2.5.4.5.1.2 Permeation Grouting

Due to the high groundwater table and the documented permeability of the Avon Park Formation beneath the site, the upper 75 ft. of the Avon Park Formation will be grouted to diminish its porosity and permeability. The grouting will allow the excavation to be made in a safe and predictable manner by minimizing the upward flow of groundwater into the excavation and to aid in the resistance to uplift pressures on the excavation bottom. An uplift analysis indicated sufficient reduction of shear stresses in the grouted rock, and the computed factor of safety exceeded 1.5.

The grouting is non safety related. However, diminishing the porosity and reducing the permeability will have the beneficial effect of impeding flow through the uppermost Avon Park Formation and, therefore, minimize the potential for the initiation and/or growth of solution activity.

Although this will be an added benefit, the increase in compressive and shear strength of the Avon Park Formation has not been considered in other analyses. Bearing capacity, settlement, and site response were assessed on the basis of properties of the Avon Park Formation as measured during the site characterization program without grouting. The success of the Grout Program will be determined by the lack of groundwater intrusion during the excavation dewatering and not the increase in density, stiffness, or strength of the Avon Park Formation.

As a design input for the determination of the grouted zone, the groundwater is conservatively considered to be at the existing ground surface (between elevation 42 ft. and elevation 43 ft. NAVD88).

As part of the construction dewatering effort, a zone beneath each proposed nuclear island will be grouted in order to achieve the following three goals:

1) Form a “bottom of the bathtub” to prevent the flow of groundwater up through the bottom of the excavation.

2) Protect the excavation base from heaving.

3) Inhibit the flow of water through porous zones in this zone beneath each nuclear island, thereby reducing the future potential for solution activity.

The top elevation of the grouted zone (elevation -24 ft. NAVD88) was based on the top of rock and defines the elevation which the RCC Bridging Mat will be founded on. The proposed thickness of this grouted zone (75 ft., to elevation -99 ft. NAVD88) was determined based on the review of site data and discussions with site geologists. For example, shear wave velocity measurements from Borings A7, I2, AD1, A8, and I3, indicate a shelf within the Avon Park Formation at approximate elevation -97 ft. NAVD88 under the North Reactor LNP 2, where shear wave velocity increases from approximately 3500 ft/sec to approximately 5000 ft/sec. Boring Logs from Borings A7, A8, A9, and A10 indicate that the Avon Park Formation, in general, becomes less weathered, has a higher recovery, and higher RQD below elevation -97 NAVD88.

A similar shelf exists under the South Reactor LNP 1 at approximately -180 feet. However, Boring Logs from Borings A14, A17, A19, and A20 indicate that the Avon Park limestone, in general, has a higher recovery and higher RQD below elevation -97 ft. Additionally, geophysical

logs from A-19 and A-20 indicate a higher shear wave velocity below elevation -97 ft. NAVD88. Based on the above information, elevation -99 ft. NAVD88 has been designated as the bottom of the grouted zone resulting in a relatively large, 75-ft.-thick zone. As discussed in FSAR Subsection 2.5.4.1.2.1.1, this shelf extends at least 50 ft. in depth and is characterized as a lower-porosity zone.

Grouting 75 ft. of the Avon Park Formation beneath the RCC Bridging Mat will accomplish goals one (1), two (2), and three (3) listed above. As previously noted, no credit was taken for this grout increasing the strength or stiffness of the grouted zone.

The grout will be bounded horizontally by the diaphragm wall between the bottom of the RCC Bridging Mat (elevation -24 ft. NAVD88) and bottom of the diaphragm wall (elevation -54 ft. NAVD88). From this elevation to the bottom of the grouted zone (elevation -99 ft. NAVD88), the grouted zone will be bounded by a grout curtain.

Grouting will be performed prior to excavation. Grout holes will be drilled from, at or near, the existing ground surface to the proposed bottom of the target grouted zone (elevation -32 m [-99 ft.] NAVD88).

State-of-the-practice computerized monitoring of all grouting will take place, including the measurement of grout take in terms of pressure and volume.

