Lee Nuclear Station Units 1 and 2

Preliminary Assessment – Evaluation of 2012 Field Investigation Results for Plant Relocation

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES (cont.)

1.0 INTRODUCTION

1.1 Purpose

This enclosure describes the preliminary assessment / evaluation results of the 2012 field investigation findings for plant relocation at Duke Energy's Lee Nuclear Station (Figure 1). The information described herein relies on initial assessments of field investigation results contained in data reports obtained in late 2012. Following a decision in August 2012 to relocate the plant, field investigations for the plant relocation included drilling five borings and performing geophysical logging in three of these borings located within the footprint of the relocated nuclear island of WLS Unit 1. Two borings, one with geophysical logging, were drilled at the relocated nuclear island of Unit 2.

Field work was performed by AMEC, FCL and LCI personnel and AMEC's qualified subcontractors as part of site investigations for the proposed Duke Energy William States Lee III Nuclear Station (WLS).

The purpose of the 2012 field work is to obtain confirmatory information at the relocated nuclear islands and to demonstrate that the relocation of the units does not affect the qualification of the AP1000 units for application at the site. Concurrent with the field work activity, FSAR-supporting project deliverables (calculation packages and project reports) were revised to reflect changes to design input brought about by the plant relocation. These concurrent revisions to project deliverables included existing boring data representative of the relocated positions of the nuclear islands but did not include the results of the 2012 field work. After December, 2012, the FSAR-supporting deliverables will be revised once more to include the 2012 field work results and the FSAR Section 2.5 text, tables, and figures will be revised for submittal to the NRC in support of the next COLA update.

The primary objective of this enclosure is to document the encountered conditions in the 2012 field work and provide an assessment of consistency with existing site data described in the FSAR Section 2.5 (Revision 6) and to the FSAR Section 3.7 (Revision 6) confirming that the conclusions of site-specific analysis are very likely to be unaffected by the relocation of the units based on the results described herein.

The 2012 field work and this preliminary assessment enclosure are focused on the Combined Operating License (COL) safety-related aspects of the AP1000 plant, namely the nuclear island.

This enclosure uses the plant configuration changes described in Section 2.0 herein for the relocated structures per Duke Energy's decision in August, 2012.

The information presented in this enclosure describes initial assessments of field investigation results in relation to their consistency with existing FSAR data as described above.

1.2 Scope of Work

The scope of work in this enclosure consists of evaluating the results of field work conducted in late 2012 to obtain new geotechnical data for confirmatory information at the relocated nuclear islands. The 2012 field work includes drilling and logging seven new geotechnical borings at relocated Unit 1 and Unit 2 nuclear island structures for the Duke Energy Lee Nuclear Station COL Project (Figures 2 and 3). Geophysical testing was performed in four of the borings. Table 1 summarizes the 2012 borings and the scope of geophysical testing. The resulting data from these borings and in situ tests are presented in field data reports. The results of these 2012 field explorations for Lee Nuclear Station Units 1 and 2 will be incorporated in a future revision of the FSAR.

1.3 Summary of Abbreviations

AMEC	AMEC Environment & Infrastructure, Inc.
CNS	Cherokee Nuclear Station
COL	Construction and Operating License
Duke	Duke Energy Corporation
ENERCON	ENERCON Services, Inc.
FCL	Fugro Consultants, Inc.
LCI	Lettis Consultants International, Inc. (formerly FCL)
LETCo	Law Engineering Testing Company (later MACTEC, now AMEC)
MACTEC	MACTEC Engineering and Consulting, Inc. (now AMEC)
NI	nuclear island
PSAR	Preliminary Safety Analysis Report
WLA	William Lettis & Associates, Inc. (now FCL)
FSAR	Final Safety Analysis Report

Other abbreviations and acronyms are defined where they are first used in the body of this enclosure.

2.0 BACKGROUND

The Duke Energy William States Lee III Nuclear Station (WLS) will consist of twin AP1000 power plants located at the site of the former partially constructed Cherokee Nuclear Station (CNS). The new AP1000 Unit 1 will reoccupy the former CNS Unit 1 footprint and is planned to overlie portions of the CNS existing foundation; the new AP1000 Unit 2 will occupy the former CNS Unit 3 footprint area. Both plants under this configuration are located within the existing excavation and some additional minor excavation will be required. A major filling operation is required to backfill the existing excavation to develop a plant yard grade.

The geotechnical investigation described in FSAR Section 2.5 is originally based on the twin AP1000 configuration described in the WLS COLA Revision 6. In August 2012, the site plan was subsequently modified to reflect relocated site layout and elevations. This relocation moved Unit 1 and Unit 2 south 66 ft.; Unit 1 was also moved 50 ft. east. The floor elevation (corresponding to AP1000 generic elevation 100.0) was raised from elevation 590 ft. to elevation 593 ft. The yard elevation was raised from elevation 589.5 ft. to elevation 592 ft. adjacent to the nuclear islands.

3.0 EVALUATION OBJECTIVES

The purpose of the field investigation and testing program was to obtain new data at the nuclear islands for the relocated plant site to confirm geologic and geotechnical evaluations described in the existing Duke Lee COL Application (FSAR Revision 6). The field investigation considered the horizontal and vertical distribution of CNS and COLA developed field investigation data within the safety-related nuclear island structures for WLS Units 1 and 2. Boring locations in 2012 were positioned to evaluate the concrete and rock beneath the relocated WLS Unit 1 nuclear island and rock beneath the proposed relocated Unit 2 nuclear island. No exploration of Seismic Category II (SC-II) facilities was performed. No laboratory testing of recovered samples was performed. The field work is summarized in Table 1.

The exploration locations and borehole testing plan are specifically configured to meet the following data collection needs:

- Confirm and demonstrate the applicability of the existing field data from the previous explorations as being representative of the conditions at the relocated plant positions.

The field testing plan and this subsequent preliminary evaluation are in compliance with requirements of 10 CFR 52, 10 CFR 50 Appendix S, and 10 CFR 100.23, using guidance provided in:

- Regulatory Guide 1.132, Revision 2 - “Site Investigations for Foundations of Nuclear Power Plants”
- Regulatory Guide 1.206, Revision 0 - “Combined License Applications for Nuclear Power Plants”
- Regulatory Guide 1.208, Revision 0 – “A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion”

The primary field investigation objective is to confirm that concrete and rock characteristics, including shear wave velocity profiles underlying the relocated nuclear islands are consistent with the information presented in WLS FSAR Revision 6.

Concrete Exploration Objectives – Unit 1

- Visual inspection of basemat slab for evidence of any significant surface cracking attributed to demolition.
- Coring of the structural and fill concrete materials in five locations for visual observation of concrete condition, using thin walled bits and/or wireline diamond coring methods.

Rock Exploration Objectives – Unit 1

- Coring through the concrete and/or rock in five locations for visual observation of the concrete and rock and the condition of the rock materials below the concrete fill or concrete slab. Obtain borehole geophysical measurements in some of the borings as follows:
  - Field compression and shear wave velocity measurements using P-S suspension test methods in two of the borings.
  - Acoustic televiewer imaging of boring walls to identify fractures and determine dip and azimuth of these features in three of the borings.

Concrete-Rock Interface Exploration Objectives – Unit 1

- Visual evaluation of the concrete-rock interface in recovered core for any separation, fracturing, or weathering.
- Televiewer logging at three locations to observe the in-situ concrete-rock contact for any separation, fracturing, or weathering.

Rock Exploration Objectives – Unit 2

- Coring into the rock in two locations for observation of the condition of the rock materials.
- Field compression and shear wave velocity measurements using P-S suspension test methods in one of the borings.
- Acoustic televiewer imaging of borehole walls in one of the borings.

4.0 FIELD EXPLORATION AND BOREHOLE GEOPHYSICAL LOGGING METHODOLOGY

Field activities including sample collection and testing at relocated WLS Units 1 and 2 were initiated on October 1, 2012 and continued through October 24, 2012. All test locations were surveyed on October 25, 2012. The additional exploration program in October 2012 consisted of seven additional borings, borehole geophysical tests consisting of P-S velocity measurements in three borings and acoustic televiewer logging at four borings. No additional laboratory testing, borehole testing, or surface geophysical testing was performed as part of this 2012 geotechnical exploration. The site exploration program is shown in Figure 3 and Figure 4. The completed boring and in-situ field testing program is summarized in Table 1.

5.0 SUMMARY OF RESULTS

The results of the preliminary evaluation of the October 2012 field investigation, including evaluation of recovered core, geophysical logging and evaluations of field results developed for WLS plant relocation are summarized below. The site exploration map explanation and the exploration map are provided as Figures 2 and 3, respectively. Boring summary sheets with results of concrete and rock coring and P-S Suspension logging for tested borings are provided as Figures 5 through 12. The results of coring and borehole testing, including interpretation of subsurface geologic materials, are described on Figures 13 through 15. Figures 16 and 17 compare the Plant Relocation P-S Suspension results to COLA (FSAR Revision 6) testing results. Comparison of the Plant Relocation RQD-Based (Static) Modulus Profile for Continuous Rock for Units 1 and 2 nuclear islands to the FSAR Revision 6 results are described in Figures 18 and 19, respectively. Comparison of Plant Relocation Shear-Wave-Based (Static) Modulus Profile for Continuous Rock at Units 1 and 2 to FSAR Revision 6 results are shown in Figures 20 and 21. Figure 22 illustrates the small increase in concrete fill thickness for the 2012 to pre-2012 Dynamic Profile - Base Case A1.

5.1 Visual Logging of Recovered Core

Visual examination of the rock and concrete core samples indicated both were of good quality. The rig geologist visually described the rock core and noted the presence of joints and fractures, distinguishing mechanical breaks from natural breaks where possible. The rig geologist also calculated Rock Quality Designation (RQD) prior to moving the core from the drill site. Field boring logs and photographs were used to document the drilling operations and recovered materials. Descriptions of the lithology, weathering and rock strength characteristics for recovered rock materials were completed according to project approved procedures.

5.1.1 Concrete

No significant surface cracking of the structural slab was noted during the field investigation based on visual inspection of the concrete basemat in and around the completed borings at Unit 1. No concrete was present at boring locations at Unit 2.

5.1.2 Rock – Unit 1

In borings B-2000, B-2001, B-2002, B-2003, and B-2004, continuous rock was encountered beneath the existing concrete. Visual logging characterized the weathering stage and strength characteristics of recovered rock core as described on the boring logs presented in Enclosure 1, Attachment 6 of this letter. Consistent with past evaluations, the rock is generally described as meta-granodiorite to meta-diorite, strong to very strong (R4 to R5). In general, weathering is characterized as fresh/unweathered to slightly weathered with infrequent minor intervals of moderately weathered rock. No significant or pervasive localized zones of highly weathered rock are observed in the recovered core.

Prior to the plant relocation in August 2012, the northwest corner of the WLS Unit 1 nuclear island extended beyond the limits of the existing concrete of the former CNS Unit 1. This locality, beyond the existing concrete, was underlain by a deep weathered rock profile with low RQD values. The relocated WLS Unit 1 nuclear island now lies entirely on the existing concrete of the CNS Unit 1. Boring B-2000, near the northwest corner of the relocated WLS Unit 1, encountered continuous rock with high RQD values under the existing concrete. Boring B-2000 thus confirms that the conditions at the former northwest corner of WLS Unit 1, before relocation, are not present at the northwest corner of the WLS Unit 1 after the 2012 relocation.
Except at the northwest corner before relocation, the rock strength and weathering characteristics in the 2012 borings at WLS Unit 1 are consistent with evaluations presented in

FSAR Revision 6. The discussions concerning the northwest corner of the WLS Unit 1 nuclear island are not relevant to the relocated WLS Unit 1 nuclear island.

5.1.3 Rock – Unit 2

In borings B-2005 and B-2006, continuous rock was encountered at 5 ft. and 3 ft. below the existing ground surface, respectively. Visual logging characterized the weathering stage and strength characteristics of recovered rock core as described on the boring logs presented in Enclosure 1, Attachment 6 of this letter. Consistent with past evaluations, the rock is generally described as meta-granodiorite to meta-diorite, strong to very strong (R4 to R5). In general, weathering is characterized as fresh/unweathered to slightly weathered with infrequent minor intervals of moderately weathered rock. No significant or pervasive localized zones of highly weathered rock are observed in the recovered core.

The rock strength and weathering characteristics in the 2012 borings at WLS Unit 2 are consistent with evaluations presented in FSAR Revision 6.

5.2 Geophysical Logging

Selected boreholes were geophysical logged using acoustic televiewer and/or P-S suspension test methods.

5.2.1 Acoustic Televiewer Logging – Unit 1

The acoustic televiewer was used to image the boring wall in three boreholes (B-2000, B2002, and B-2003) at the relocated WLS Unit 1 with fracture dips and dip azimuths identified. The concrete-rock interface imaged at borings located at Unit 1, B-2000, B2002, B-2003, show that the concrete-rock interface is irregular, very tight, with the absence of major fracturing or separation, and no significant weathering. These televiewer logs confirm that rock below the fill concrete contact exhibits slight to slightly moderate fracturing with slight to moderate weathering.

5.2.2 Acoustic Televiewer Logging – Unit 2

The acoustic televiewer was used to image the boring wall in one borehole (B-2005) at the relocated WLS Unit 2 with fracture dips and dip azimuths identified. The televiewer log at B-2005 exhibits slight to slightly moderate fracturing with slight to moderate weathering with foundation quality rock near the top of hole.

5.2.3 P-S Suspension Logging – Unit 1

In Figure 16, the seismic wave velocities from P-S Suspension data for the relocated Unit 1 nuclear island 2012 borings B-2000 and B-2002 is compared to the results from 2006-2007 logs. Inspection of this figure shows the 2012 shear wave (Vs) and compression wave (Vp) data are consistent with previous results and show good correlation to the COLA data in FSAR Revision 6.

Seismic wave velocities for Unit 1 CNS fill concrete measured in B-2000, were 8330 and 8440 feet per second (ft./sec.) with a corresponding Vp of 15,150 and 15,500 ft./sec. The measured fill concrete velocities are considered to represent very good concrete as shown by the average wave velocities. The values of v for the fill concrete were 0.28 to 0.29 and are slightly higher than the typical range for concrete (v = 0.20 to 0.30).

Note that the shear wave velocity data in the rock at boring B-2000 at the northwest corner of the relocated WLS Unit 1 nuclear island is consistent with the shear wave velocity in other borings for rock beneath the existing concrete of former CNS Unit 1. The P-S velocity data in boring B-2000 thus confirm that the conditions at the former northwest corner of the WLS Unit 1, before relocation, are not present at the northwest corner of the relocated WLS Unit 1 nuclear island.

The comparisons described above show that the Vs and Vp data at WLS Unit 1 from the 2012 borings is consistent with the 2006-2007 borings; thus the dynamic profile (Base Case A1 – Unit 1, FSAR Figure 2.5.4-252) for the Unit 1 relocated nuclear island is valid for the relocated plant. Note that the FIRS A1 – Unit 1 dynamic profile has 3 ft. thickness of fill concrete added to the top of the profile due to the raised plant elevation and is shown in Figure 22. The local velocity profile B (FSAR Figure 2.5.4-249) at the northwest corner of WLS Unit 1, before relocation, does not exist at the northwest corner of the relocated WLS Unit 1 and therefore is not considered as part of this evaluation.

5.2.4 P-S Suspension Logging – Unit 2

In Figure 17, the seismic wave velocities from P-S Suspension data for the relocated Unit 2 nuclear island 2012 boring B-2005 is compared to the results from 2006-2007 logs. Inspection of this figure shows the 2012 shear wave and compression wave data are consistent with previous results and show good correlation to the COLA data in FSAR Revision 6.

The comparison described above shows that the Vs and Vp data at WLS Unit 2 from the 2012 borings is consistent with the 2006-2007 borings; thus the dynamic profile (Smoothed Profile C – Unit 2 (FSAR Figure 2.5.4-250)) for the Unit 2 relocated nuclear island is valid for the relocated plant.

6.0 EVALUATION OF PLANT RELOCATION FIELD EXPLORATION RESULTS TO COLA RESULTS

This chapter describes the changes that are expected to be made to FSAR Subsections 2.5.4.2.4, 2.5.4.3, 2.5.4.5, 2.5.4.6, 2.5.4.7, and 2.5.4.10 based on the 2012 plant relocation and elevation change, as well as the new geotechnical field data consisting of geotechnical borings and geophysical tests that were obtained from recent explorations completed at the relocated nuclear islands in 2012. No additional exploration of facilities beyond the nuclear islands was conducted in 2012. This section presents a qualitative comparison of the field conditions at the relocated plant location with respect to the conditions at the initial plant location described in FSAR Revision 6 and prior. Potential changes to the results and conclusions in the existing FSAR Revision 6, if any, are identified.

The 2012 field data has been reviewed and based on this review the rock and foundation conditions at the relocated nuclear islands are the same as those at the nuclear islands before their relocation with the exception that the localized weathered rock condition related to the northwest corner of Unit 1 before relocation does not exist beneath the northwest corner of the Unit 1 after the relocation.

6.1 Evaluation of FSAR Subsection 2.5.4.2.4, Material Properties

Minor text revisions will be made in various locations throughout FSAR Subsection 2.5.4.2.4 as necessary to accommodate the relocated plant structures and the results of recently-completed geotechnical exploration. The geotechnical model described will not be revised because the 2012 explorations encountered only materials already included in the geotechnical model. No additional laboratory tests were performed, so the static soil properties described in FSAR Subsection 2.5.4.2.4.2 and supporting tables and figures are unchanged.

No significant changes to this subsection are required.

6.2 Evaluation of FSAR 2.5.4.3, Foundation Interfaces

Text revisions will be made in various locations throughout FSAR Subsection 2.5.4.3 as necessary to describe the relocated plant structures and the results of recently-completed geotechnical exploration. The description of the power block exploration in FSAR Subsection 2.5.4.3.1 will be updated to reflect the relocated plant structures and the results of geotechnical and geophysical explorations performed in 2012. Borehole Summary figures presented as Figures 6 through 12 of this enclosure, prepared using for 2012 boring data including P-S velocity logging, will be referenced in FSAR Subsection 2.5.4.3.4. The geotechnical plan and profile drawings described in FSAR Subsection 2.5.4.3.5 will be updated to reflect the relocated plant structures and the results of the 2012 explorations in a future revision of the FSAR.

