault — Western

At closest approach, the western Swan Islands fault source is located 620 miles from the Units 6 & 7 site (Figure 2.5.2-217). Subsection 2.5.1.1.2.3.1.1 provides discussion of the geologic, geodetic, and seismic characteristics of the Swan Islands fault. Table 2.5.2-217 summarizes source parameters for this fault source.

The western Swan Islands fault source is associated with abundant seismicity along its entire length (Figure 2.5.2-217). The largest earthquake from the Phase 2 catalog associated with this source is the historical 1856 M_w 7.69 event.

The first paragraph of FSAR Subsection 2.5.2.4.4.3.2.8 will be divided into two paragraphs and the following text will be inserted as a new paragraph in-between in a future FSAR update:

2.5.2.4.4.3.2.8 Swan Islands Fault — Eastern

At closest approach, the eastern Swan Islands fault source is located 540 miles from the Units 6 & 7 site (Figure 2.5.2-217). Subsection 2.5.1.1.2.3.1.1 provides discussion of the geologic, geodetic, and seismic characteristics of the Swan Islands fault. Table 2.5.2-217 summarizes source parameters for this fault source.

The eastern Swan Islands fault source is associated with abundant seismicity along its entire length, with an apparent concentration of epicenters located near its eastern end near the Cayman trough (Figure 2.5.2-217). No earthquakes from the Phase 2 catalog greater than or equal to M_w 6.75 are associated with this source.

The first paragraph of FSAR Subsection 2.5.2.4.4.3.2.9 will be divided into two paragraphs and the following text will be inserted as a new paragraph in-between in a future FSAR update:

2.5.2.4.4.3.2.9 Walton-Duanvale Fault

At closest approach, the Walton-Duanvale fault source is located 490 miles from the Units 6 & 7 site (Figure 2.5.2-217). Subsection 2.5.1.1.2.3.2.3 provides discussion of the geologic, geodetic, and seismic characteristics of the Walton-Duanvale fault. Table 2.5.2-217 summarizes source parameters for this fault source.

The Walton-Duanvale fault source is associated with moderately abundant seismicity along its length, with an apparent concentration of epicenters located near its western end near the Cayman trough (Figure 2.5.2-217). Seismicity also appears concentrated at the eastern end of this source near Jamaica, where the left-lateral Walton-Duanvale and Enriquillo-Plantain Garden faults form a restraining bend. The largest earthquakes from the Phase 2 catalog associated with this source are the two approximately M_w 6.6 events that occurred in 1907 and 1957.

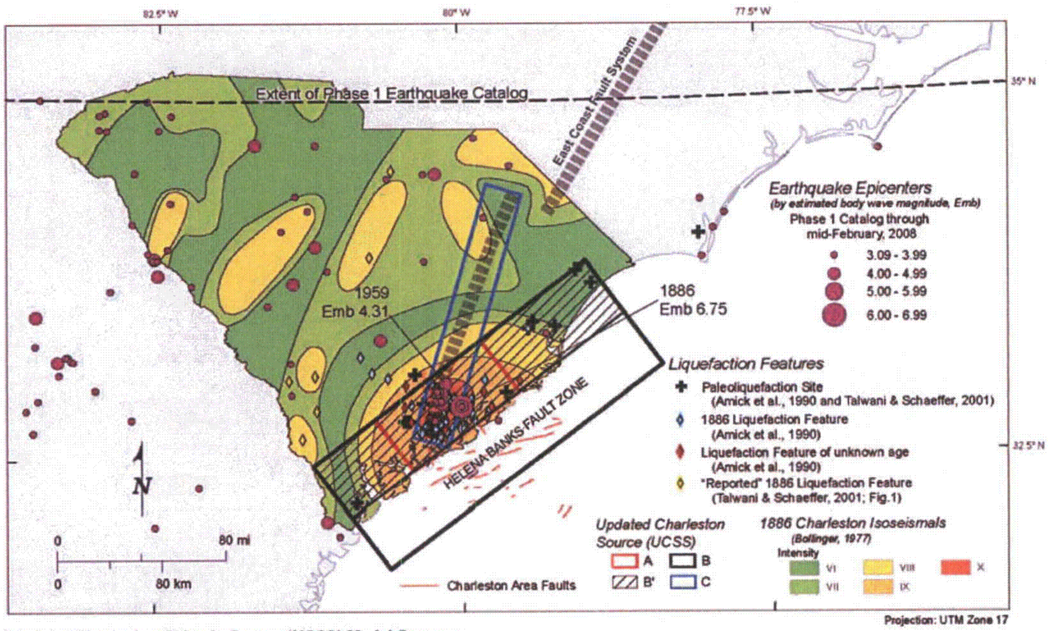
The first paragraph of FSAR Subsection 2.5.2.4.4.3.2.10 will be divided into two paragraphs and the following text will be inserted as a new paragraph in-between in a future FSAR update:

2.5.2.4.4.3.2.10 Enriquillo-Plantain Garden Fault

At closest approach, the western Enriquillo-Plantain Garden fault source is located 560 miles from the Units 6 & 7 site (Figure 2.5.2-217). Subsection 2.5.1.1.2.3.2.3 provides discussion of the geologic, geodetic, and seismic characteristics of the Enriquillo-Plantain Garden fault. Table 2.5.2-217 summarizes source parameters for this fault source.