Deleted: The Grout Program will be accomplished in two phases. Prior to the excavation of the nuclear island foundations, grout holes will be drilled from the existing ground surface to the proposed bottom of the target grouted zone (approximately 150 ft bgs). The first phase will consist of drilling and grouting on 8-ft. center-to-center spacing with a relatively low mobility grout (LMG). This LMG helps to form a perimeter to contain the second phase of grouting. The LMG grouting includes the installation of the grout curtain below the diaphragm wall. The purpose of the grout curtain is to “extend” the diaphragm wall and form a border around the grouted zone. A high mobility grout (HMG) will be drilled and grouted on split-spacing between the LMG holes. The HMG will fill in the area defined by the LMG. This is considered the second phase of the Grout Program. ¶
¶
State-of-the-practice computerized monitoring of all grouting will take place, including the measurement of grout take in terms of pressure and volume. A field test will be conducted prior to construction of this grouted zone to establish appropriate mixes for both the LMG and HMG and to confirm that the grout hole spacing is adequate. The 8-ft. grout hole spacing is currently based on experience in the industry. It is noted as a good starting point to be refined with a field test prior to and during construction.¶

Comment [AKB1]: VAL 02.05.04.05.01.02-001

2.5.4.5.1.2.1 Permeation Grouting Operation

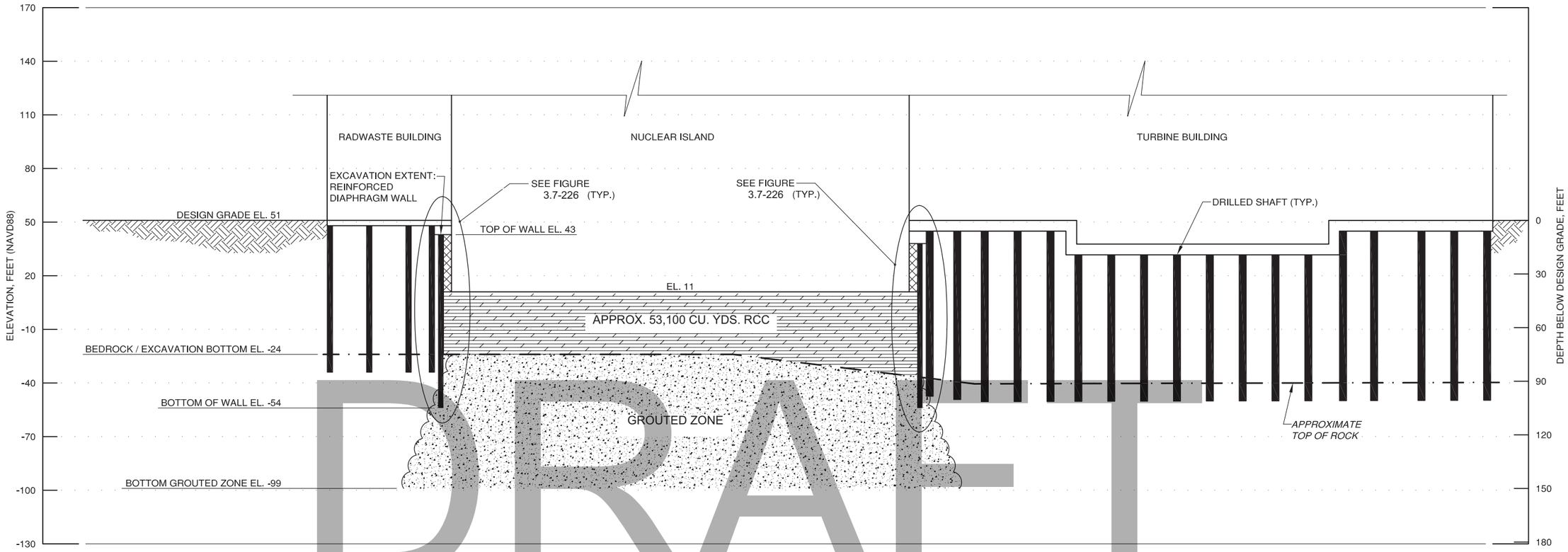
The grouting operation will be conducted from, at or near, the existing ground surface by drilling boreholes from the surface down to the approximate elevation of -30.2 m (-99 ft.) NAVD88. The top elevation of the grouted zone will be at elevation -7.3 m (-24 ft.) NAVD88, resulting in a 22.9 m (75 ft.) thick grouted zone.

Grouting will generally be performed by the upstage method with pneumatic packers and a suite of grout mixes that range in viscosities from 35 seconds to over 80 seconds. Primary grout holes will be spaced on a 4.8 m (16 ft.) hexagonal pattern, and split spaced with secondary grout holes to achieve “no take” conditions.

