Progress Energy

Serial: NPD-NRC-2010-041 10CFR52.79
June 8, 2010

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

LEVY NUCLEAR PLANT, UNITS 1 AND 2
DOCKET NOS. 52-029 AND 52-030
SUPPLEMENT 1 TO RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 055 RELATED TO FOUNDATIONS

References:

1. Letter from Chandu P. Patel (NRC) to Garry Miller (PEF), dated June 9, 2009, "Request for Additional Information Letter No. 055 Related to SRP Section 3.8.5 for the Levy County Nuclear Plant, Units 1 and 2 Combined License Application"

2. Letter from John Elnitsky (PEF) to U. S. Nuclear Regulatory Commission, dated November 17, 2009, "Response to Request for Additional Information Letter No. 055 Related to Foundations", Serial: NPD-NRC-2009-231

Ladies and Gentlemen:

Progress Energy Florida, Inc. (PEF) hereby submits a supplemental response to the Nuclear Regulatory Commission's (NRC) request for additional information provided in Reference 1.

A revised response to one of the NRC questions (03.08.05-03) is addressed in the enclosure. The enclosure also identifies changes that will be made in a future revision of the Levy Nuclear Plant Units 1 and 2 application.

If you have any further questions, or need additional information, please contact Bob Kitchen at (919) 546-6992, or me at (727) 820-4481.

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

Executed on June 8, 2010.

Sincerely,

John Elnitsky
Vice President
New Generation Programs & Projects

Enclosure/Attachments

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

Progress Energy Florida, Inc.
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NRO

Levy Nuclear Plant Units 1 and 2
Supplement 1 to Response to NRC Request for Additional Information Letter No. 055
Related to SRP Section 3.8.5 for the Combined License Application,
Dated June 9, 2009

NRC RAI #	Progress Energy RAI #	Progress Energy Response
03.08.05-2	L-0428	November 17, 2009; NPD-NRC-2009-231
03.08.05-3	L-0699	Revised response enclosed – see following pages

NRC Letter No.: LNP-RAI-LTR-055

NRC Letter Date: June 9, 2009

NRC Review of Final Safety Analysis Report

NRC RAI NUMBER: 03.08.05-3

Text of NRC RAI:

Levy FSAR Section 2.5.4.8.5 states that liquefaction analysis has identified random zones of soil with an inadequate FS against liquefaction. These zones occur beneath buildings that are adjacent to the NI. The adjacent buildings are to be supported on piles that bear on rock.

The section further states that liquefaction will not affect the NI and that the piles will be designed in a manner that precludes soil liquefaction effects from having an impact on the surrounding structures such that they might unfavorably interact with the NI. Increasing pile shaft lateral stiffness, grouting, excavation and soil remediation are cited as possible remedies.

An updated seismic interaction review is to be conducted as described in FSAR Section 3.7.5.3. The review will consider as-built information. This review is listed as a COL Holder action Item in Table 1.8-202.

AP1000 DCD Section 3.7.2.8 discusses seismic interaction between the NI and adjacent buildings. Five soil profiles have been addressed. Liquefaction has not been considered in any of the seismic interaction analyses.

Zones of liquefied soil may reduce effective foundation stiffness for earthquake conditions even if they are isolated. This softening effect would depend in part on the extent and distribution of liquefiable soil. A concern is that the softening may produce horizontal seismic displacements that exceed the gaps between buildings, either above ground (4 inch minimum gap) or at the foundation level (2 inch minimum gap).

Please provide more detail on how liquefaction potential has been addressed in the existing seismic interaction calculations:

1. Levy FSAR Section 3.7.2.8.1 states that analyses have shown that seismic displacements at the foundation level are less than 1 inch. Please provide the calculations for peak foundation displacements discussed in Section 3.7.2.8 for the Annex, Radwaste and Turbine Buildings.

2. Please describe how foundation stiffness has been addressed in the seismic interaction calculations in light of the liquefiable soil; please include the values used for soil shear moduli and the assumed extent (volume and distribution) of liquefiable soil. If soil liquefaction is not considered then please address why this is justified.

3. Please explain how the AP1000 DCD seismic interaction analysis for the Annex Building bounds the Levy site given that liquefaction was not considered in the DCD analysis.

4. With regard to liquefaction, what soil data will be recorded during pile test boring and how will this data be used to verify the seismic interaction analyses?

FSAR Section 2.5.4.8.5 indicates that, based on test borings at pile locations and design studies, measures to control seismic displacements will be developed. Piles are identified as a design measure to control seismic displacement but no description is provided about methods for seismic design of piles. Typically, for a long pile, the lateral stiffness provided by the pile originates mainly from lateral bearing on the upper layers of soil (pile embedment). Lateral stiffness can also be provided by the use of battered piles. Moment frame action (moment fixity at pile ends) is often a small contributor to stiffness when the piles are long. Please provide more information on the planned method for seismic design of piles:

5. Please identify if pile seismic design will rely on lateral bearing on soil and how potential zones of liquefaction will affect the pile stiffness. Also, does the 7 foot depth of engineered fill (FSAR Section 2.5.4.8.1) account for required pile stiffness?

6. If pile seismic design will not rely on the upper soil layers as a load path, please demonstrate that a practical stiffening design can be achieved by moment frame action given the length of the piles.

7. Will the use of battered piles be considered as a design method?

PGN RAI ID #: L-0699

PGN Response to NRC RAI:

Revised Figures 2.5.4.2-201A Rev. 2, 2.5.4.2-201B Rev. 2, and 2.5.4.2-201C Rev. 2 and revised Table 2.5.4.2-201 show the borehole locations for LNP 1 and 2 including Offset Boring Program boreholes O-1 through O-6, B-31, and B-33.

Revised Tables 2.5.4.8-202A and 2.5.4.8-202B present liquefaction analysis results including those from the Offset Boring Program for Units 1 and 2 respectively. The methodology for liquefaction analysis used is described in Subsection 2.5.4.8. Soils under the AP1000 footprint that would be excavated or improved as part of the overall construction were excluded from the liquefaction analysis. The revised Tables 2.5.4.8-202A and 2.5.4.8-202B also present the computed factors of safety against liquefaction and the depth below the Annex, Radwaste, or Turbine Building basemat where liquefaction is postulated. Figure RAI 03.08.05-03-1 Rev.1 and Figure RAI 03.08.05-03-2 Rev. 1 show, in plan and elevation respectively, the location of the liquefaction zones identified in revised Table 2.5.4.8-202A for LNP Unit 1. Figure RAI 03.08.05-03-3 Rev.1 and Figure RAI 03.08.05-03-4 Rev. 1 show, in plan and elevation view respectively, the liquefaction zones identified in revised Table 2.5.4.8-202B for LNP Unit 2. In these figures the liquefaction zones with a factor of safety of less than or equal to 1.1 are shown by circles with yellow infill. For Unit 1, liquefiable zones were postulated in boreholes O-2, A-15, A-18/O-4, and B-28. Boreholes O-2, A-15 and A-18/O-4 are in the nuclear island excavation zone. Borehole B-28 is under the Annex Building. For Unit 2, liquefiable zones were postulated for boreholes B-01, B-07, B-07A, B-31, and B-33. Borehole B-01 is well away from the AP1000 footprint. Boreholes B-07, B-07A, B-31, and B-33 are under the Turbine Building. Based on these figures, it can be concluded that liquefiable zones under the LNP Units 1 and 2 footprints are confined to the northwest corner of the Unit 2 Turbine Building and in isolated random pockets under the remaining LNP Units 1 and 2 footprints.

Soil beneath the nuclear island foundation will be removed and replaced with Roller Compacted Concrete (RCC). Thus, the bearing stability of the nuclear island foundation is not affected by liquefaction. The random isolated pockets of liquefiable soils also do not affect the nuclear island sliding and overturning stability based on Westinghouse analysis performed in response to RAI-TR85-SEB1-10 Rev. 3. For sliding stability and overturning stability the Westinghouse RAI response concludes "it can be concluded that the nuclear island is stable against sliding, and there is no quality requirement for backfill material adjacent to the NI (side soil) to maintain stability against sliding. Also, as noted in Revision 1 of this response, there is no passive pressure required to maintain stability against overturning".

For the area under the Annex, Turbine, and Radwaste building footprint, in-situ soil will be replaced or improved to a depth of approximately 2.1 m (7 ft.) below existing grade (elevation 12.8 m [42 ft.]). In addition, this earthwork design will incorporate measures that prevent the excess pore pressure from the deeper liquefiable pockets from adversely affecting the shear modulus of the replaced/improved soil layer above. The plant design grade elevation will be established at elevation 15.5 m (51 ft.) NAVD88 by placing engineered fill above the improved/replaced in-situ material. The resulting typical soil profile under the Turbine Building and the Annex and Radwaste Buildings is shown in Figure RAI 03.08.05-03-5 and Figure RAI 03.08.05-03-6 respectively. Calculations show that the lateral stiffness of the drilled shaft is primarily governed by soil properties in the top 10 ft. for drilled shafts up to 4 ft. in diameter and the top 16 ft. for 6 ft. diameter drilled shafts. No additional liquefaction evaluation or remediation for Annex and Radwaste Building foundation is necessary because their design uses 2.5 ft. diameter, 3 ft. diameter, or 4 ft. diameter drilled shafts and the top 10 ft. of soil under these buildings is engineered fill that is not susceptible to liquefaction. For the Turbine Building, the top of the 6 ft. thick foundation mat is at two levels; at grade elevation 15.5 m (51 ft.) and at elevation 9.1 m (30 ft.). For the mat at grade, 4 ft. diameter drilled shafts will be used. Thus the top 10 ft. of these drilled shafts are laterally supported by engineered fill that is not susceptible to liquefaction. For the condenser pit area (elevation 9.1 m [30 ft.]) of the Turbine Building where 6 ft. diameter drilled shaft may be used, lateral support from 16 ft. of non-liquefiable in-situ soil is required. This condition is satisfied under the condenser pit of Unit 1 and 2 Turbine Buildings except in the northwest (plant coordinates) corner of Unit 2 Turbine Building condenser pit. For this area, the earthwork design will incorporate provisions to prevent buildup of excess pore pressures that cause liquefaction within the 16 ft. depth required for lateral support. In addition, the earthwork design will incorporate measures which may include a horizontal gravel drainage layer in conjunction with a system of vertical drains (where necessary) that prevent the excess pore pressure from the deeper liquefiable pockets from adversely affecting the shear modulus of soils within the 16 ft. depth during SSE. The computed lateral displacement for the Annex, Turbine, and Radwaste Building drilled shaft support foundation during SSE is less than 1 inch which is less than the 2 inch gap between the nuclear island and the Turbine, Annex, and Radwaste basemat. Thus, no seismic interaction between these buildings and the nuclear island is expected at the foundation level of these buildings.

