FPL.

L-2015-131
10 CFR 52.3

April 29, 2015

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 to NRC Request for Additional Information Letter No. 082 (eRAI 7811)
SRP Section 02.05.04 – Stability of Subsurface Materials and Foundations

Reference:

1. NRC Letter to FPL dated February 18, 2015 Request for Additional Information Letter No. 082 Related to SRP Section 02.05.04 – Stability of Subsurface Materials and Foundations for the Turkey Point Nuclear Plant Units 6 and 7 Combined License Application

Florida Power & Light Company (FPL) provides, as attachments to this letter, its responses to the Nuclear Regulatory Commission's (NRC) requests for additional information (RAIs) 02.05.04-27 and 02.05.04-36 provided in Reference 1. The attachments identify changes that will be made in a future revision of the Turkey Point Units 6 and 7 Combined License Application (if applicable).

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 April 29, 2015

Sincerely,

William Maher
Senior Licensing Director – New Nuclear Projects

WDM/RFB

Attachment 1: FPL Response to NRC RAI No. 02.05.04-27 (eRAI 7811)
Attachment 2: FPL Response to NRC RAI No. 02.05.04-36 (eRAI 7811)

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NRO

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-082

SRP Section: 02.05.04 - Stability of Subsurface Materials and Foundations

Question from Geosciences and Geotechnical Engineering Branch 1 (RGS1)

NRC RAI Number: 02.05.04-27 (eRAI 7811)

FSAR Subsection 2.5.4.5.4 states that grouting will be conducted beneath the nuclear island between the elevations of approximately -35ft and -60 ft to form a grout plug for construction related groundwater control. In accordance with 10 CFR 100.23 and RG 1.208, please describe what inspection and test programs will be conducted for ensuring the shear wave velocity post grouting is consistent with the shear wave velocity used in the site response analyses you performed in your previous calculation of the GMRS in FSAR Subsection 2.5.2.6.

FPL RESPONSE:

Note that all elevations referred to in this RAI response are relative to North American Vertical Datum of 1988 [NAVD 88].

The main objective in response to this request is to compare the post-grouting shear wave velocity in the grouted zone (El. –35 feet to El. –60 feet) to the pre-grouting shear wave velocity profiles as given in Figures 1 and 2, and show that any variation in shear wave velocity due to grouting is within the variability considered in site response analyses (Figure 3) and within the variability considered elsewhere in the FSAR (i.e., Subsection 2.5.4).

To meet this objective, an ITAAC is proposed that will involve field tests (post-grouting shear wave velocity measurements) and the associated interpretation. The ITAAC is described in this response.

The grouted zone between El. –35 feet and El. –60 feet encompasses approximately 14 feet of the Key Largo Limestone Formation (average top El. –27 feet) and approximately 11 feet of the Fort Thompson Formation (average top El. –49.4 feet). This zone shows the shear wave velocity profiles ranging from approximately 4000 ft/s to 8000 ft/s, as seen on Figures 1 through 3.

The proposed ITAAC requires the best estimate shear wave velocity for the grouted zone (El. –35 to El. –60) to be between 5000 ft/s and 7500 ft/s for post-grouting conditions. The best estimate shear wave velocity is to be measured over the full grouted elevation interval.

The lower end of the acceptance criteria (5000 ft/s) is assigned such that it is substantially lower than the FSAR best estimate for the interval of El. –35 feet to El. –60 feet, and larger than the lower bound shear wave velocity (4945 ft/s) for the interval of El. –35 feet to El. –60 feet (Figure 1). The higher end of the acceptance criteria (7500 ft/s) is lower than the upper bound of shear wave velocity (7575 ft/s) for the interval of El. –35 feet to El. –60 feet (Figure 1).

The lower end of the acceptance criteria also considers the settlement calculations for FSAR Subsection 2.5.4.10. The settlement sensitivity analysis provided in the Response to RAI 02.05.04-36 represents a case where the corresponding velocity would be even lower than 5000 ft/s for the interval of El. –35 feet to El. –60 feet. Thus, the velocity of 5000 ft/s for the lower end of the acceptance criteria does not impact the settlement calculations.