6.3 Evaluation of FSAR 2.5.4.5, Excavations and Backfill

FSAR Subsection 2.5.4.5 will be revised to indicate that, within the foundation support zone of the SC-II annex building area and the SC-II turbine building first bay, the soil and partially weathered rock (PWR) will be removed to rock (the foundation support zone of these SC-II buildings is defined in the AP1000 DCD as being within a prism whose sides extend at 1:1 (horizontal:vertical) from the base edge of the structural foundations). If the rock, (or, in the case of Unit 1, existing concrete), elevation is below the elevation of the bottom of the nuclear island, the foundation support zone will use fill concrete to build up to the elevation of the bottom of the nuclear island before placing granular fill to support the SC-II structures near plant grade. If the elevation of the existing concrete or rock is above the bottom of the nuclear island, the concrete or rock will be removed to the elevation of the bottom of the nuclear island.

FSAR Subsection 2.5.4.5 will also note that the excavation for the foundation support zone of the SC-II annex building at Unit 1 may expose PWR or fractured rock in the northwest corner. This will be a relatively small area at the extreme northwest extent of the annex building support zone, and will not affect the demands on the annex building. The majority of the foundation support zone for the SC-II annex building of Unit 1 will, upon excavation, expose rock or CNS Unit 1 concrete over rock.

FSAR Subsection 2.5.4.5.2.1 – Unit 1 Excavation Conditions, will be revised to illustrate that the former CNS auxiliary building mat and some underlying rock is removed in the south end of the relocated nuclear island because the CNS auxiliary building mat in this area is at an elevation higher than the nuclear island of the relocated WLS Unit 1. Otherwise, the CNS auxiliary building mat will remain in-place beneath the relocated nuclear island except where a 2 ft. strip must be removed to remove the isolation joint surrounding the former CNS Unit 1 circular reactor building mat.

FSAR Subsection 2.5.4.5.2.1 – Unit 1 Excavation Conditions, will be revised to remove consideration of the deep profile of weathered rock that occupied the area northwest of the corner of the WLS Unit 1 nuclear island before it was relocated southeast in August, 2012.

FSAR Subsection 2.5.4.2.2 – Unit 2 Excavation Conditions, will be revised to note that the eastern edge of the relocated nuclear island will require about 20 ft. of fill concrete between the bottom of the nuclear island and the top of continuous rock. The central and western portions of the relocated WLS Unit 2 nuclear island will require only minimal thicknesses of fill concrete.

FSAR Subsection 2.5.4.5.3 – Specifications and Control, will require no changes.

FSAR Subsection 2.5.4.5.3.1 – Nuclear Island Foundation Materials, will require no changes.

FSAR Subsection 2.5.4.5.3.2 – Fill Concrete beneath the Nuclear Island Foundation Limits, will be revised to indicate the requirements for fill concrete are also applicable to the fill concrete that is used to build up the rock surface exposed by excavation to the same level as the bottom of the nuclear island foundation in the foundation support zones of the SC-II building areas (annex building and turbine building first bay).

FSAR Subsection 2.5.4.5.3.3 – Foundation Materials Outside the Nuclear Island, will be revised to describe the requirement for rock, fill concrete, or partially weathered rock to support the granular backfill within the foundation support zone of the SC-II annex building and the SC-II turbine building first bay.

FSAR Subsection 2.5.4.5.3.4 – Fill Concrete Outside the Nuclear Island Foundation Limits, will be revised to note that requirements for fill concrete used within the foundation support zone of the SC-II building areas adjacent to the nuclear island (see FSAR Subsection 2.5.4.5.3.2).

FSAR Subsection 2.5.4.5.3.5 – Granular Backfill Outside the Nuclear Island, will require no changes.

6.4 Evaluation of FSAR 2.5.4.6, Groundwater Conditions

FSAR Subsection 2.5.4.6 – Groundwater Conditions, will be revised to note changes to the nuclear island elevation and corresponding standard plant elevation. The elevation used to confirm the DCD design groundwater characteristic will be revised to conform to the change in vertical position of the plant. No other changes are planned for this section.

6.5 Evaluation of FSAR 2.5.4.7, Response of Soil and Rock to Dynamic Loading

Revisions will be made in various locations throughout FSAR Subsection 2.5.4.7 as necessary to describe the relocated plant structures, the results of recently-completed compressional and shear wave velocity logging, and foundation condition and uniformity. The description of the compressional and shear wave velocity logging in FSAR Subsection 2.5.4.7.2 will be updated to reflect geophysical explorations performed in 2012. FSAR Subsection 2.5.4.7.4 – Foundation Conditions and Uniformity will be updated to reflect the relocated plant structures based on the results of the 2012 explorations.

FSAR Subsection 2.5.4.7.1 – Prior Earthquake Effects and Geologic Stability, will require no changes.

FSAR Subsection 2.5.4.7.2 – Field Dynamic Measurements, will be revised to reflect geophysical explorations performed in 2012 and 2006-2007. This subsection will be revised to remove information associated with geophysical logging of borings B-1074A and B-1075A located in the former Unit 1 northwest corner of the nuclear island performed in 2006-2007. The August 2012 plant relocation shifted the Unit 1 nuclear island 50 ft. east and 66 ft. to the south of the proposed location in 2006-2007. The local lower seismic velocities at the Lee Nuclear Station Unit 1 northwest corner are no longer representative of conditions beneath the Lee Nuclear Station Unit 1 nuclear island in its relocated position. In 2012, borehole P-S suspension log seismic velocity surveys were made in the relocated nuclear island positions to obtain new data at the relocated plant site and to confirm geologic and geotechnical evaluations described in the FSAR, Revision 6. The locations of these 2012 P-S velocity measurements will be included on FSAR Figure 2.5.4-215.

FSAR Subsection 2.5.4.7.4 – Foundation Conditions and Uniformity, will be revised to reflect foundation conditions and uniformity for the relocated nuclear islands. Compliance with the subsurface uniformity criteria as described in DCD Subsection 2.5.4.5 is confirmed as part of the 2012 evaluations.

FSAR Subsection 2.5.4.7.4.1 – Lee Nuclear Station, Unit 1 Nuclear Island

The foundation support zone for the relocated Lee Nuclear Station nuclear island is entirely underlain by the footprint of the existing concrete foundation of Cherokee Nuclear Station Unit 1 which is underlain by continuous rock. Discussions concerning the northwest corner of the Lee Nuclear Station Unit 1 nuclear island and its extension beyond the limits of the Cherokee

Nuclear Station structure are not relevant to the relocated Lee Nuclear Station Unit 1 nuclear island and will therefore be removed from the FSAR.

FSAR Subsection 2.5.4.7.4.2 – Lee Nuclear Station, Unit 2 Nuclear Island

This subsection will be revised to reflect the maximum thickness of fill concrete is about 16 to 20 feet beneath the east portion of the nuclear island, but generally will be less than about 1 to 2 feet.

FSAR Subsection 2.5.4.7.5 – Dynamic Profile

This subsection will describe comparisons demonstrating that the Vs and Vp data at WLS Unit 1 from the 2012 borings is consistent with the 2006-2007 borings; thus the dynamic profile (Base Case A1 – Unit 1, FSAR Figure 2.5.4-252) for the Unit 1 relocated nuclear island is valid for the relocated plant. Note that the FIRS A1 – Unit 1 dynamic profile has 3 ft. thickness of fill concrete added to the top of the profile due to the raised plant elevation (FSAR Figure 2.5.4-252a). The local velocity profile B (FSAR Figure 2.5.4-249) at the northwest corner of WLS Unit 1, before relocation, does not exist at the northwest corner of the relocated WLS Unit 1 and therefore is not considered as part of this evaluation. Profile B (FSAR Figure 2.5.4-249) will be removed from this subsection as this discussion is no longer relevant to the Unit 1 nuclear island assessments as a result of plant relocation. The 2012 data, by inspection, indicate conclusively that the local lower velocities at the Lee Nuclear Station Unit 1 northwest corner are no longer representative of conditions beneath the Lee Nuclear Station Unit 1 nuclear island in its relocated position.

Change in the shear wave velocity profile attributed to the increased concrete fill thickness (3 ft.) at the hard rock condition is anticipated to result in a negligible variation in site response calculations for relocated Unit 1. The additional thickness of fill concrete amounts to a 15% increase in the fill concrete profile for relocated FIRS A1 for the relocated Lee Nuclear Station Unit 1 nuclear island. The average shear wave velocity of the shear wave velocity profile with the added concrete will be only slightly different from the average shear wave velocity of the profile before the addition of the 3 ft. of fill concrete. This will have no practical significance on differential shear wave velocity, site amplification or foundation performance and compliance with the subsurface uniformity criteria as described in DCD Subsection 2.5.4.5.

FSAR Subsection 2.5.4.7.5 will describe comparisons demonstrating that the Vs and Vp data at WLS Unit 2 from the 2012 borings is consistent with the 2006-2007 borings. FSAR Subsection

2.5.4.2.2 describes the Unit 2 excavation conditions and notes that the eastern edge of the relocated nuclear island will require about 20 ft. of fill concrete between the bottom of the nuclear island and the top of continuous rock. This relatively small area of fill concrete required to build up the eastern edge of the Unit 2 nuclear island basemat will not result in localized adverse conditions due to the relatively small difference in shear wave velocity of fill concrete (7,500 ft./sec.) and rock (8391 to 8983 ft./sec.) in this area. The fill concrete conditions described for the relocated Lee Nuclear Station Unit 2 nuclear island eastern portion have no practical significance on differential shear wave velocity, site amplification or foundation performance and compliance with the subsurface uniformity criteria as described in DCD Subsection 2.5.4.5. The dynamic profile (Smoothed Profile C – Unit 2 (FSAR Figure 2.5.4-250) for the Unit 2 relocated nuclear island is valid for the relocated plant.

The shear wave velocities presented in FSAR Tables 2.5.4-224a, 2.5.4-224b, and 2.5.4-224c are estimated based on the ground surface (yard elevation) at Elevation 589.5 feet. The change of the yard to Elevation 592 feet adds 2.5 feet of non-buoyant soil weight over the layers in these tables, resulting in slightly higher wave velocities. The slightly higher shear wave velocities for the yard at Elevation 592 feet averaged over a profile depth of 40 feet are 0.9% to 2.3% higher than those based on the previous yard at Elevation 589.5 ft. Thus, the shear wave velocities and other parameters summarized in FSAR Tables 2.5.4-224a, 2.5.4-224b, and 2.5.4-224c are representative of shear wave velocities and shear modulus values associated with either yard elevation (589.5 feet or 592 feet). The same is true for the modulus ratio and damping ratio results in FSAR Tables 2.5.4-224d, 2.5.4-224e and 2.5.4-224f. In all the tables, the depth reference is the ground surface.

6.6 Evaluation of FSAR 2.5.4.10, Static Stability

The nuclear island bearing capacity and settlement analyses consider borings in the Unit 1 and Unit 2 vicinities. As a result of the plant relocation and 2012 explorations, the borings considered for the Unit 1 and Unit 2 bearing capacity and settlement analyses will be revised as summarized in the table below. In the following, "initial assessment for this enclosure" refers to bearing capacity or settlement assessment using boring data representative of the relocated nuclear islands but not including the borings completed in 2012.

	Unit 1	Unit 2
Borings removed for initial assessment for this enclosure and for a future revision of the FSAR	B-1074A and B-1075A	None
Borings added for initial assessment for this enclosure	B-1005, B-1007, B64 [(1)], and B151P [(1)]	B-1021 and B66 [(1)],
Borings added for a future revision of the FSAR	B-1005, B-1007, B64 [(1)], B151P [(1)], B-2000, B-2001, B-2002, B-2003 and B-2004[(2)]	B-1021, B66 [(1)], B-2005 and B-2006[(2)]

(1) Historic borings from CNS explorations.

(2) Boring B-2000 series completed in 2012.

6.6.1 Bearing Capacity of Nuclear Islands

The bearing capacity of the Unit 1 and Unit 2 relocated nuclear island foundation is evaluated for each unit. Two independent methods are used to determine the bearing capacity of the foundation materials. The first method is based on the RQD of the rock. The second method is based on the strength of the rock.

The allowable bearing pressure method utilizes an empirical relationship between allowable bearing pressure and average RQD. The allowable bearing pressure determined from this empirical relationship is compared to the required allowable bearing capacity provided in the DCD Subsection 2.5.4.2. RQD data are compared in Figures 18 and 19 by way of computing the RQD-based Young's modulus as described later herein (subsection 6.6.2). On Figure 18a, RQD data for the Unit 1 nuclear island 2012 borings is compared to that from the 2006-2007 borings used for the calculation supporting FSAR Revision 6. Figure 18b compares RQD data with the values used in the initial assessment for this enclosure. Similarly, Figures 19a and 19b show the RQD data for the Unit 2 nuclear island 2012 borings compared to that used for input to the FSAR Revision 6 and to the initial assessment for this enclosure, respectively. These comparisons show that the RQD data from the 2012 borings is consistent with the previous data from the 2006-2007 borings and the historic CNS borings. Thus the allowable bearing pressure determined from the RQD data for the Unit 1 and Unit 2 relocated nuclear islands including the 2012 boring data will be comparable to the allowable bearing pressures for the nuclear islands in their 2006-2007 locations and to that for the relocated nuclear islands as determined in the initial assessment for this enclosure. Thus, there will be no change to the conclusion in the FSAR Revision 6 that the allowable bearing pressure at the relocated positions of the Lee Nuclear Station Unit 1 and Unit 2 nuclear islands will exceed the bearing requirements provided in the DCD.

The ultimate bearing capacity method utilizes Hoek-Brown parameters of the rock mass to establish the Mohr-Coulomb parameters of friction angle and cohesion for the rock. The bearing capacity factors are determined based on the established Mohr-Coulomb parameters. The rock quality evaluated from the 2012 borings in the relocated positions of the Unit 1 and Unit 2 nuclear islands is comparable to the rock quality in the 2006-2007 locations and in the relocated positions as described for the initial assessment for this enclosure (note that borings B-1074A and B-1075A are removed from consideration in the relocated WLS Unit 1 nuclear island). The Hoek-Brown parameters of the rock mass are the same for the 2012 locations as they were for the 2006-2007 locations and the relocated positions in the initial location. Thus, there will be no change to the conclusion in the FSAR Revision 6 that the allowable bearing pressure at the relocated positions of the Lee Nuclear Station Unit 1 and Unit 2 nuclear islands, including the 2012 boring data, will exceed the bearing requirements provided in the DCD.

6.6.2 Settlement of Nuclear Islands

Estimates of post-construction settlement are calculated separately for relocated Unit 1 and Unit 2 based on the theory of elasticity. Three settlement methods (equations) are employed for estimation of settlement beneath the nuclear island using this approach. The three methods used are the Steinbrenner equation, the Corps of Engineers equation, and the Boussinesq equation. The calculations utilize rock modulus values determined from the RQD values and from the seismic shear wave velocities.

The calculations estimate settlement resulting from static loading of the nuclear island foundation bearing directly on rock or bearing on a depth of fill concrete in turn resting on rock.

The RQD-based Young's modulus values are compared in Figures 18 and 19. On Figure 18a, RQD-based Young's modulus values for the Unit 1 nuclear island 2012 borings is compared to that from the 2006-2007 borings used for the calculation supporting FSAR Revision 6. Figure 18b compares RQD-based Young's modulus values with the values used to make initial assessments described in this enclosure. Similarly, Figure 19a and 19b show the RQD-based

Young's modulus values for the Unit 2 nuclear island 2012 borings compared to that used for input to the FSAR Revision 6 and to make initial assessments described in this enclosure, respectively. These comparisons show that the RQD-based Young's modulus values from the 2012 borings is consistent with the previous data from the 2006-2007 borings and the historic CNS borings. Thus the elastic settlement values determined from the RQD-based Young's modulus profiles for the Unit 1 and Unit 2 relocated nuclear islands will be comparable to the settlement values for the nuclear islands in their 2006-2007 locations and to that for the relocated nuclear islands as determined in the initial assessment for this enclosure. Thus, there will be no change to the conclusion in the FSAR Revision 6 that the settlement of the relocated positions of the Lee Nuclear Station Unit 1 and Unit 2 nuclear islands, including the 2012 boring data, is within the limits allowed by the DCD.

In Figure 20, the Young's modulus values for the Unit 1 nuclear island computed from the P-S velocity measurements and reduced by 50 percent are compared to the Young's modulus values from the P-S velocity measurements in the 2006-2007 locations and used for the settlement predictions in the FSAR Revision 6 and to make initial assessment for this enclosure. Figure 21 compares the Young's modulus values for the Unit 2 nuclear island based on the P-S velocity measurements in 2012 and in 2006-2007 and to and make initial assessment for this enclosure. Inspection of Figures 20 and 21 indicates the Young's modulus values derived from the 2012 P-S velocity measurements are consistent with those from the 2006-2007 measurements. Thus, elastic settlement values calculated for the relocated nuclear islands considering the Young's modulus values adjusted for the shear wave velocity measurements for the rock at the 2012 relocations will be similar to those for the 2006-2007 locations for Lee Nuclear Station Unit 1 and Unit 2 nuclear islands.

Based on the consistency of RQD values and P-S seismic velocity values in the 2012 and 2006-2007 borings at Lee Nuclear Station Unit 1 and Unit 2, the settlement calculated for the relocated nuclear islands will be similar to the settlements calculated for the 2006-2007 locations as contained in the FSAR, Revision 6 and those used to make initial assessments described in this enclosure. Thus, there will be no change to the conclusion in the FSAR Revision 6 that the settlement of the relocated positions of the nuclear islands, including 2012 boring data, is within the limits allowed by the DCD.

6.6.3 Bearing Capacity and Settlement of Adjacent Structures

The bearing capacity of the non-safety related structures adjacent to the relocated nuclear islands [radwaste buildings, annex buildings (both non-seismic and Category II portions), and turbine buildings] is evaluated using allowable bearing pressure and using ultimate bearing capacity, and the results are applicable to each unit.

The allowable bearing pressure method is used to estimate the allowable bearing pressure to limit settlement based on SPT blow count of the granular fill. This method determines the allowable foundation loading which, if not exceeded, will result in settlements not to exceed 1 inch for smaller footings and not to exceed 2 inches for larger foundation areas (e.g., mat foundations). The ultimate bearing capacity is also calculated to verify that foundations that would appear not to undergo the limiting settlement also have an acceptable margin of safety against a bearing capacity failure.

The relocation of the nuclear islands in 2012 also involved raising the plant yard elevation by 2.5 feet. This effectively places the water table deeper below the bottom of the foundations bearing in the granular fill. This increases the computed ultimate bearing capacity and allowable bearing pressure of foundations in the granular fill. Thus there will be no change to the conclusion expressed in the FSAR Revision 6 that the foundations supported on the granular fill will perform as intended and will meet the requirements for these foundations.

6.6.4 Lateral Pressures on Nuclear Island Foundation Walls

The relocated plant structures also involved raising the plant yard elevation by 2.5 ft. The design high and low groundwater elevations remained unchanged so that the depth to the high and low groundwater levels is increased by 2.5 ft., thus increasing the lateral earth pressures on the nuclear island foundation walls by a small amount due to the extra thickness of non-buoyant soil above the water table.