The term "piles" in the RAI has not been used when discussing the foundation design in the FSAR. However, the planned construction is a pile variation commonly referred to as drilled shafts (sometimes called a drilled pier or reinforced caisson). An important difference between piles and drilled shafts is the installation. Construction of drilled shafts includes a bored hole as opposed to a driven pile. The hole will be bored to the top of rock, a casing is generally set and further boring into the rock creates a rock socket. A reinforcing "cage" is placed in the shaft and the shaft is filled with concrete. Depending on the design and subsurface conditions, a steel casing is generally used to support the sidewall of the hole and allow for proper concrete placement. A drilled shaft derives most of its vertical capacity from the sidewall of the rock socket. The lateral capacity of drilled shaft is primarily from the top layers of soil surrounding the drilled shaft. Drilled shafts are normally vertical and rarely battered. Also, they are larger in diameter and considerably stiffer than conventional driven piles. The following paragraphs provide specific information requested by the corresponding NRC RAI 03.08.05-03 paragraphs:

1. The statement in FSAR Section 3.7.2.8.1 that analyses have shown that seismic displacement at the foundation level is less than 1 inch was based on calculation LNG-0000-XCC-002 Revision 0. The calculation was based on the conceptual design parameters for the Turbine, Radwaste, and Annex building foundation current when the LNP COLA was prepared. Calculation LNG-0000-XCC-002 has been revised to incorporate a range of conceptual design parameters for the Turbine, Radwaste, and Annex Building foundation to account for future changes. Calculation LNG-0000-XCC-002 Revision 1 has been placed in the Progress Energy provided reading room for NRC's review. The calculation shows that the maximum foundation displacement of the Turbine, Annex, and Radwaste Building during the SSE is less than 1 inch which is less than the 2 inch gap at the foundation level between these buildings and the Nuclear Island. The calculation also shows that the lateral stiffness of the drilled shaft is primarily governed by soil properties in the top 10 ft. for drilled shafts up to 4 ft. diameter and the top 16 ft. for 6 ft. diameter drilled shafts. The calculation LNG-0000-XCC-002 Revision 1 considers the following:

    a. The drilled shafts have no moment constraint at the top. The drilled shaft lengths considered are the maximum length based on the lowest competent rock elevation for LNP Units 1 and 2. Drilled shaft concrete compressive strength, f'_c = 4000 psi was considered. A range for the number of drilled shafts and drilled shaft diameters for each building was considered that envelops the likely final foundation design parameters for the Turbine, Annex, and Radwaste Buildings as follows:

Building	Lower Estimate	Upper Estimate
Turbine Building	110 - 4 ft. diameter drilled shafts	150 – 6 ft. diameter drilled shafts
Annex Building	100 - 3 ft. diameter drilled shafts	135 – 4 ft. diameter drilled shafts
Radwaste Building	15 – 2.5 ft. diameter drilled shafts	30 – 4 ft. diameter drilled shafts

    b. Best Estimate (BE) and Lower Bound (LB) soil and engineered fill properties were considered. The Upper Bound (UB) soil properties will yield lower displacements and was thus not considered. The BE, and LB of soil/fill properties considered were based on the shear wave velocity profile used in the seismic convolution analysis (RAI 03.07.01-01 Figure 2). The engineered backfill properties used in the calculation are derived from published literature and the basis document is attached to the calculation.

    c. Lateral stiffness of soil below 10 ft. (for up to 4 ft. diameter drilled shafts) or 16 ft. (for 6 ft. diameter drilled shafts) was varied to assess sensitivity. Reducing soil properties below 10 ft. (for up to 4 ft. diameter drilled shafts) or 16 ft. (for 6 ft. diameter drilled shafts) depth by a factor of 4 resulted in ~3% reduction in lateral stiffness of the drilled shafts when compared to the BE soil case. Similarly reducing the soil properties by a factor of 8 in the same region resulted in a ~5%

reduction in lateral stiffness of the drilled shafts when compared to the BE soil case. Thus, the lateral stiffness of the drilled shaft is primarily derived from the top 10 ft. (for up to 4 ft. diameter drilled shaft) and 16 ft. (for 6 ft. diameter drilled shafts) of soil and isolated pockets of liquefaction at deeper elevations will not significantly affect the lateral displacement of the drilled shaft foundation for the Annex, Radwaste, and the Turbine Buildings during SSE.

d. The dynamic impedance functions for the drilled shafts were calculated using S&L proprietary computer program PILAY. PILAY used the methodology for impedance functions for piles embedded in layered media by M. Novak and F. Aboul-Ella (Reference RAI 03.08.05-03-1).

e. Currently, the building frequencies of the Turbine Building, Annex Building, and Radwaste Building cannot be accurately determined. Thus, conservatively the peak of the scaled performance based surface response spectra (PBSRS) (RAI 03.07.01-01 Figure 1) was used. PBSRS was developed using Section 5.2.1 of the Interim Staff Guidance DC/COL-ISG-017. In addition, effects of higher modes were considered by using a 1.5 factor per SRP 3.7.2. The maximum lateral load was calculated by multiplying the building mass (dead load plus 40% of the live load) by 1.5 times the peak spectral acceleration. The maximum lateral displacement was calculated by dividing the computed maximum lateral load for each building by the number of drilled shafts and the dynamic stiffness of the individual drilled shafts for each building.

2. As stated in paragraph 1 above, isolated pockets of soil liquefaction in soil layers below the lateral support zone have an insignificant effect on the lateral stiffness of the drilled shaft foundation. Thus, soil liquefaction is not considered in calculation LNG-0000-XCC-002 Revision 1. For the Annex and the Radwaste Buildings where 2.5 ft. diameter, 3 ft. diameter, or 4 ft. diameter drilled shafts are used for design, it is shown that the foundation lateral stiffness is not sensitive to soil properties below 10 ft. from the top of the drilled shafts. For these buildings, the top 10 ft. of the drilled shafts is in engineered fill or improved soil that is not susceptible to liquefaction. For the Turbine Building soils (including the engineered fill) up to 10 ft. depth (for 4 ft. diameter drilled shafts) are not susceptible to liquefaction. For the condenser pit area (elevation 9.1 m [30 ft.]) of the Turbine Building where 6 ft. diameter drilled shaft may be used, lateral support from 16 ft. of non-liquefiable in-situ soil is required. This condition is satisfied under the condenser pit area of Unit 1 and 2 Turbine Buildings except in the northwest (plant coordinates) corner area of Unit 2 Turbine Building condenser pit. In this area, the earthwork design will incorporate provisions to prevent buildup of excess pore pressures that cause liquefaction within the 16 ft. depth required for lateral support. In addition, the earthwork design will incorporate measures that prevent the excess pore water pressures from the deeper liquefiable pockets from adversely affecting the shear modulus of soils within the 16 ft. depth during SSE.

The BE and LB soil property used for the lateral displacement calculation are discussed in paragraph 1b above. Liquefaction in the top 10 ft. for 2.5 ft. diameter, 3 ft. diameter, and 4 ft. drilled shafts and in the top 16 ft. for 6 ft. diameter drilled shafts is not considered for reasons stated in paragraph 1 above. The lateral stiffness of drilled shaft foundation is not sensitive to large variation of soil properties below these depths as shown in Calculation LNG-0000-XCC-002 Revision 1.

3. In DCD Section 3.7.2.8.1, the maximum displacement of the roof of the Annex Building is reported as 1.6 inches for response spectra input at the base of the building that envelops the SSI spectra for the six soil profiles and also the Certified Seismic Design Response Spectra (CSDRS). The Annex building foundation (top of mat) is at finished grade. RAI 03.07.01-01 Figure 1 shows a comparison of the LNP PBSRS at the plant finished grade and the CSDRS. The CSDRS envelops the LNP PBSRS by a wide margin. Thus, the LNP Annex Building roof displacement relative to its foundation is expected to be less than the 1.6 inches reported in the DCD for the CSDRS. In calculation LNG-0000-XCC-002 Revision 1 the maximum foundation displacement during SSE of the drilled shaft supported Annex Building is conservatively computed to be less than 1 inch. Thus, the LNP Annex building roof displacement during SSE is expected to be less than 2.6 inches. As stated in DCD Section 3.7.2.8.1, the minimum clearance between the structural elements of the Annex Building above grade and the nuclear island (NI) is 4 inches. The gap between the Annex Building foundation and the Nuclear Island is 2 inches. Thus, no seismic interaction between the Annex Building and the NI is expected.

4. As stated earlier in the response, no additional liquefaction evaluation or soil remediation for Annex, Radwaste Building, and Turbine Building foundation is necessary. The only exception is in the northwest (plant coordinates) corner area of Unit 2 Turbine Building condenser pit. In this area, as stated in paragraph 2 above, the earthwork design will incorporate provisions to prevent buildup of excess pore pressures that cause liquefaction within the 16 ft. depth required for lateral support.

5. The seismic interaction analysis of calculation LNG-0000-XCC-002 Revision 1 relies on the lateral bearing on soils including the engineered fill and improved soils. The engineered fill and improved soils extend from elevation approximately 10.7 m (35 ft.) to the plant design grade elevation 15.5 m (51 ft.). As stated in paragraph 2 above, in the northwest corner of the Unit 2 Turbine Building condenser pit earthwork design will incorporate provisions to prevent buildup of excess pore pressures that cause liquefaction within the 16 ft. depth required for lateral support.