The shear wave velocity acceptance interval in the grouted zone is compared with the variability of shear wave velocity considered in site response analysis, represented by the randomized profiles on Figure 3. The variability considered in the site response analysis is wider than the acceptance criteria.

Field Inspection Methodology

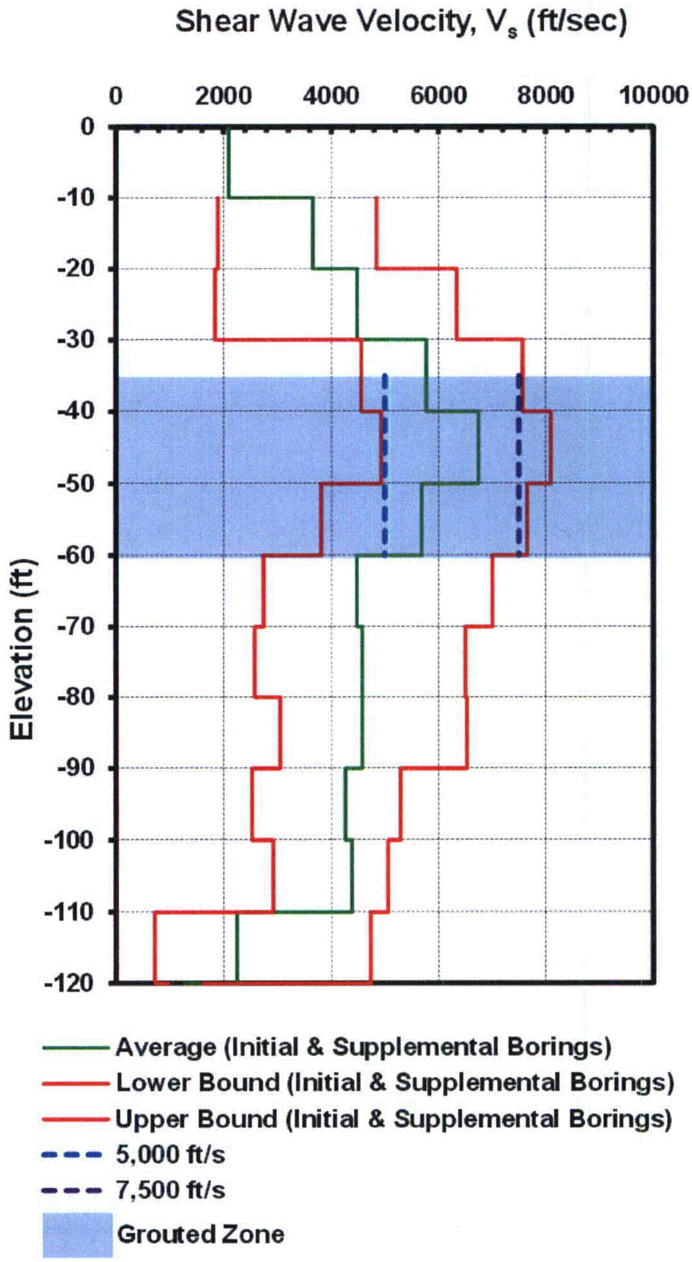
Multiple geophysical methods, including surface (multi-channel analysis of surface waves [MASW] or spectral analysis of surface waves [SASW]) and borehole geophysical methods, can be utilized to measure the best estimate shear wave velocity of the grouted elevation interval. Surface geophysical methods can be used alone or in combination with the borehole geophysical methods.

The surface geophysical methods may be limited by data quality issues which may be exacerbated with the decrease in shear wave velocity in transition from the Key Largo Formation to the Fort Thompson Formation, or in transition from the Fort Thompson Formation to the upper Tamiami Formation. If the data quality for surface geophysical methods is acceptable, they are preferred due to larger spatial coverage with these methods. If the data quality is not considered adequate, borehole surveys such as P-S Suspension or cross-hole survey can be considered. If the borehole geophysics is utilized, surveys will be conducted at two different locations laterally across the nuclear island footprint.