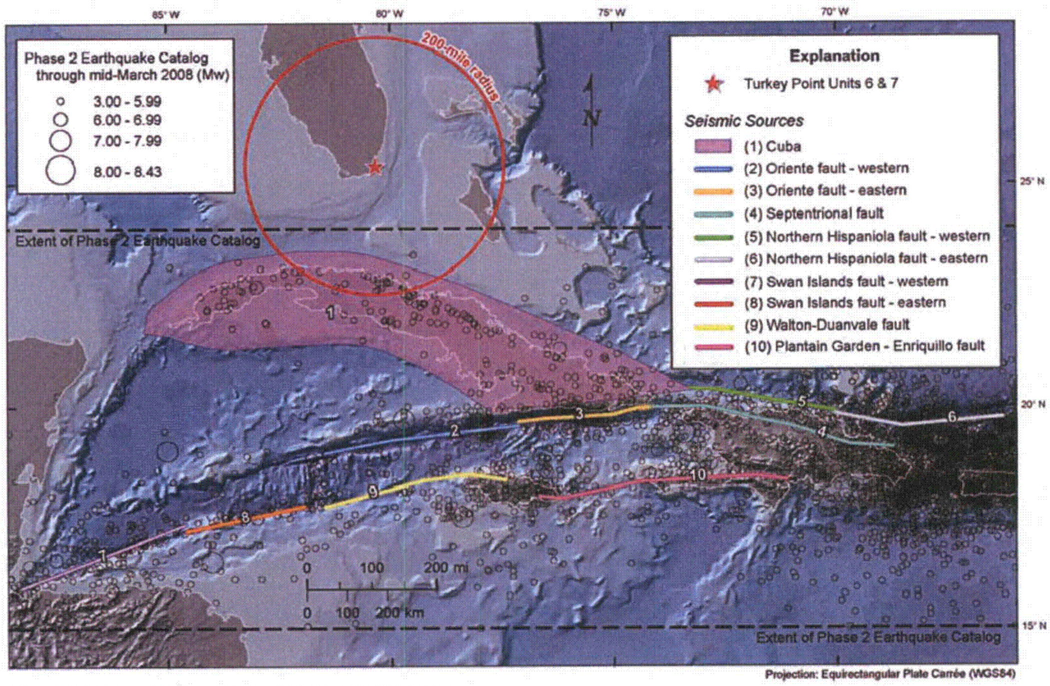
The Enriquillo-Plantain Garden fault source is associated with abundant seismicity along its length, with apparent concentrations of epicenters at its western and eastern ends (Figure 2.5.2-217). Multiple large historical earthquakes have ruptured along the Enriquillo-Plantain Garden fault (FSAR Reference 2.5.2-282), including from the Phase 2 catalog the 1692 M_w 7.78 earthquake near Jamaica and the 1751 M_w 7.28 and 1770 M_w 7.53 earthquakes near Port-au-Prince, Haiti.

Figure 2.5.2-212 will be replaced with the following revised figure in a future FSAR update:



Updated Charleston Seismic Source (UCSS) Model Sources

Figure 2.5.2-217 will be replaced with the following revised figure in a future FSAR update:



Cuba and Northern Caribbean Seismic Source Model Sources

ASSOCIATED ENCLOSURES:

None

NRC RAI Letter No. PTN-RAI-LTR-037

SRP Section: 02.05.02 - Vibratory Ground Motion

Question for Geosciences and Geotechnical Engineering Branch 1 (RGS1)

NRC RAI Number: 02.05.02-12 (eRAI 5896)

FSAR Subsection 2.5.2.4.4.3.2 discusses the existence of several large, but very distant seismic sources. Regarding these sources the FSAR states that: "... these tectonic features would not significantly contribute" to the hazard at TPNPP. In accordance with NUREG-0800, Standard Review Plan, Chapter 2.5.2, "Vibratory Ground Motion," and Regulatory Guide (RG) 1.208, "A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion," please explain whether this assessment is based on preliminary sensitivity calculations showing very small hazard contributions from these sources or simply on best judgment. If best judgment, please further elaborate on the rationale used.