6. As stated in paragraph 1 above, the seismic interaction analysis relies on lateral bearing on soil including the engineered backfill and improved soil. The drilled shafts have no moment restraint at the top, i.e., moment frame action is not considered for the Annex Building, Radwaste Building, or the Turbine Building.

7. As stated in paragraph 1 above, the lateral capacity of drilled shaft foundations is primarily derived from the top layers of soil surrounding the drilled shaft. Drilled shafts are normally vertical and rarely battered. The use of battered drilled shafts for the Turbine Building, Annex Building, or the Radwaste Building is not planned.

Reference RAI 03.08.05-03-1: M. Novak and F. Aboul-Ella, "Impedance Functions for Piles Embedded in Layered Media", Journal of Engineering Mechanics Division, ASCE, June 1978.

Associated LNP COL Application Revisions:

The following changes will be made to Sections 2.5 and 3.7 of the FSAR in a future revision:

1) Text changes to Subsection 2.5.4 as noted below;
2) Revised and new Figures for Subsection 2.5.4 are included in Attachment 03.08.05-03A;
3) Revised Tables for Subsection 2.5.4 are included in Attachment 03.08.05-03B;

4) Following new reference will be added to Subsection 2.5.4:

   M. Novak and F. Aboul-Ella, "Impedance Functions for Piles Embedded in Layered Media", Journal of Engineering Mechanics Division, ASCE, June 1978.

5) Text changes to Subsection 3.7.2 as noted below.

<u>Text changes:</u>

Subsection 2.5.4 Changes

a. *The first paragraph of Subsection 2.5.4.2.1.1 will be modified from:*

"The subsurface investigation program of soil boring and rock coring was completed in three phases: initial, main, and supplemental investigation phases. They included the following field activities:"

To read:

"The subsurface investigation program of soil boring and rock coring was completed in four phases: initial, main, supplemental investigation, and offset boring program phases. They included the following field activities:"

b. *The following bullet will be added at the end of the first bullet list in Subsection 2.5.4.2.1.1:*

- Offset Boring Program phase: This phase included 8 additional boreholes.

c. *The following paragraph will be added after the second bullet list in Subsection 2.5.4.2.1.1:*

The offset boring program phase consisted of the following field activities:

- Six (6) PQ-size, triple tube type offset core borings were drilled within a 1.5 m (5 ft.) radius of a previously drilled borehole.
- Two (2) borings were drilled to better establish the top of rock surface underlying the Turbine Building in LNP2.

d. *The last paragraph of Subsection 2.5.4.2.1.1 will be modified from:*

"Figures 2.5.4.2-201A, 2.5.4.2-201B, and 2.5.4.2-201C show the plan view of the borehole locations for the three phases of field investigations, and Table 2.5.4.2-201 summarizes the borehole information for boreholes drilled within the nuclear island and adjacent structures."

To read:

"Figures 2.5.4.2-201A, 2.5.4.2-201B, and 2.5.4.2-201C show the plan view of the borehole locations for the four phases of field investigations, and Table 2.5.4.2-201 summarizes the borehole information for boreholes drilled within the nuclear island and adjacent structures."

e. *The following paragraph will be added immediately before the last paragraph in Subsection 2.5.4.2.1.1.1:*

"As part of the offset boring program phase, six boreholes were drilled within a 1.5 m (5 ft.) radius of an existing A-series borehole in order to evaluate the properties of materials previously not recovered during core drilling, including the verification of the existence, thickness, and location of postulated beds of soft, soil-like material. Two additional borings were also drilled to evaluate the top-of-rock surface beneath the LNP Unit 2 turbine building."

f. *The first sentence of the last paragraph in Subsection 2.5.4.2.1.1.1 will be modified from:*

"In total, the boreholes drilled during the initial, main, and supplemental subsurface investigation phases provide coverage for the safety-related structures that satisfies and exceeds the criteria listed in Regulatory Guide 1.132."

To read:

"In total, the boreholes drilled during the initial, main, supplemental, and offset boring program subsurface investigation phases provide coverage for the safety-related structures that satisfies and exceeds the criteria listed in Regulatory Guide 1.132."

g. *The following bullet will be added to the bullet list in Subsection 2.5.4.2.1.1.3:*

- In the offset boring program phase, drilling efforts consisted of advancing through the overburden down to rock using mud rotary methods, and included sampling in some instances. After casing was set through the overburden and at least five feet into rock, the rock coring was advanced using PQ sized triple tube type coring methods. Rock drilling was monitored, at a minimum, for drilling pressure and rotational speed. In addition, time of drilling, RQD, recovery, blow count, circulation data, and soil / rock visual classifications were recorded on the boring logs. Thin Wall Shelby Tubes and/or split-spoons were used to obtain samples of the postulated soft beds while rock coring. In-situ Vane Shear Testing was also attempted.

h. *The second bullet in Subsection 2.5.4.8.1 will be modified from:*

"Soil beyond the nuclear island perimeter, which will be left in place, was subject to liquefaction analysis except for soil within approximately 2.1 m (7 ft.) of existing grade which will be removed or improved to prevent liquefaction, unless detailed analysis for nuclear island sliding and adjacent building foundations demonstrate negligible consequences from liquefaction."

To read:

"Soil beyond the nuclear island perimeter, which will be left in place, was subject to liquefaction analysis except for soil within approximately 2.1 m (7 ft.) of existing grade which will be removed or improved to prevent liquefaction."

i. The text in Subsection 2.5.4.8.5 starting with the 3rd paragraph to the end will be modified from:

"The Borings, Soil Types and SPT Values used for Liquefaction Analysis are summarized in Tables 2.5.4.8-202A and 2.5.4.8-202B along with the FS for each.

It is noted that the results in these tables indicate random zones in the Tertiary deposits where the analyses indicate low inadequate FS and possible triggering of liquefaction based on comparison to the criteria listed above. These random zones are, however, surrounded by materials that exhibit high blow counts.

It is important to note that the nuclear island will be supported on RCC above material that is not liquefiable. The occurrence of liquefaction in the random locations adjacent to the nuclear island does not impact these structures as described below. The adjacent nonsafety-related structures (Annex Building, Radwaste Building, Turbine Building, and Diesel Generator Building) will be supported on deep foundations that extend to rock.

The random zones of soil with low FS will not affect the development of passive pressure resistance to sliding of the AP1000 basemat because of any of the following:

- The zones are isolated, not continuous, and negligible.
- The zone is not in the passive wedge on any side of the nuclear island.
- The zone will be specifically excavated and replaced with non-liquefiable material, or detailed analysis for nuclear island sliding demonstrates adequate margin of safety without credit for passive wedge resistance.

The random zones of soil with inadequate FS will not affect the lateral soil reaction acting on the drilled shafts supporting the nonsafety-related structures during an earthquake, and thereby, causing the structure to affect the structural integrity of the nuclear island structures because:

- The drilled shafts will be designed to account for the possible existence of random zones of soil with reduced shear strength caused by elevated dynamic pore pressures.
- The area at each shaft will be investigated with a test boring (pilot hole) prior to construction of the shaft. The combination of exploration and design studies will be used to select drilled shaft stiffness that precludes motions during the SSE that could affect adjacent structures. If the design considerations dictate, the zone will be remediated such as by grouting or by excavation and replacement with non-liquefiable material to protect adjacent structures."

To read:

"For borings where the liquefaction analysis shows potential for liquefaction, the borehole identification, bottom depth of the SPT sample, soil type, and the field SPT N-Value used in the liquefaction analysis are summarized in revised Tables 2.5.4.8-202A and 2.5.4.8-202B. The revised Tables 2.5.4.8-202A and 2.5.4.8-202B also present the results of the liquefaction analysis including the factors of safety against liquefaction and the depth of the postulated liquefiable zone. Figures RAI 03.08.05-03-1 Rev.1 and RAI 03.08.05-03-2 Rev. 1 show, in plan and elevation respectively, the location of the liquefaction zones identified in revised Table 2.5.4.8-202A for LNP Unit 1. Figure RAI 03.08.05-03-3 Rev.1 and Figure RAI 03.08.05-03-4 Rev. 1 show, in plan and elevation view respectively, the liquefaction zones identified in revised

Table 2.5.4.8-202B for LNP Unit 2. In these figures the liquefaction zones with a factor of safety of less than or equal to 1.1 are shown by circles with yellow infill. For Unit 1, liquefiable zones were postulated in boreholes O-2, A-15, A-18/O-4, and B-28. Boreholes O-2, A-15 and A-18/O-4 are in the nuclear island excavation zone. Borehole B-28 is under the Annex Building. For Unit 2, liquefiable zones were postulated for boreholes B-01, B-07, B-07A, B-31, and B-33. Borehole B-01 with liquefiable zones is well away from the AP1000 footprint. Boreholes B-07, B-07A, B-31, and B-33 are under the Turbine Building. Based on these figures, it was concluded that liquefiable zones under the LNP Units 1 and 2 footprints are confined to the northwest corner of the Unit 2 Turbine Building and in isolated random pockets under the remaining LNP Units 1 and 2 footprints.

Soil beneath the nuclear island foundation will be removed and replaced with Roller Compacted Concrete (RCC). Thus, the bearing stability of the nuclear island foundation is not affected by the postulated liquefaction. The random isolated pockets of liquefiable soils also do not affect the nuclear island sliding and overturning stability based on Westinghouse analysis. The Westinghouse analysis concludes that the nuclear island is stable against sliding, and there is no quality requirement for backfill adjacent to the nuclear island to maintain stability against sliding. The Westinghouse analysis also concludes that there is no passive pressure required to maintain stability against overturning.

