FPL.

L-2014-357
10 CFR 52.3

December 11, 2014

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
Voluntary Revised Response to NRC Request for Additional Information Letter
No. 62 (eRAI 6433) Related to SRP Section 03.08.05 – Foundations

References:

1. NRC Letter to FPL dated May 21, 2012, Request for Additional Information Letter No. 62 Related to SRP Section 03.08.05 Foundations for the Turkey Point Nuclear Plant Units 6 and 7 Combined License Application
2. FPL Letter L-2014-285 to NRC dated October 3, 2014, Voluntary Revised Response to NRC Request for Additional Information Letter No. 040 (eRAI 6006) – Standard Review Plan Section 02.05.04 Stability of Subsurface Materials and Foundations
3. FPL Letter L-2014-314 to NRC dated October 29, 2014, Submittal of the Annual Update of the COL Application – Revision 6 and the Semi-Annual Update of the Departures Report

Florida Power & Light Company (FPL) provides, as an attachment to this letter, its revised responses to the Nuclear Regulatory Commission's (NRC) request for additional information (RAI) 03.08.05-1 and 03.08.05-2 (Reference 1). These revisions resulted from the supplemental site investigation testing and analyses performed to support the revised responses for FSAR Subsection 2.5.4 submitted in Reference 2.

The voluntary revised responses do not provide any associated COLA changes as any COLA revisions resulting from the revised responses were incorporated in Revision 6 of the Turkey Point 6 & 7 COL Application submitted in Reference 3.

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

D097
NRO

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

Executed on December 11, 2014

Sincerely,

William Maher
Senior Licensing Director – New Nuclear Projects

WDM/RFB

Attachment 1: FPL Revised Response to NRC RAI No. 03.08.05-1 (eRAI 6433)
Attachment 2: FPL Revised Response to NRC RAI No. 03.08.05-2 (eRAI 6433)

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-062 Dated May 21, 2012

SRP Section: 03.08.05 – Foundations

Questions from Structural Engineering Branch 1

NRC RAI Number: 03.08.05-1 (eRAI 6433)

In Revision 3 of the applicant's FSAR, (aka. TPG-1000-S2R-802, "Turkey Point Site-Specific Seismic Evaluation Report") the second paragraph under Section 1.0, "Purpose," indicates that the lean concrete beneath the NI is a bridging mat. If this lean concrete is indeed a 'bridging mat' then it is spanning over potential voids and thus the lean concrete performs a structural function. Additionally, Figure 3.1-2 of the report shows the lean concrete bridging mat extending approximately 30 feet beyond the reinforced concrete base mat of the NI. This extension will result in shears and moments in the 19 foot thick unreinforced concrete bridging mat as the load from the NI is transferred to the supporting underlying soils. Since there is no reinforcement in the 19 foot thick mat, if the mat cracks, there is no direct mechanism to transfer shear (for example) across the crack. If the foundation stability relies on the ability of the unreinforced concrete to spread out the load from the NI structure to the underlying (softer) foundation materials or to span potential zones of weakness, then the ability of the 19 foot thick mat to spread the load out and bridge over soft regions needs to be assured.

No quantitative assessment of the lean concrete has been performed to determine the stresses (shear and moment) in the lean concrete and the capability of the mat to carry those stresses. Thus, the applicant is requested to provide an evaluation of the ability of the mat to transfer the expected demand to the underlying soil. In addition, since the mat performs a necessary structural function of transferring loads from the base of the foundation mat to the underlying soils, the staff requests that the applicant describe the safety classification, and basis or the classification of the mat.

FPL RESPONSE:

The lean concrete fill in the approximately 19 foot thick concrete base is used for filling and replaces the in-situ limestone. It provides a uniform base for the Nuclear Island (NI) foundations with well-defined material properties. The lean concrete fill is defined as "mass concrete" per American Concrete Institute (ACI) 207 (Reference 1) guidelines. Its dimensions are large enough to require measures be taken to cope with generation of heat from hydration of the cement and attendant volume change to minimize cracking. Reference 1 guidelines for mass concrete will be followed for the design and construction of the lean concrete fill.