Provisions will be in place to perform additional split-spacing to tertiary grout holes, as dictated by the performance of the production grouting. Effective grouting pressures will be limited to approximately 0.5 psi/ft of depth, monitored using a GIN curve and penetrability curve developed during the Grout Test Program (discussed in FSAR Subsection 2.5.4.5.1.2.2). Hole spacing, grouting pressures, and acceptable grout takes will be established with the grout program. The target residual conductivity of the production grouting will be 15 Lugeons. Grouting is nonsafety-related, however it will be performed under a quality program.

Deleted: The grouting operation will be conducted from, at or near, the existing ground surface by drilling boreholes from the surface down to the approximate elevation of -30.2 m (-99 ft.) NAVD88, and setting casing (either perforated or “tube-a-manchette” – a rubber sleeve between two packers). While uncased holes would be preferred, the existing site characterization data suggest that the holes may cave before they can be grouted; therefore, casing will be specified. The top elevation of the grouted zone will be at elevation -7.3 m (-24 ft.) NAVD88, resulting in a 22.9 m (75 ft.) thick grouted zone.¶
¶
Grouting will generally be performed by the upstage method with pneumatic packers and a combination of lower mobility grout (LMG) and high mobility grout (HMG) to be established with a Grout Test Program prior to the commencement of the grouting program, as discussed in FSAR Subsection 2.5.4.5.1.2.2. Grout holes are initially spaced to achieve “no take” conditions. Hole spacing, grouting pressures, and acceptable grout takes will be established with the Grout Test Program. Grouting is non safety-related, however it will be performed under a quality program.¶
¶
A grout intensity number (GIN) curve and target permeability (in Lugeons) will be used to dictate target grout pressures/volumes. The grout holes will be installed using an automated real-time monitoring system for water pressure testing and grouting, capable of computing a suite of engineering data allowing side-by-side evaluation of geology, grout mixes, Lugeon values and apparent Lugeon values, and plotting data into reports and CADD drawings.

Comment [AKB1]: VAL 02.05.04.05.01.02.01-001



NOTES:

1. THE VERTICAL ELEVATION DATUM IS BASED ON NAVD 88.

SCALE
30 0 30 60 FEET

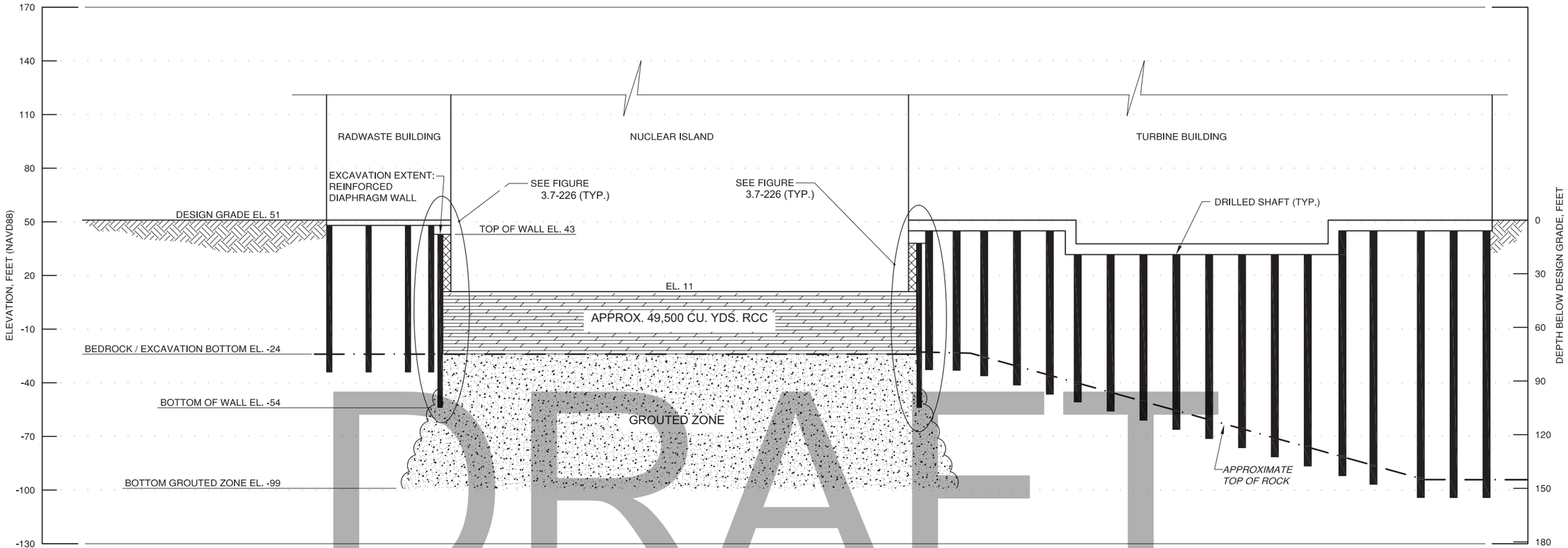
NOTE:
THIS FIGURE PRESENTS A CONCEPTUAL DESIGN THAT WAS DEVELOPED FOR COL APPLICATION. DETAILED DESIGN WILL BE COMPLETED PRIOR TO CONSTRUCTION, AND THE DIMENSIONS AND QUANTITIES SHOWN HEREIN ARE SUBJECT TO CHANGE AT THAT TIME.