For the area under the Annex, Turbine, and Radwaste building footprint, in-situ soil will be replaced or improved to a depth of approximately 2.1 m (7 ft.) below existing grade (elevation 12.8 m [42 ft.]). The plant finished grade will be established at elevation 15.5 m (51 ft.) NAVD88 by placing engineered fill above the improved/ replaced in-situ material. In addition, this earthwork design will incorporate measures that prevent the excess pore pressure from the deeper liquefiable pockets adversely affecting the shear modulus of the replaced/improved soil layer above. The resulting typical soil profile under the Turbine Building and the Annex and Radwaste Buildings is shown in Figure RAI 03.08.05-03-5 and Figure RAI 03.08.05-03-6 respectively. Calculations show that the lateral stiffness of the drilled shaft is primarily governed by soil properties in the top 10 ft. for drilled shafts up to 4 ft. in diameter and the top 16 ft. for 6 ft. diameter drilled shafts. No additional liquefaction evaluation or remediation for Annex and Radwaste Building foundation is necessary because their design uses 2.5 ft. diameter, 3 ft. diameter, or 4 ft. diameter drilled shafts and the top 10 ft. of soil under these buildings is engineered fill that is not susceptible to liquefaction. For the Turbine Building, the top of the 6 ft. diameter thick foundation mat is at two levels; at grade elevation 15.5 m (51 ft.) and at elevation 9.1 m (30 ft.). For the mat at grade, 4 ft. diameter drilled shafts will be used. Thus the top 10 ft. of these drilled shafts are laterally supported by engineered fill that is not susceptible to liquefaction. For the condenser pit area (elevation 9.1 m [30 ft.]) of the Turbine Building where 6 ft. diameter drilled shaft may be used, lateral support from 16 ft. of non-liquefiable in-situ soil is required. This condition is satisfied under the condenser pit of Unit 1 and 2 Turbine Buildings except in the northwest (plant coordinates) corner of the Unit 2 Turbine Building condenser pit. In this area, the earthwork design will incorporate provisions to prevent buildup of excess pore pressures that cause liquefaction within the 16 ft. depth required for lateral support. In addition, the earthwork design will incorporate measures that prevent the excess pore water pressures from the deeper liquefiable pockets from adversely affecting the shear modulus of soils within the 16 ft. depth during SSE.

The maximum foundation displacement of the Turbine, Annex, and Radwaste Building during the SSE is less than 1 inch which is less than the 2 inch gap at the foundation level between these buildings and the Nuclear Island."

Section 3.7.2 Text changes

j. Section 3.7.2.8.1 will be modified from:

"Add the following text to the end of DCD Subsection 3.7.2.8.1.

LNP SUP 3.7-5 Peak foundation elevation displacement resulting from a GMRS scaled to 0.1g is conservatively computed to be less than 2.5 cm (1 in.). Considering that 5 cm (2 in.) seismic gaps are installed between the Annex Building foundation and the Auxiliary Building, no seismic interaction at the Annex Building foundation elevation is expected."

To read:

"Add the following text to the end of DCD Subsection 3.7.2.8.1.

LNP SUP 3.7-5 In DCD Section 3.7.2.8.1, the maximum displacement of the roof of the Annex Building is reported as 1.6 inches for response spectra input at the base of the building that envelops the SSI spectra for the six soil profiles and also the CSDRS. The Annex Building foundation (top of mat) is at finished grade. RAI 03.07.01-01 Figure 1 shows a comparison of the LNP scaled performance based surface response spectra (PBSRS) at the plant finished grade and the CSDRS. The CSDRS envelops the LNP PBSRS by a wide margin. Thus, the LNP Annex Building roof displacement relative to its foundation is expected to be less than the 1.6 inches in the DCD for the CSDRS. The foundation displacement during SSE of the drilled shaft supported Annex Building is computed to be less than 1 inch. Thus, the LNP Annex building roof displacement during SSE is expected to be less than 2.6 inches. As stated in DCD Section 3.7.2.8.1, the minimum clearance between the structural elements of the Annex Building above grade and the nuclear island (NI) is 4 inches. The gap between the Annex Building foundation and the Nuclear Island is 2 inches. Thus, no seismic interaction between the Annex Building and the NI is expected."

k. Section 3.7.2.8.2 will be modified from:

"Add the following text to the end of DCD Subsection 3.7.2.8.2.

LNP SUP 3.7-5 Peak foundation elevation displacement resulting from a GMRS scaled to 0.1g is conservatively computed to be less than 2.5 cm (1 in.). Considering that 5 cm (2 in.) seismic gaps are installed between the Radwaste Building foundation and the Auxiliary Building, no seismic interaction at the Radwaste Building foundation elevation is expected."

To read:

"Add the following text to the end of DCD Subsection 3.7.2.8.2.

LNP SUP 3.7-5 Peak foundation elevation displacement resulting from a Performance Based Surface Response Spectra (PBSRS) is conservatively computed to be less than 2.5 cm (1 in.). Considering that 5 cm (2 in.) seismic gaps are installed between the Radwaste Building foundation and the Nuclear Island Structures, no seismic interaction at the Radwaste Building foundation elevation is expected."

I. Section 3.7.2.8.3 will be modified from:

"Add the following text to the end of DCD Subsection 3.7.2.8.3.

LNP SUP 3.7-5 Peak foundation elevation displacement resulting from a GMRS scaled to 0.1g is conservatively computed to be less than 2.5 cm (1 in.). Considering that 5 cm (2 in.) seismic gaps are installed between the Radwaste Building foundation and the Auxiliary Building, no seismic interaction at the Annex Building foundation elevation is expected."

To read:

"Add the following text to the end of DCD Subsection 3.7.2.8.3.

LNP SUP 3.7-5 Peak foundation elevation displacement resulting from a Performance Based Surface Response Spectra (PBSRS) is conservatively computed to be less than 2.5 cm (1 in.). Considering that 5 cm (2 in.) seismic gaps are installed between the Turbine Building foundation and the Nuclear Island Structures, no seismic interaction at the Turbine Building foundation elevation is expected. "

Attachments/Enclosures:

Attachment 03.08.05-3A: Revised Figures 2.5.4.2-201A, 2.5.4.2-201B, 2.5.4.2-201C, and new Figures RAI 03.08.05-03-1 through RAI 03.08.05-03-6

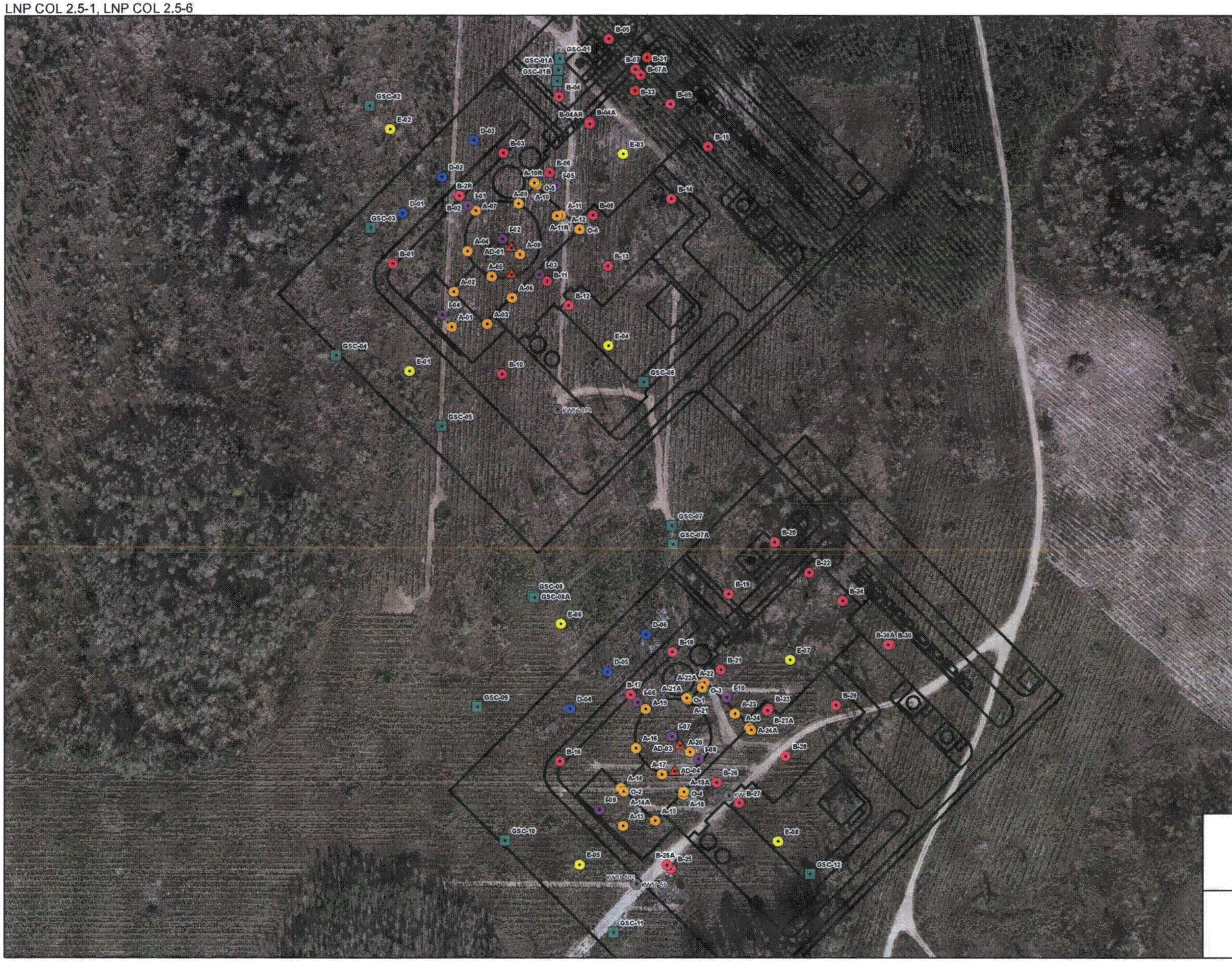
Attachment 03.08.05-3B: Revised Tables 2.5.4.2-201, 2.5.4.8-202A, and 2.5.4.8-202B

Attachment 03.08.05-03A

Figures

(9 pages after cover sheet)

LNP COL 2.5-1, LNP COL 2.5-6



State Plane North

Plant North (N45E)

LEGEND

- A Series
- B Series
- D Series
- E Series
- I Series
- AD Series
- GSC Series
- Control Point
- LNP 1 and 2

