SNC000091
Vogtle ESP Mandatory Hearing Presentation #7
Safety Topic #1

Seismic Evaluation

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Southern Nuclear

Professional Experience

- 40 years in the Commercial Nuclear Power Industry
  - Structural/ seismic analysis and design of NPP Structures and compounds
  - Seismic soil-structure interaction analysis and dynamic soil behavior
  - Seismic qualification of equipment
  - Authored over 10 technical papers
- Registered Professional Engineer (PE)
- Education
  - Bachelors of Science in Civil Engineering
  - Masters of Science in Engineering

Exhibit SNC000092

Professional Experience – Industry Activities

- ASCE Dynamic Analysis of Committee
- ASCE 4 Seismic Analysis of Nuclear Structures
- ASCE 43 Seismic Design of Nuclear Facilities
- IEEE 344 Seismic Qualification of Equipment in Nuclear Stations
- ASME QME Qualification of Active Mechanical Equipment in NPP
- NEI Seismic Issues Task Force
- EPRI Structural Reliability of Integrity Committee

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SSAR 2.5 Geology and Seismic (ESP & LWA)

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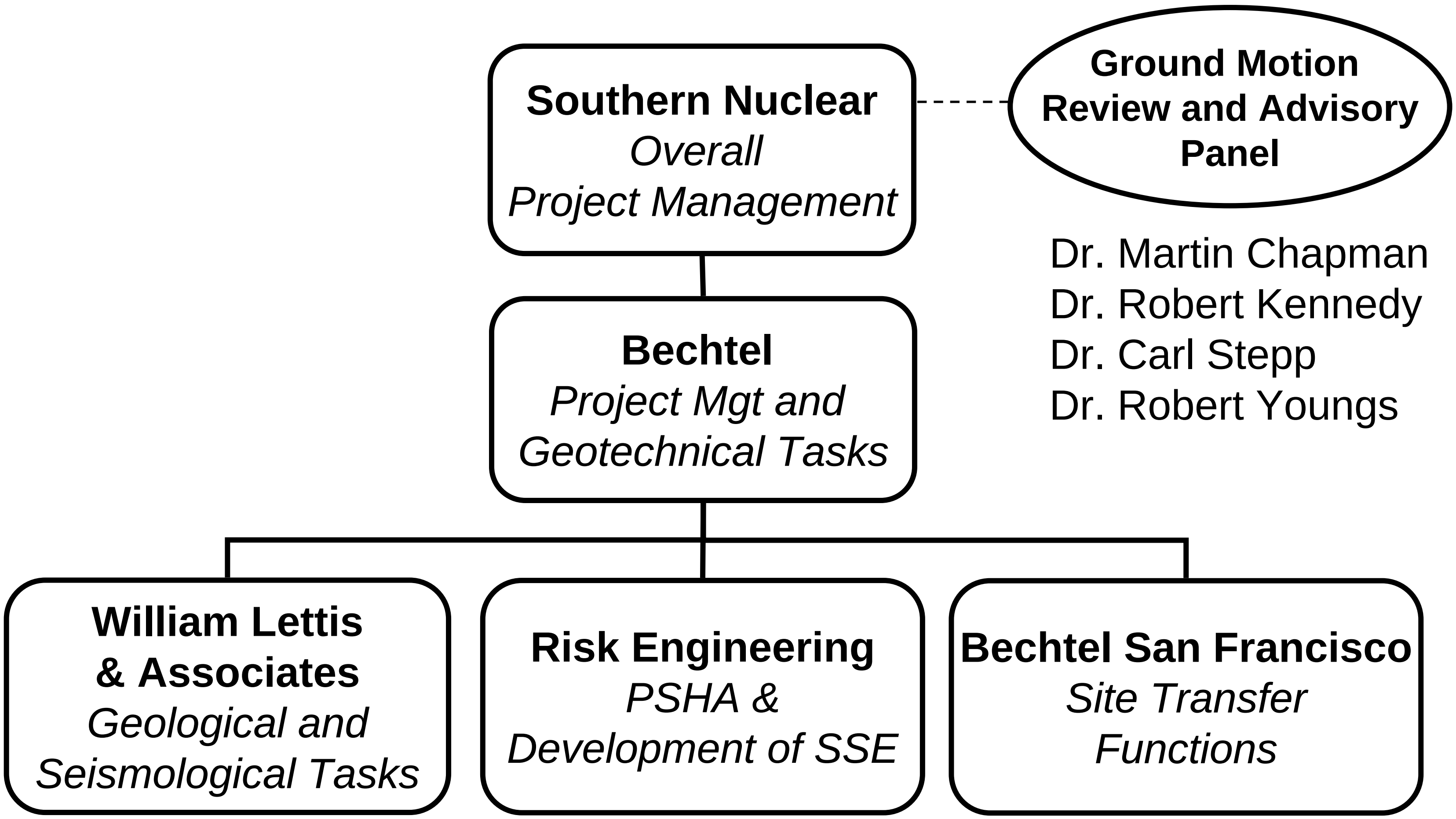
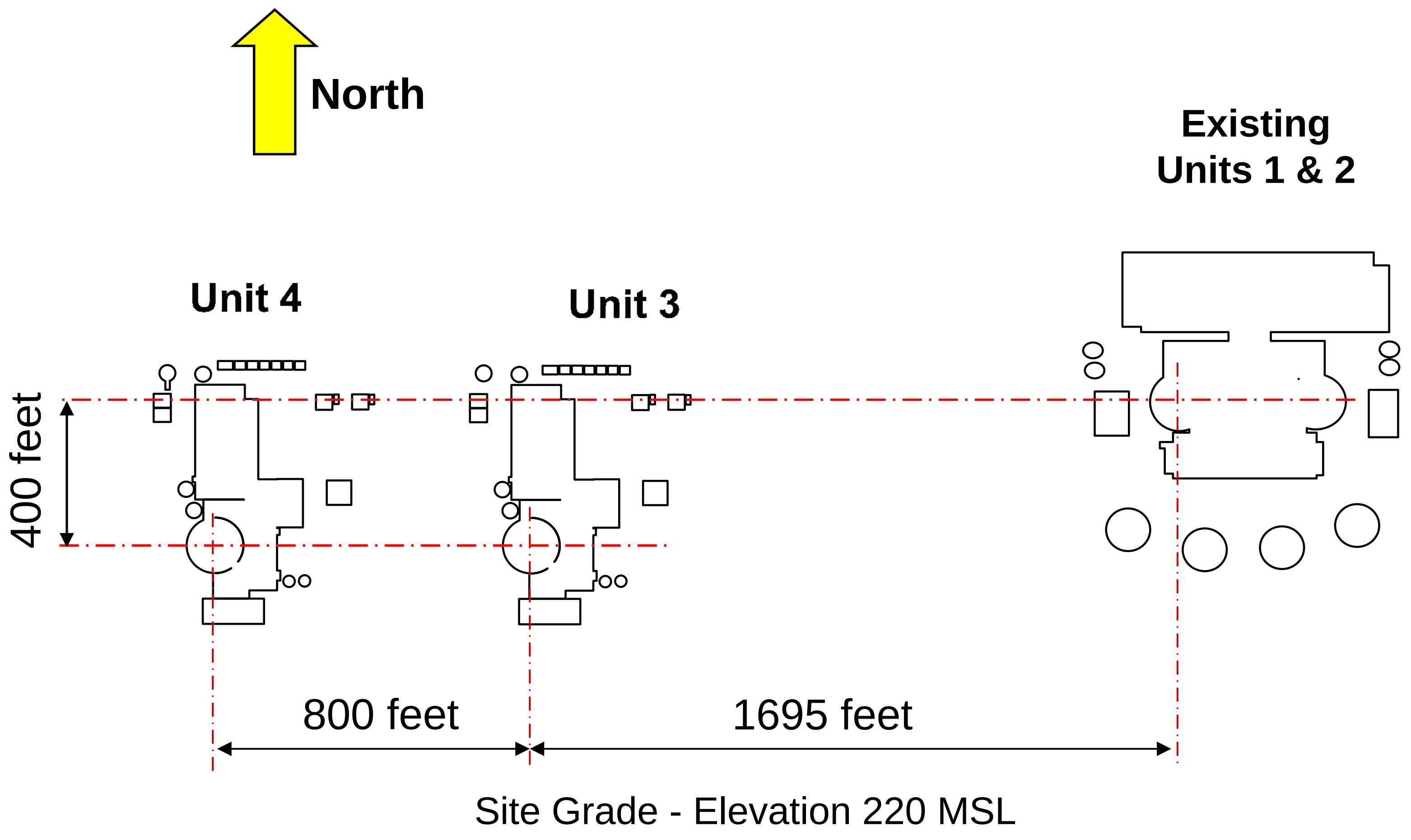
Topics:

- 2.5.1 Site and Regional Geology ☑
- 2.5.2 Seismic Evaluation ☑
- 2.5.3 Surface Faulting
- 2.5.4 Stability of Subsurface Materials ☑
- 2.5.5 Stability of Slopes
- 2.5.6 Embankments and Dams
- App. 2.5E Vogtle Site Specific Seismic Evaluation Report ☑

☑ Topics to be discussed
☑ Topics to be discussed that include additional data for LWA

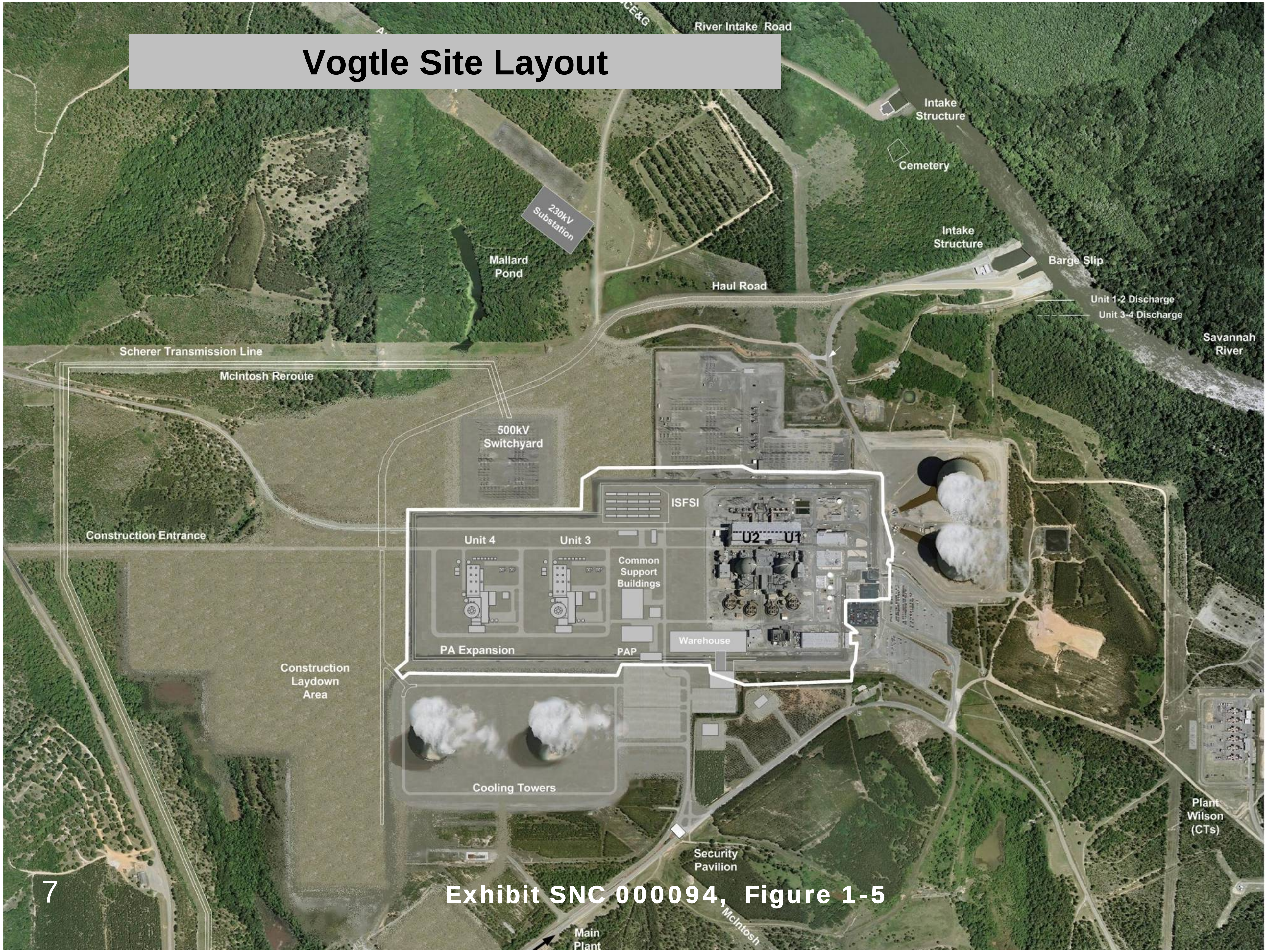
Seismic Program Organization





Site Layout

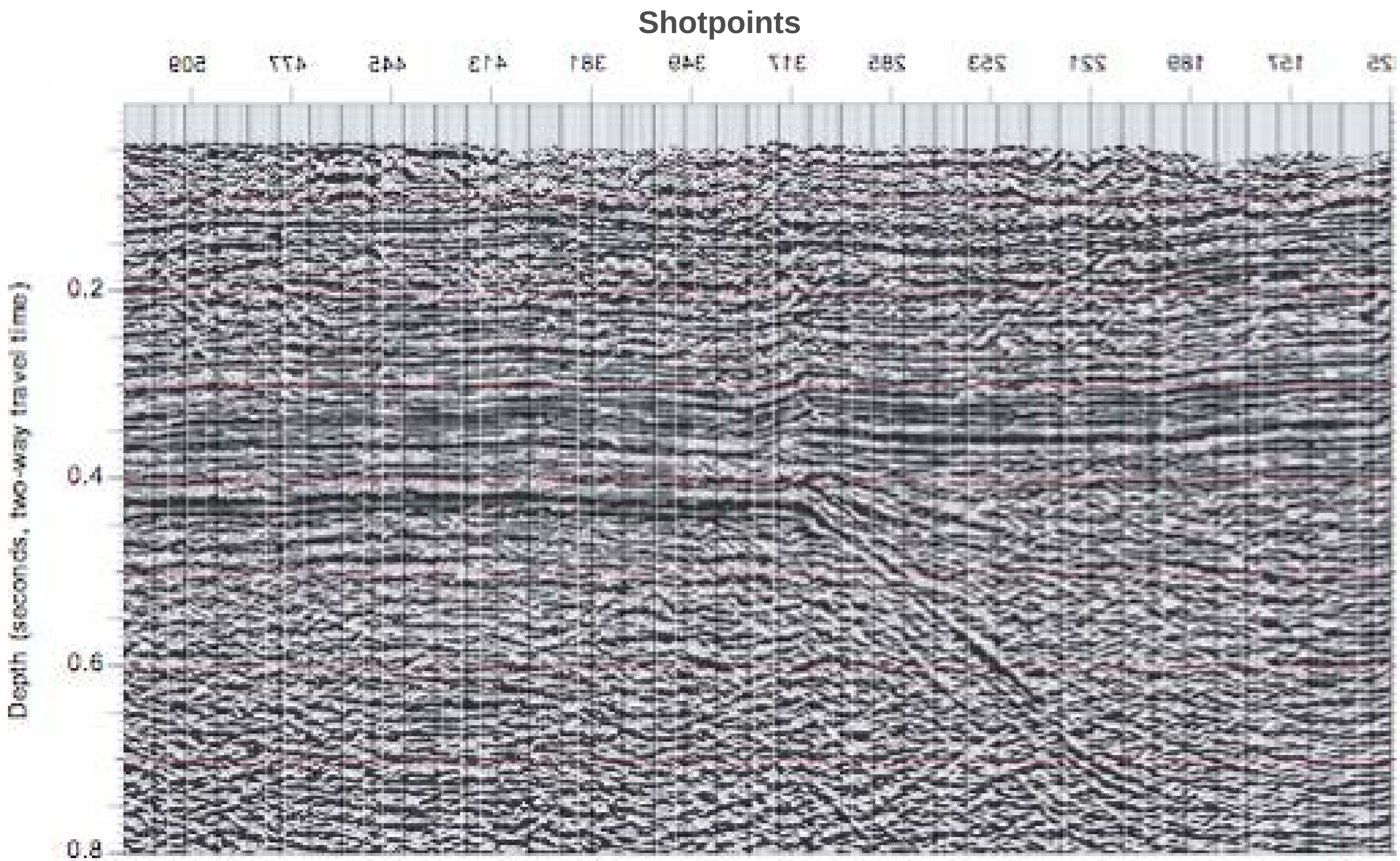
Exhibit SNC 000093, pg 2.1-2
Exhibit SNC 000094, Figures 1-4 and 1-5


Vogtle Site Layout
River Intake Road
Intake Structure
Cemetery
230kV Substation
Mallard Pond
Intake Structure
Barge Slip
Haul Road
Unit 1-2 Discharge
Unit 3-4 Discharge
Savannah River
Scherer Transmission Line
McIntosh Reroute
500kV Switchyard
ISFSI
Construction Entrance
Unit 4
Unit 3
U2
U1
Common Support Buildings
Warehouse
PA Expansion
PAP
Construction Laydown Area
Cooling Towers