7.0 CONCLUSIONS

The preliminary assessments of the plant relocation geotechnical investigation evaluated in this enclosure confirm that the geological, seismological, and geotechnical engineering information described in the Lee Nuclear Station FSAR Revision 6 are valid for the relocated units. The foundation support zone for the relocated WLS Unit 1 nuclear island is entirely underlain by the footprint of the existing concrete foundation of the CNS Unit 1 which is underlain by continuous rock. Discussions and analysis results contained in FSAR Revision 6 concerning the northwest corner of the WLS Unit 1 nuclear island are not relevant to the relocated WLS Unit 1 nuclear island and will therefore be deleted from subsequent revisions to the FSAR. Otherwise, the key geotechnical and seismological interfaces described in FSAR Revision 6 are confirmed to be valid.

The summary presented below describes the relevant findings and conclusions for FSAR Section 2.5 and Section 3.7.

7.1 FSAR Chapter 2.5, Geology, Seismology, and Geotechnical Engineering

7.1.1 FSAR Subsection 2.5.1, Basic Geologic and Seismic Information

Subsection 2.5.1 describes basic geological and seismologic information.

- The logs of borings confirm similar rock characteristics as described in the site area geologic characteristics presented in FSAR Revision 6.
- No significant changes to the site area geology information presented in FSAR 6 Subsection 2.5.1 are planned for future revisions of the FSAR.

7.1.2 FSAR Subsection 2.5.2, Vibratory Ground Motion

- Subsection 2.5.2 presents the vibratory ground motion at the site, including the Ground Motion Response Spectra (GMRS) and Foundation Input Response Spectra (FIRS) for the Lee Nuclear Site. Evaluations conducted as part of the relocation geotechnical investigation confirm that the site dynamic profiles used to compute the site-specific GMRS (FSAR Figure 2.5.4-250) and FIRS A1 (FSAR Figure 2.5.4-252) spectra described in FSAR Revision 6 remain valid and are suitable for evaluations of the AP1000 seismic design (FSAR Section 3.7).

- For relocated Unit 1 the addition of 3 ft. of fill concrete to bring up the basemat level to 553.5 ft. will increase the horizontal and vertical spectra a small increment at frequencies of about 20 Hz and above. The additional thickness of fill concrete amounts to a 15% increase in the fill concrete profile for relocated FIRS A1 (Figure 22) for the relocated Lee Nuclear Station Unit 1 nuclear island. The average shear wave velocity of the shear wave velocity profile with the added concrete will be only slightly different from the average shear wave velocity of the profile before the addition of the 3 ft. of fill concrete. Because of this 15% increase in fill concrete thickness from 20 ft. to 23 ft., the resulting FIRS in the new Unit 1 location can be expected to have similar characteristics compared to GMRS, but will likely be somewhat more pronounced. FSAR Figures 3.7-201 and 3.7-202 illustrate the comparison between

GMRS and FIRS A1 based upon 20 feet of fill concrete on top of hard rock. This small increase in seismic demand associated with the addition of 3 feet of fill concrete is unlikely to deplete the existing margin reflected in the current site-specific analysis shown in FSAR Figures 3.7-206a through 3.7-208c. This small change in fill concrete thickness will have no practical significance on differential shear wave velocity, site amplification or foundation performance and compliance with the subsurface uniformity criteria as described in DCD Subsection 2.5.4.5. Based on this evaluation, the site-specific nuclear island analysis presented in FSAR Figure 3.7-201 in the former locations can also be considered applicable to the revised locations.

- For relocated Unit 2, the eastern edge of the relocated nuclear island foundation will be supported on about 20 ft. of fill concrete between the bottom of the nuclear island and the top of continuous rock (FSAR Subsection 2.5.4.4.2). This relatively small localized area of concrete fill underlying the eastern edge of the relocated Unit 2 nuclear island will not result in localized amplification / deamplification effects due to the relatively small difference in the average shear wave velocities for fill concrete (7,500 ft./sec.) and surface rock (8391 ft./sec. to about 8983 ft./sec.) in this area (FSAR Figure 2.5.4-250). The addition of fill concrete to support the relocated Lee Nuclear Station Unit 2 nuclear island eastern portion will have no practical significance on differential shear wave velocity, site amplification or foundation performance and compliance with the subsurface uniformity criteria as described in DCD Subsection 2.5.4.5.
- Site-specific ground motion evaluations currently described in FSAR Subsection 2.5.2 will be confirmed as part of an update to existing project calculations in support of a future revision to the FSAR.
- Only minor changes to the text of the vibratory ground motion subsection presented in FSAR Revision 6 are planned for a future revision to the FSAR.

7.1.3 FSAR Subsection 2.5.3, Surface Faulting

Subsection 2.5.3 describes the potential for surface faulting in the site area.

- Evaluations for the potential of surface faulting were beyond the scope of the plant relocation geotechnical investigation. No information derived from the plant relocation investigation is conceived to exist that would result in significant changes relevant to this subsection.
- No significant changes to FSAR Subsection 2.5.3 conclusions currently presented in FSAR Revision 6 are planned for a future revision of the FSAR.

7.1.4 FSAR Subsection 2.5.4, Stability of Subsurface Materials and Foundations

Subsection 2.5.4, describes the stability of subsurface materials and foundations.

- Evaluations for the stability of subsurface materials and foundations were the primary focus of the plant relocation geotechnical investigation program.
- Compression and shear wave velocities measured at WLS Unit 1 and Unit 2 2012 borings are consistent with the 2006-2007 borings.
  - Unit 1 – Dynamic profile (Base Case A1 – Unit 1, FSAR Figure 2.5.4-252) for the Unit 1 relocated nuclear island is valid for the relocated plant. Note that the FIRS A1 – Unit 1 dynamic profile has 3 ft. thickness of fill concrete added to the top of the profile due to the raised plant elevation (Figure 22). Local velocity profile B (FSAR Figure 2.5.4-249) at the northwest corner of WLS Unit 1, before relocation, does not exist at the northwest corner of the relocated WLS Unit 1 and therefore is not considered as part of this evaluation. Profile B (FSAR Figure 2.5.4-249) will be removed from this subsection in a future revision of the FSAR.
  - Unit 2 - Dynamic profile (Smoothed Profile C – Unit 2 (FSAR Figure 2.5.4-250) for the Unit 2 relocated nuclear island is valid for the relocated plant.
- The allowable bearing pressure at the relocated positions of the WLS Unit 1 and Unit 2 nuclear islands will exceed the bearing requirements provided in the DCD.
- There will be no change to the conclusion in the FSAR, Revision 6 that the allowable bearing pressure at the relocated positions of the Lee Nuclear Station Unit 1 and Unit 2 nuclear islands will exceed the bearing requirements provided in the DCD.
- The settlement of the relocated nuclear islands is within the limits allowed by the DCD.
- There will be no change to the conclusion expressed in the FSAR Revision 6 that the foundations supported on the granular fill will perform as intended and will meet the requirements for these foundations.
- The Lee Nuclear Station site is considered a hard rock site with rock having a shear wave velocity generally greater than 8,000 ft./sec. The rock underlying the relocated WLS Units 1 and 2 nuclear islands complies with the subsurface uniformity criteria as described in DCD Subsection 2.5.4.5.

7.1.5 FSAR Subsection 2.5.5, Stability of Slopes

Subsection 2.5.5 describes that stability of slopes which could adversely affect the safety of the seismic Category I plant components.

- There are no permanent slopes within one-quarter mile radius whose failure would impact the relocated WLS nuclear island facilities.

- No change to the FSAR Subsection 2.5.5 conclusions presented in FSAR Revision 6 is planned for a future revision of the FSAR.

7.2 FSAR Chapter 3.7, Seismic Design

Subsection 3.7 describes the design ground motion response spectra at the site, including comparisons of the site-specific Ground Motion Response Spectra (GMRS) and Foundation Input Response Spectra (FIRS) for the Lee Nuclear Site to certified seismic design response spectrum (CSDRS) and the AP1000 generic hard rock spectrum (WEC).
Additional geotechnical field data was obtained in 2012 to obtain new data at the relocated plant site to confirm geologic and geotechnical evaluations described in the FSAR Revision 6. The 2012 field data confirm similar rock subsurface conditions for the relocated structures to those evaluated from the 2006-2007 field data before relocation. The only exception is that the 2012 field data confirm that the deep weathered rock beneath the northwest corner of Unit 1, before relocation, is not present beneath the northwest corner of Unit 1 after relocation in 2012.

For relocated WLS Unit 1, the foundation support zone for the relocated nuclear island is entirely underlain by the footprint of the existing concrete foundation of Cherokee Nuclear Station Unit 1 which is underlain by continuous rock. The 2012 field data indicates conclusively that the deeply weathered rock condition beyond the northwest corner of Unit 1, before relocation in 2012, does not exist beneath the northwest corner of Unit 1 after relocation. Discussions concerning the northwest corner of the Lee Nuclear Station Unit 1 nuclear island and its extension beyond the limits of the Cherokee Nuclear Station structure are not relevant to the relocated Lee Nuclear Station Unit 1 nuclear island and will therefore be deleted from the FSAR.

For relocated Unit 2, the eastern edge of the relocated nuclear island foundation will be supported on about 20 ft. of fill concrete between the bottom of the nuclear island and the top of continuous rock (FSAR Subsection 2.5.4.4.2). This relatively small localized area of concrete fill underlying the eastern edge of the relocated Unit 2 nuclear island will not result in localized amplification / deamplification effects due to the relatively small difference in the average shear wave velocities for fill concrete (7,500 ft./sec.) and surface rock (8391 ft./sec. to about 8983 ft./sec.) in this area (FSAR Figure 2.5.4-250).

- FSAR Subsection 3.7.1.1.1 Design Ground Motion Response Spectra results remain valid and are suitable for evaluations of the relocated AP1000 nuclear islands with the exception of evaluations for the northwest corner WLS Unit 1. The discussions concerning the northwest corner of the WLS Unit 1 nuclear island are not relevant to the relocated WLS Unit 1 nuclear island.

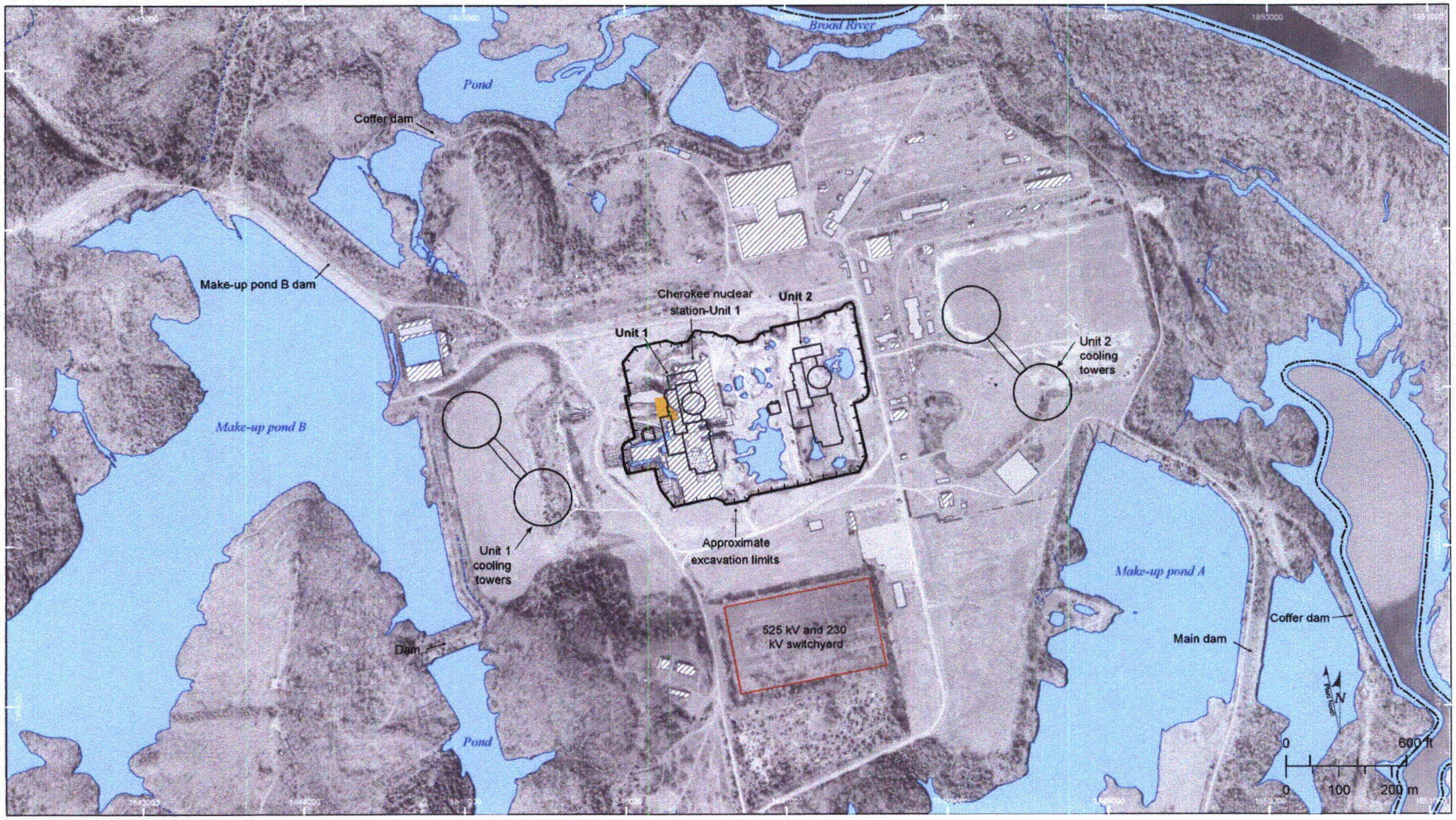
- FSAR Subsection 3.7.2.8.4 Seismic Modeling and Analysis of Seismic Category II Building results remain valid and are suitable for evaluations of the relocated AP1000 Seismic Category II Buildings. The analyses in FSAR Reference 3.7-205 consider a range of granular fill thicknesses from approximately ten feet thicker than that considered in the DCD to approximately 10 feet thinner than that considered in the DCD. Duke Energy's decision to relocate the plant also replaces the lower portions of thick granular fill with fill concrete which is very similar to the hard rock considered in the DCD. Natural rock that would make the granular fill thinner than considered in the DCD will also be removed. As a result, the site-specific range of cases considered in FSAR Reference 3.7-205 bounds the conditions associated with the chosen configuration supporting the Seismic Category II buildings, including raising the nuclear islands by three feet.
- Only minor changes to the text of the seismic design subsection presented in FSAR Revision 6 are planned for a future revision of the FSAR with the exception of evaluations for the northwest corner WLS Unit 1. The discussions concerning the northwest corner of the WLS Unit 1 nuclear island are not relevant to the relocated WLS Unit 1 nuclear island.

Table 1

Summary of Completed Borings and In-Situ Testing, 2012 Plant Relocation

Facility or Zone	Boring Number	Coordinates and Elevation			Boring Type					Depth (ft bgs)		In-Situ Testing					
		Northing	Easting	Elevation (ft MSL)	Rock Coring		Soil Sampling Method			Proposed	Actual	P-S Velocity	Downhole Velocity	Televiewer	Goodman Jack	Pressure-meter	Packer Test
					HQ	NQ(5)	SPT	UD	CME								
Power Block AP1000 (Nuclear Island)																	
Unit 1	**B-2000**	1166027.29	1846301.71	544.45	X					125	126	X		X			
(Basemat Elevation 553.5 ft.)	**B-2001**	1165894.29	1846423.34	544.47		X				100	100.5						
	B-2002	1165782.16	1846364.98	558.84		X				100	225.6	X		X			
	B-2003	1165773.77	1846448.63	559.03	X					225	54.6	(Note 6)		X			
	B-2004	1165936.81	1846506.19	544.55		X				100	101						
Unit 2	**B-2005**	1165972.37	1847267.57	550.28	X					225	225	X		X			
(Basemat Elevation 553.5 ft.)	**B-2006**	1166175.58	1847173.13	558.37		X				100	101						

Notes:
1. Locations indicated in **black** depict exploration points intended to confirm conditions similar to those described in FSAR Revision 6.
2. ft bgs = feet below ground surface
3. ft MSL = feet above mean sea level
4. Coordinate and elevation values represent the as-drilled positions. Northing and Easting values are the same coordinate system used in FSAR Table 2.5.4-203.
5. Where NQ coring is specified, HQ coring was performed for convenience.
6. Boring B-2003 was planned to be a 225 foot deep boring with P-S Velocity logging and Acoustic Televiewer testing. Boring B-2002 was planned to be a 100 foot deep boring with no in-situ testing. Boring B-2003 experienced issues with the verticality of the borehole which lead to excessive vibrations of the drilling equipment during rock coring beginning at a depth of about 36 feet. Continuing to advance boring beyond the completed depth of 54.6 feet would have likely lead to damage to the drilling equipment and was not considered practical. The decision was made to drill Boring B-2002 to a depth of 225 feet and to perform P-S Velocity logging and Acoustic Televiewer testing in Boring B-2002. Boring B-2003 was terminated at its drilled depth of 54.6 feet with no P-S Velocity logging but with Acoustic Televiewer testing.