The term "bridging mat" is used only in the "Turkey Point Site-Specific Seismic Evaluation Report" and nowhere else in the FSAR. The term has been removed from this report and the revised report will be provided in a future revision of the COLA. A non-proprietary version of this report may be found in FSAR Chapter 3 as Appendix 3KK and a proprietary version is in COLA Part 9. The use of the term "bridging mat" to imply that the lean concrete fill is used to span over large voids, and therefore must be designed for stresses from bending and shear loads, is not correct. This is based on FPL conclusions regarding the absence of extensive dissolution beneath the power block based on the integration of geological/geotechnical data collected during the subsurface investigation program as well as the use of three concurrent geophysical surveys (microgravity, seismic refraction, and multi-channel analysis of surface waves). The seismic refraction and multi-channel analysis of surface waves (MASW) data are helpful in removing the effects of the overlying less dense muck/peat in the interpretation of the microgravity survey data. As shown in FSAR Figure 2.5.4-227 and Figure 1, the MASW survey data also indicate that the muck/peat is thicker above surficial solution features (vegetated depressions) that appear to be floored by continuous Key Largo limestone.

The subsurface investigation and testing program and the aerial photo analysis and geologic reconnaissance, described in FSAR Subsection 2.5.3.8.2.1, produced the data used to support the conclusion noted above. FPL did not rely on offsite data or publications, as the extent or absence of karst is generally site-specific and a function of mineralogy, lithology, groundwater elevation, groundwater gradient, and geochemistry.

The assumptions used in the microgravity data analysis include assuming that a spherical, water-filled cavity would have a sufficient density contrast with the surrounding limestone to produce a microgravity anomaly. The density contrast is based on laboratory test and published data summarized in FSAR Subsection 2.5.4.4.5.4 and on experience conducting similar geophysical surveys in south Florida. A spherical cavity was used in the analysis as the most conservative approach since it represents the most compact form of "missing mass," and therefore, produces the smallest gravity anomaly for a given cavity diameter. Other geometric distributions of a cavity, having the same diameter as the sphere, would produce a significantly larger gravity anomaly. The detectability of the anomaly varies with cavity size, depth, and location with respect to the survey line.

As mentioned in Reference 7 (Attachment 3, revised response to RAI 02.05.04-03), a supplemental field investigation was conducted in 2013. To support the microgravity assessment with physical sampling, selected vegetated depression and surficial drainage channels areas were studied with inclined borings and surficial "muck" sampling field investigation (References 3 and 4). Objectives of this supplemental program were to identify potential fractures or cavities at depth, and to further examine the characteristics of the surficial deposits. Details of this assessment are provided in Reference 7 (Attachment 1, revised response to RAI 02.05.04-01).

In addition to the three inclined geotechnical borings (R-6-1a, R-6-1a-A, and R-7-4), the supplemental field investigation involved two vertical geotechnical borings (R-6-1b and R-7-1) with rock coring from ground surface down to the base of the Fort Thompson Formation. Boring and sampling locations from the supplemental field investigation can be seen on Figure 2.

Samples from surficial sediments were collected at nine locations, inside and around the vegetated depressions from the Turkey Point Units 6 & 7 site, using a sampling apparatus commonly known as a Russian peat borer or Macaulay Sampler.

The surficial sediment sampling (Reference 4) revealed the presence of peat within the surficial depressions above the Miami Limestone. The peat zone was described as a thin basal layer, interbedded as part of the organic-rich elastic silt deposits, or the only deposit covering the Miami Limestone inside the vegetated depressions. Significantly lower density of the peat deposits (Reference 4) explains the low-gravity anomalies encountered during the original microgravity survey (Reference 6).

Results of the muck sampling were used to re-model the original microgravity survey resulting profiles, for only the lines intersecting the vegetated depression areas (Reference 5). This was done considering the newly described material densities, which correlates with the presence of only peat, with lower densities, inside the vegetated depressions (Reference 4). These new models do not include the softer pockets of Miami Limestone presented in the original microgravity survey models (Reference 6) so that the modeled gravity response of the muck and peat thickness could be assessed independently of deeper density variations within the limestone (Reference 5).