Table 1
ITAAC for Shear Wave Velocity of Grouted Zone

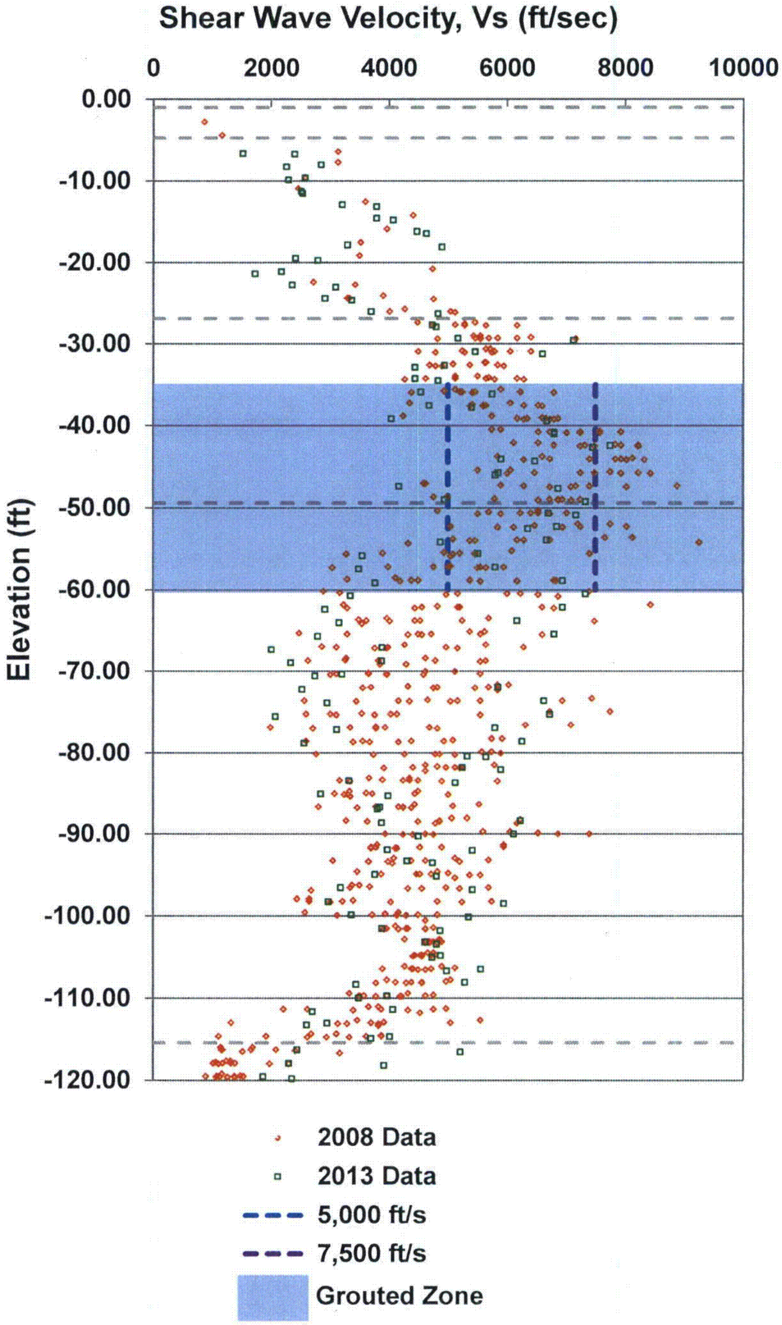
Design Commitment	Inspections, Tests, and Analyses	Acceptance Criteria
The best estimate shear wave velocity measured over the elevation interval El. –35 to El. –60 (grouted zone) from field measurements is consistent with the shear wave velocity profiles considered in the site response analyses (FSAR Subsection 2.5.2.5.2) and in the settlement analysis (FSAR Subsection 2.5.4.10.3) for post-grouting conditions.	Field shear wave velocity measurements of the elevation interval El. –35 to El. –60 will be performed after grouting through a field seismic survey at two locations (laterally) within the footprint of the grouted zone.	The best estimate shear wave velocity measured in the grouted zone (El. –35 to El. –60) falls within the interval (5000 ft/s, 7500 ft/s) for post-grouting conditions.