Plant Wilson (CTs)
Security Pavilion
McIntosh
Main Plant
7
Exhibit SNC 000094, Figure 1-5

Evaluation of Tectonic Features (2.5.1)

- Literature review
- Contact local researchers
- Air photo interpretation
- Aerial reconnaissance
- Field reconnaissance
- Review of seismicity
- Seismic reflection profiles at Vogtle
- Geomorphic analysis of river terraces

***Exhibit SNC000080*, pp. 2.5.1-137 to 2.5.1-161**



Pen Branch Fault Image from Reflection Line 4

Looking Northeast

Exhibit SNC 000080, Figure 2.5.1-37

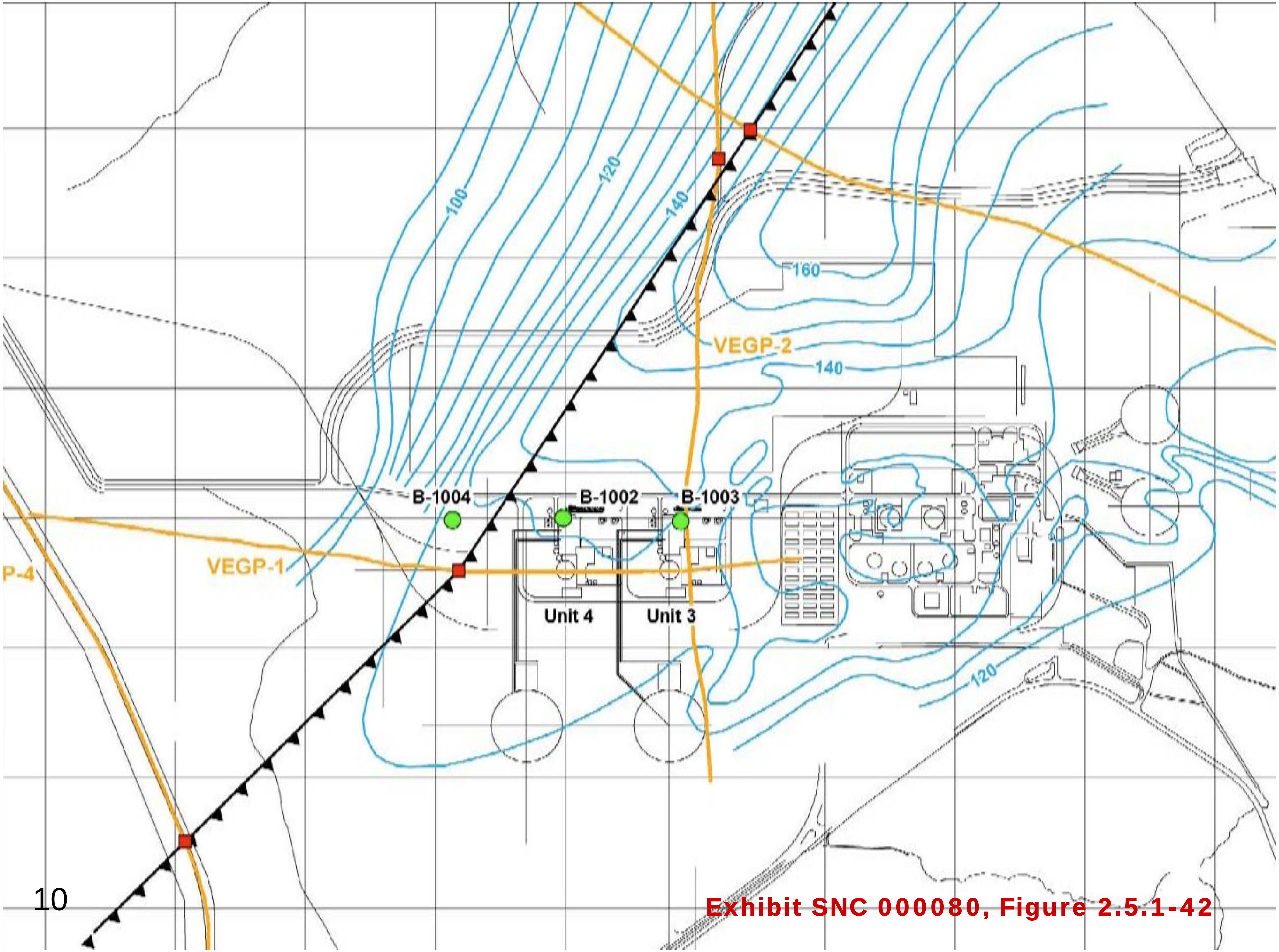


Exhibit SNC 000080, Figure 2.5.1-42

Summary (2.5.1)

- None of the tectonic features within the Site Vicinity (25 miles) or Site Area (5 miles) are capable tectonic sources

- Non-tectonic deformation and related features can be mitigated by removal of strata overlying Blue Bluff Marl

***Exhibit SNC 000080*, section 2.5.1**

Subsurface Profile (2.5.4)