Results from this new model (Reference 5) indicate that the microgravity results are in good agreement with the evidence derived from the sampling of the surficial deposits as outlined in the following paragraphs. The MASW models presented in Reference 5 are the same as those presented in Reference 6. In Reference 5, the MASW models have been re-contoured with a color scheme that enhances the low end of the shear-wave velocity range (Figure 3). Therefore, the results presented in Reference 5, based on the updated microgravity model and MASW re-countering results, do not indicate the presence of the potential cavities originally described (Reference 6).

Inclined borings were aimed at finding potential cavities. No cavities of significant size were found under the targeted vegetated depression area or the drainage channels. The largest potential voids or sediment infills that were found (based on tool drops in borings) are very limited in size and extent. In addition, fractured zones were encountered by inclined borings as described in Reference 8 (Attachment, revised response to RAI 02.05.04-25).

The evaluation of all data (Reference 2 and Reference 3) indicates that outside the vegetated depressions and drainages (in vertical borings), a total of 20.1 feet of interpreted tool drops (due to voids and/or voids filled with soft sediments) are observed, in a total of 7918.4 feet cored, for a total of 0.3 percent of the total cored length in 93 borings. Individual drops in the vertical borings range from 0.4 feet to 4 feet (1.5 feet max within the Unit 6 & 7 building footprints). Results from the site investigations (Reference 2 and Reference 3), show that interpreted tool drops are found more often under the vegetated depressions and drainages. In the three inclined borings, a total of 15.2 feet of tool drops are observed, in a total of 356.4 feet cored, for a 4.3 percent of the total cored length. Individual drops in the inclined borings range from 0.3 feet to 2.5 feet. Boring locations with interpreted tool drops, among all sampling locations, are shown in Figure 2.

The maximum length of interpreted tool drop (due to voids and/or voids filled with soft sediments) is limited to 1.5 feet within the Unit 6 & 7 building footprints, and the frequency of encountering an interpreted tool drop is less than 0.5 percent site-wide. These statistics are based on the drilling conducted during both the initial and supplemental site investigations (Reference 2 and Reference 3).

To further reduce any uncertainties in the resolution and interpretation of microgravity data with depth, and away from geophysical survey lines and boreholes, FPL proposes a commitment to conduct a microgravity survey on the base of the nuclear island (NI) excavation. The current excavation concept is to grout the excavation as part of the dewatering program. FSAR Subsection 2.5.4.5.4 describes the dewatering and excavation methods. A grout plug, approximately 25 feet thick, will be provided to prevent vertical seepage as follows. The grout plug will be constructed from elevation -35 feet NAVD 88 to elevation -60 feet NAVD 88 by first boring from the ground surface and then grouting. Vertical boreholes will be arranged in a grid pattern and grouted in an iterative process to establish overlapping grout coverage between adjacent boreholes, prior to excavation. It is an iterative, sequential process that reduces the distance between adjacent injections. The volume of grout is reduced with successive rounds of injections with each round resulting in a more closely-spaced grid. This grouting program is expected to fill voids that may exist beneath the nuclear island excavation to an elevation of -60 feet. It is anticipated that the density of the grout will be similar to that of the foundation limestone and that the proposed microgravity survey will be designed to detect 25 foot diameter spherical voids and cylindrical voids as small as 12 feet in diameter at the base of the 25 foot thick grout plug at an elevation of approximately -60 feet NAVD 88. Preliminary estimates indicate that a hypothetical solution feature with an approximate diameter of 30 feet at a depth immediately below El. -60 feet will have a negligible effect on the stability of the nuclear island foundation, i.e., negligible effect on bearing capacity, settlement, or resistance to sliding. Such a cavity would cause an increase in stress levels in the vicinity of the cavity due to stress redistribution. However, the stresses from the design loading on the nuclear island at that depth are comparatively low (less than 50 psi) so that the effects are insignificant in the limestone of the Fort Thompson Formation with an average unconfined compressive strength of about 2,300 psi (FSAR Table 2.5.4-209). The maximum stresses occur in the lean concrete fill directly beneath the NI. The lean concrete fill extending approximately 30 feet beyond the NI reinforced concrete base mat would have stresses even less than the 50 psi estimated directly beneath the Nuclear Island.