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NUCLEAR STATION UNITS 1 & 2

Site Features of Lee Nuclear Station
Unit 1 and 2 Area

FIGURE 1

Explanation

WLS Borings

- CPT
- SCPT
- Geotech boring
- Monitoring well - other facilities
- Monitoring well - power block area
- Other facilities
- Principal boring
- Secondary boring
- UD boring
- Test pit
- Test pit trench

Historic Borings (Cherokee)

- Boring location (information available)
- Boring location (information not available)

WLS Borings (2012)

- Plant relocation investigation boring

Symbols

- Project limits
- SASW survey line
- Cross section location
- Cooling tower
- Pipeline
- Power Block configuration
- Crane pedestal
- Limits of excavated area
- 525 kV and 230 kV switchyard
- CNS Unit 1 turbine building condenser pit
- Lee Nuclear Station nuclear island
- CNS existing structure
- Concrete slab surface
- Concrete slab, buried
- Stream course
- Water body

5' Topographic Contours

- Certain
- Approximated

Sources: Site topography and structure - Sanborn 2006
Shaw, Stone & Webster, September, 2007

Coordinate System: South Carolina State Plane, NAD83 Int'l Feet
Vertical - NAVD88

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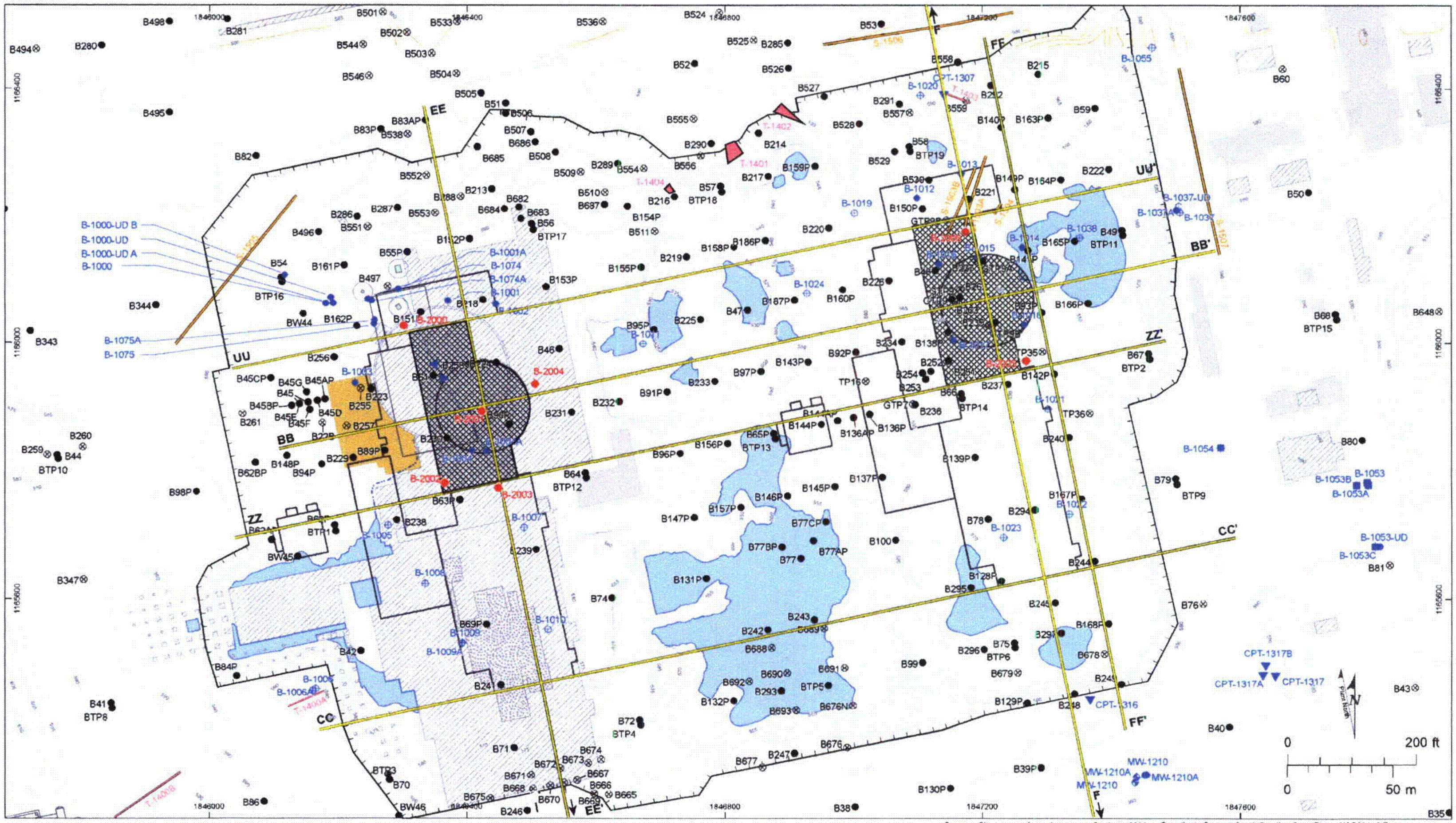
Site Exploration Map - Explanation

FIGURE 2



Sources: Site topography and structure - Sanborn, 2006
Shaw, Stone & Webster, September, 2007

Coordinate System: South Carolina State Plane, NAD83 Int'l Feet
Vertical - NAVD88

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Site Exploration Map - Power Block and Adjacent Areas - Map

FIGURE 3

Sources: Site topography and structure - Sanborn, 2006
Shaw, Stone & Webster, September, 2007

Coordinate System: South Carolina State Plane, NAD83 Int'l Feet
Vertical - NAVD88

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Borehole Geophysical
Test Locations

FIGURE 4

Explanation

Symbols

Lab test

RQD / Percent of recovery (0 – 100%)	Rock Quality Designation (RQD) and percent of recovery
● 16,930 psi	Laboratory unconfined compression test result (E, psi)
(8,238,000 psi)	Young's Modulus (psi)
P	Petrographic analysis
UTA-54-A ⬢	Resonant column and torsional shear test

In situ test

3,200,000 psi 4,300,000 psi	Goodman Jack (True Young's Modulus, Et, psi)
90,000 psi ◆	Pressuremeter (Shear Modulus, G, psi)

Abbreviations

Res = Residuum

Sap = Saprolite

Col = Colluvium

PWR = Partially weathered rock

MW = Moderately weathered

SL-F = Slightly weathered to fresh rock

BOH = Bottom of hole

Lithology

- Concrete
- Silty sand (SM)
- Sandy silt (ML)
- Gravel
- Diabase
- Meta-granodiorite
- Meta-quartz Diorite
- Meta-diorite

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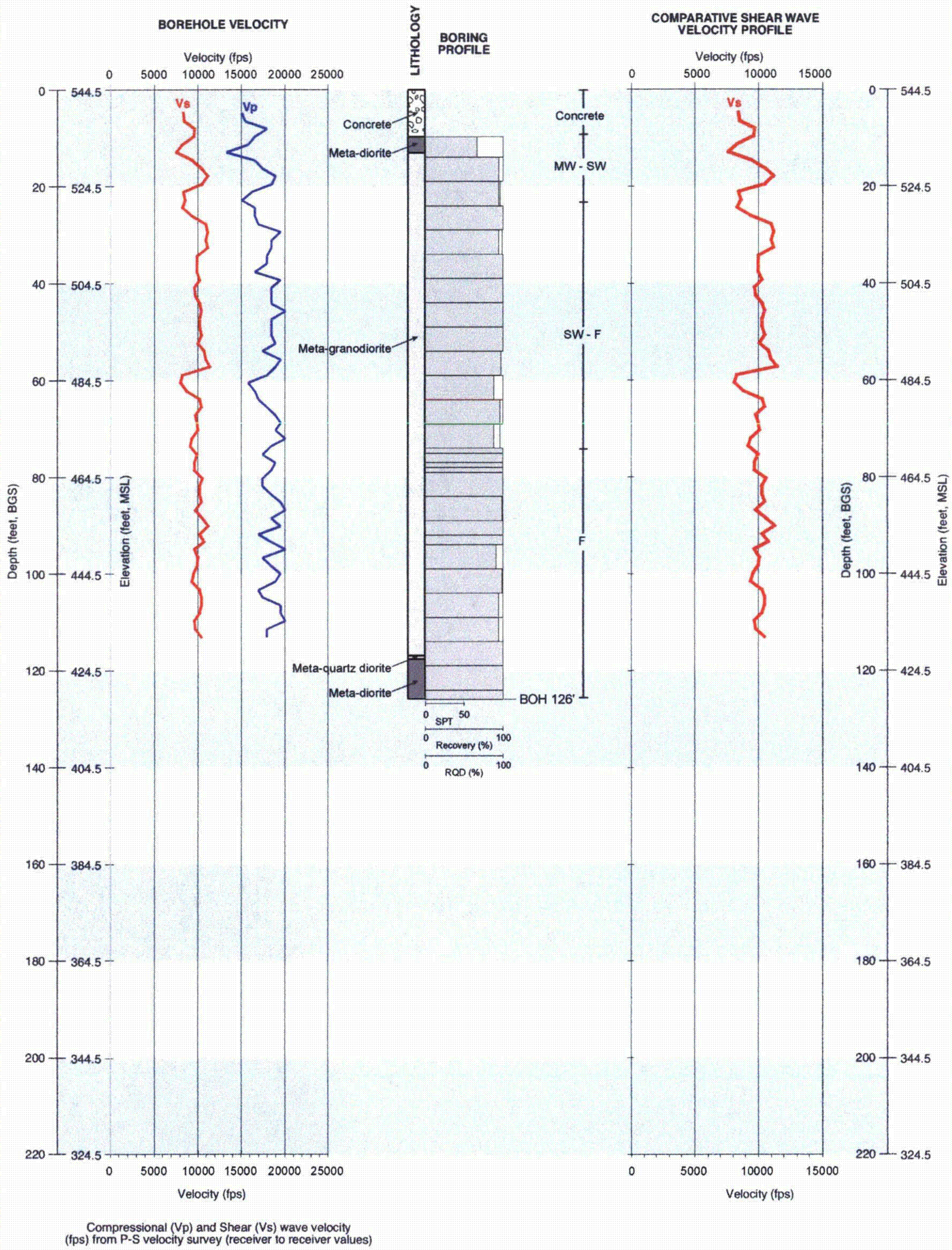
Boring Summary Sheet Explanation

FIGURE 5

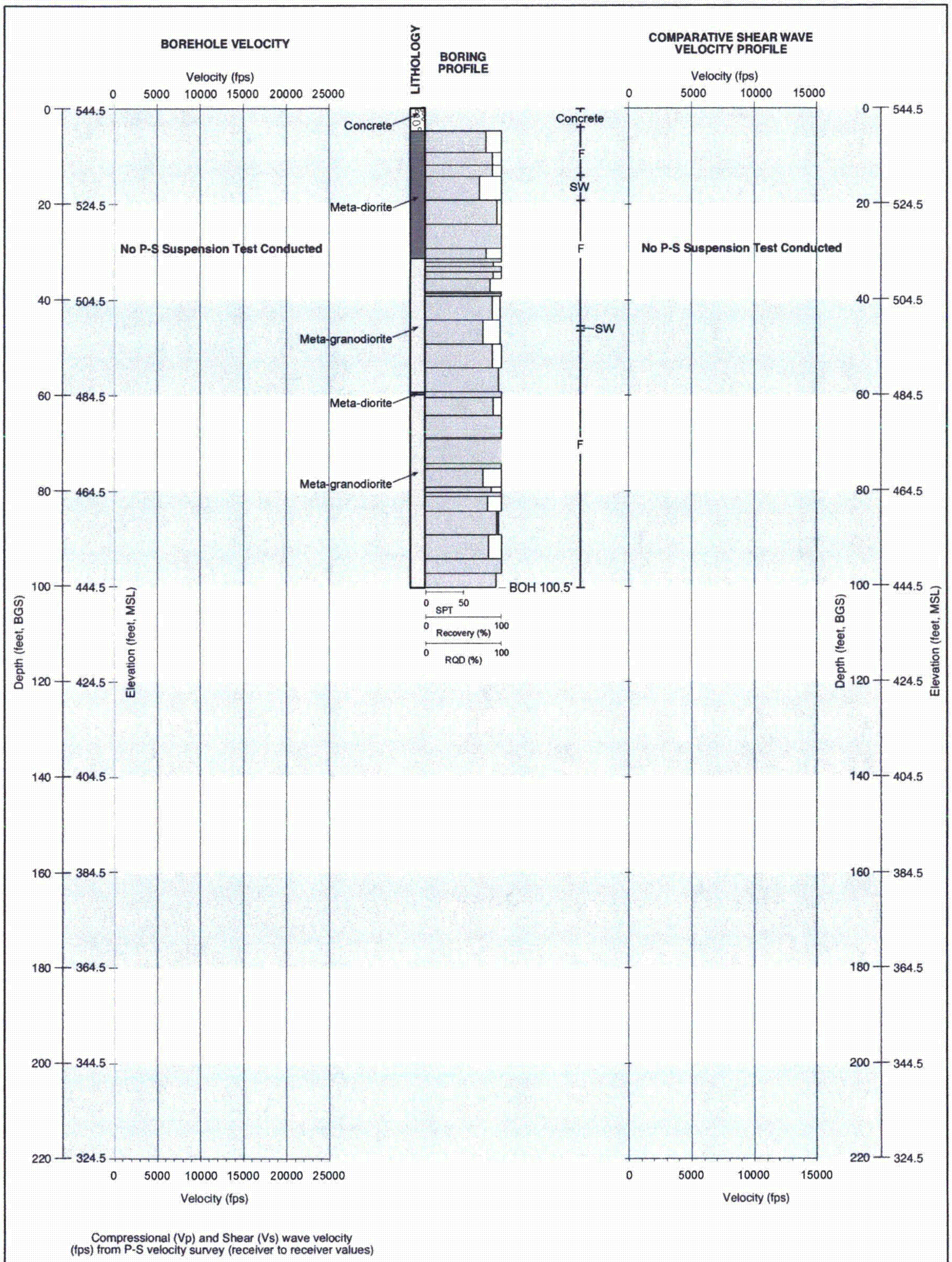


Notes:
1. Borehole geophysics performed by V. Gonzales of GEOVision Geophysical Services
2. RQD (Rock Quality Designation) - a percentage of solid core segments larger than 0.33 feet relative to core run length, excluding mechanical breaks

WILLIAM STATES LEE III NUCLEAR STATION UNITS 1 & 2

Boring Summary Sheet, B-2000

FIGURE 6



Note:
RQD (Rock Quality Designation) - a percentage of solid core segments larger than 0.33 feet relative to core run length, excluding mechanical breaks

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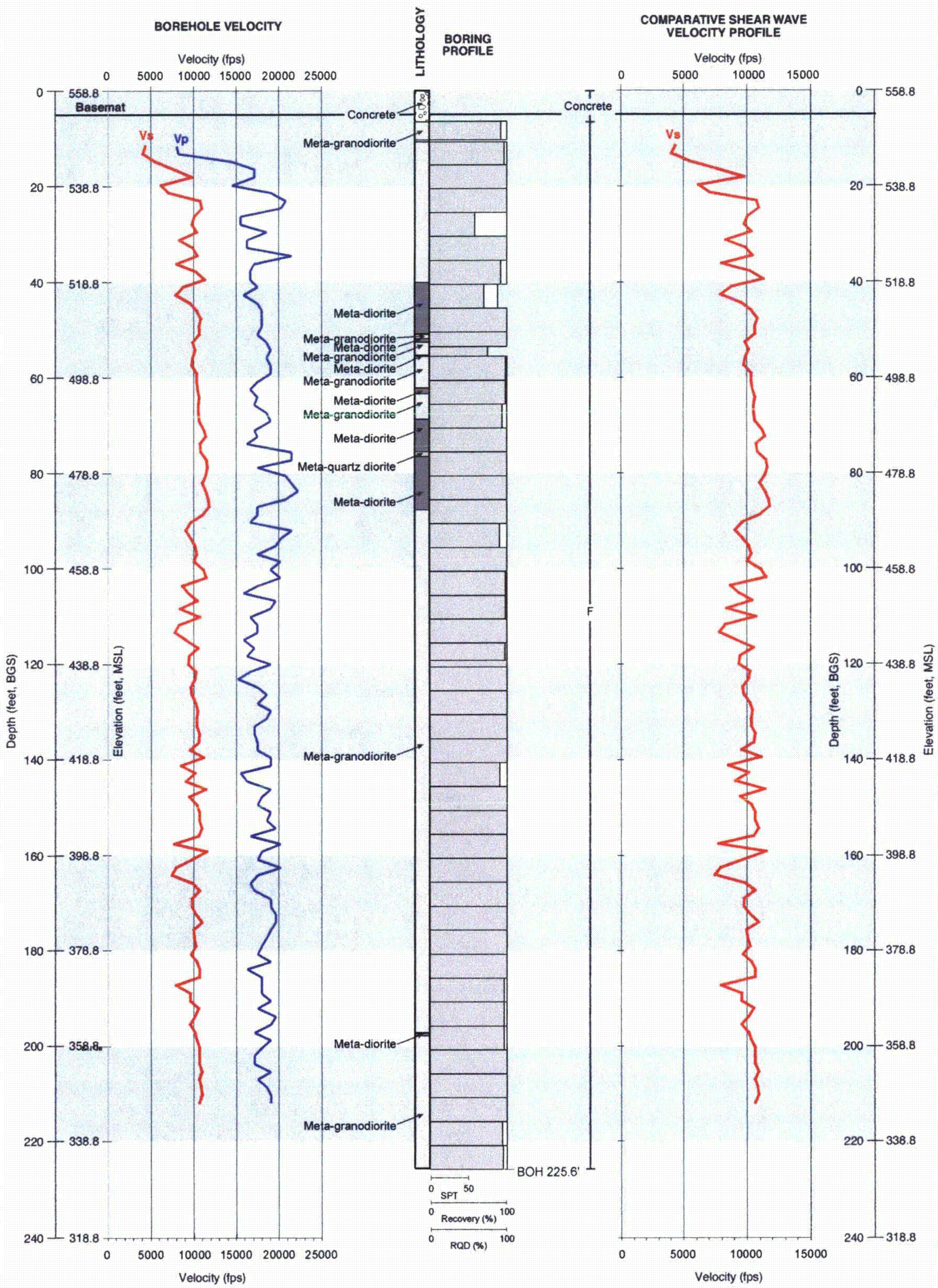
NUCLEAR STATION UNITS 1 & 2

Boring Summary Sheet, B-2001

FIGURE 7



Compressional (Vp) and Shear (Vs) wave velocity (fps) from P-S velocity survey (receiver to receiver values)

Notes:

1. Borehole geophysics performed by V. Gonzales of GEOVision Geophysical Services
2. RQD (Rock Quality Designation) - a percentage of solid core segments larger than 0.33 feet relative to core run length, excluding mechanical breaks