- **Upper sands (Barnwell Group):**
  - Very loose to very dense sands
  - Average thickness of about 90 ft
  - Ground water elevation is 165 ft (55-60 ft below grade)
- **Blue Bluff Marl - (Lisbon Formation):**
  - Very hard, slightly sandy, cemented, calcareous silt/clay
  - Average thickness of 76 ft
- **Lower sands (coastal plain deposits):**
  - Dense sands
  - Thickness of 900 ft
- **Dunbarton Basin bedrock:**
  - Triassic sandstone
  - 1,049 ft below grade at B-1003

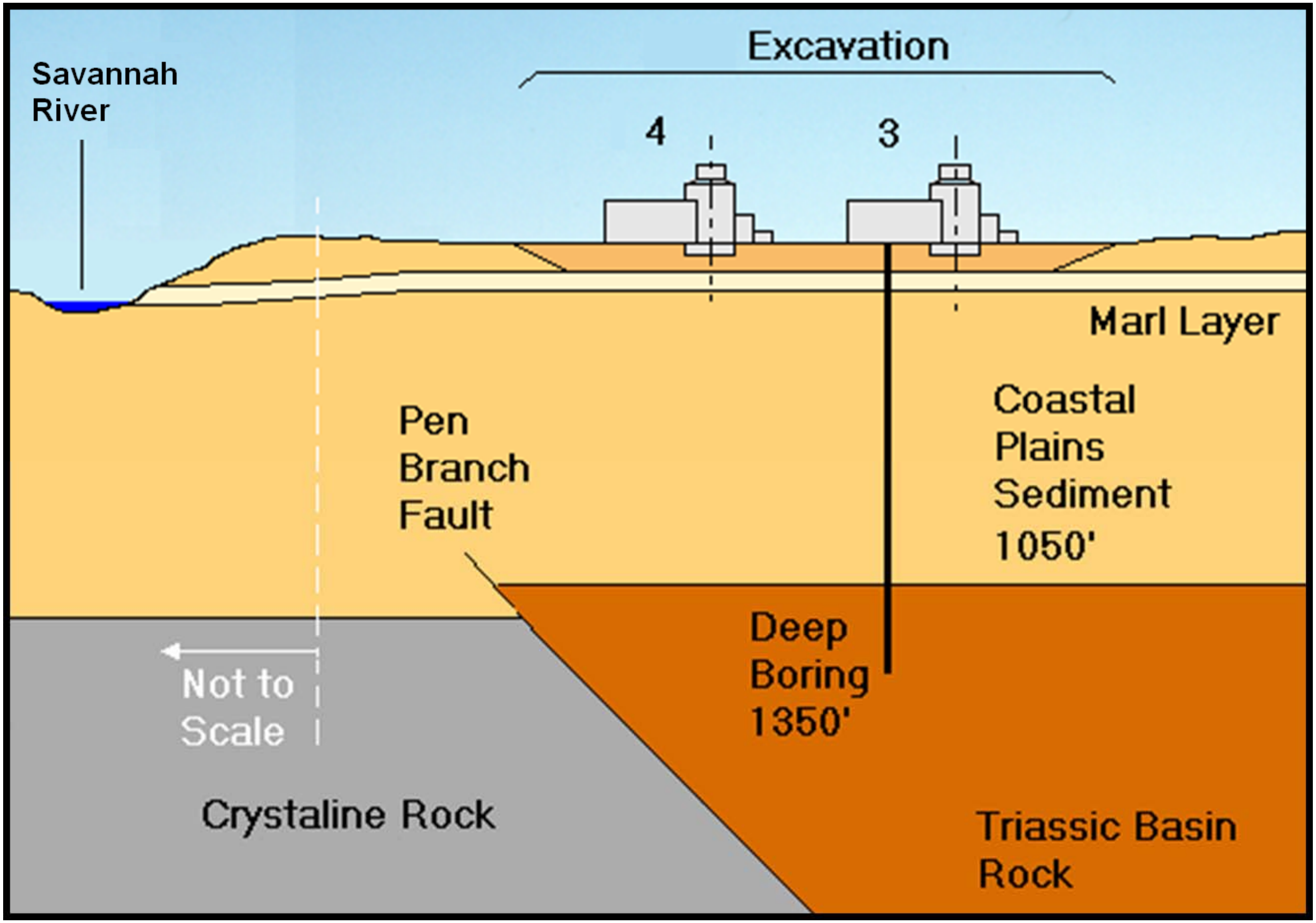
***Exhibit SNC 000080*, section 2.5.4.2.2**

Construction Excavation (2.5.4)

Removal of The Upper Sands - Barnwell Group

- Have highly variable density along the depth and from borehole to borehole
- A shell-rich, very porous material was encountered at the bottom of the Barnwell Group/top of Blue Bluff Marl that caused drilling fluid losses
- These soils were completely removed and replaced with compacted granular fill for construction of existing units.
- For these reasons, these soils will be removed

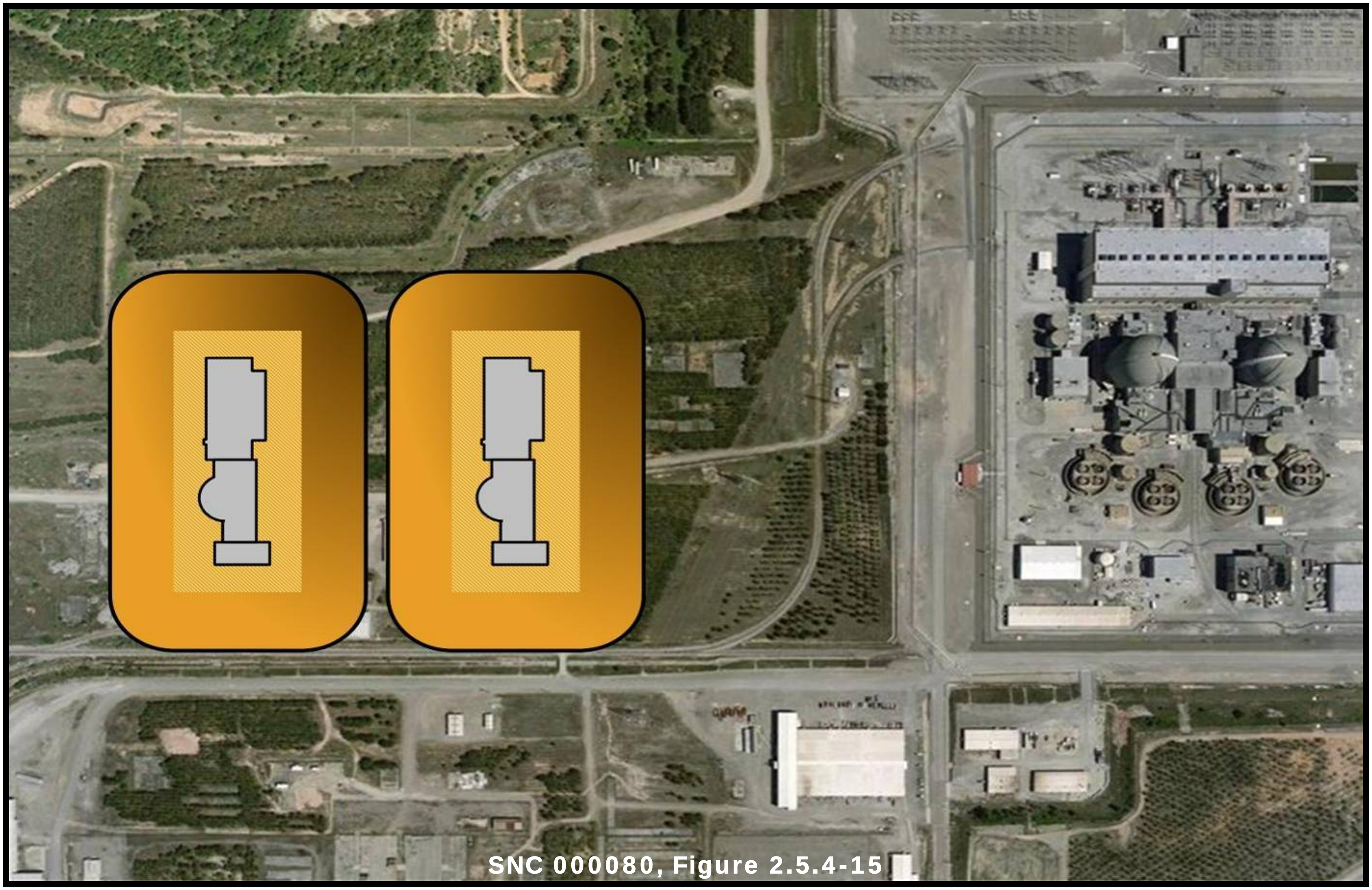
***Exhibit SNC 000080* ,section 2.5.4.2.2.1**