The lean concrete fill is used for filling and serves no safety-related function. As such, the lean concrete fill is not safety-related. It is noted that no proposed AP1000 site which uses concrete fill under safety-related foundations has classified the concrete fill as safety-related, even though the fill transfers loads to the underlying rock or soil where used. These sites are V.C. Summer, W.S. Lee, Shearon Harris and Bellefonte.

This response is PLANT SPECIFIC.

Figure 1. Line 9 Geophysical Data

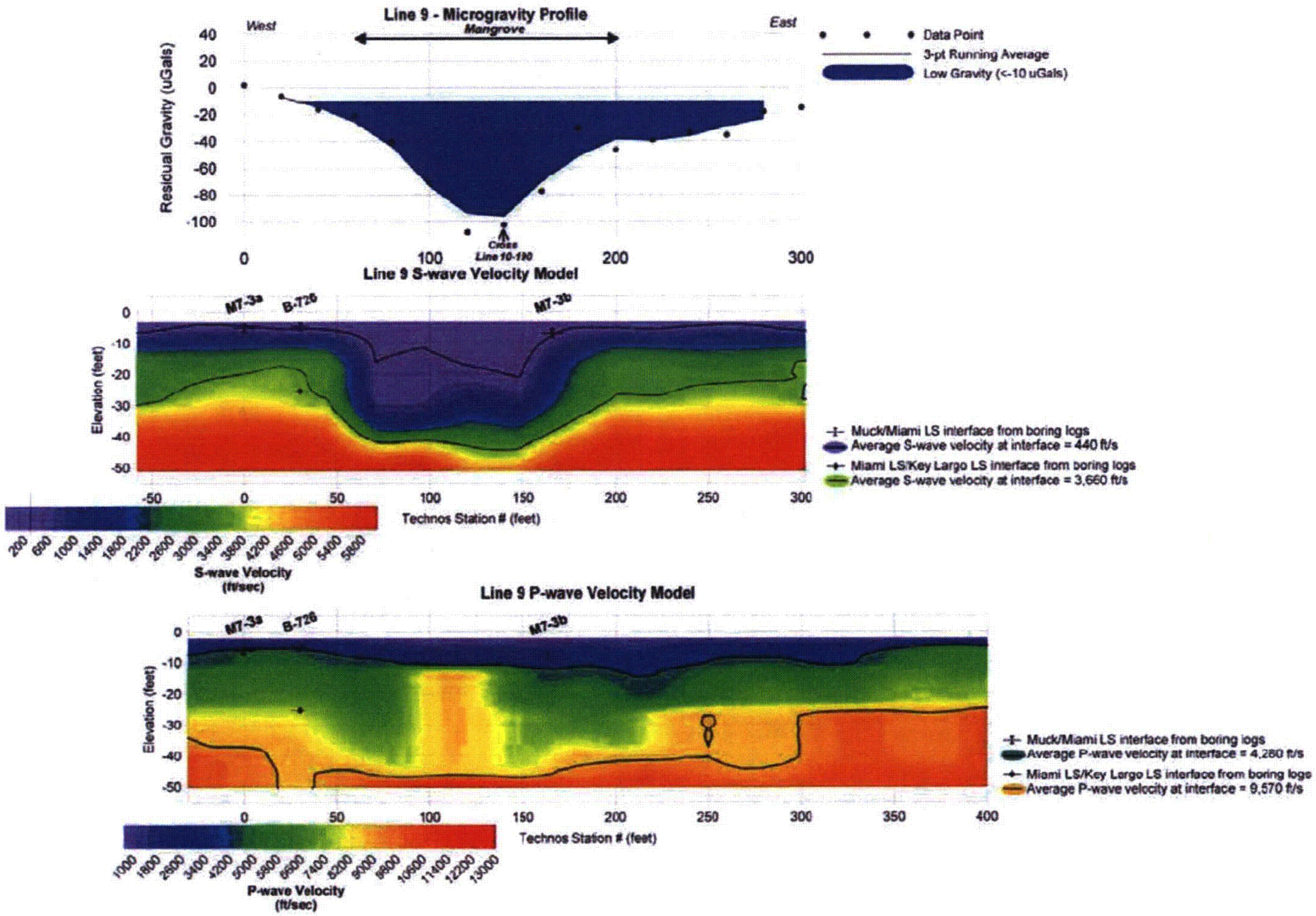


Figure 2. General Boring Locations – Specifically Indicated are Borings with Tool Drops within the Turkey Point Site