BOREHOLE

- Offset Borehole
- Turbine Building Borehole

Sources

Hydrography and Base Data: Florida Geographic Data Library
LNP Site: Sargent & Lundy, 2007
Borehole Locations: CH2M HILL, 2008
Offset Borehole Locations: PCR, 2010

0 25 50
Meters

0 110 220
Feet

Progress Energy Florida

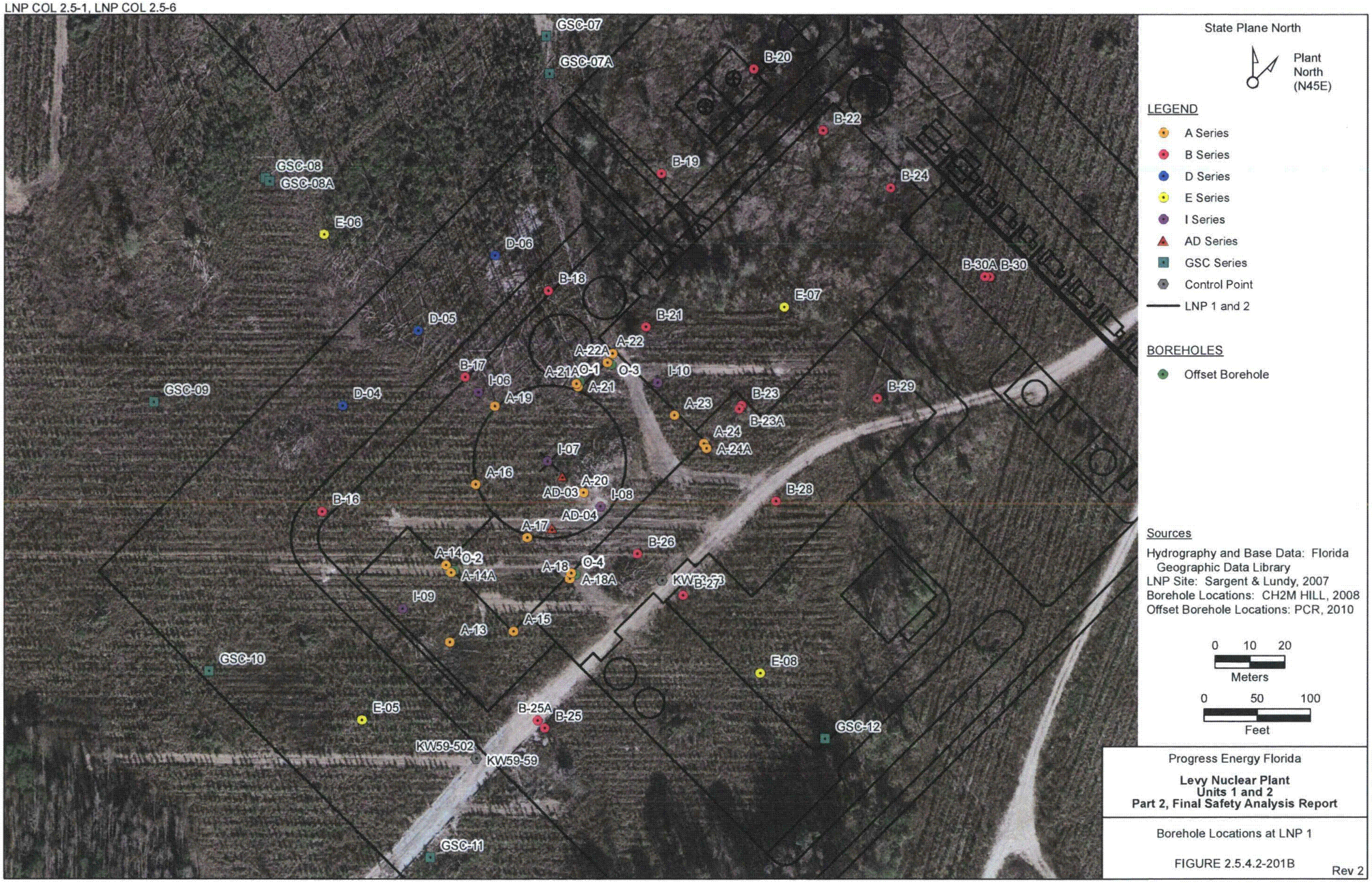
Levy Nuclear Plant
Units 1 and 2
Part 2, Final Safety Analysis Report