Progress Energy Florida

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

LNP 1 Nuclear Island Excavation Limits
Plant South To Plant North Cross Section

FIGURE 2.5.4.5-201B
Rev 5



NOTES:

1. THE VERTICAL ELEVATION DATUM IS BASED ON NAVD 88.

SCALE

30 0 30 60 FEET

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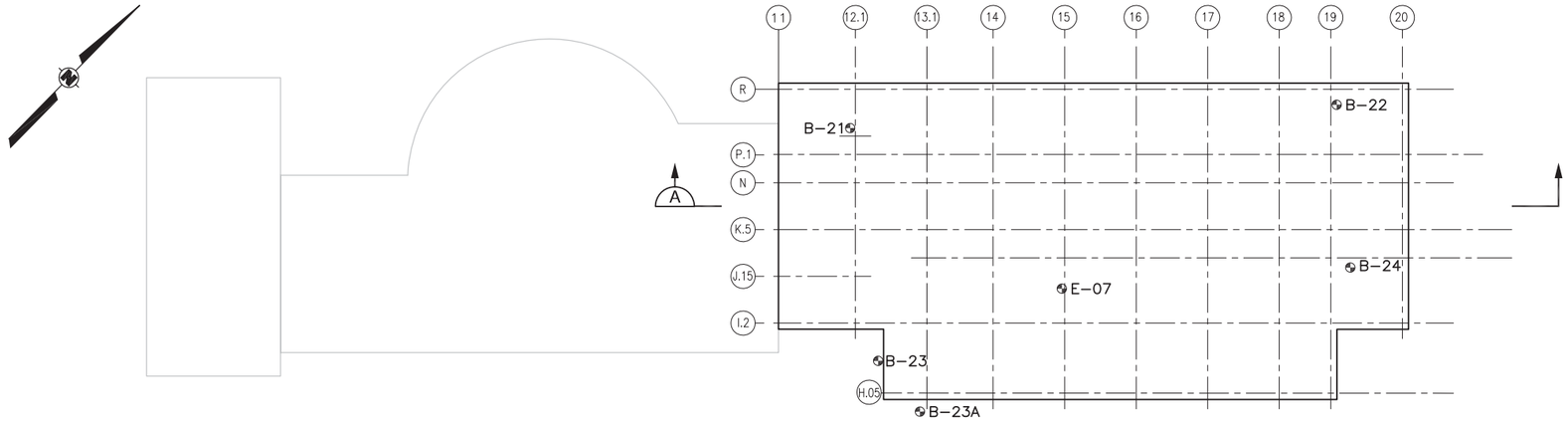
Progress Energy Florida