Figure 1 Shear Wave Velocity Profile



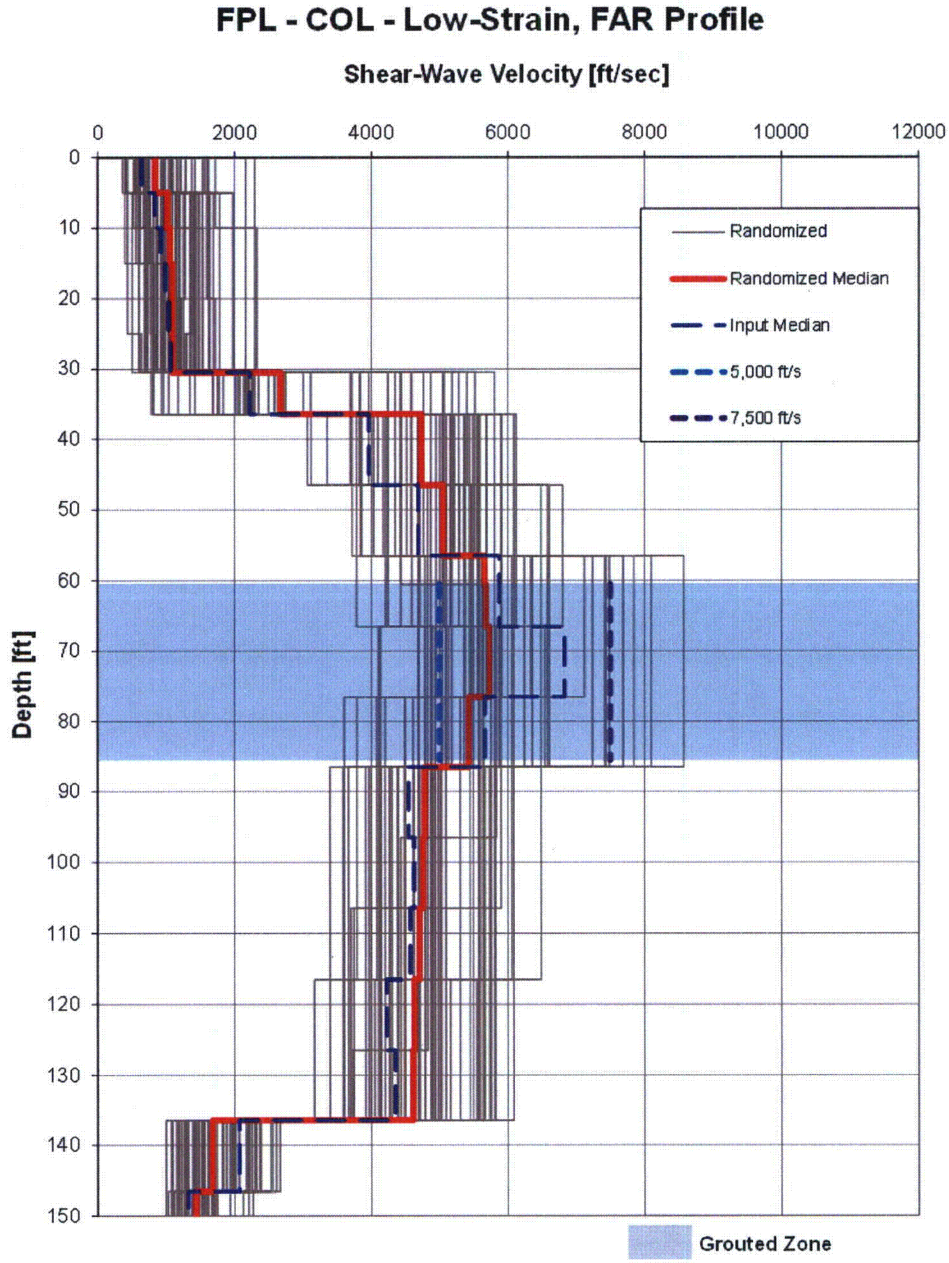
Reference: FSAR Figure 2.5.4-220

Figure 2 Shear Wave Velocity – All Data



Reference: Data from References 1 and 2

Figure 3 Randomized Shear Wave Velocity Profile



Reference: FSAR Figure 2.5.2-239

Note: Depth (feet) below finish grade (El. +25.5 feet)

This response is PLANT SPECIFIC.