Borehole Locations at LNP 1 & 2

FIGURE 2.5.4.2-201A

Rev 2

LNP COL 2.5-1, LNP COL 2.5-6



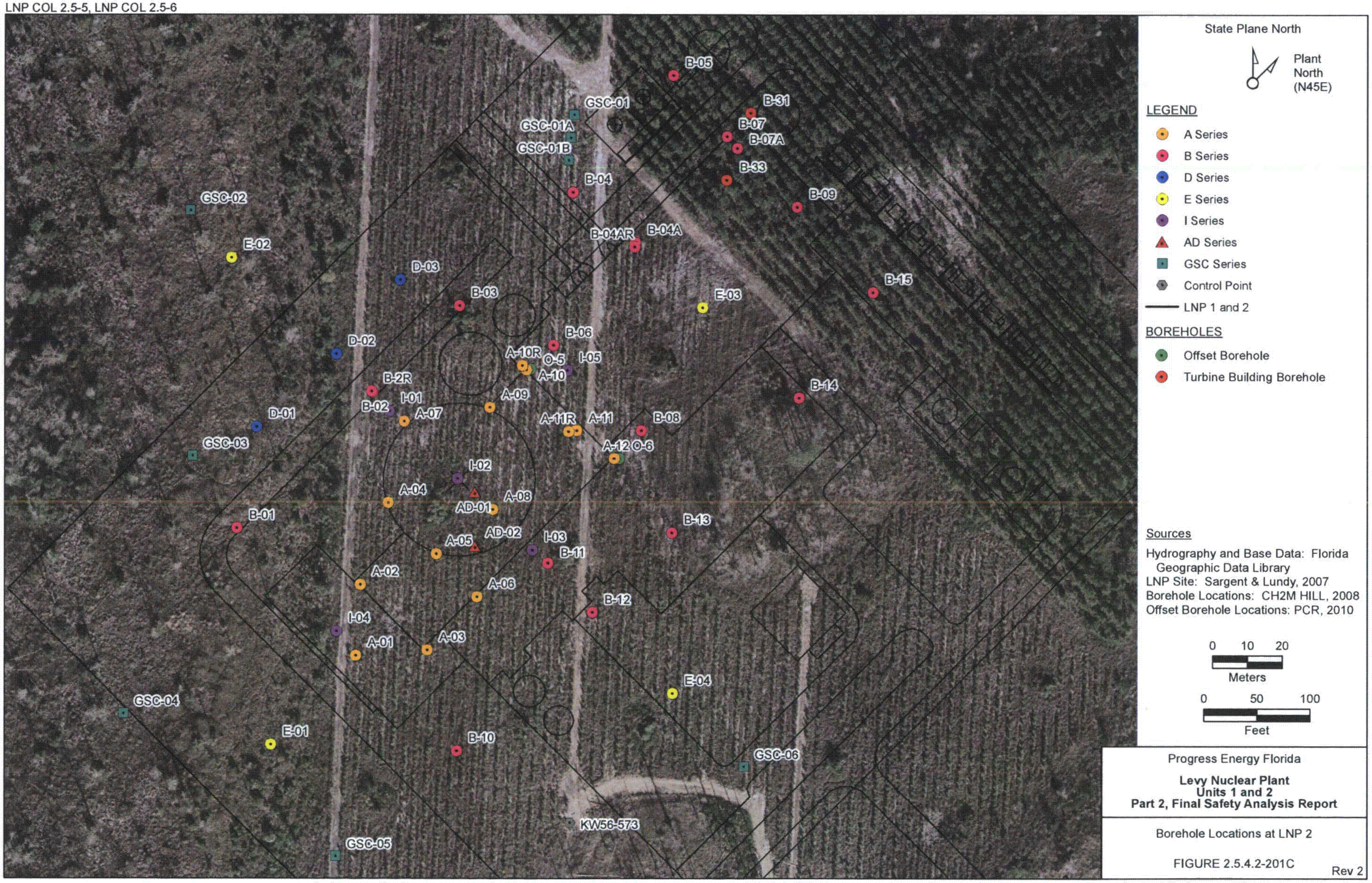
Progress Energy Florida

Levy Nuclear Plant
Units 1 and 2
Part 2, Final Safety Analysis Report

Borehole Locations at LNP 1

FIGURE 2.5.4.2-201B

Rev 2



Progress Energy Florida

Levy Nuclear Plant
Units 1 and 2
Part 2, Final Safety Analysis Report

Borehole Locations at LNP 2

FIGURE 2.5.4.2-201C

Rev 2

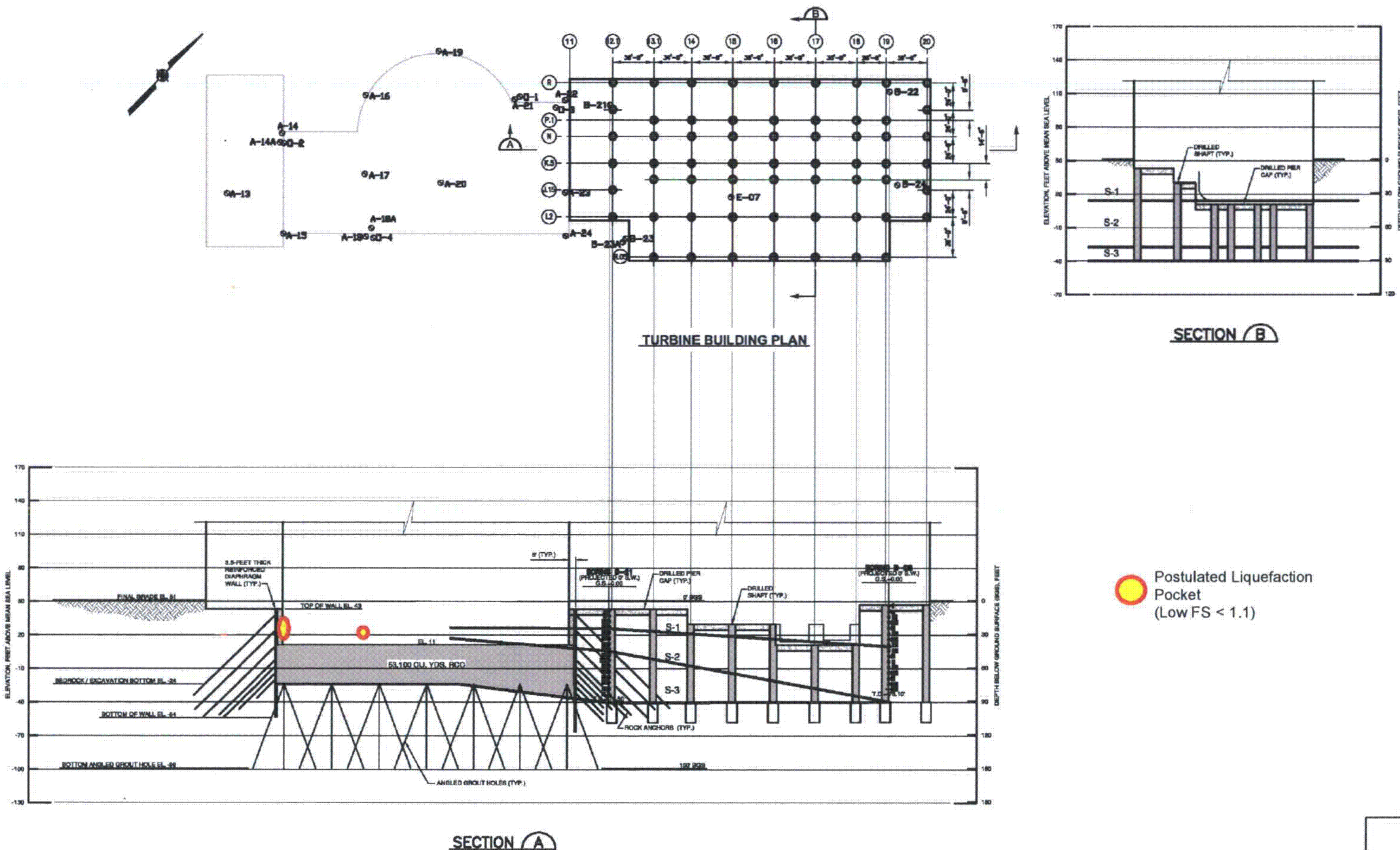
Progress Energy Florida

Levy Nuclear Plant
Units 1 and 2
Part 2, Final Safety Analysis Report

LNP 1 Postulated Liquefaction Pockets (plan)

Figure RAI 03.08.05-03-1

Rev 1



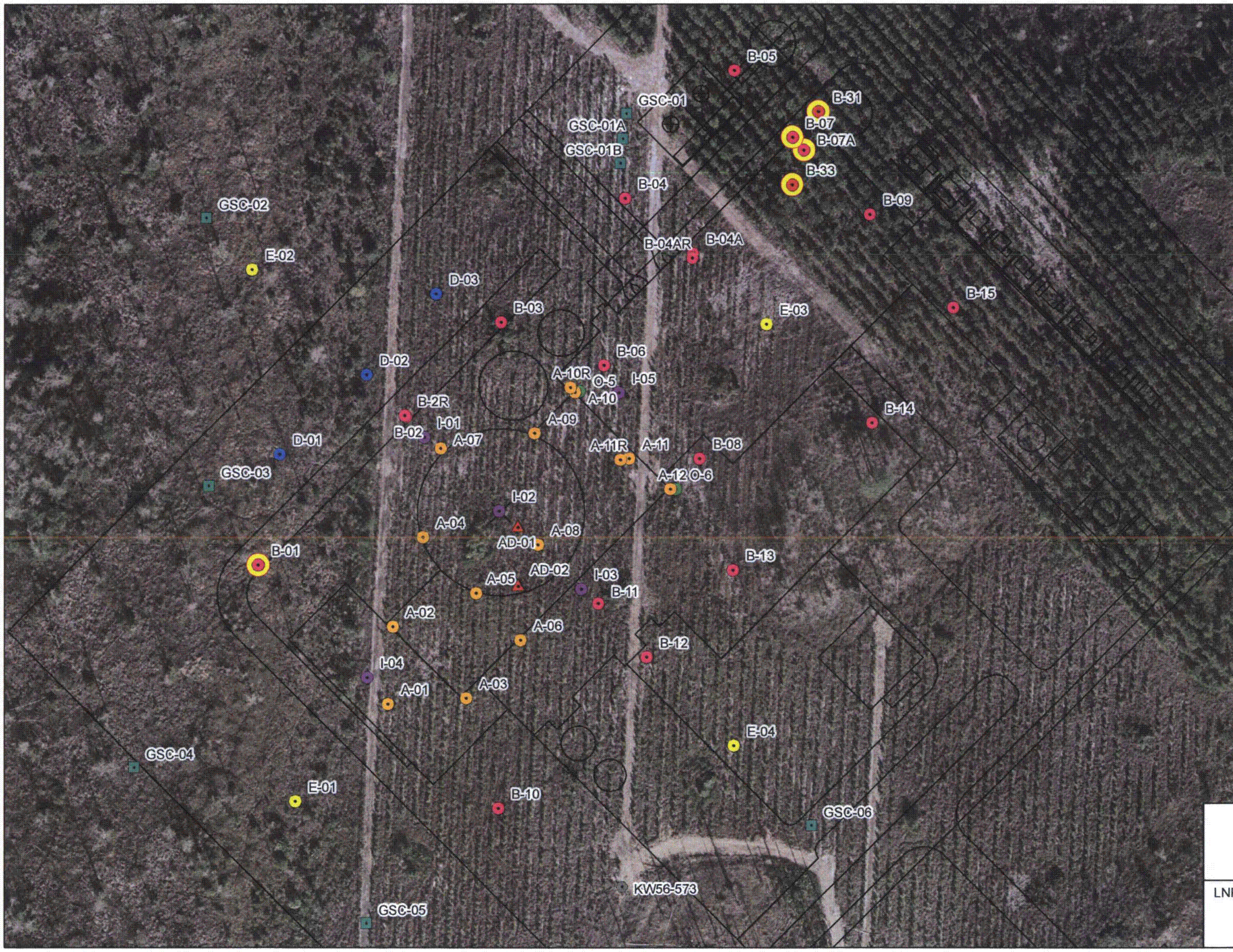
Progress Energy Florida

Levy Nuclear Plant
Units 1 and 2
Part 2, Final Safety Analysis Report

LNP 1 Postulated Liquefaction Pockets (Section)

Figure RAI 03.08.05-03-2

Rev 1



State Plane North

Plant North (N45E)

LEGEND

- A Series
- B Series
- D Series
- E Series
- I Series
- AD Series
- GSC Series
- Control Point
- LNP 1 and 2

BOREHOLES

- Offset Borehole
- Turbine Building Borehole

LIQUEFACTION POCKETS

- Postulated Liquefaction Pocket (Low FS<1.1)

Sources

Hydrography and Base Data: Florida Geographic Data Library
LNP Site: Sargent & Lundy, 2007
Borehole Locations: CH2M HILL, 2008
Offset Borehole Locations: PCR, 2010

0 10 20
Meters

0 50 100
Feet

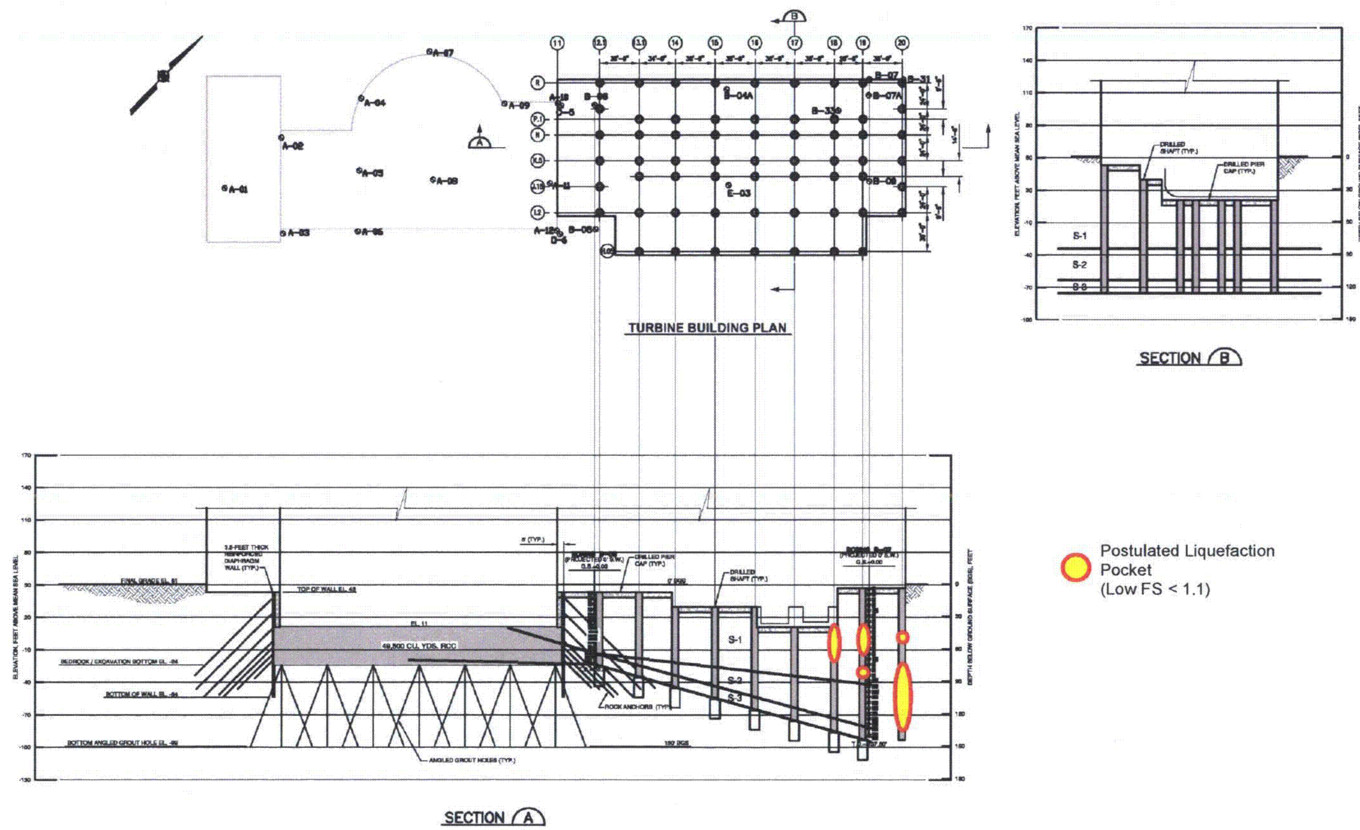
Progress Energy Florida

Levy Nuclear Plant
Units 1 and 2
Part 2, Final Safety Analysis Report

LNP 2 Postulated Liquefaction Pockets (plan)