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

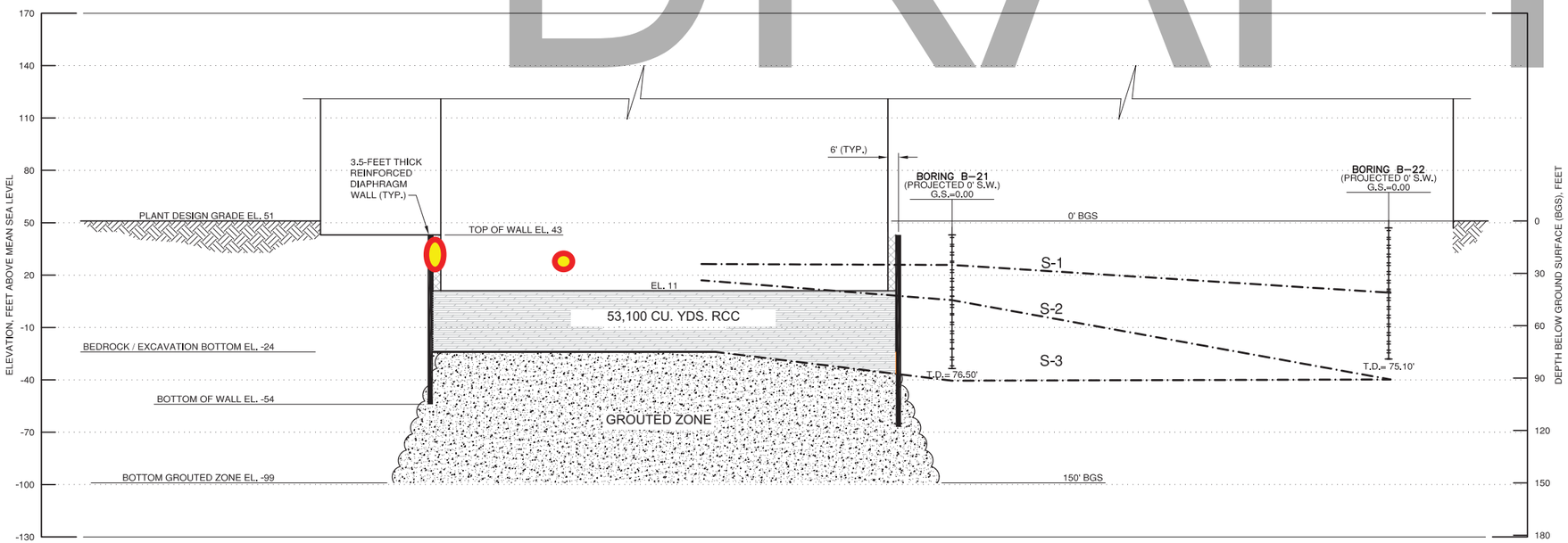
LNP 2 Nuclear Island Excavation Limits
Plant South To Plant North Cross Section

FIGURE 2.5.4.5-202B

Rev 5



TURBINE BUILDING PLAN



SECTION A

Postulated Liquefaction Pocket
(Low FS ≤ 1.1)

Progress Energy Florida
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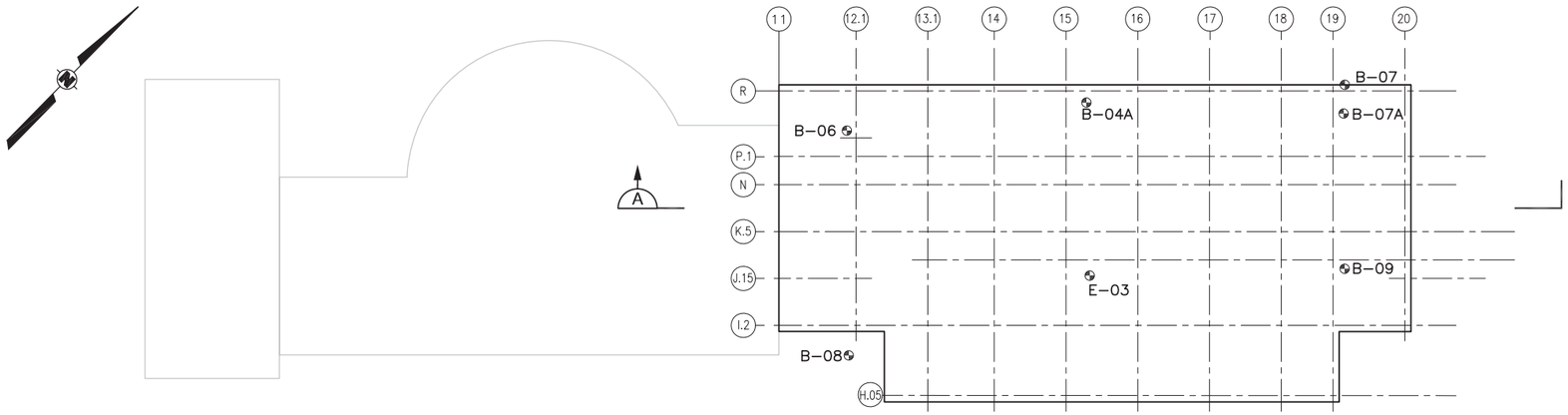
Units 1 and 2
Part 2, Final Safety Analysis Report

LNP 1 Postulated Liquefaction Pockets (Section)
For PBSRS
Figure 2.5.4.8-201B
Rev 5