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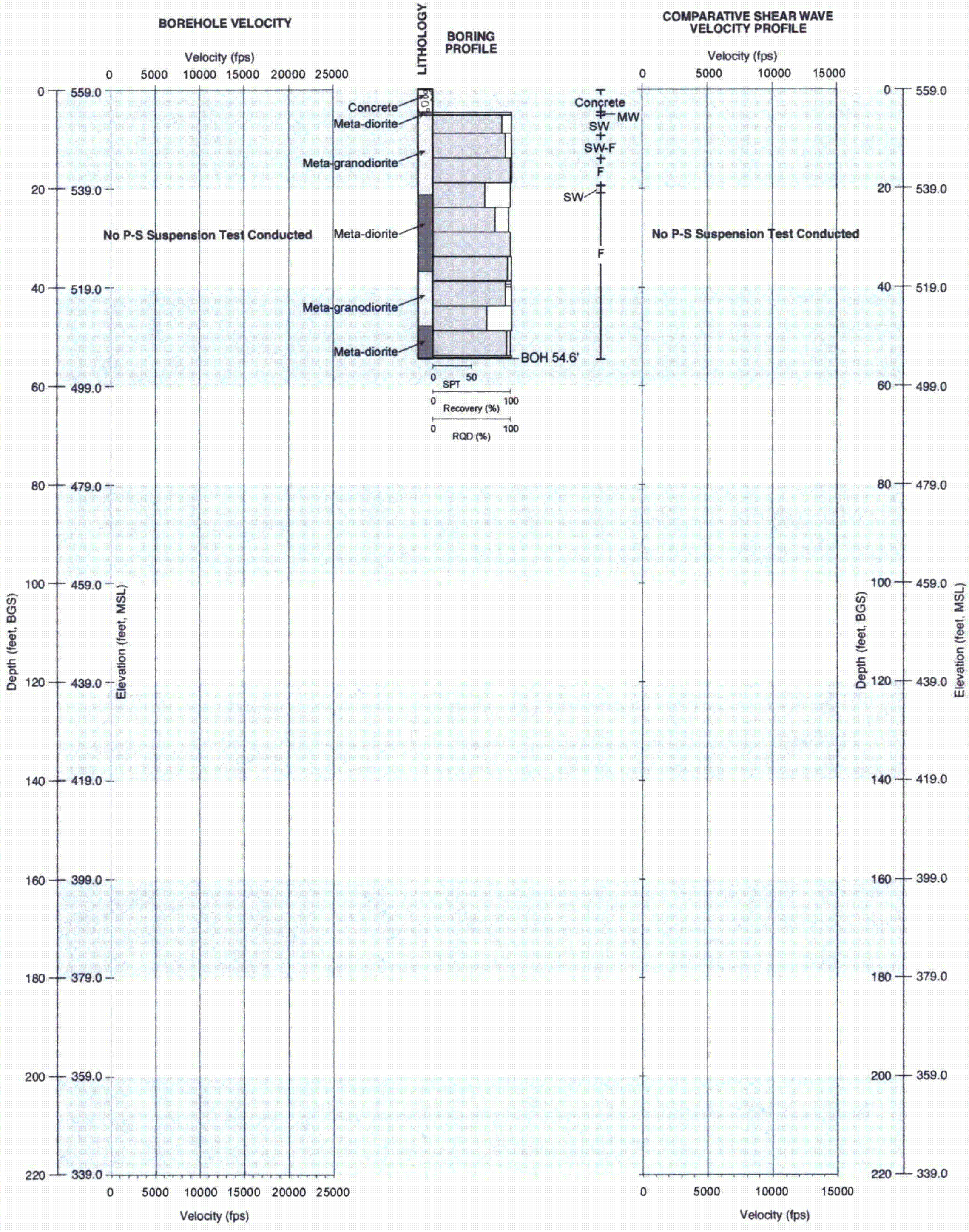
Boring Summary Sheet, B-2002

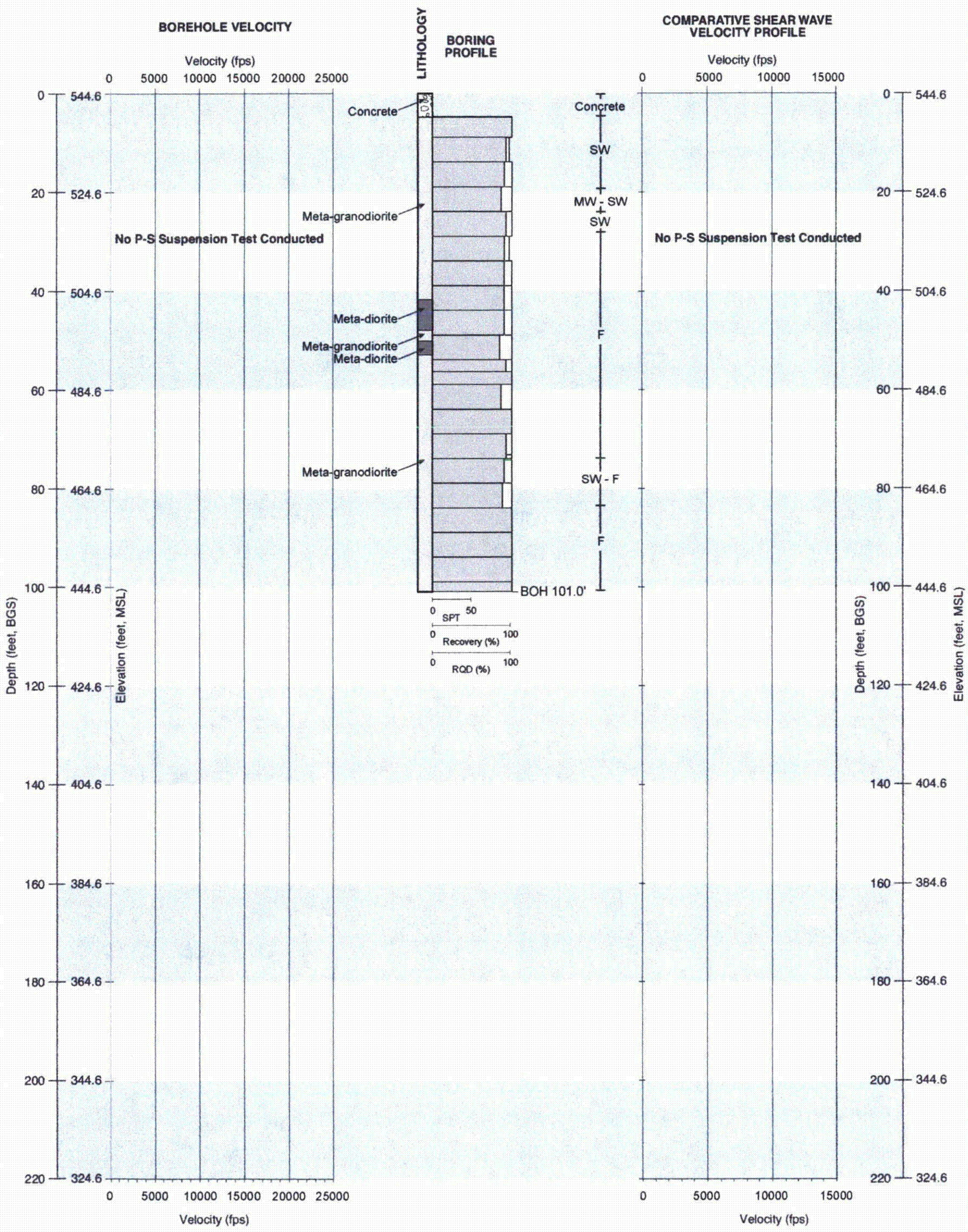
FIGURE 8



Compressional (Vp) and Shear (Vs) wave velocity (fps) from P-S velocity survey (receiver to receiver values)

Note:
RQD (Rock Quality Designation) - a percentage of solid core segments larger than 0.33 feet relative to core run length, excluding mechanical breaks

WILLIAM STATES LEE III NUCLEAR STATION UNITS 1 & 2
Boring Summary Sheet, B-2003 FIGURE 9



Compressional (Vp) and Shear (Vs) wave velocity (fps) from P-S velocity survey (receiver to receiver values)

Note:
RQD (Rock Quality Designation) - a percentage of solid core segments larger than 0.33 feet relative to core run length, excluding mechanical breaks

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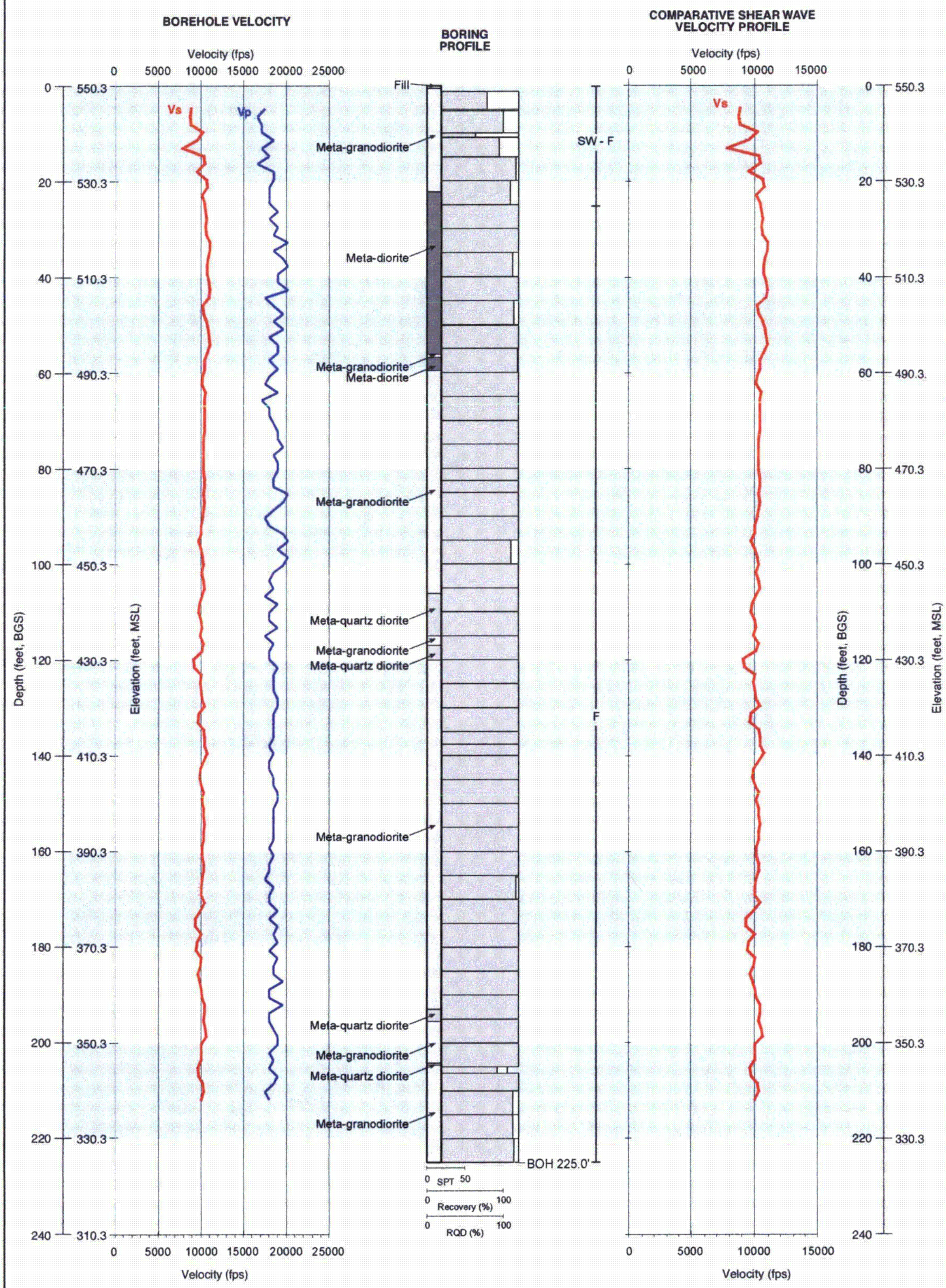
Boring Summary Sheet, B-2004

FIGURE 10



Compressional (Vp) and Shear (Vs) wave velocity (fps) from P-S velocity survey (receiver to receiver values)

Notes:
1. Borehole geophysics performed by V. Gonzales of GEOVision Geophysical Services
2. RQD (Rock Quality Designation) - a percentage of solid core segments larger than 0.33 feet relative to core run length, excluding mechanical breaks

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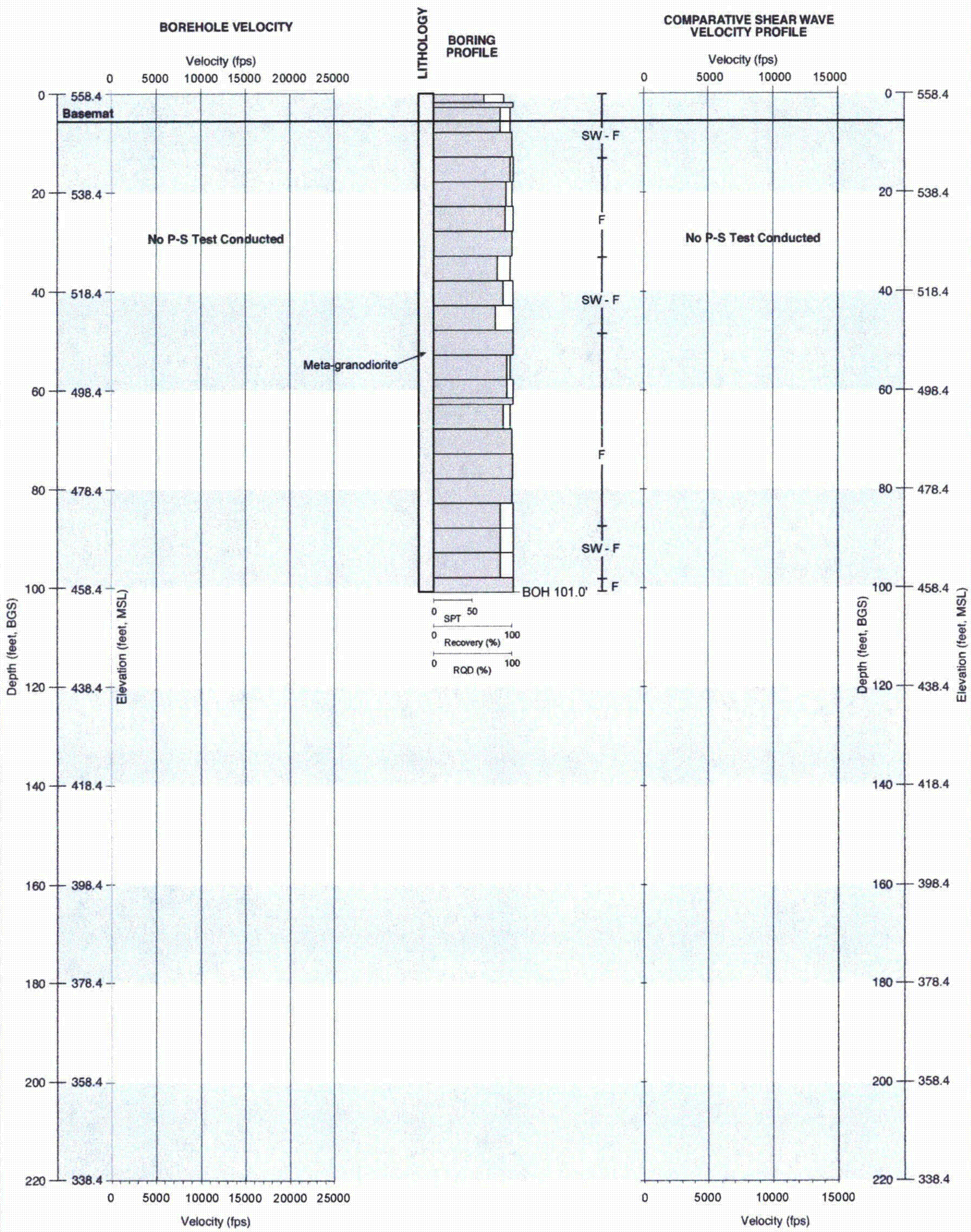
NUCLEAR STATION UNITS 1 & 2

Boring Summary Sheet, B-2005

FIGURE 11



Compressional (Vp) and Shear (Vs) wave velocity (fps) from P-S velocity survey (receiver to receiver values)

Note:
RQD (Rock Quality Designation) - a percentage of solid core segments larger than 0.33 feet relative to core run length, excluding mechanical breaks

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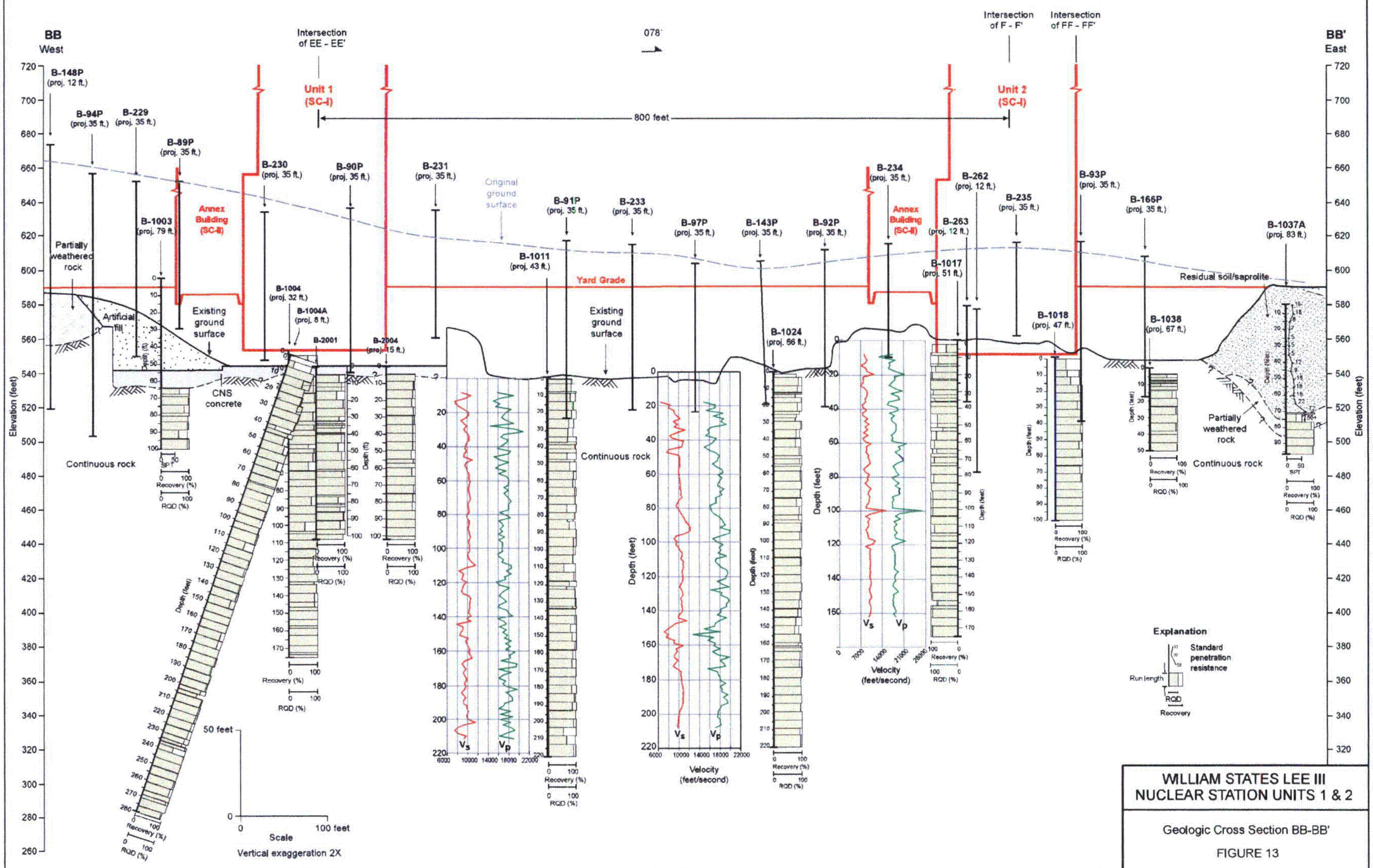
NUCLEAR STATION UNITS 1 & 2