FPL RESPONSE:

Distant seismic sources were excluded in the source model, based on a combination of judgment and preliminary sensitivity studies that demonstrated the New Madrid seismic source was an insignificant contributor to the site hazard. Comparing the contributions of individual sources from PSHA deaggregated results also supports this rationale. The specific tectonic features that were excluded from the source model described in FSAR Subsection 2.5.2.4.4.3.2 are the Muertos Trough, Mona Passage extensional zone, eastern portion of the Puerto Rico Trench, and Beata Ridge.

As shown on FSAR Figures 2.5.1-202 and Figure 1 (Map of Cuba and Caribbean Seismic Sources and Other Distant Tectonic Features Not Included in the Seismic Source Model) of this response, the Muertos Trough, Mona Passage extensional zone (MPEZ), Puerto Rico Trench, and Beata Ridge are elements of the Northern Caribbean-North America plate boundary and are located more than 760 miles from the Turkey Point Units 6 & 7 site. More detailed descriptions of these tectonic features are included in FSAR Subsection 2.5.1.1.2.3. The western portion of the Puerto Rico Trench is included in the seismic source model as the North Hispaniola fault – Eastern fault source (FSAR Figure 2.5.2-217 and Figure 1). However, more distant portions of the Puerto Rico Trench were not included in the seismic source model.

The rationale to exclude these tectonic features (partially or entirely) from the seismic source model is based on: (1) their great distance from the site; (2) the insignificant hazard contribution from the distant New Madrid source; (3) the presence of high slip rate plate boundary structures capable of generating large to great earthquakes much closer to the site; and (4) the very small hazard contribution from the North Hispaniola fault – Eastern, which lies closer to the site than the subject tectonic features that were excluded.

As stated in FSAR Subsection 2.5.2.4.6, sensitivity runs demonstrated that the New Madrid seismic source contributed less than 0.1% of the mean hazard from other sources for 1 Hz spectral acceleration. The New Madrid source, which is approximately 900 miles from the Turkey Point Units 6 & 7 site, has a return period on the order of 500 years for Mmax earthquakes (Exelon, 2006).

Comparing the contribution of individual sources to the mean total hazard also supports the initial decision to exclude the Beata Ridge, Muertos Trough, and Mona Passage extension zone, and eastern portion of the Puerto Rico Trench from the seismic source model. The most distant Caribbean seismic source included in the model is the Northern Hispaniola fault – Eastern fault source. At its nearest point, this source is approximately 760 miles from the site.

For a 1 Hz spectral acceleration of 0.03g (which corresponds to a mean total hazard of 1.59×10^{-4}), the contribution of the most distant source, the Northern Hispaniola fault – Eastern, is only 0.3% of the total mean hazard. At higher spectral accelerations, the contribution of this source is less. Therefore, any source with the same magnitude and slip rate as the Northern Hispaniola fault – Eastern, but at greater distance to the site, would contribute less than 0.3% of the total mean hazard at 0.03g spectral acceleration, and would contribute even less at higher amplitudes.

The Northern Hispaniola fault – Eastern is assigned a maximum magnitude range of M_w 8.0 to 8.6 and a slip rate of 4 to 8 mm/yr (Table 2.5.2-217) and it is unlikely that the subject seismic sources excluded from the model can be modeled with both magnitudes and slip rates greater than these values. This is supported in that the Beata Ridge is not a major plate boundary element and visually exhibits a lower rate of earthquakes (revised Figure 2.5.2-217 that accompanies RAI 02.05.02-7), the Muertos Trough exhibits lower slip rates (FSAR Reference 2.5.1-577) and some researchers do not consider it an active feature (Reference 2.5.1-589), the Mona Passage extension zone cannot produce great earthquakes with its much smaller dimensions (Figure 2.5.1-322), and the plate interface along the eastern portion of the Puerto Rico Trench is largely decoupled (FSAR References 2.5.1-577 and 2.5.1-643). Since these distant potential sources are located at similar or greater distances to the site than the Northern Hispaniola fault – Eastern (Figure 1), they would not be significant contributors to the mean total hazard at spectral accelerations of interest (those with annual frequencies of exceedence of 1×10^{-4} and less). Spectral frequencies higher than 1 Hz would be even less affected by distant sources. Based on our judgment and the rationale presented above, these distant sources were excluded from hazard calculations.