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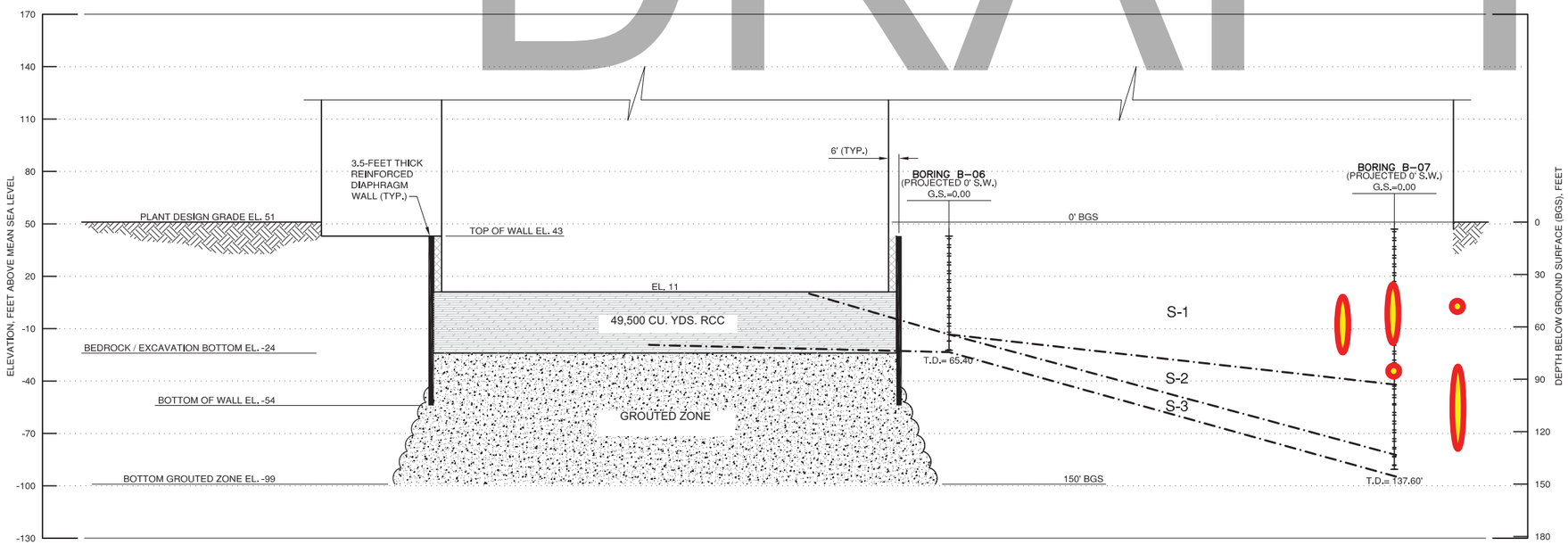
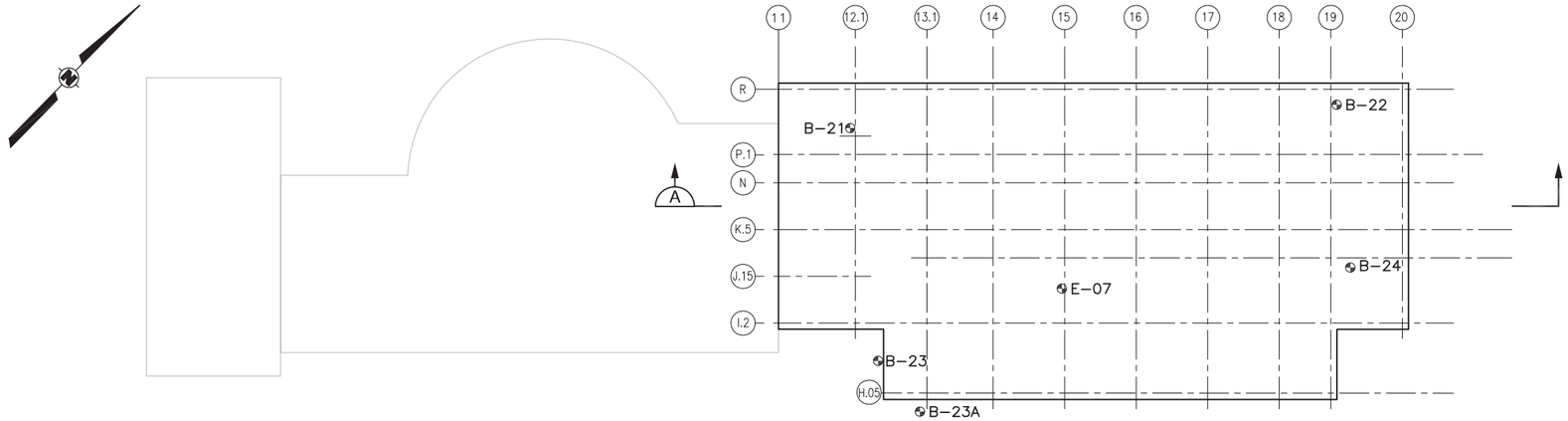