Site Soil/Rock Profile with Backfill

Exhibit SNC 000080, SSAR Figure 2.5.1-41

Excavation Plan



Engineered Backfill – Test Pad

Comparison – Field and Lab V_s Profiles (2.5.4)

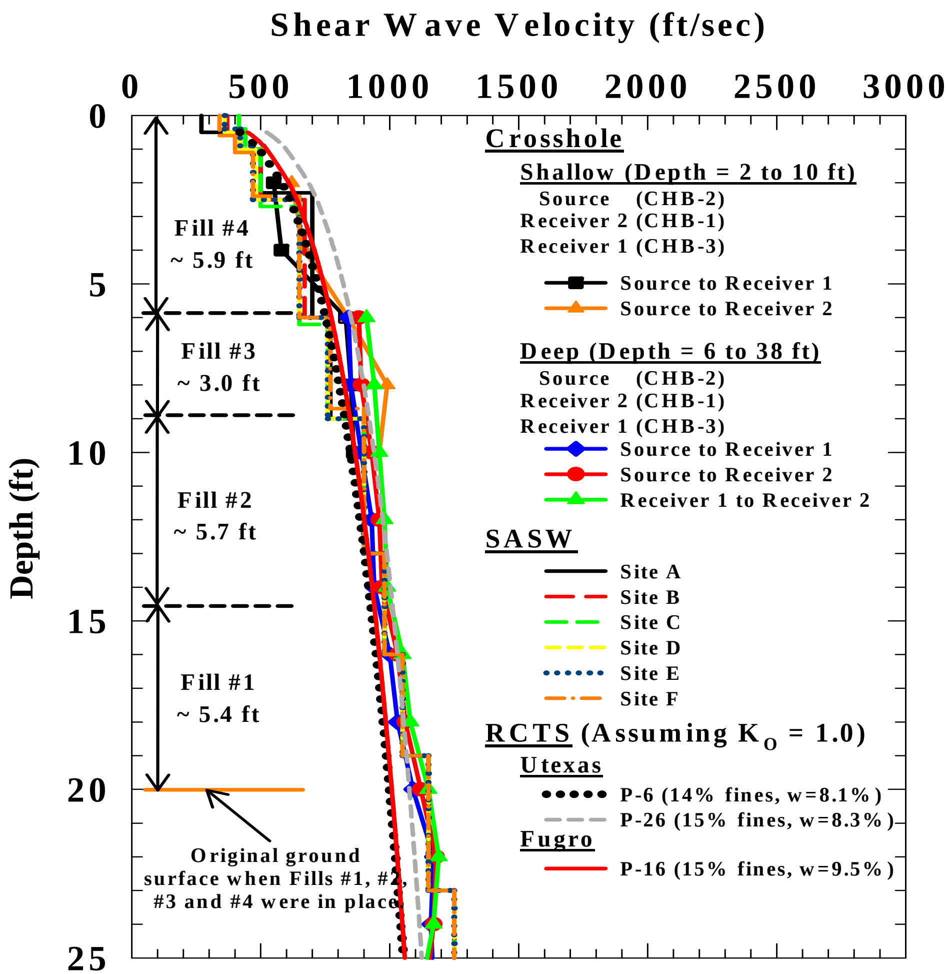
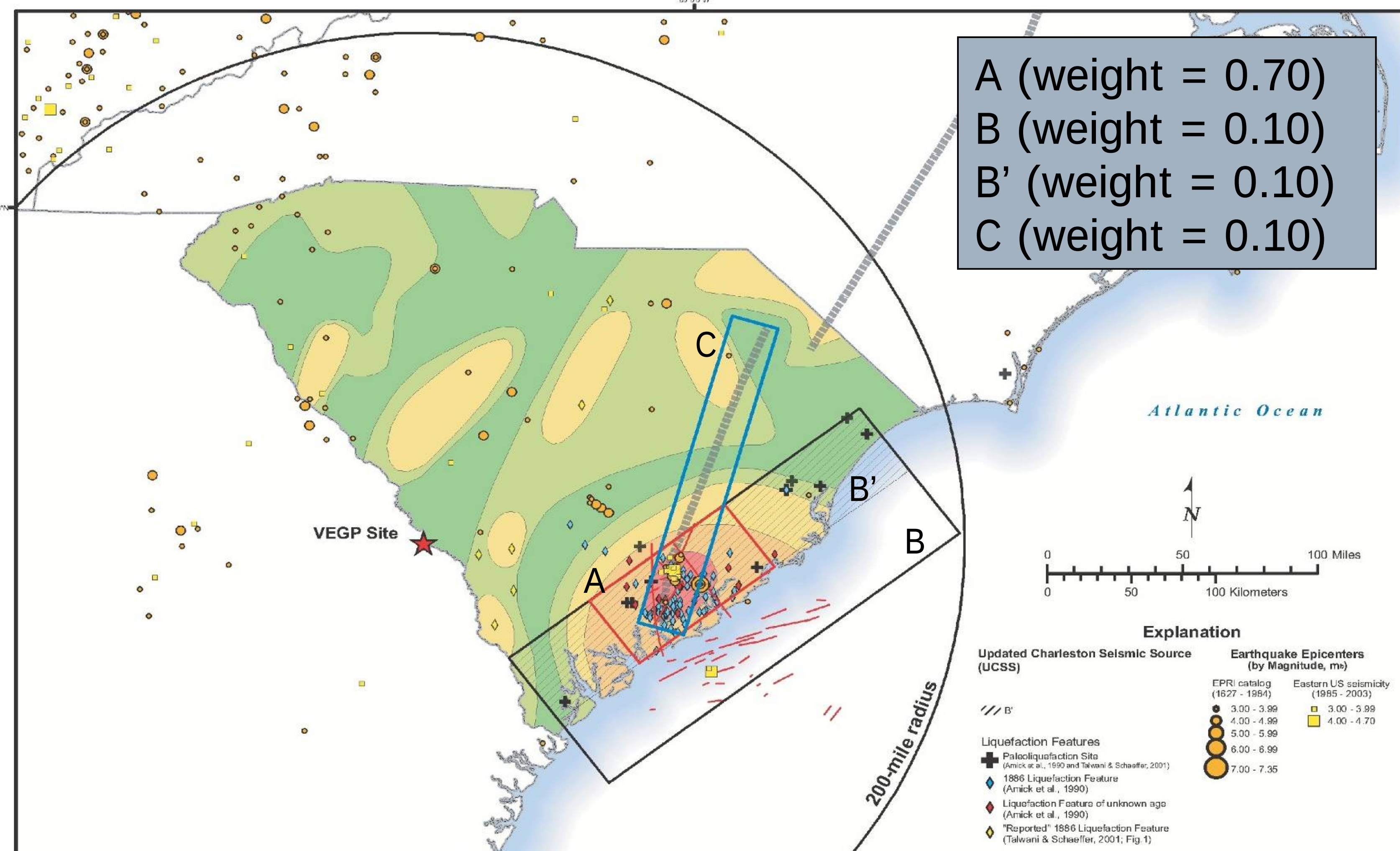