Boring Summary Sheet, B-2006

FIGURE 12



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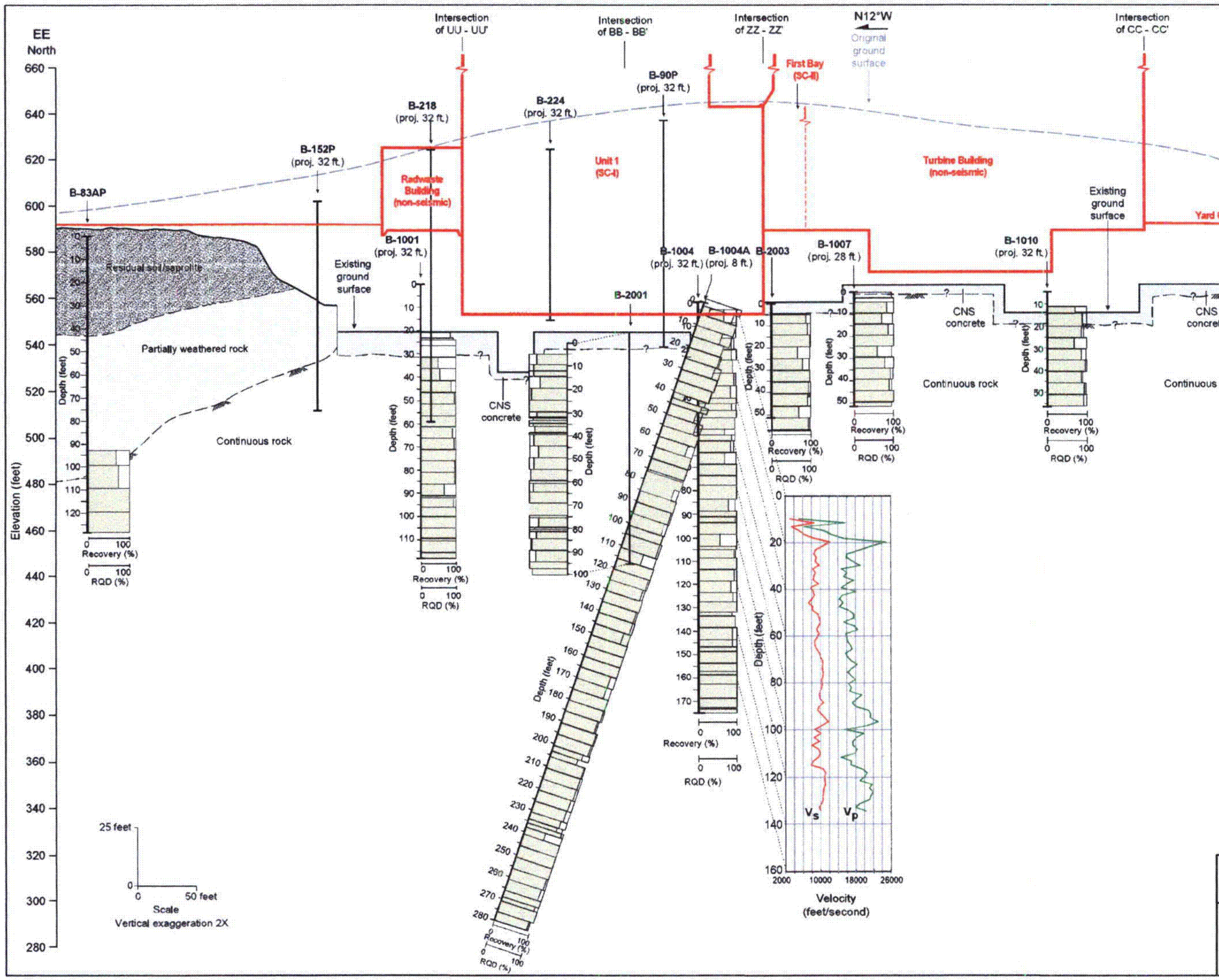
Geologic Cross Section BB-BB'

FIGURE 13



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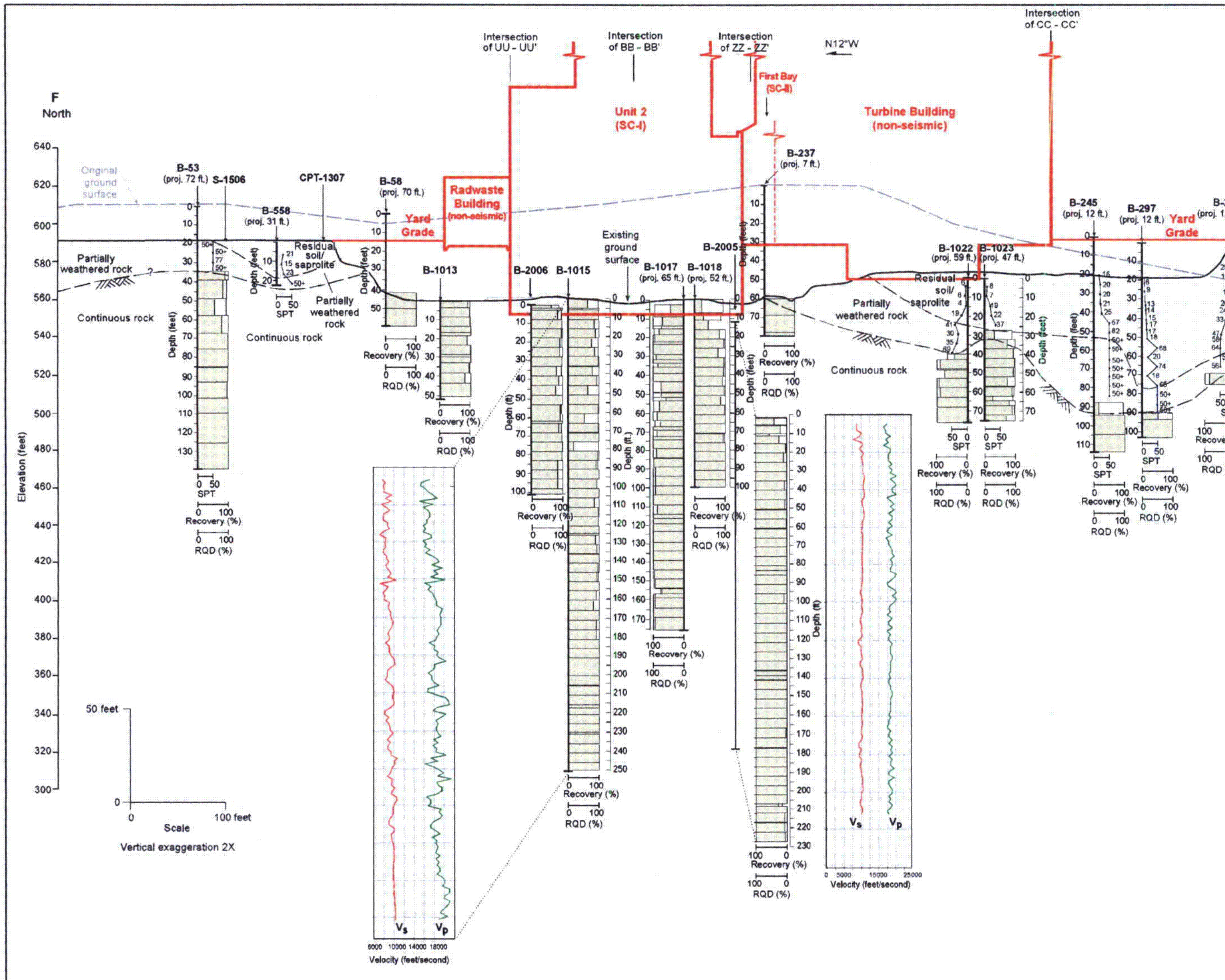
NUCLEAR STATION UNITS 1 & 2

Geologic Cross Section EE-EE'

FIGURE 14



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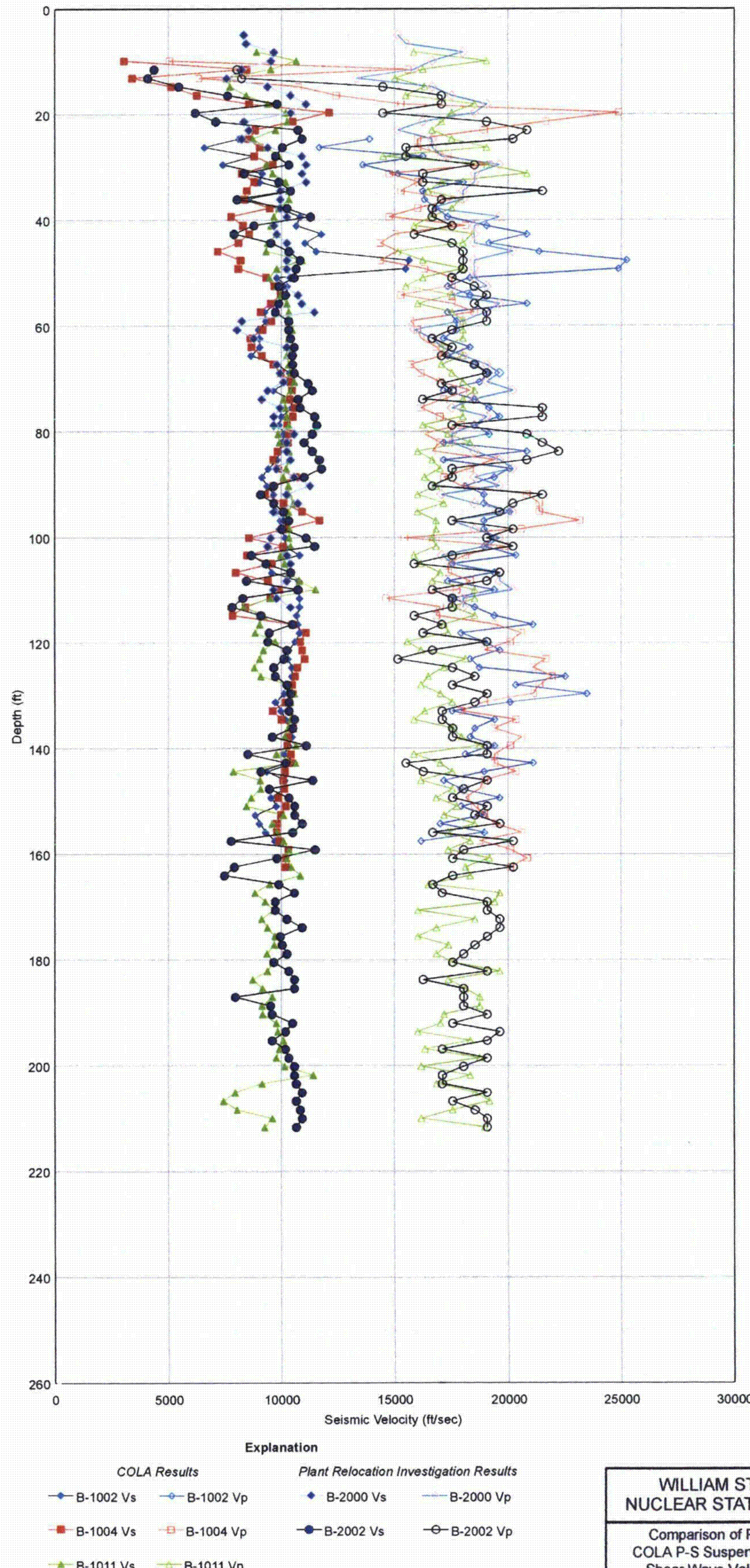
NUCLEAR STATION UNITS 1 & 2

Geologic Cross Section F-F'

FIGURE 15



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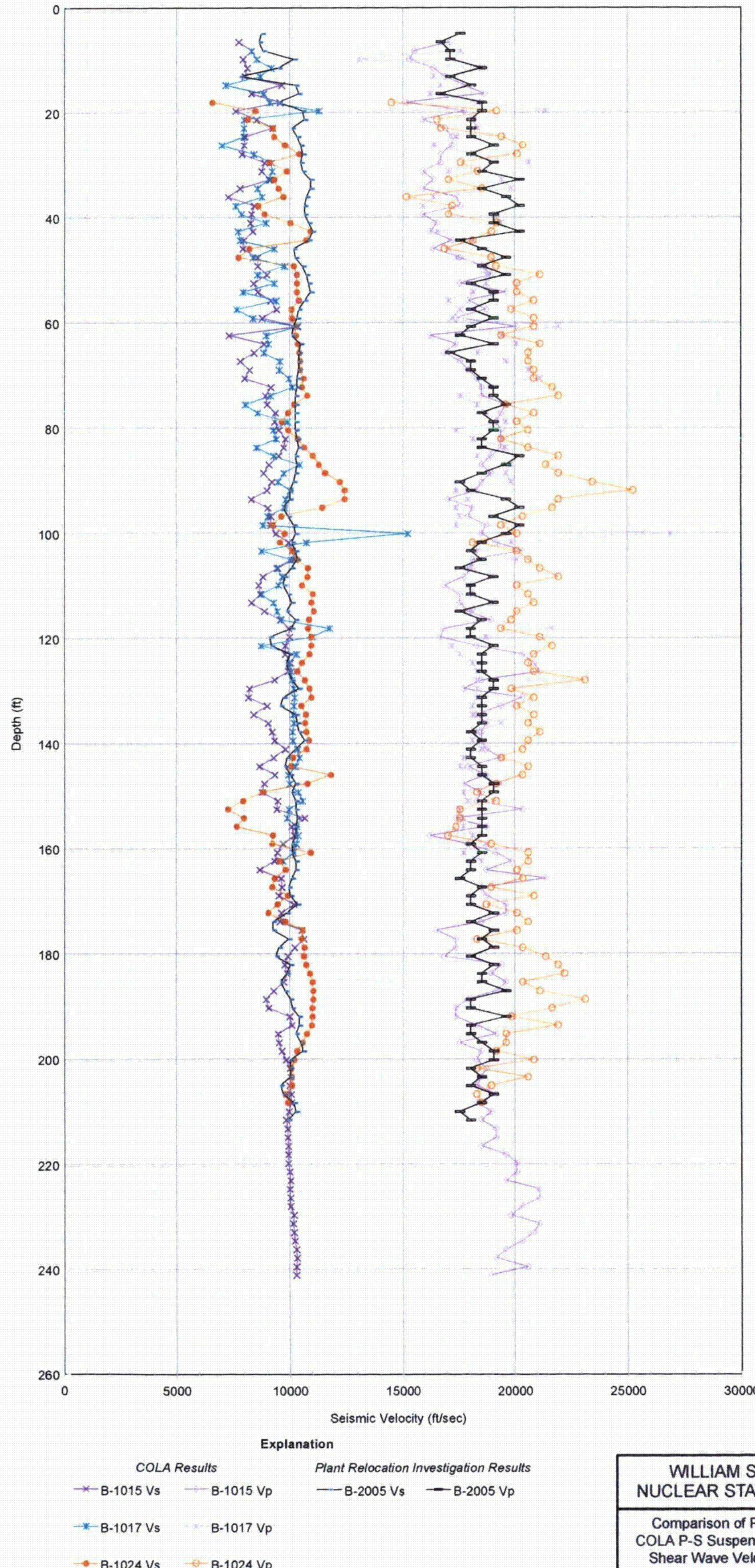
NUCLEAR STATION UNITS 1 & 2

Comparison of Plant Relocation and COLA P-S Suspension Compressive and Shear Wave Velocity Results - Unit 1

FIGURE 16



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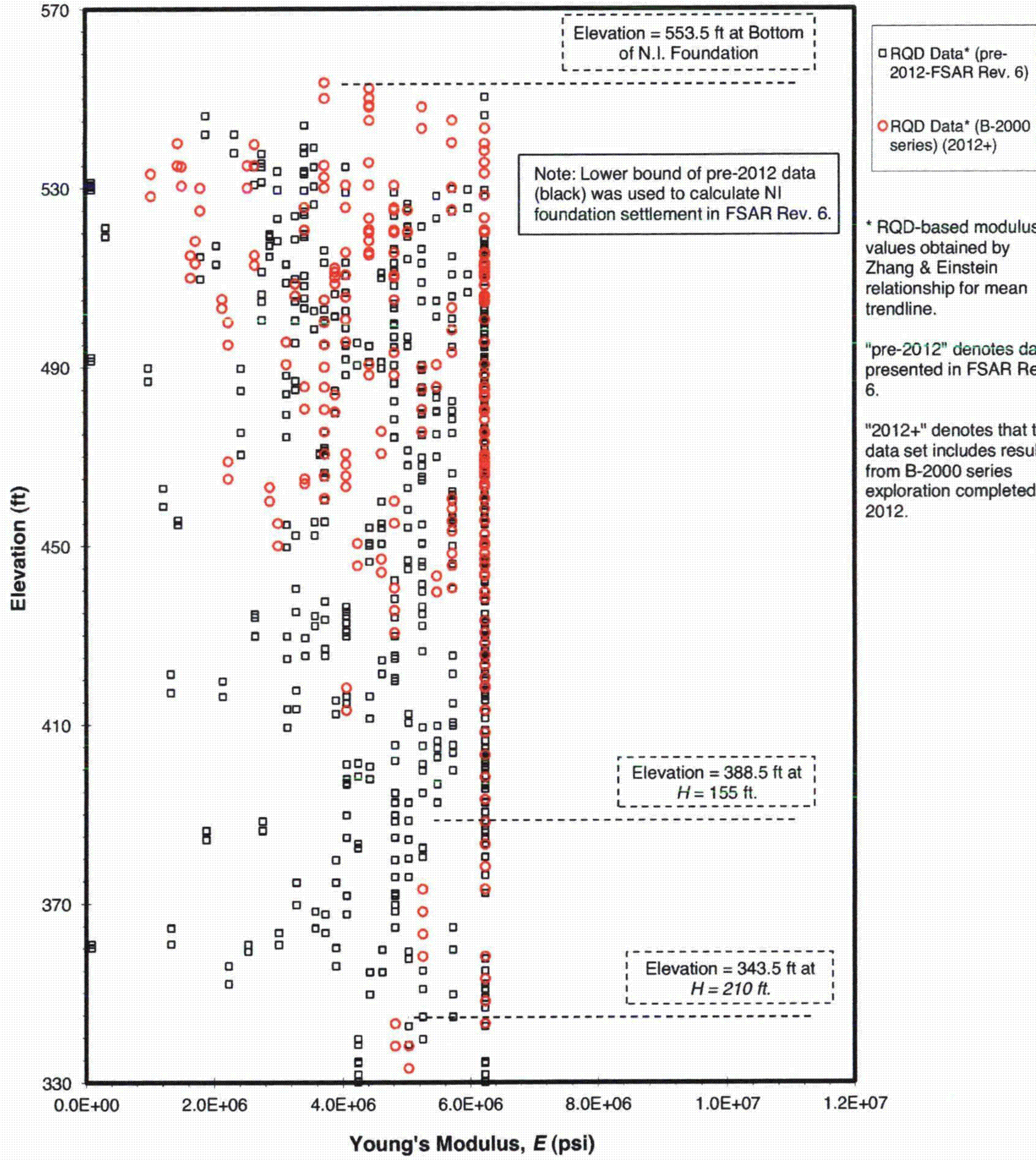
NUCLEAR STATION UNITS 1 & 2

Comparison of Plant Relocation and COLA P-S Suspension Compressive and Shear Wave Velocity Results - Unit 2
FIGURE 17



* RQD-based modulus values obtained by Zhang & Einstein relationship for mean trendline.