References:

1. Paul C. Rizzo Associates, Inc., *Supplemental Field Investigation Data Report, Turkey Point Nuclear Power Plant Units 6 & 7*, Rev. 2, Pittsburgh, Pennsylvania, included In COL Application Part 11, April 15, 2014.

2. MACTEC Engineering and Consulting, Inc., *Final Data Report – Geotechnical Exploration and Testing: Turkey Point COL Project Florida City, Florida*, Revision 2, included in COL Application Part 11, October 6, 2008.

ASSOCIATED COLA REVISIONS:

FSAR Subsection 14.3.3.7 will be added in a future COLA revision as follows:

14.3.3.7 Shear Wave Velocity of Grouted Zone ITAAC

Subsection 2.5.4.5.4 discusses installing a grout plug between approximately El. –35 feet and the bottom of the diaphragm wall at approximately El. –60 feet. An ITAAC has been developed to provide a comparison between post-grouting shear wave velocities and the shear wave velocities obtained from field investigations to show that any variability in shear wave velocity in the grouted zone is within the variability considered in the design.

The acceptance criteria in Table 3.8-7 are conservative. In the event that the best estimate shear wave velocity in the grouted zone (El. –35 to El. –60) does not fall within the interval (5000 ft/s, 7500 ft/s) for post-grouting conditions, the design commitment can be evaluated by reperforming the site response and settlement analyses under the actual shear wave velocity measured over the grouted zone elevation interval.

The following ITAAC will be added to the COLA, Part 10, Appendix B:

Table 3.8-7
ITAAC for Shear Wave Velocity of Grouted Zone

Design Commitment	Inspections, Tests, and Analyses	Acceptance Criteria
The best estimate shear wave velocity measured over the elevation interval El. –35 to El. –60 (grouted zone) from field measurements is consistent with the shear wave velocity profiles considered in the site response analyses (FSAR Subsection 2.5.2.5.2) and in the settlement analysis (FSAR Subsection 2.5.4.10.3) for post-grouting conditions.	Field shear wave velocity measurements of the elevation interval El. –35 to El. –60 will be performed after grouting through a field seismic survey at two locations (laterally) within the footprint of the grouted zone.	The best estimate shear wave velocity measured in the grouted zone (El. –35 to El. –60) falls within the interval (5000 ft/s, 7500 ft/s) for post-grouting conditions.

ASSOCIATED ENCLOSURES:

None

NRC RAI Letter No. PTN-RAI-LTR-082

SRP Section: 02.05.04 - Stability of Subsurface Materials and Foundations

Question from Geosciences and Geotechnical Engineering Branch 1 (RGS1)

NRC RAI Number: 02.05.04-36 (eRAI 7811)

In response to RAI 02.05.04-19, the applicant indicated that for a sensitivity analysis of hand calculation, the Upper Tamiami and Peace River layers are chosen for the lower bound case. However, the stress distribution is also dependent on the stiffness contrast between harder and softer layers. If the stiffness of harder layer is less, more settlement will be expected. In accordance with 10 CFR 100.23, please provide the settlement calculation to include all layers using lower bound stiffness.

FPL RESPONSE:

In the Response to RAI 02.05.04-19, a lower bound sensitivity case was performed for the hand calculation using lower bound stiffness for the upper Tamiami and Peace River layers. As the lower bound is defined as the 16th percentile, indicating a 16 percent probability of that or a lower stiffness occurring, the probability of having two layers with lower bound stiffness is approximately 2.5 percent. The upper Tamiami and Peace River layers were chosen for the lower bound case since they are the layers with the largest impact on settlement.