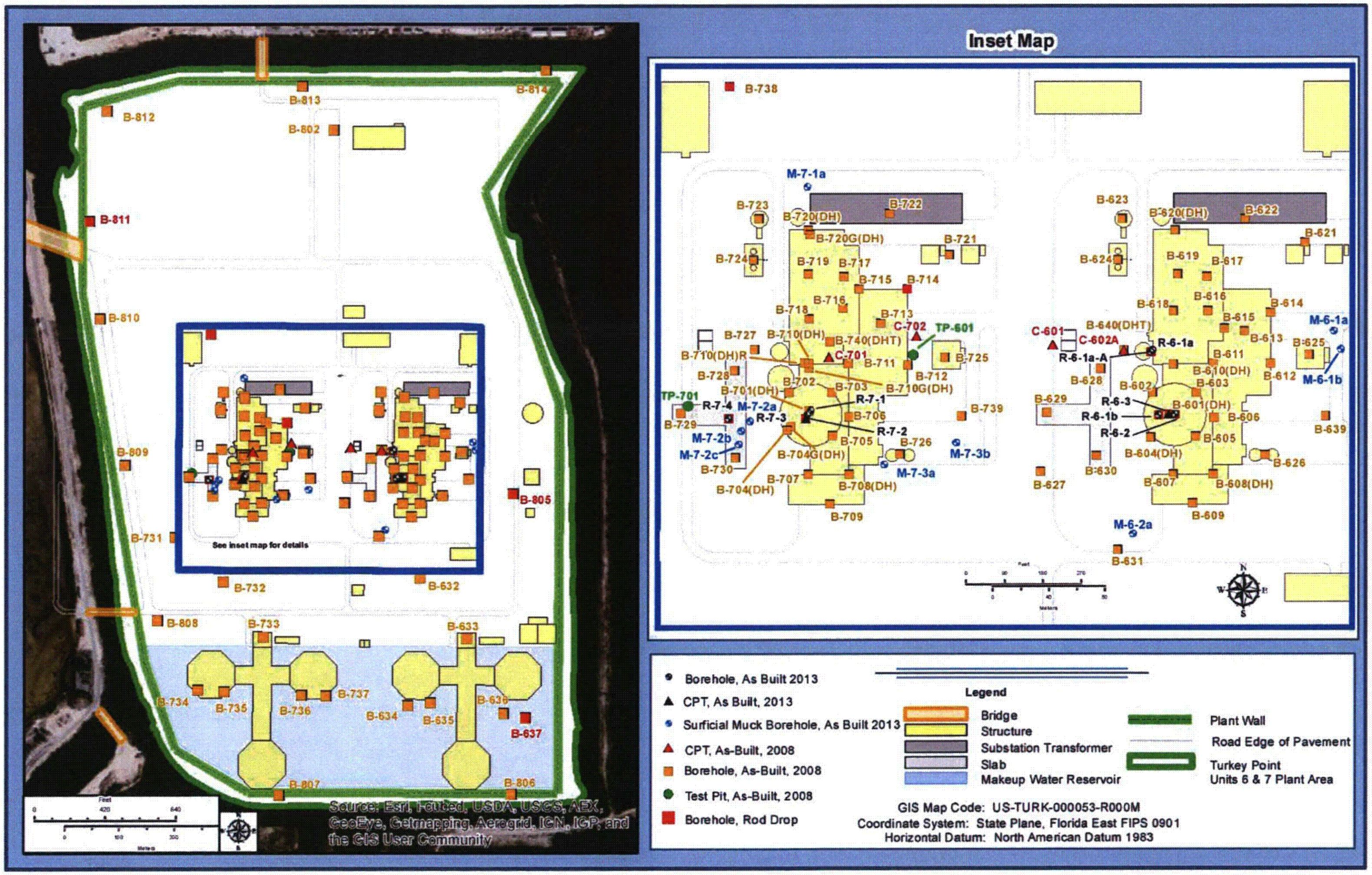