Exhibit SNC 000080, Appendix 2.5D

Seismic Ground Motion (2.5.2)

- PSHA Updated per RG 1.165
- Assessed effects of additional seismicity, 1985 through mid-2005
- Updated EPRI-SOG seismic sources to account for new source information
- Used updated EPRI-SOG ground motion models (EPRI 2004)

2.5.2 Vibratory Ground Motion

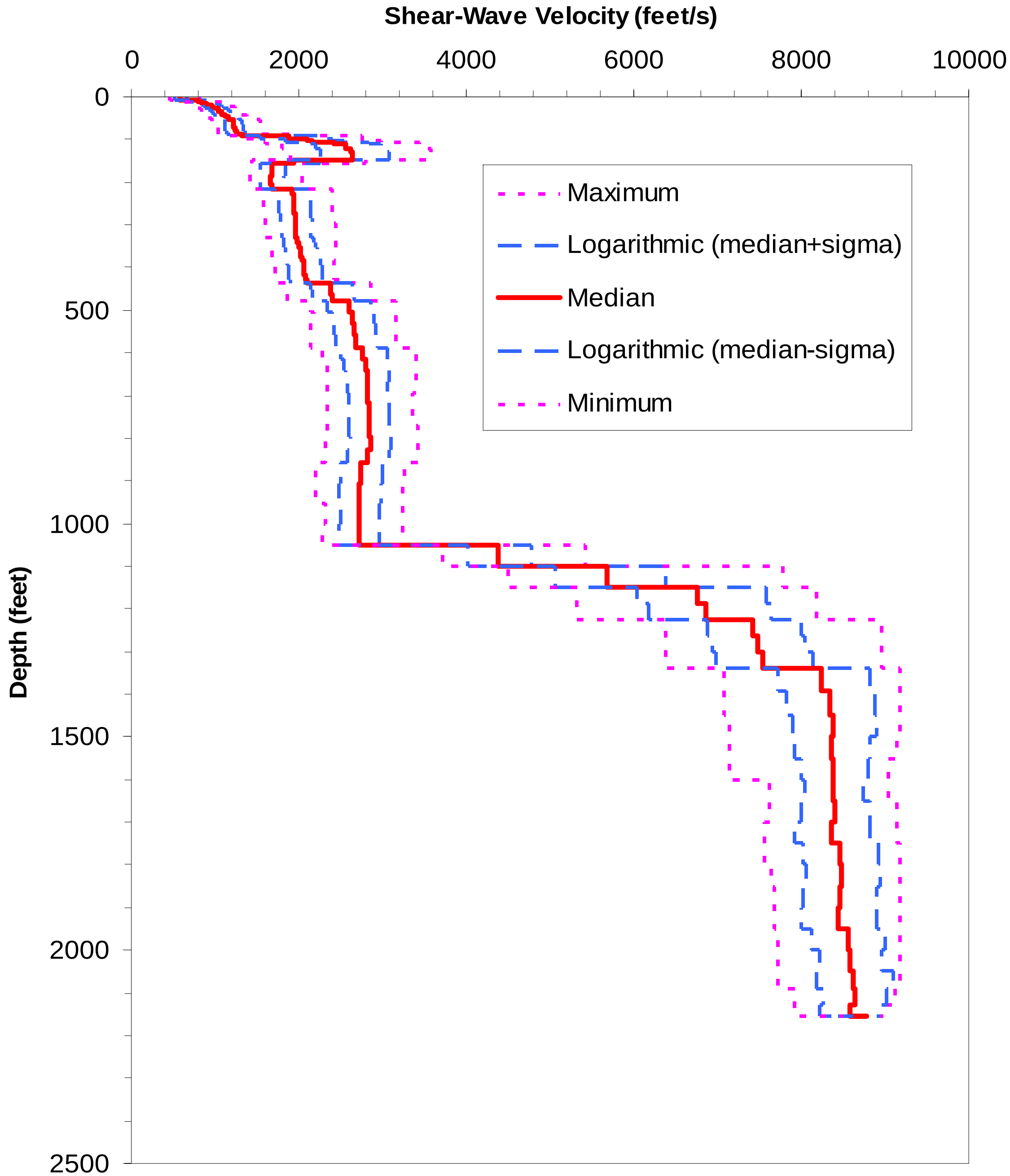


Updated Charleston Seismic Source

Exhibit SNC 000080 Figure 2.5.2-9

Calculation of Soil Hazard (2.5.2)

- Developed soil profile with properties
- Determined soil amplitudes for multiple rock input amplitudes (frequencies from 100 Hz to 0.1 Hz) (1D SHAKE analysis) using M and R from deaggregation (high- and low-frequency spectra)
- Combined rock hazard with site amplification to obtain soil UHS for multiple mean annual frequencies of exceedance



Soil-Rock Shear Wave Velocity Calculated from the 60 Shear-Wave Velocity Profiles

Exhibit SNC000080,Figure 2.5.2-34

Development of Vogtle SSE (2.5.2)

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- SSE developed following performance-based procedures (ASCE 43-05)
- Define SSE (GMRS) @ ground surface at top of Engineered Structural Backfill
- Vertical SSE = V/H x Horiz. SSE