"pre-2012" denotes data presented in FSAR Rev. 6.

"2012+" denotes that the data set includes results from B-2000 series exploration completed in 2012.

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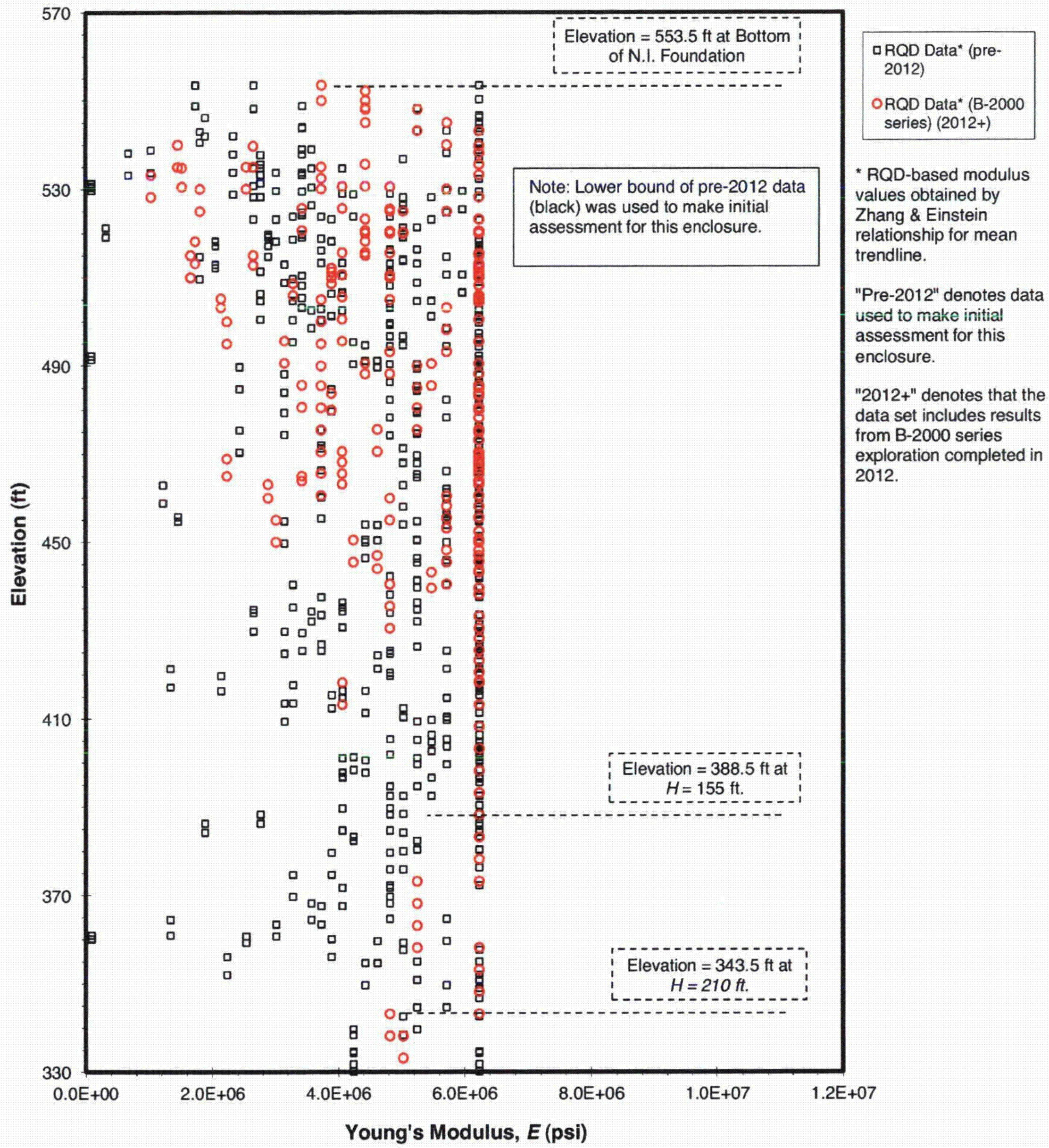
NUCLEAR STATION UNITS 1 & 2

Comparison of Plant Relocation, RQD-Based Modulus Values for Continuous Rock Unit 1 Nuclear Island Foundation
FIGURE 18a



* RQD-based modulus values obtained by Zhang & Einstein relationship for mean trendline.

"Pre-2012" denotes data used to make initial assessment for this enclosure.

"2012+" denotes that the data set includes results from B-2000 series exploration completed in 2012.

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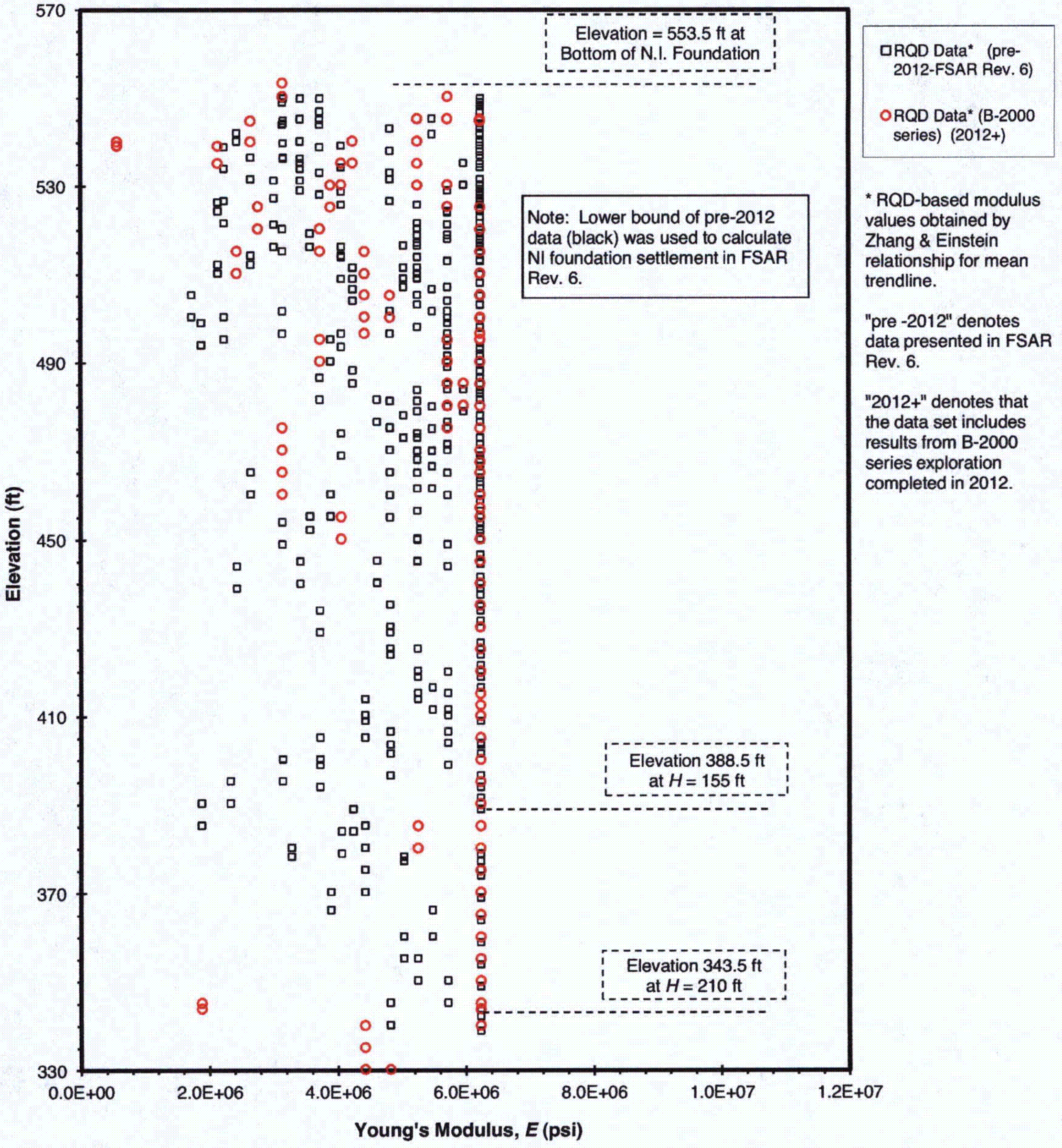
NUCLEAR STATION UNITS 1 & 2

Comparison of Plant Relocation, RQD-Based Modulus Values for Continuous Rock
Unit 1 Nuclear Island Foundation
FIGURE 18b



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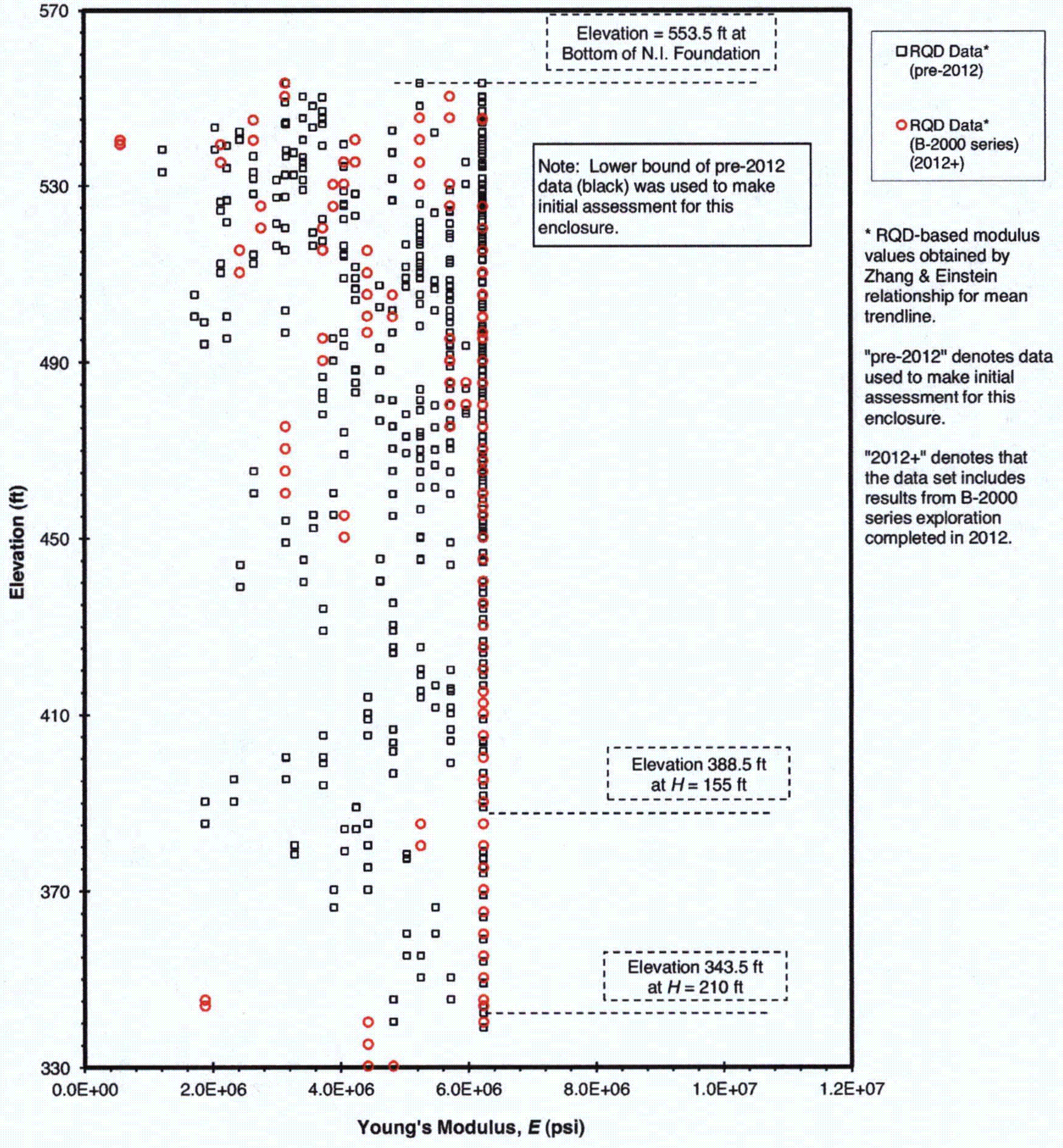
Comparison of Plant Relocation, RQD-Based Modulus Values for Continuous Rock
Unit 2 Nuclear Island Foundation
FIGURE 19a



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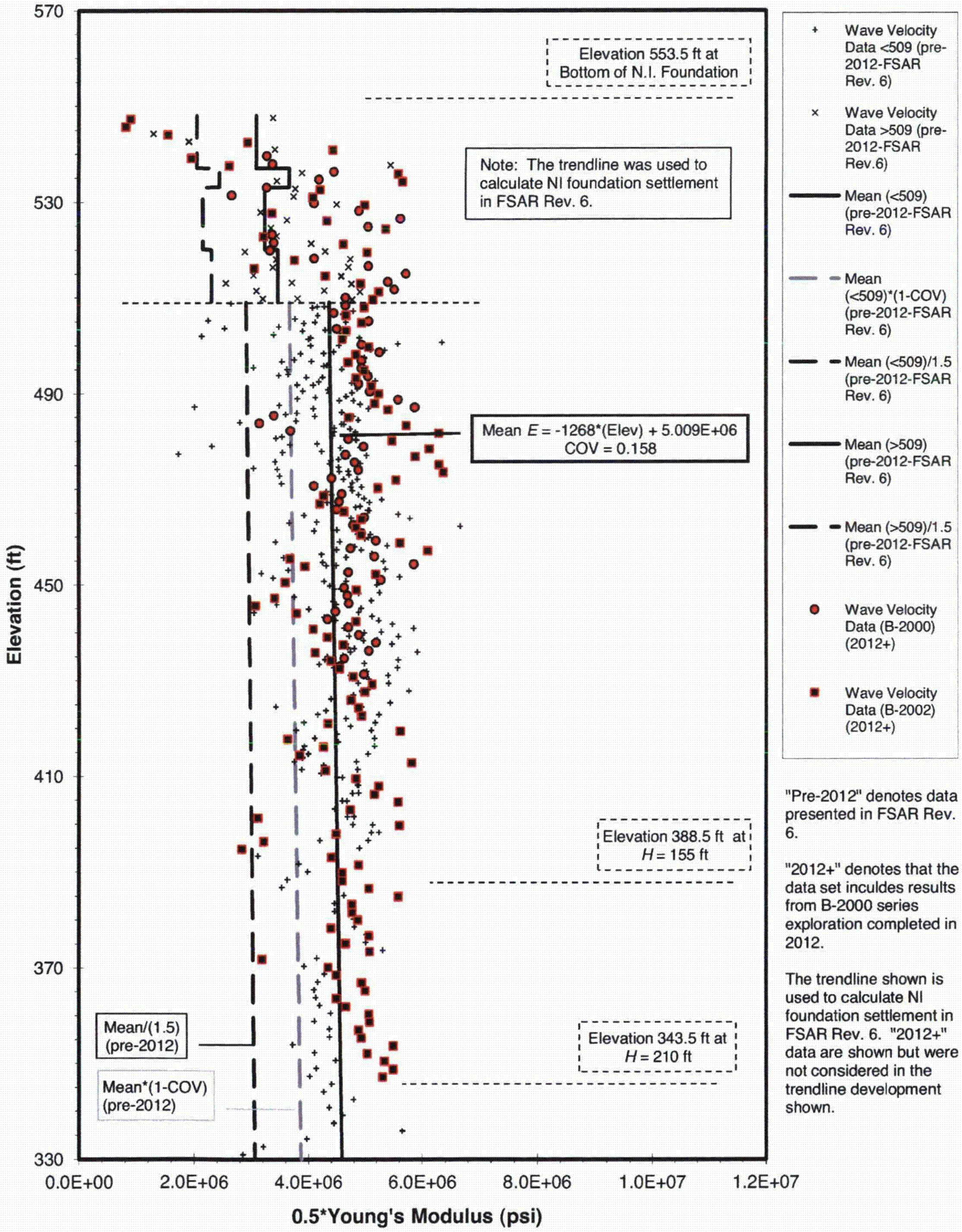
NUCLEAR STATION UNITS 1 & 2

Comparison of Plant Relocation,
RQD-Based Modulus Values
for Continuous Rock
Unit 2 Nuclear Island Foundation
FIGURE 19b



"Pre-2012" denotes data presented in FSAR Rev. 6.

"2012+" denotes that the data set inculdes results from B-2000 series exploration completed in 2012.

The trendline shown is used to calculate NI foundation settlement in FSAR Rev. 6. "2012+" data are shown but were not considered in the trendline development shown.