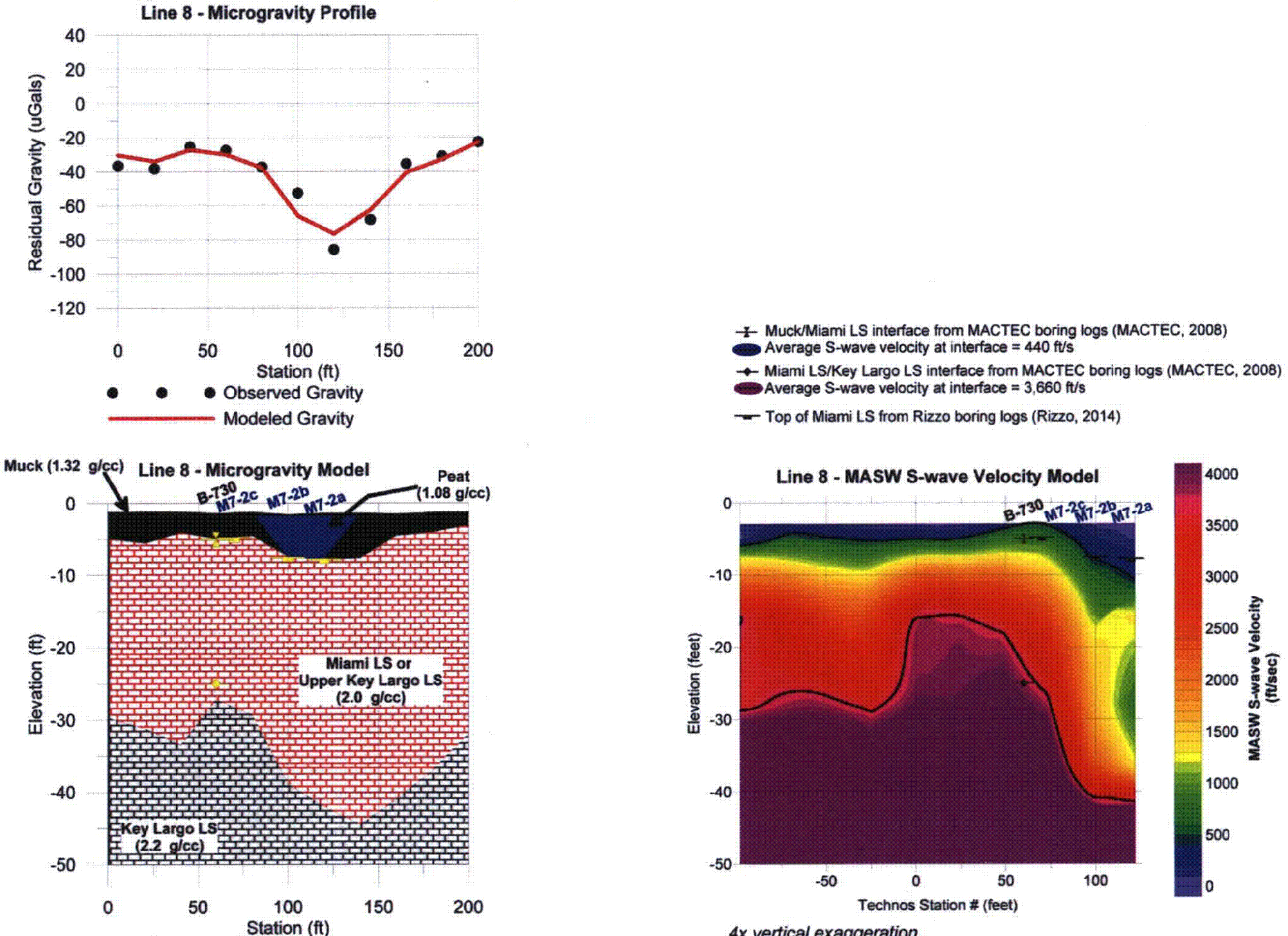