After review of the Response to RAI 02.05.04-19, the staff requested an additional settlement sensitivity analysis using lower bound stiffness for all layers. Although the likelihood of realization of this case is considered to be extremely unlikely (approximately 0.002 percent), another settlement sensitivity analysis is conducted for the hand calculation and three-dimensional finite element model (using PLAXIS 3D) to consider this scenario. Lower bound stiffness values are presented in the Response to RAI 02.05.04-30.

The results for the PLAXIS 3D settlement analysis using lower bound stiffness for all layers are presented in Table 1, below. For reference, results of the settlement sensitivity analyses (best estimate, lower bound, soil hardening, and fractured zone) provided in the Response to RAI 02.05.04-19 are also presented in Table 1. The simulated loads in the models (load other buildings, load nuclear island phases. etc.) are provided in detail in FSAR Subsection 2.5.4.10.3.2.

Table 1
Fractured Zone, Soil Hardening, Lower Bound, and All Layers Lower Bound Sensitivity Analyses Compared to the Best Estimate Case

Maximum Settlement (in)		Nuclear Island	Turbine Building Interior	Turbine Building Exterior	Annex Building	First Bay Building	Radwaste Building	Ancillary Water Tank	Condensate Water Tank	Diesel Generator
Load other buildings	Best Estimate	—	2.0	2.1	2.1	1.9	1.0	1.9	1.9	0.9
	Lower Bound	—	2.5	2.5	2.5	2.4	1.3	2.2	2.3	1.2
	All Layers Lower Bound	—	3.0	3.0	3.0	2.8	1.4	2.5	2.7	1.3
	Soil Hardening	—	1.9	2.0	2.0	1.8	0.9	1.7	1.8	0.8
	Fractured Zone	—	2.1	2.1	2.1	1.9	1.0	1.9	1.9	0.9
Load nuclear island(1)	Best Estimate	2.5	2.9	3.0	3.0	3.0	2.2	3.1	2.9	1.4
	Lower Bound	3.4	3.8	3.9	3.9	3.9	2.9	4.0	3.8	2.0
	All Layers Lower Bound	4.3	4.5	4.7	4.6	4.7	3.4	4.7	4.5	2.1
	Soil Hardening	2.5	3.0	3.1	3.1	3.1	2.2	3.1	3.0	1.5
	Fractured Zone	2.6	2.9	3.1	3.0	3.0	2.2	3.1	3.0	1.4
Considering buoyancy effects	Best Estimate	2.1	2.6	2.7	2.7	2.7	1.8	2.7	2.6	1.1
	Lower Bound	2.9	3.3	3.4	3.4	3.4	2.4	3.4	3.3	1.6
	All Layers Lower Bound	3.7	4.0	4.1	4.1	4.1	2.8	4.1	4.0	1.8
	Soil Hardening	2.4	2.8	3.0	2.9	2.9	2.0	3.0	2.9	1.4
	Fractured Zone	2.2	2.6	2.7	2.7	2.7	1.8	2.8	2.6	1.1

(1) The loading nuclear island phase is inclusive of previous phases.

Table 2 shows the comparison of the settlement predicted by the hand calculation and PLAXIS 3D model to the DCD requirements.

Table 2
Comparison of Limits of Acceptable Settlement without Additional Evaluation

		Differential Across Nuclear Island Foundation Mat (inch per 50 feet)	Total for Nuclear Island Foundation Mat (inch)(3)	Differential Between Nuclear Island and Turbine Building(1)(3) (inch)	Differential Between Nuclear Island and Other Buildings(1)(2)(3) (inch)
DCD Requirement		One-half inch in 50 feet	6	3	3
Best Estimate	PLAXIS 3D	0.20	2.5	0.8	1.6
	Hand Calculation	0.22	2.4	0.6	2.0
Lower Bound	PLAXIS 3D	0.23	3.4	1.2	2.2
	Hand Calculation	0.26	3.2	0.9	2.7
All Layers Lower Bound	PLAXIS 3D	0.31	4.3	1.5	3.0
	Hand Calculation	0.35	3.9	1.6	3.4

(1) Differential settlement is measured at the center of the nuclear island (load nuclear island phase) and the center of adjacent structures (load other buildings phase).