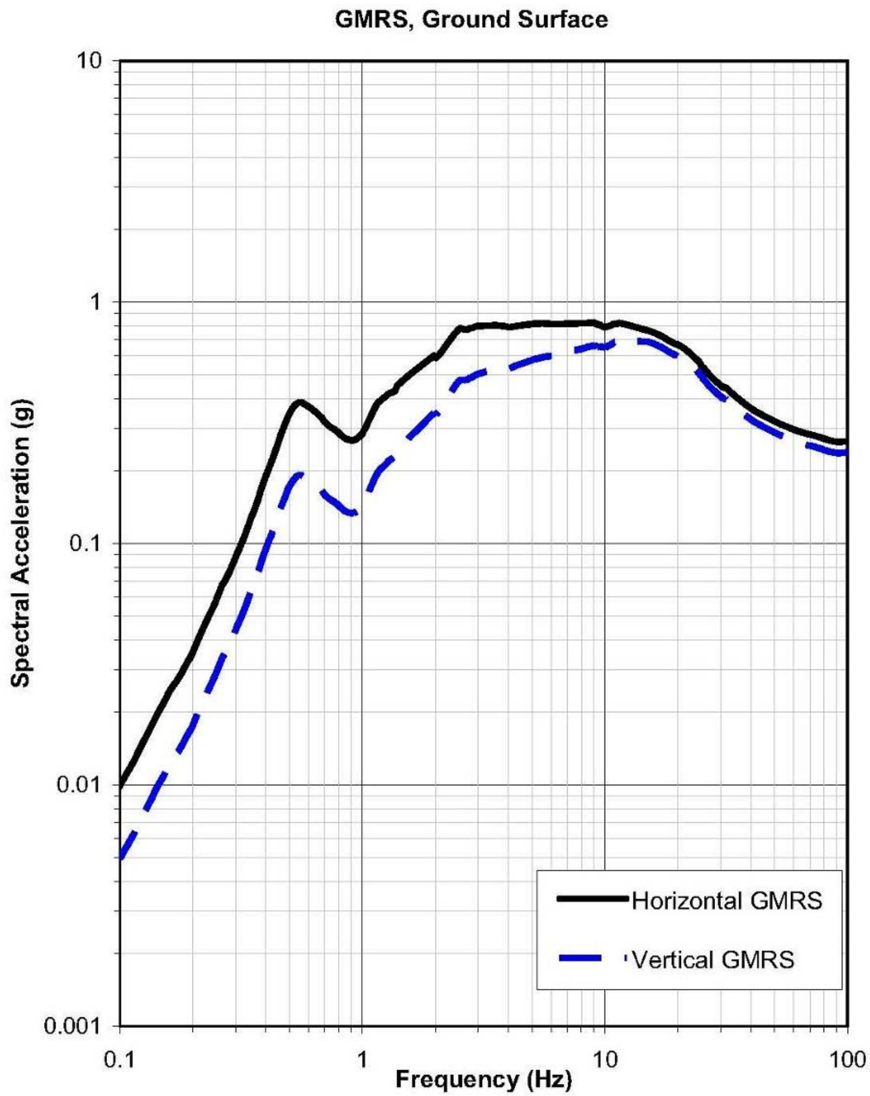
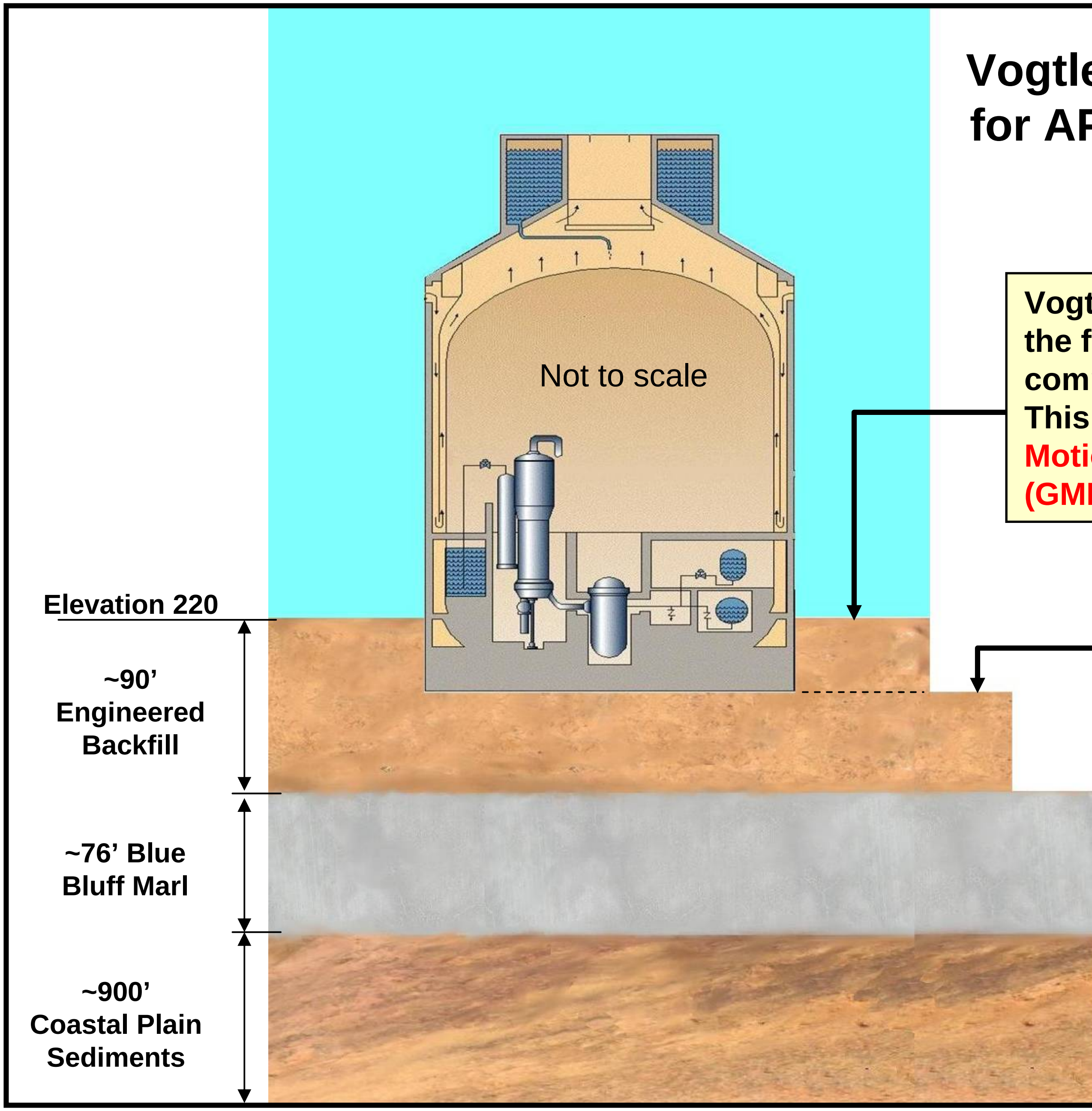


Figure 2.5.2-44b VEGP ESP Horizontal and Vertical GMRS Spectra (5% Damping)

Vogtle ESP SSE (GMRS) at Ground Surface (0-foot Depth)

Exhibit SNC000080 Figure 2.5.2-44b

Vogtle Site-Specific Model for AP1000 Nuclear Island

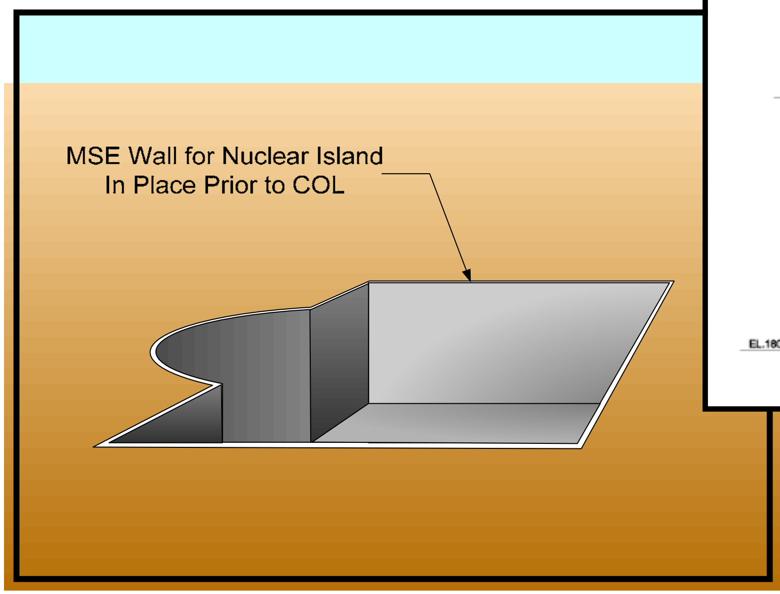


Vogtle ESP/COL SSE defined at the free ground surface of competent structural backfill. This is the Site Specific Ground Motion Response Spectrum (GMRS)

Vogtle input motion SSE at hypothetical outcrop at 40' depth for control point seismic input for site specific SSI analysis of AP1000 nuclear island. This is a Foundation Input Response Spectra (FIRS)

Limited Work Authorization (LWA)