Figure 3. Line 8 Microgravity Model and MASW Shear Wave Velocity Model



4x vertical exaggeration

Note: Top of Miami LS constrained by MASW model and borings
Top of Key Largo LS constrained by Seismic Refraction model

4x vertical exaggeration

Note: MASW cross-section ends at Station 122 due to vegetation limiting access for seismic equipment

Source: Reference 5

Note: Please refer to Figure 2 for boring locations

References:

1. American Concrete Institute, *Guide to Mass Concrete* (ACI 207) Detroit, MI 2006.
2. MACTEC Engineering and Consulting, Inc., Final Data Report – Geotechnical Exploration and Testing – Turkey Point COL Project, Florida City, Florida, Volume 1, Appendix B, pp. 84–64, MACTEC, Raleigh, North Carolina, October 6, 2008.
3. RIZZO, Supplemental Field Investigation Data Report, Turkey Point Nuclear Power Plant Units 6 & 7, Paul C. Rizzo Associates, Inc., Revision 2, Pittsburgh, Pennsylvania, April 15, 2014.
4. RIZZO, Surficial Muck Deposits, Field and Laboratory Investigation Data Report, Turkey Point Nuclear Power Plant Units 6 & 7, Paul C. Rizzo Associates, Inc., Revision 1, Project No. 13-5054, Pittsburgh, Pennsylvania, 229 p.
5. Spotlight Geophysical Services, Microgravity Modeling and MASW Re-Contouring in Vegetated Surface Depressions FPL Turkey Point Nuclear Power Plant Units 6 and 7, Miami-Dade County, Florida, for AMEC Environment & Infrastructure Durham, North Carolina, Supplemental Report, Revision 0, SGS Project No.: 2014230, AMEC Project No.: 6468-07-1950, 21 p., April 9, 2014.
6. Technos, *Geophysical Survey for Karst Characterization at Proposed Units 6 and 7 Turkey Point Nuclear Plant, Miami-Dade County, Florida.* Prepared for MACTEC Engineering and Consulting, Inc., Project No. 08-148, March 27, 2009.
7. FPL Letter L-2014-285 to NRC dated, October 3, 2014, Voluntary Revised Response to NRC Request for Additional Information Letter No. 040 (eRAI 6006) – Standard Review Plan Section 02.05.04 – Stability of Subsurface Materials and Foundations
8. FPL Letter L-2014-286 to NRC dated, October 3, 2014, Voluntary Revised Response to NRC Request for Additional Information Letter No. 044 (eRAI 6184) – Standard Review Plan Section 02.05.04 – Stability of Subsurface Materials and Foundations

ASSOCIATED COLA REVISIONS:

No additional changes to COLA Revision 6 have been identified as a result of this revised response.

ASSOCIATED ENCLOSURES:

None

NRC RAI Letter No. PTN-RAI-LTR-062 Dated May 21, 2012

SRP Section: 03.08.05 – Foundations

Question from Structural Engineering Branch 1 (SEB1)

NRC RAI Number: 03.08.05-2 (eRAI 6433)

Section 2.5.4.1.3 of the AP1000 DCD, "Mudmat," requires that the compressive strength of the mudmat (located beneath the NI foundation) have a minimum compressive strength of 2500 psi. The third paragraph in Section 2.5.4.5.1.2, "Power Block and Site Grade Raising," states, in part, "Replacement material below the nuclear islands consists of lean concrete. The selection of lean concrete mix design is made at project detailed design. The compressive strength of 1.5 ksi is estimated for lean concrete fill." The staff believes that the difference in compressive strength is a significant variance from the DCD requirements. It is also noted that ACI 318 requires a minimum compressive strength of 2500 psi for concrete used for structural purposes. As a result, the staff is requesting the applicant to provide the basis for using materials of lower strength than those specified in the DCD.