SECTION A

Postulated Liquefaction Pocket
(Low FS ≤ 1.1)

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

LNP 2 Postulated Liquefaction Pockets (Section)
For PBSRS
Figure 2.5.4.8-202B
Rev 5



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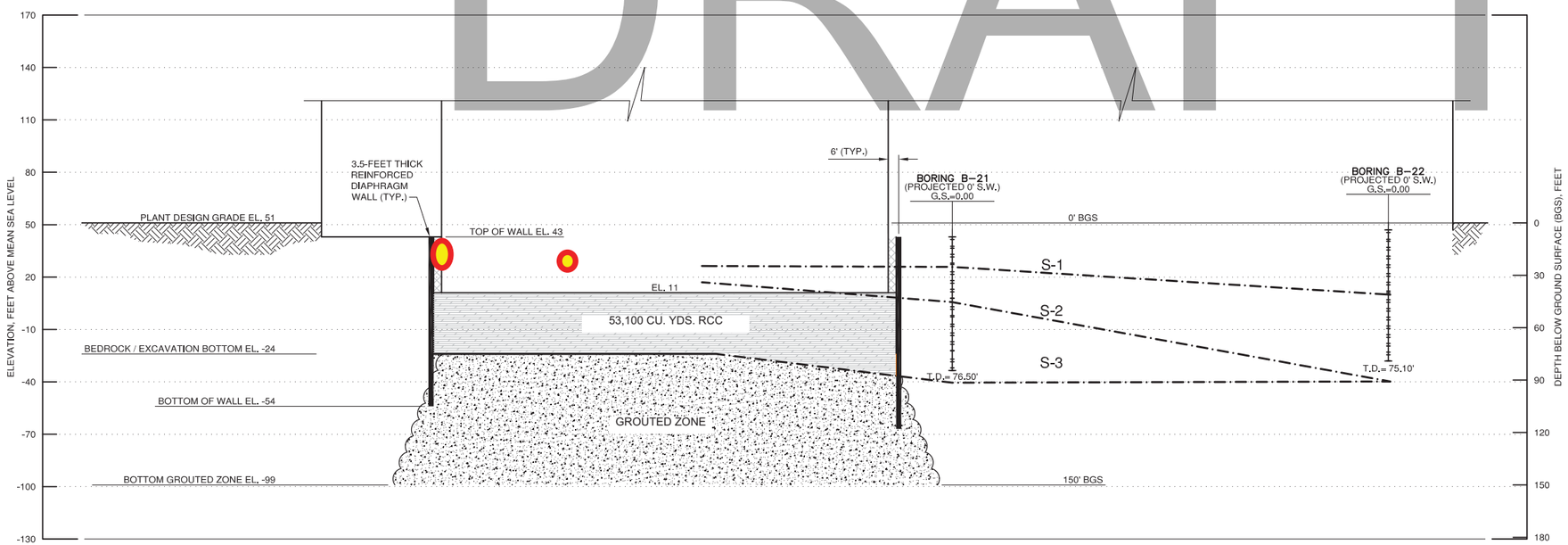
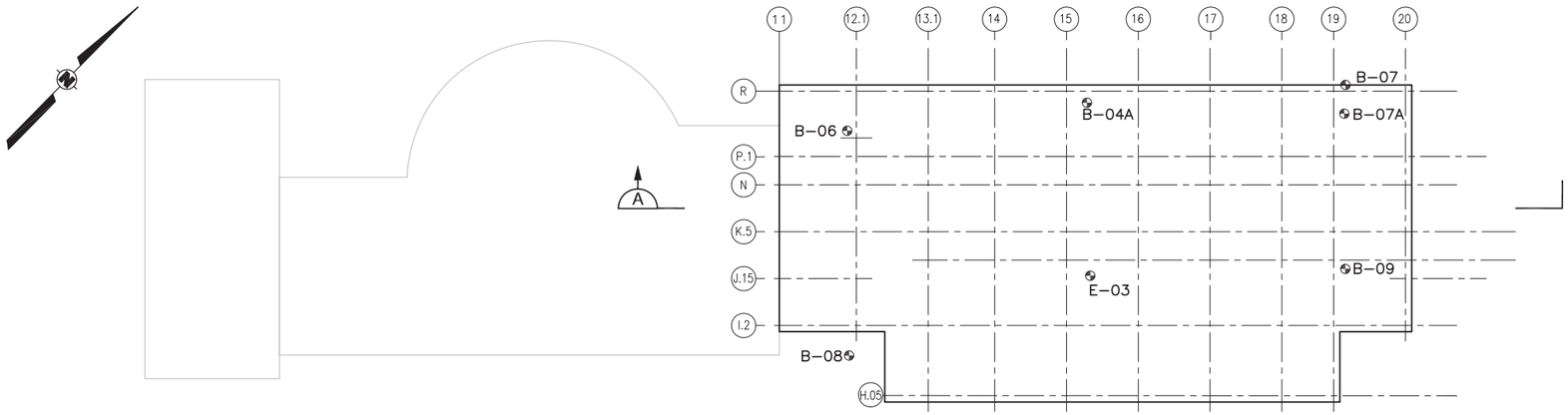