Figure RAI 03.08.05-03-3

Rev 1



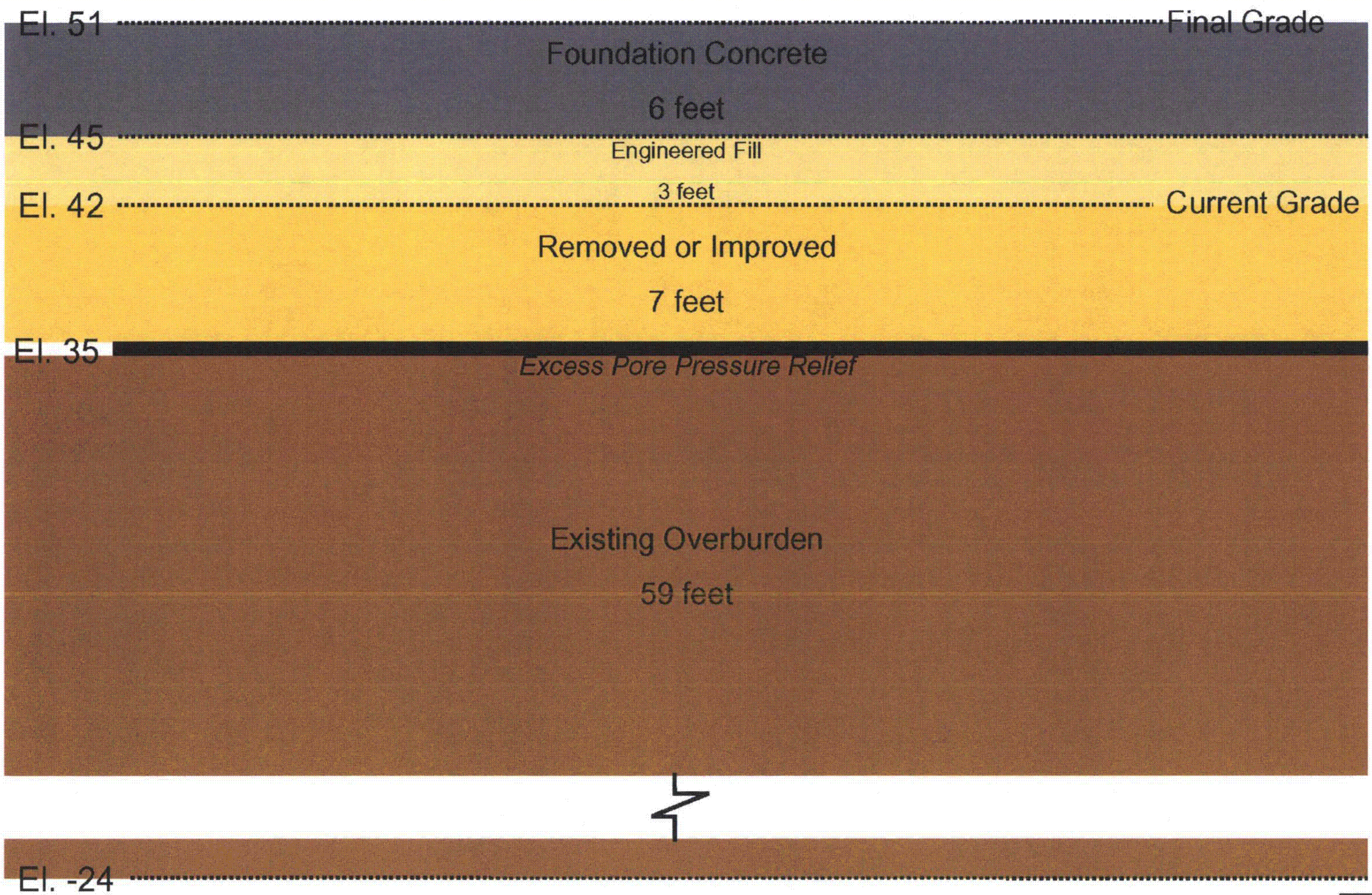
Progress Energy Florida

Levy Nuclear Plant
Units 1 and 2
Part 2, Final Safety Analysis Report

LNP 2 Postulated Liquefaction Pockets (Section)

Figure RAI 03.08.05-03-4

Rev 1



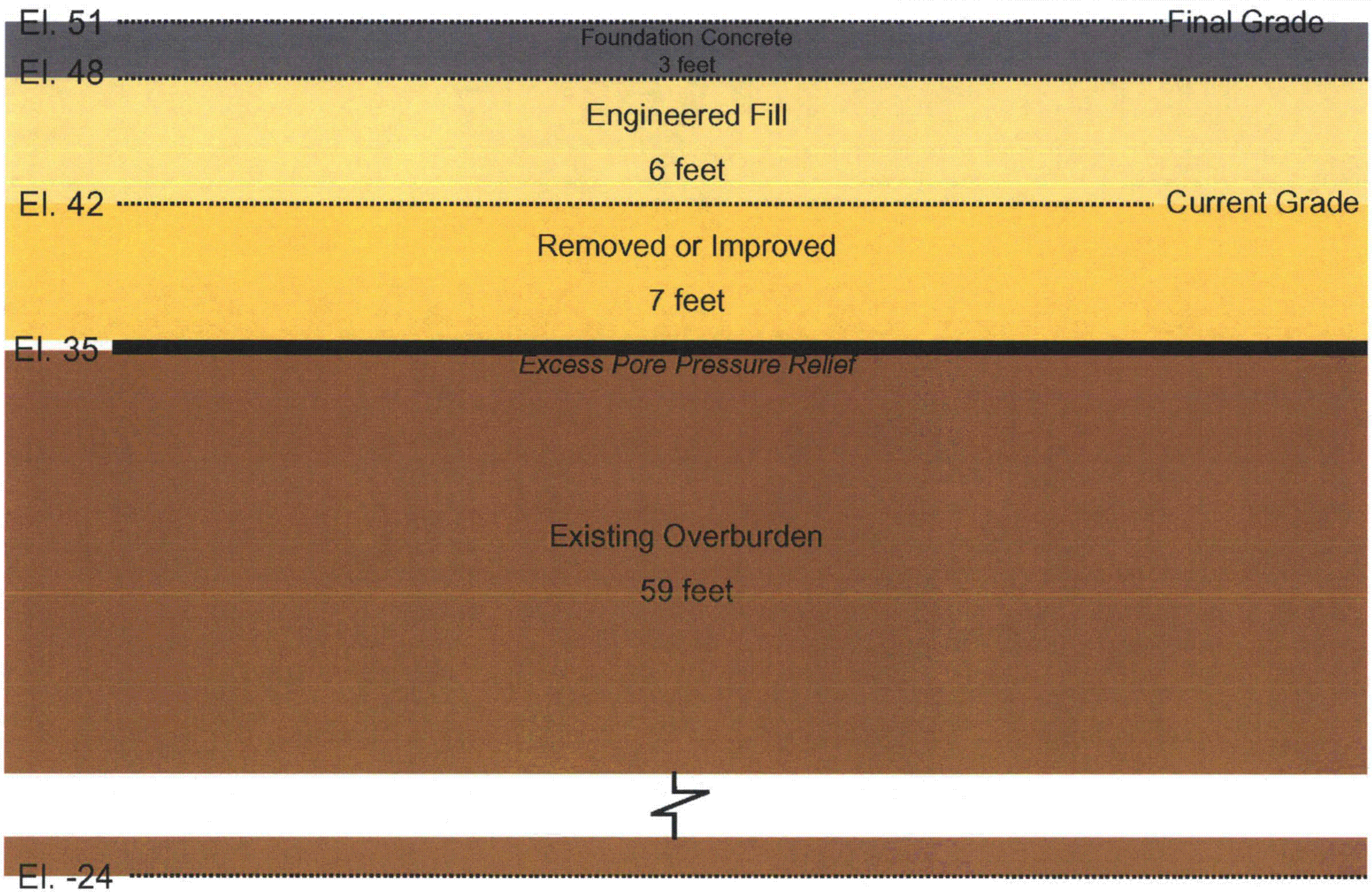
Progress Energy Florida

Levy Nuclear Plant
Units 1 and 2
Part 2, Final Safety Analysis Report

Turbine Building Subgrade

Figure RAI 03.08.05-03-5

Rev 0



Progress Energy Florida

Levy Nuclear Plant
Units 1 and 2
Part 2, Final Safety Analysis Report

Radwaste/Annex Building Subgrade

Figure RAI 03.08.05-03-6

Rev 0

Attachment 03.08.05-03B

Revised Tables

(7 pages after cover sheet)

Revised Table 2.5.4.2-201 (Sheet 1 of 3)
Summary of Boreholes Drilled within Nuclear Island and Adjacent Structures