FPL RESPONSE:

In response to an NRC Letter to FPL dated May 21, 2012, Request for Additional Information
Letter No. 62 Related to SRP Section 03.08.05 Foundations for the Turkey Point Nuclear Plant Units 6 and 7 Combined License Application, FPL submitted a response to eRAI 6433 in a letter, L-2012-353, to the NRC dated October 15, 2012, "Response to NRC Request for Additional Information Letter No. 62 (eRAI 6433) Related to SRP Section 03.08.05 – Foundations". Subsequent to that submittal, supplemental subsurface investigations were conducted at the Turkey Point Units 6 & 7 site that resulted in changes to one of the unconfined compressive strength values previously provided in the initial RAI response.

This submittal revises the initial response to provide an updated unconfined compressive strength value, as follows:

As noted in the AP1000 DCD, the mudmat is located directly beneath the seismic Category I structures exposed to flood and groundwater. The mudmat consists of approximately one-foot thick upper and lower concrete layers with a waterproofing membrane sandwiched between them. The mudmat is placed directly above the approximate 19 foot thick lean concrete fill. Concrete used for the mudmat layers will have a minimum compressive strength of 2500 psi as required per the AP1000 DCD.

The proposed 1500 psi lean concrete fill beneath the mudmat replaces the in-situ Miami Limestone and part of the Key Largo Limestone, with best-estimate unconfined compressive strengths of 200 and about 2700 psi, respectively, as noted in FSAR Table 2.5.4-209, and provides a uniform base with well-defined material properties. The lean concrete used for the approximately 19 foot thick concrete base is unreinforced concrete and is used for filling and not for structural purposes. Stresses from the design loading of the Nuclear Island on the bottom of the lean concrete fill are comparatively low (estimated less than 50 psi) so that effects are insignificant in the in-situ limestone with compressive strength of approximately 2700 psi. The lean concrete fill has been modeled and analyzed using 1500 psi strength concrete for static and dynamic, i.e. seismic, loads as described in FSAR Subsection 2.5.4 and found to be acceptable.

The lower strength of the concrete fill will require less cement and thus reduce the heat of hydration found in stronger mixes. Uncontrolled heat of hydration is the cause of thermal cracking and thus minimizing the heat of hydration for this mass concrete will reduce the possibility of such cracking. American Concrete Institute (ACI) defines mass concrete as "any volume of concrete with dimensions large enough to require that measures be taken to cope with generation of heat from hydration of the cement and attendant volume change to minimize cracking." The definition is intentionally vague because many factors, including the concrete mix design, the dimensions, the type of the placement, and the curing methods, affect whether or not cracking will occur. ACI 207, "Mass Concrete," prepared by ACI Committee 207, governs the design and construction of mass concrete. There are two design considerations: (1) the maximum temperature inside a concrete pour and (2) the maximum temperature difference between the hottest spot and the surface of a concrete pour. Specifications of mass concrete typically limit the maximum temperature difference between the interior and the surface to 20° Celsius, so that early-age thermal cracks in mass concrete will be minimized. It is a common practice to limit the least dimension of each concrete pour so that the temperature and temperature differences of the pour can stay within their respective limits.

The lean concrete fill proposed strength of 1500 psi, as a replacement for soil fill, is significantly stronger than any compacted soil fill. Concrete in excess of 300 psi would be significantly stronger than any compacted soil fill.

This response is PLANT SPECIFIC.

Reference:

1. American Concrete Institute, *Guide to Mass Concrete ACI 207,* Detroit, MI, 2006

ASSOCIATED COLA REVISIONS:

No additional changes to COLA Revision 6 have been identified as a result of this revised RAI response.

ASSOCIATED ENCLOSURES:

None