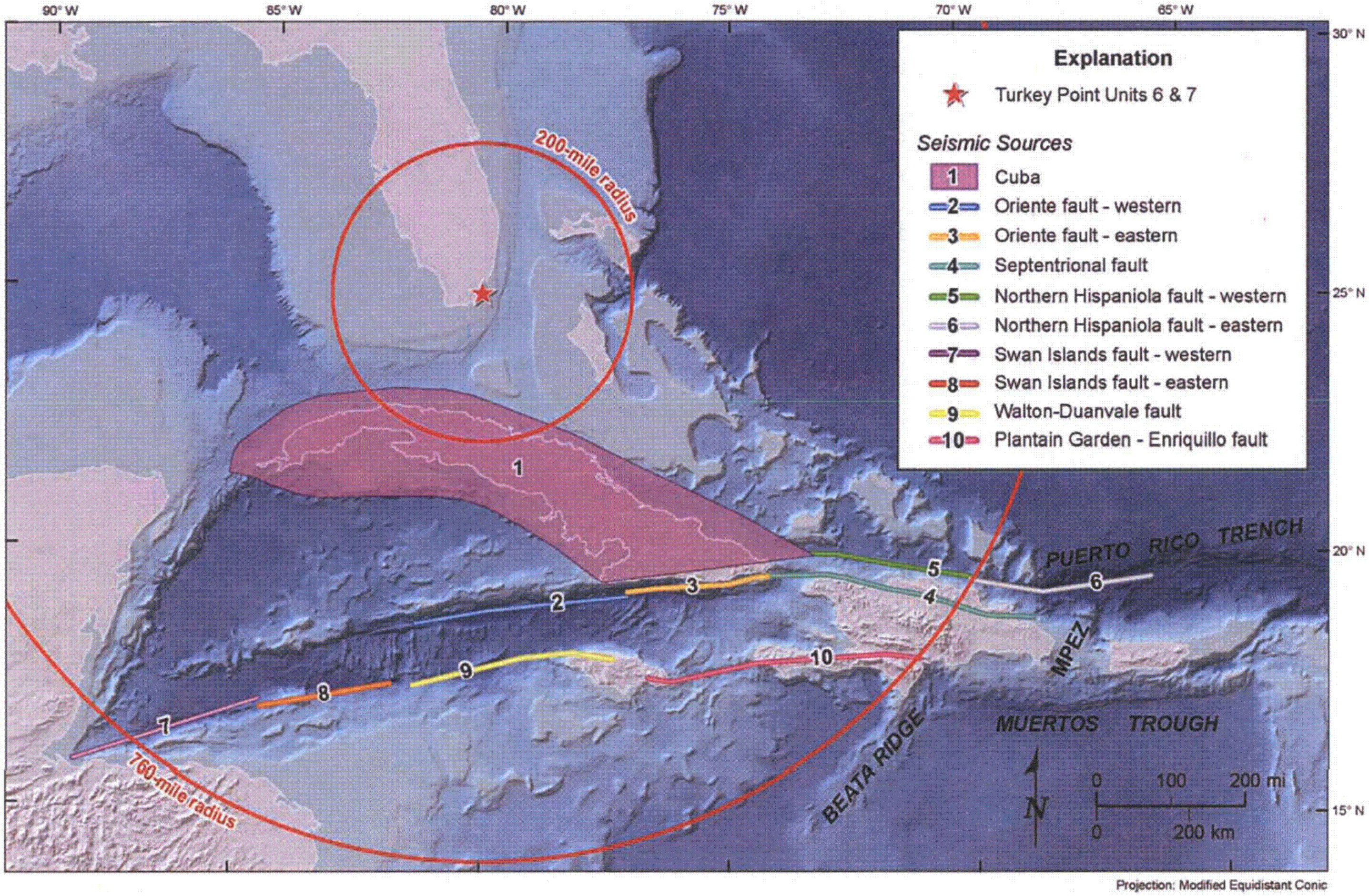


Figure 1 - Map of Cuba and Caribbean Seismic Sources and Other Distant Tectonic Features Not Included in the Seismic Source Model

This response is PLANT SPECIFIC.

References:

Exelon Generation Company, LLC, *Site Safety Analysis Report for the Clinton ESP Site*, Rev. 4, April 2006.

ASSOCIATED COLA REVISIONS:

The text in the second paragraph of FSAR Subsection 2.5.2.4.4.3.2 will be revised in a future update of the FSAR:

These ten seismic sources are based on geologic, geophysical, and seismic data described in Subsections 2.5.1.1.1.3.2.4 (Cuba) and 2.5.1.1.2.3 (Active Tectonic Structures of the Northern Caribbean Plate). Subsection 2.5.1.1.2.3 also describes tectonic features that are too distant from the Units 6 & 7 site to contribute to the ground motion hazard, even from the largest earthquakes that could occur in them. These distant tectonic features are not included in the seismic source characterization, and include the Muertos Trough, Mona Passage extensional zone, **eastern portion of the** Puerto Rico Trench, and the Beata Ridge (Figure 2.5.1-202). The decision to exclude these tectonic features from this seismic source characterization is based on the assessment that these tectonic features would not significantly contribute to ground motion hazard at the Units 6 & 7 site. Specifically, this assessment is based on the great site-to-source distances for these tectonic features.

ASSOCIATED ENCLOSURES:

None