Location	Nuclear Plant Site	Investigation Phase	Borehole Information: ID	Easting (ft.)	Northing (ft.)	Ground Surface Elevation (ft. NAVD88)	Maximum Depth Explored (ft.)
Middle of nuclear island	LNP 1	Initial	I-07	458026.5	1723097.83	42.4	307
		Main	A-16	457958.14	1723075.88	42.7	176
			A-17	458007.32	1723025.65	42.3	251
			A-19	457976.41	1723149.85	43.1	266
			A-20	458060.91	1723068.13	42.3	265
			A-21	458055.57	1723168.46	42.4	200
		Supplement	AD-03	458040.43	1723083.80	42.4	500
			AD-04	458030.47	1723034.55	42.6	500
			A-21A	458054.06	1723171.13	42.8	150
		Offset	O-1	458057.4	1723173.4	42.7	205
	LNP 2	Initial	I-02	457700.57	1724046.46	42.3	317
		Main	A-04	457634.24	1724023.64	41.3	161.5
			A-05	457680.2	1723975.26	42	161.5
			A-07	457649.39	1724100.76	42.3	266
			A-08	457734.11	1724017.18	42.1	266
			A-09	457731.35	1724113.79	41.9	201
		Supplement	AD-01	457716.32	1724033.54	42	500
			AD-02	457716.61	1723982.46	42.3	500

Revised Table 2.5.4.2-201 (Sheet 2 of 3)
Summary of Boreholes Drilled within Nuclear Island and Adjacent Structures

			Borehole Information				
Location	Nuclear Plant Site	Investigation Phase	ID	Easting (ft.)	Northing (ft.)	Ground Surface Elevation (ft. NAVD88)	Maximum Depth Explored (ft.)
Immediately outside the middle of nuclear island but within footprint of nuclear island	LNP 1	Initial	I-08	458076.81	1723054.99	42.5	266
		Main	A-14	457929.76	1722999.73	42.4	223.4
			A-15	457994.33	1722937.17	42.5	202
			A-18	458047.86	1722986.91	42.3	200.5
			A-22	458088.04	1723199.82	42.6	201.5
			A-23	458146.47	1723141.37	40.8	250
			A-24	458174.25	1723114.5	40.6	160
		Supplement	A-14A	457934.54	1722992.56	42.2	111
			A-18A	458049.26	1722992.24	42.1	100.5
			A-22A	458083.35	1723191.23	42.9	121
			A-24A	458176.73	1723110.02	40.3	86.5
		Offset	O-2	457937.7	1722994.8	42.7	225
			O-3	458086.9	1723189.3	42.5	205
			O-4	458053.5	1722990.9	42.3	205
	LNP 2	Initial	I-03	457771.7	1723978.77	42.1	266
		Main	A-02	457608.03	1723946.22	41.6	251.5
			A-03	457671.79	1723884.35	42.1	201
			A-06	457719.1	1723934.54	42.5	161.5
			A-10	457766.24	1724149.29	42.2	202
			A-11	457813.34	1724091.71	42.5	285.5
			A-12	457848.86	1724065.26	42.1	165
		Offset	O-5	457769.9	1724150.2	42.6	240
			O-6	457853.4	1724065.3	42.2	205

Revised Table 2.5.4.2-201 (Sheet 3 of 3)
Summary of Boreholes Drilled within Nuclear Island and Adjacent Structures

Location	Nuclear Plant Site	Investigation Phase	Borehole Information				
			ID	Easting (ft.)	Northing (ft.)	Ground Surface Elevation (ft. NAVD88)	Maximum Depth Explored (ft.)
Along the sides and within the footprint of structures adjacent to the nuclear island	LNP 1	Initial	I-09	457888.42	1722958.55	42.4	267
			I-10	458130.66	1723172.15	42	266
		Main	A-13	457933.48	1722927.1	40.6	200
			B-21	458119.39	1723224.85	41.8	152
			B-22	458287.4	1723410.27	40.5	150
			B-23	458210.12	1723150.69	40.7	150.5
			B-24	458351.54	1723356.33	40.9	150
			B-26	458111.7	1723010.2	42.4	151.5
			B-27	458154.74	1722971.12	42.4	150
			B-28	458242.56	1723060.05	41.5	150
			E-07	458250.48	1723243.73	41.7	186.5
		Supplement	B-23A	458207.72	1723147.49	42.4	70.1
	LNP 2	Initial	I-04	457585.56	1723902.28	41.6	266
			I-05	457804.46	1724148.79	42.2	266
		Main	A-01	457603.76	1723879.21	41.6	161.5
			B-06	457791.61	1724172.55	42.5	151.5
			B-07	457955.45	1724369.74	43.1	151
			B-08	457874.54	1724091.94	42.4	151
			B-09	458022.24	1724303.19	42.9	151
			B-11	457786.69	1723966.34	42.7	151.5
			B-12	457828.46	1723919.8	43.3	150
			B-13	457903.45	1723995.13	42.2	150
			E-03	457932.62	1724208.16	42	186
		Supplement	B-7A	457965.47	1724358.85	43.2	150
		Offset	B-31	457978	1724391.9	43.4	150
			B-33	457955.2	1724328.8	43	100

Notes:

ft. = foot

LNP COL 2.5-9

Revised Table 2.5.4.8-202A (Sheet 1 of 1)
Summary of Soil Layers Susceptible to Liquefaction in LNP 1 Site

Borehole	Bottom Depth of SPT Sample (ft.) [(a)]	Soil Type [(c), (d), (e) (f), (g)]	Field SPT N-Value (BPF) [(b)]	Factor of Safety (FS)
A-15	16.0	SP	5	1.0
A-15	21.0	SP	1	0.8
A-15	26.0	SC	2	1.1
A-18	20.0	NR	0	0.7
B-28	36.5	ML	0	0.9
O-2	9.0	SP-SC	2	0.9
O-2	10.5	SP-SC	2	0.9
O-2	12.0	SP-SC	1	0.8
O-4	24.0	ML	0	0.9

Notes:

a) Depth of SPT sample is relative to original site grade at approximately El 41-43 ft. NAVD88

b) BPF = Blows per Foot

c) SC = Clayey Sand

d) SM = Silty Sand

e) SP = Poorly Graded Sand

f) NR = Not Recorded

g) ML = Silt with Sand

LNP COL 2.5-9

Revised Table 2.5.4.8-202B (Sheet 1 of 3)
Summary of Soil Layers Susceptible to Liquefaction in LNP 2 Site

Borehole	Bottom Depth of SPT Sample (ft.) [(a)]	Soil Type, [(c), (d), (e) (f), (g)]	Field SPT N-Value (BPF) [(b)]	Factor of Safety (FS)
B-01	26.5	SM	2	0.8
B-01	31.5	SM	2	0.8
B-07	31.5	SP-SM	3	1.0
B-07	36.5	SP-SM	2	0.8
B-07	51.5	SP-SM	2	0.8
B-07	56.5	SP-SM	2	0.8
B-07	61.5	SP-SM	3	0.9
B-07	76.5	SP-SM	3	1.0
B-07A	26.5	SP-SM	5	1.0
B-07A	31.5	SM	4	1.1
B-07A	36.5	SP-SM	3	0.8
B-07A	41.5	SM	3	0.8
B-07A	51.5	SM	2	1.1
B-07A	76.5	SP-SM	6	0.9
B-31	40.5	SP	4	1.0
B-31	69.0	SP	5	1.0
B-31	70.5	SP	6	1.1
B-31	73.5	SP	5	1.0
B-31	76.5	SP	2	0.7
B-31	78.0	SP	6	1.1
B-31	79.5	SP	4	0.9
B-31	81.0	SP	2	0.7
B-31	82.5	SP	3	0.8
B-31	84.0	SP	3	0.8

LNP COL 2.5-9

Revised Table 2.5.4.8-202B (Sheet 2 of 3)
Summary of Soil Layers Susceptible to Liquefaction in LNP 2 Site

Borehole	Bottom Depth of SPT Sample (ft.) [(a)]	Soil Type, [(c), (d), (e) (f), (g)]	Field SPT N-Value (BPF) [(b)]	Factor of Safety (FS)
B-31	85.5	SP	3	0.8
B-31	87.0	SP	2	0.7
B-31	88.5	SP	1	0.7
B-31	90.0	SP	0	0.7
B-31	91.5	SP	4	0.9
B-31	93.0	SP	3	0.8
B-31	94.5	SP	7	1.1
B-31	96.0	SP	0	0.6
B-31	97.5	SP	0	0.6
B-31	99.0	SP	1	0.6
B-31	103.5	SP-SM	7	1.1
B-31	109.5	SP-SC	5	0.9
B-31	118.5	SP-SM	0	0.7
B-31	120.0	SP-SM	0	0.7
B-31	121.5	SP-SM	0	0.7
B-31	123.0	SP-SM	0	0.7
B-31	124.5	SP-SM	0	0.7
B-31	126.0	SP-SM	0	0.7
B-31	127.5	SP-SM, ML	0	1.0
B-31	129.0	SP-SM	0	0.7
B-31	130.5	SP-SM	0	0.7
B-33	28.5	SP	4	1.0
B-33	30.0	SP	5	1.2
B-33	31.5	SP	3	0.9
B-33	33.0	SP	2	0.8

LNP COL 2.5-9

Revised Table 2.5.4.8-202B (Sheet 3 of 3)
Summary of Soil Layers Susceptible to Liquefaction in LNP 2 Site

Borehole	Bottom Depth of SPT Sample (ft.) [(a)]	Soil Type, [(c), (d), (e) (f), (g)]	Field SPT N-Value (BPF) [(b)]	Factor of Safety (FS)
B-33	34.5	SP	2	0.8
B-33	36.0	SP	1	0.7
B-33	37.5	SP	2	0.8
B-33	39.0	SP	2	0.8
B-33	40.5	SP	2	0.8
B-33	42.0	SP	1	0.7
B-33	43.5	SP	0	0.7
B-33	45.0	SP	0	0.7
B-33	46.5	SP	0	0.7
B-33	58.5	SP	5	1.1
B-33	66.0	SP	7	1.1

Notes:

a) Depth of SPT sample is relative to original site grade at approximately El 41-43 ft. NAVD88

b) BPF = Blows per Foot

c) SC = Clayey Sand

d) SM = Silty Sand

e) SP = Poorly Graded Sand

f) NR = Not Recorded

g) ML = Silt with Sand