(2) Maximum differential settlement occurs between nuclear island and radwaste buildings.

(3) Settlements presented exclude the rewatering phase.

The results for the settlement sensitivity analysis using lower bound stiffness for all layers generally meet the DCD criterion despite the conservatism involved in the analysis. The only exception to this is the differential settlement of 3.4 inches between the nuclear island and the radwaste buildings according to the hand calculation. Results of the PLAXIS 3D model, however, show that the differential settlement requirement for this specific case is met.

The reported differential settlements (both hand calculation and the PLAXIS 3D model) between the nuclear island and other adjacent buildings are calculated by subtracting the settlement of adjacent buildings from the settlement of the nuclear island building at center locations of each respective building. In this calculation, the differential settlement between the nuclear island and other adjacent buildings does not account for the influence of the nuclear island loads on the settlement of adjacent buildings, and is therefore conservative. If nuclear island loads are considered in the settlement of adjacent structures then the differential settlement between the nuclear island and radwaste buildings (calculated by either the hand calculation or PLAXIS 3D model) is reduced. For example, if nuclear island loads are considered in the settlement of the radwaste building then the differential settlement as calculated by the PLAXIS 3D model is reduced to 1.1 inches for the all layers lower bound case; this is well within the DCD criteria.

In summary, the results of the sensitivity analysis indicate that even the extremely conservative case of having lower bound properties in all layers produces settlements that are within the DCD limits. The exception of the differential settlement between the nuclear island and radwaste buildings according to the hand calculation does not impact this conclusion as this calculation is very conservative and the finite element model results are still within the DCD limits.

This response is PLANT SPECIFIC.

References:

None

ASSOCIATED COLA REVISIONS:

FSAR Table 2.0-201 (Sheet 6 of 8) will be revised in a future COLA revision as follows:

Table 2.0-201 (Sheet 6 of 8)
Comparison of DCD Site Parameters and Turkey Point Units 6 & 7 Site Characteristics

	AP 1000 DCD Site Parameters[a]		Units 6 & 7 Site Characteristics	Units 6 & 7 Site Characteristic Reference	Bounding Yes/No
Soil (cont.)					
Limits of Acceptable Settlement Without Additional Evaluation[k]	Differential Across Nuclear Island Foundation Mat	1/2 inch in 50 feet	~~<0.1~~ **0.2** inch in 50 feet (projected)	Subsection 2.5.4.10	Yes (projected)
	Total for Nuclear Island Foundation Mat	6 inches	2.5 inches (projected)		
	Differential Between Nuclear Island and Turbine Building[l]	3 inches	~~0.3–2~~ **0.6-0.8** inches (projected)		
	Differential Between Nuclear Island and Other Buildings[l]	3 inches	~~0.3–2.3~~ **1.6-2.0** inches (projected)		

The fifth paragraph of FSAR Subsection 2.5.4.10.3.3 will be revised in a future COLA revision as follows:

Table 2.5.4-224 shows the comparison between the settlement predicted by the hand calculation and the PLAXIS 3D model to the DCD requirements. The lower bound and best estimate cases for the hand calculation and the PLAXIS 3D model are within the acceptable limits provided by the DCD. **The reported differential settlements (both hand calculation and the PLAXIS 3D model) between the nuclear island and other adjacent buildings are calculated by subtracting the settlement of adjacent buildings from the settlement of the nuclear island building at center locations of each respective building. The differential settlement between the nuclear island and other adjacent buildings does not account for the influence of the nuclear island loads on the settlement of adjacent buildings, and is therefore conservative. If nuclear island loads are considered in the settlement of adjacent structures, then the differential settlement between the nuclear island and radwaste buildings is reduced.**

ASSOCIATED ENCLOSURES:

None