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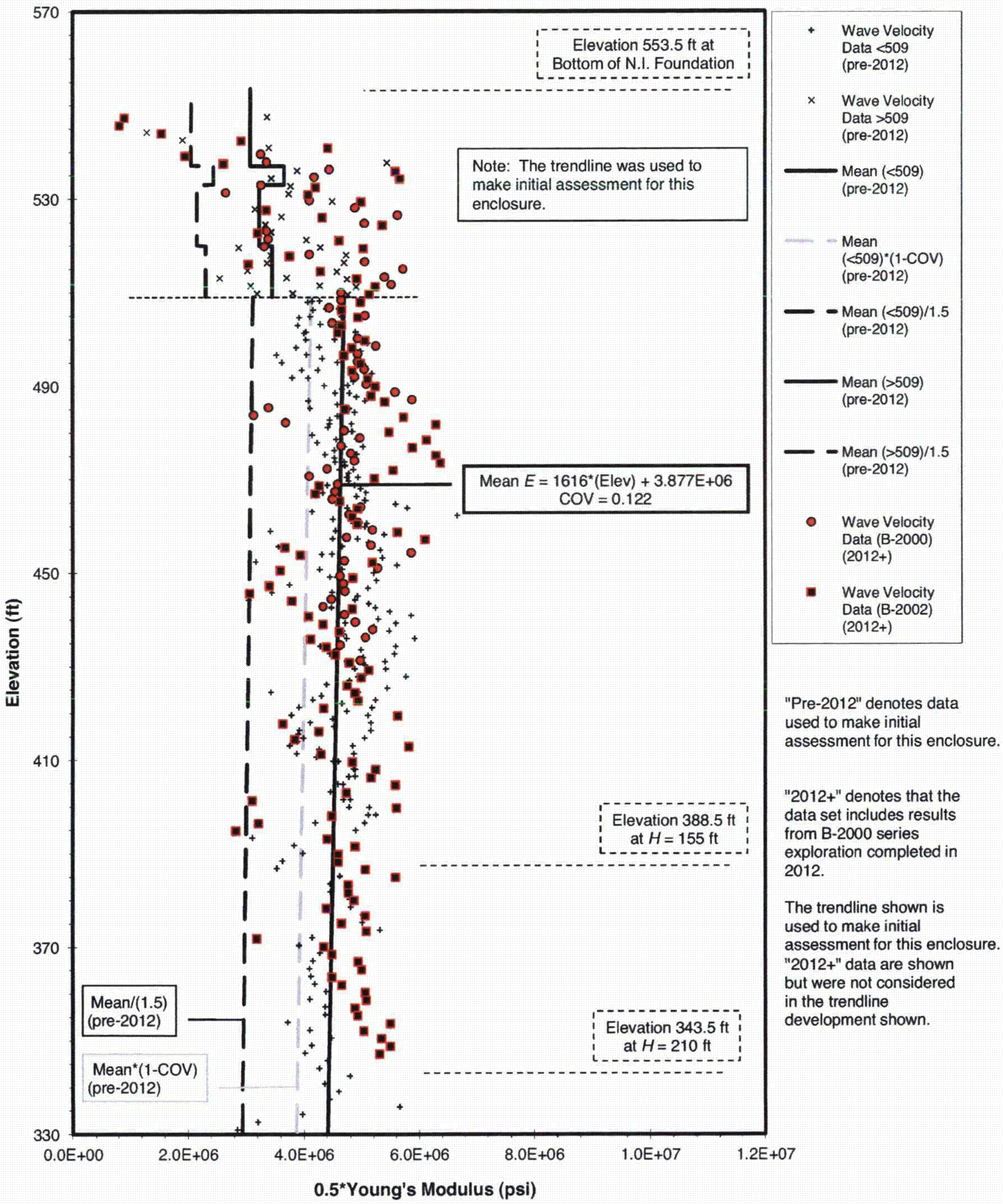
NUCLEAR STATION UNITS 1 & 2

Comparison of Plant Relocation,
Shear Wave Velocity-Based Modulus Profile
for Continuous Rock,
Unit 1 Nuclear Island Foundation
FIGURE 20a



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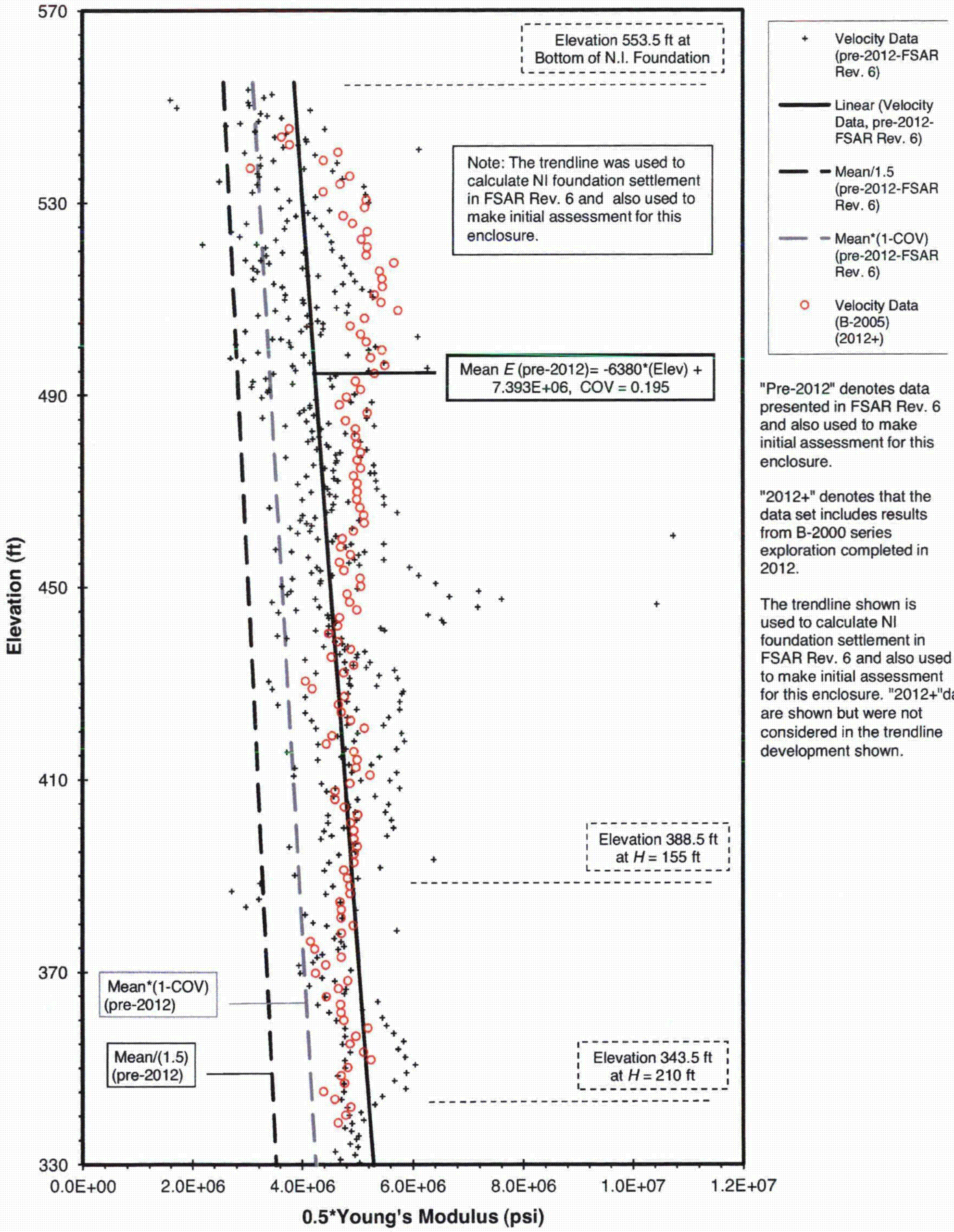
NUCLEAR STATION UNITS 1 & 2

Comparison of Plant Relocation,
Shear Wave Velocity-Based Modulus Profile
for Continuous Rock,
Unit 1 Nuclear Island Foundation
FIGURE 20b



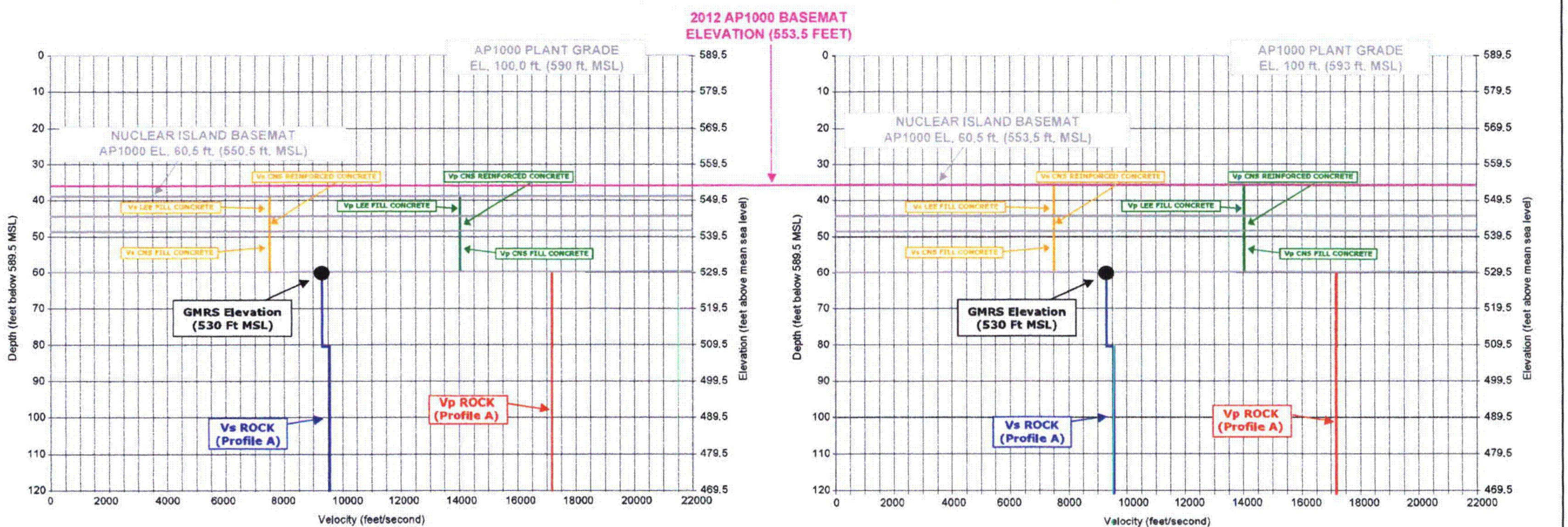
"Pre-2012" denotes data presented in FSAR Rev. 6 and also used to make initial assessment for this enclosure.

"2012+" denotes that the data set includes results from B-2000 series exploration completed in 2012.

The trendline shown is used to calculate NI foundation settlement in FSAR Rev. 6 and also used to make initial assessment for this enclosure. "2012+"data are shown but were not considered in the trendline development shown.

WILLIAM STATES LEE III
NUCLEAR STATION UNITS 1 & 2

Comparison of Plant Relocation,
Shear Wave Velocity-Based Modulus Profile
for Continuous Rock,
Unit 2 Nuclear Island Foundation
FIGURE 21



Pre-2012 Base Case A1

2012 Base Case A1

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Schematic Comparison of August 2012 to Pre-August 2012 Dynamic Profile - Base Case A1 at Unit 1 Nuclear Island
FIGURE 22

Lee Nuclear Station
FSAR Content Not Impacted due to Units 1 and 2 Relocation

FSAR Chapter 2

Section 2.2

This subsection evaluates off-site hazards due to an explosion and a toxic gas release.

For the explosive hazard, the computer program ALOHA was used to determine the overpressure. The ALOHA analysis was based on a "nominal" center of the site from which lines are drawn to the nearest point of various accidents. This analysis shows that the resulting maximum overpressure is insensitive to the distance from the Lee site to the accident site. Therefore, the slight relocation of Units 1 and 2 does not invalidate the analysis' conclusions.

For the toxic gas release, the analysis uses the site property boundary as the point of reference used to analyze the distance from the potential hazard location to the site. Therefore, the slight relocation of Units 1 and 2 does not invalidate the analysis' conclusions.

The conclusions of the off-site hazard analyses for explosions and toxic gas releases are not impacted by the relocation of Lee Units 1 and 2. Therefore, plant relocation has no impact to the content of Subsection 2.2.

FSAR Chapter 4

The information provided in FSAR Chapter 4 is limited to the incorporation by reference to the AP1000 DCD and a future commitment to calculate departure from nuclear boiling ratio (DNBR) limits following the selection of actual plant operating instrumentation. The instrumentation selection is not dependent on the plant location and therefore the plant relocation has no impact on the content Chapter 4.

FSAR Chapter 5

The information provided in FSAR Chapter 5 is limited to the incorporation by reference to the AP1000 DCD and programmatic information that is independent of the Lee Units 1 and 2 locations. Therefore plant relocation has no impact to the content Chapter 5.

FSAR Chapter 6

The information provided in FSAR Chapter 6 is limited to the incorporation by reference to the AP1000 DCD, programmatic information, and the assessment of control room habitability from the release of toxic chemicals either on-site or off-site. The programmatic information provided is not dependent on the plant location.

For the off-site toxic hazards, the analysis (see Reference 1) was evaluated for impacts resulting from plant relocation. Unit 1 is moved 50 feet east of the previous location analyzed. Units 1 and 2 are moved 66 feet south and raised 3 feet in elevation. The intake height used in the analysis was 17 m (56 ft.) since the release point was assumed to be at the same elevation as plant grade. Raising the plant elevation by three feet increases the control room intake elevation relative to the spill elevation, which reduces concentrations at the intake. The analysis was also based on the site being 5100 m (16732 ft) from Highway 329, which is located slightly north of due west of the site. The relocation of both units described above increases the distance from the nearest approach of Highway 329 to the Unit 1 and Unit 2 nuclear islands, which increases the dispersion of the gas and reduces its concentration prior to reaching the control room intake. The plant relocation allows the results of the previously presented analysis to remain bounding. Therefore, the plant relocation has no impact to the content of this Chapter 6 due to off-site toxic hazards.

For the on-site toxic hazards analysis, the maximum distance from the chemical release point, (located in the turbine building), to the control room air intake is 203 ft. (see Reference 2). The relocation of Unit 1 50 ft. closer to Unit 2 does not make the distance between a turbine building and the other unit's control room intake more limiting. The distance from the turbine building to the control room for the same unit's control room intake remains unchanged from the previously submitted analysis since the principal buildings in the standard plant layout (nuclear island, turbine building, annex building, diesel generator, and radwaste building) for each unit remain in the same relative position. The distances from the Unit 1 Circulating Water System (CWS) cooling towers to the Unit 1 and Unit 2 control room intakes are increasing. The distances between the Unit 2 CWS cooling towers and the Unit 1 and Unit 2 control room intakes are decreasing slightly, but remain bounded by the certified design distances listed in the AP1000 DCD. The plant relocation does not impact the results of Duke Energy's on-site toxic hazards analysis. Therefore, the plant relocation has no impact to the content of Chapter 6 due to on-site toxic hazards.

FSAR Chapter 7

The information provided in FSAR Chapter 7 is limited to the incorporation by reference to the AP1000 DCD, programmatic information, and identification of site-specific information related to environmental monitoring. The location of these instruments is not specified in FSAR Chapter 7, but is addressed in FSAR Chapter 2. The programmatic information provided in FSAR Chapter 7 is not dependent on the plant location. Therefore the plant relocation has no impact to the content of Chapter 7.

FSAR Chapter 9

The information provided in FSAR Chapter 9 is limited to the incorporation by reference to the AP1000 DCD, programmatic information, and conceptual design information related to site-specific design. The programmatic information provided in FSAR Chapter 9 is not dependent on the plant location.

The plant relocation changes the physical relationship between the Service Water System (SWS) cooling towers and the Circulating Water System (CWS) cooling towers. FSAR Subsection 9.2.1.2.2 (SUP 9.2-2) was assessed for impact and determined to be valid for the revised configuration. The response to RAI 09.02.01-008 (see Reference 3) was reviewed and determined to remain valid for the relocated configuration. This review noted the number of CWS cooling towers per unit has been changed from three to two by a conceptual design change (see Reference 4). This conceptual design change does not affect the conclusions discussed in the response to RAI 09.02.01-008.

No other subsections in FSAR Chapter 9 are impacted by the plant relocation. Therefore, the plant relocation has no impact to the content of Chapter 9.

FSAR Chapter 10

The information provided in FSAR Chapter 10 is limited to the incorporation by reference to the AP1000 DCD, programmatic information, and conceptual design information related to site-specific design. The programmatic information provided in FSAR Chapter 10 is not dependent on the plant location. The locations of the Circulating Water System cooling towers are unchanged. Therefore, the information contained in FSAR Chapter 10 remains valid and the plant relocation has no impact to Chapter 10.

FSAR Chapter 13

The information provided in FSAR Chapter 13 is limited to the incorporation by reference to the AP1000 DCD, programmatic information, and site-specific organizational information. The programmatic and organizational information is not dependent on the plant location. Therefore, the plant relocation has no impact to the content of Chapter 13.

FSAR Chapter 14

The information provided in FSAR Chapter 14 is limited to the incorporation by reference to the AP1000 DCD and programmatic information that is not dependent on the plant location. Therefore, plant relocation has no impact to the content of Chapter 14.

FSAR Chapter 15

The information provided in FSAR Chapter 15 is limited to the incorporation by reference to the AP1000 DCD and a future commitment to calibration and testing requirements of feedwater flow instrumentation. Additional pointers to other sections of the FSAR for additional information are also presented. This information is not dependent on the plant location. Therefore, plant relocation has no impact to the content of Chapter 15.

FSAR Chapter 16

The information provided in FSAR Chapter 16 is limited to the incorporation by reference to the AP1000 DCD and programmatic information that is not dependent on the plant location. Therefore, plant relocation has no impact to the content of Chapter 16.

FSAR Chapter 17

The information provided in FSAR Chapter 17 is limited to the incorporation by reference to the AP1000 DCD and programmatic information that is not dependent on the plant location. Therefore, plant relocation has no impact to the content of Chapter 17.

FSAR Chapter 18

The information provided in FSAR Chapter 18 is limited to the incorporation by reference to the AP1000 DCD, programmatic information, and departures for the locations of the Technical Support Center (TSC) and Operations Support Center (OSC). The programmatic information provided in FSAR Chapter 18 is not dependent on the plant location. Although the buildings within which the TSC and OSC are located will be moved, the locations of the TSC and OSC remain the same within the buildings following plant relocation. Therefore, plant relocation has no impact on the content of Chapter 18.

References:

1. Letter from Christopher M. Fallon (Duke Energy) to NRC Document Control Desk, Response to Request for Additional Information, Ltr# WLG2012.05-03, dated May 31, 2012 (ML12156A212)
2. Letter from Christopher M. Fallon (Duke Energy) to NRC Document Control Desk, Response to Request for Additional Information (RAI No. 6339), Ltr# WLG2012.03-07, dated March 28, 2012 (ML12090A052)
3. Letter from Bryan J. Dolan (Duke Energy) to NRC Document Control Desk, Response to Request for Additional Information (RAI No, 5464), Ltr# WLG2011.03-05, dated March 14, 2011 (ML110750044)
4. Letter from Ronald A. Jones (Duke Energy) to NRC Document Control Desk, Supplemental Information Related to Design Changes to the Circulating Water System, Ltr# WLG2011.11-04, dated November 22, 2011 (ML11327A153)