SECTION A

Postulated Liquefaction Pocket
(Low FS ≤ 1.0)

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

LNP 1 Postulated Liquefaction Pockets (Section)
For 10^{-5} UHRS
Figure 2.5.4.8-208
Rev 5



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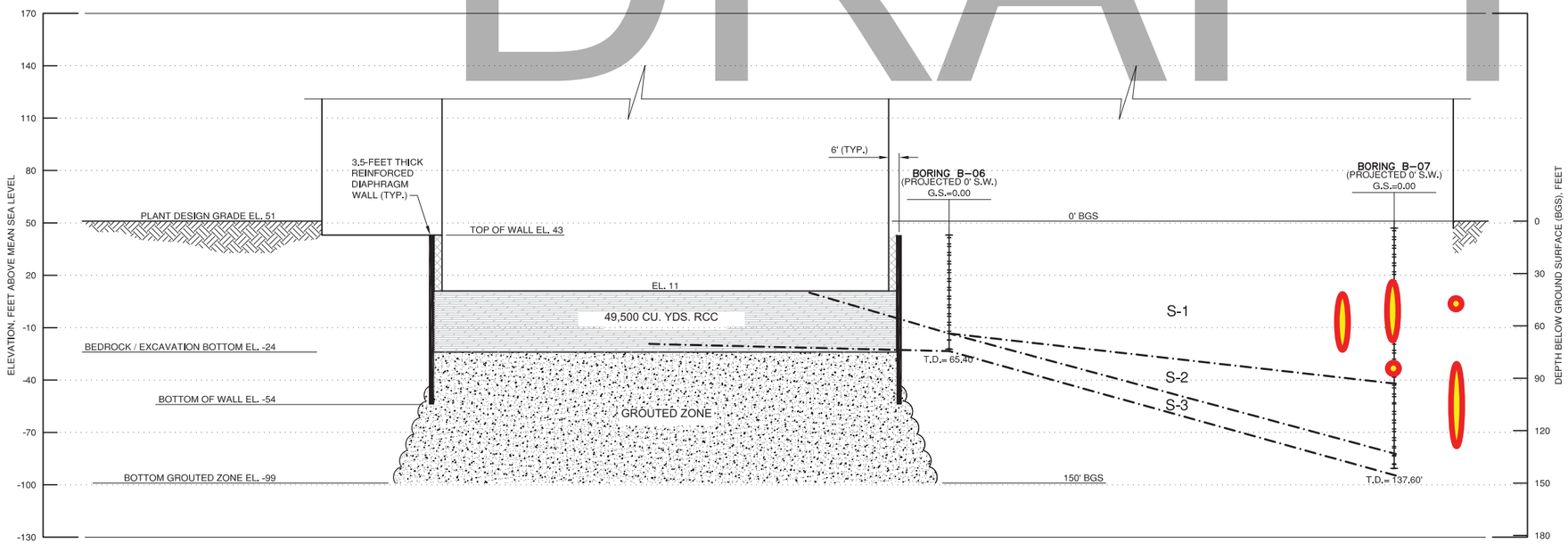

SECTION A

Postulated Liquefaction Pocket
(Low FS ≤ 1.0)

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

LNP 2 Postulated Liquefaction Pockets (Section)
For 10^{-5} UHRS
Figure 2.5.4.8-210
Rev 5