Backfill, MSE Wall, Mudmat and Waterproof Membrane



Nuclear Island Foundation at Receipt of COL

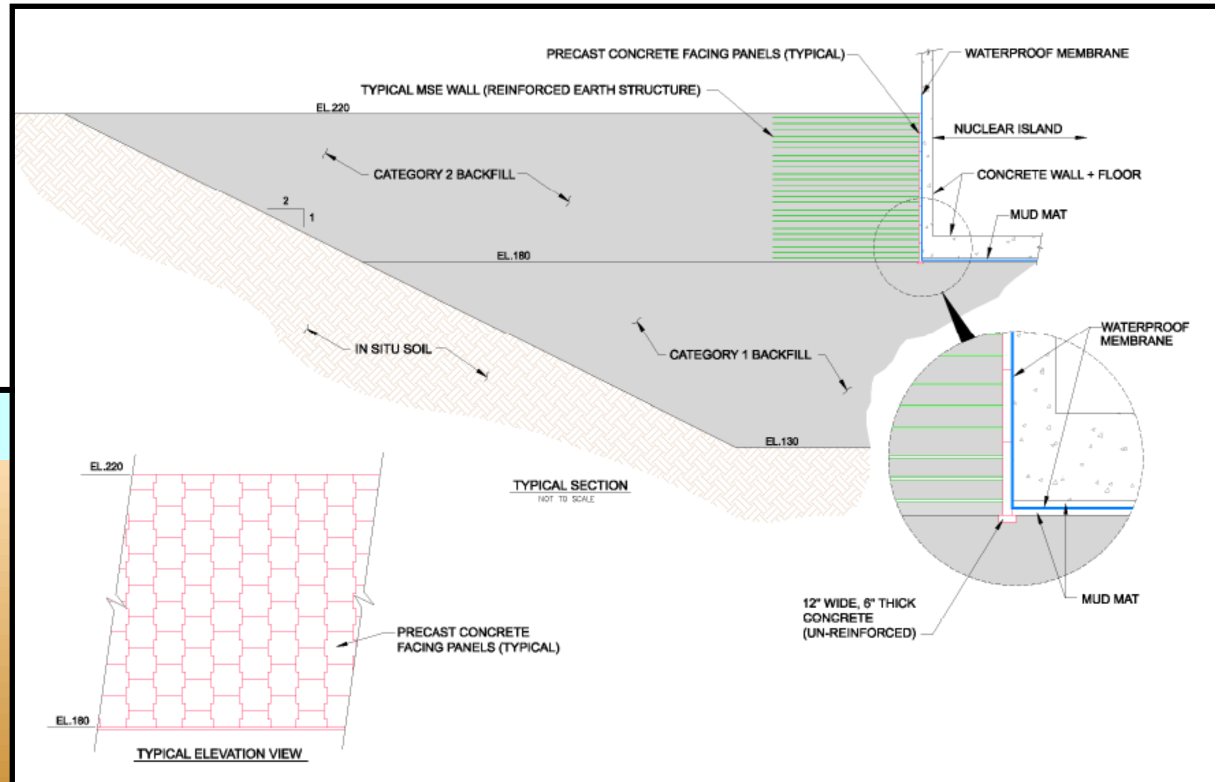


Exhibit SNC 000080, Figure 2.5.4-17

LWA SEISMIC ISSUES

- Backfill directly supports the Nuclear Island
- Construction of the backfill part of LWA
- Site-specific seismic evaluation required to verify the backfill capacities (C) exceed the site-specific demand (D) by an adequate design margin (C/D > Required Factor of Safety)

Appendix 2.5E
Site-Specific Seismic Evaluation

Comparison of Vogtle Horizontal GMRS and FIRS with AP1000 CSDRS

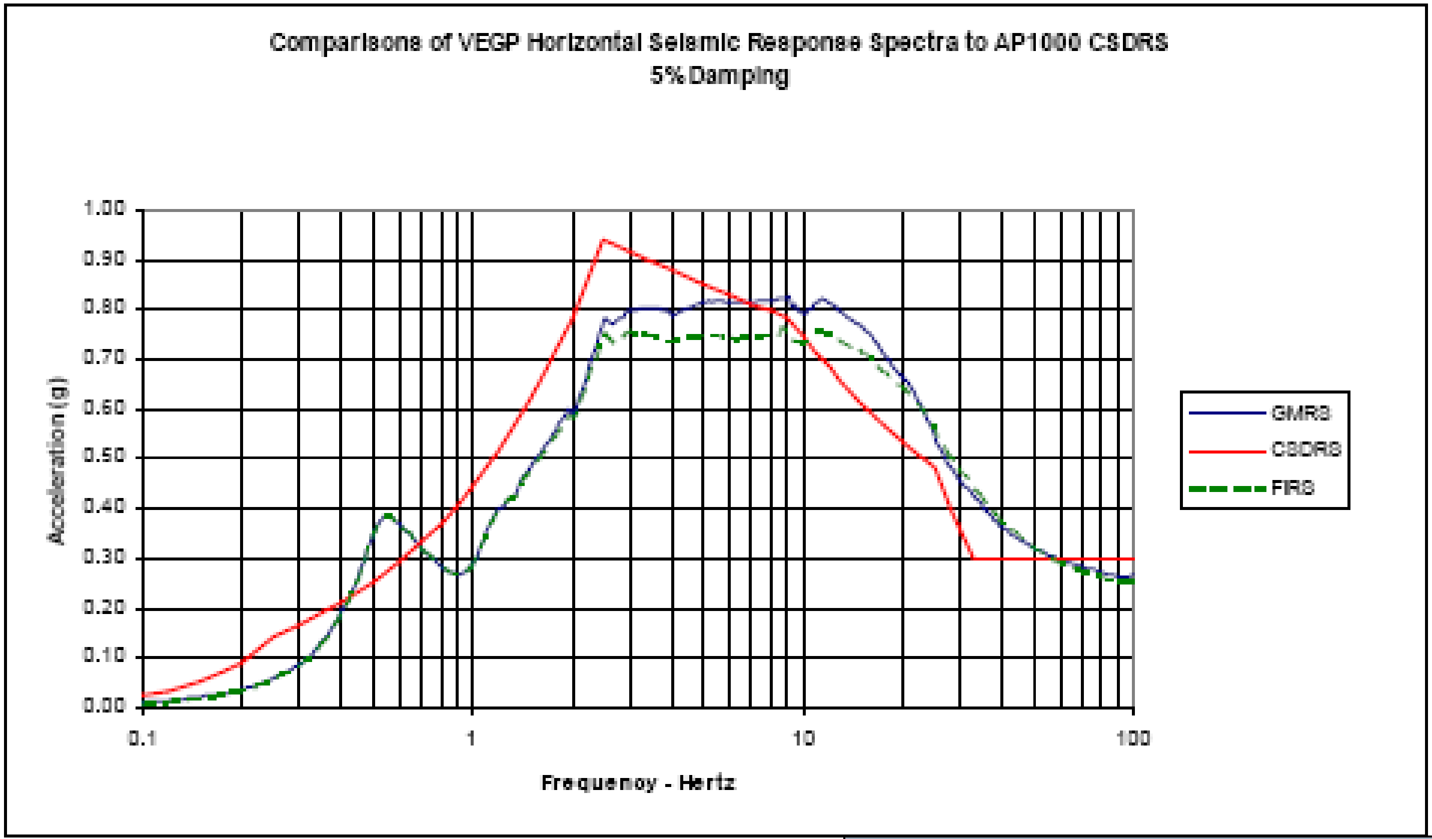
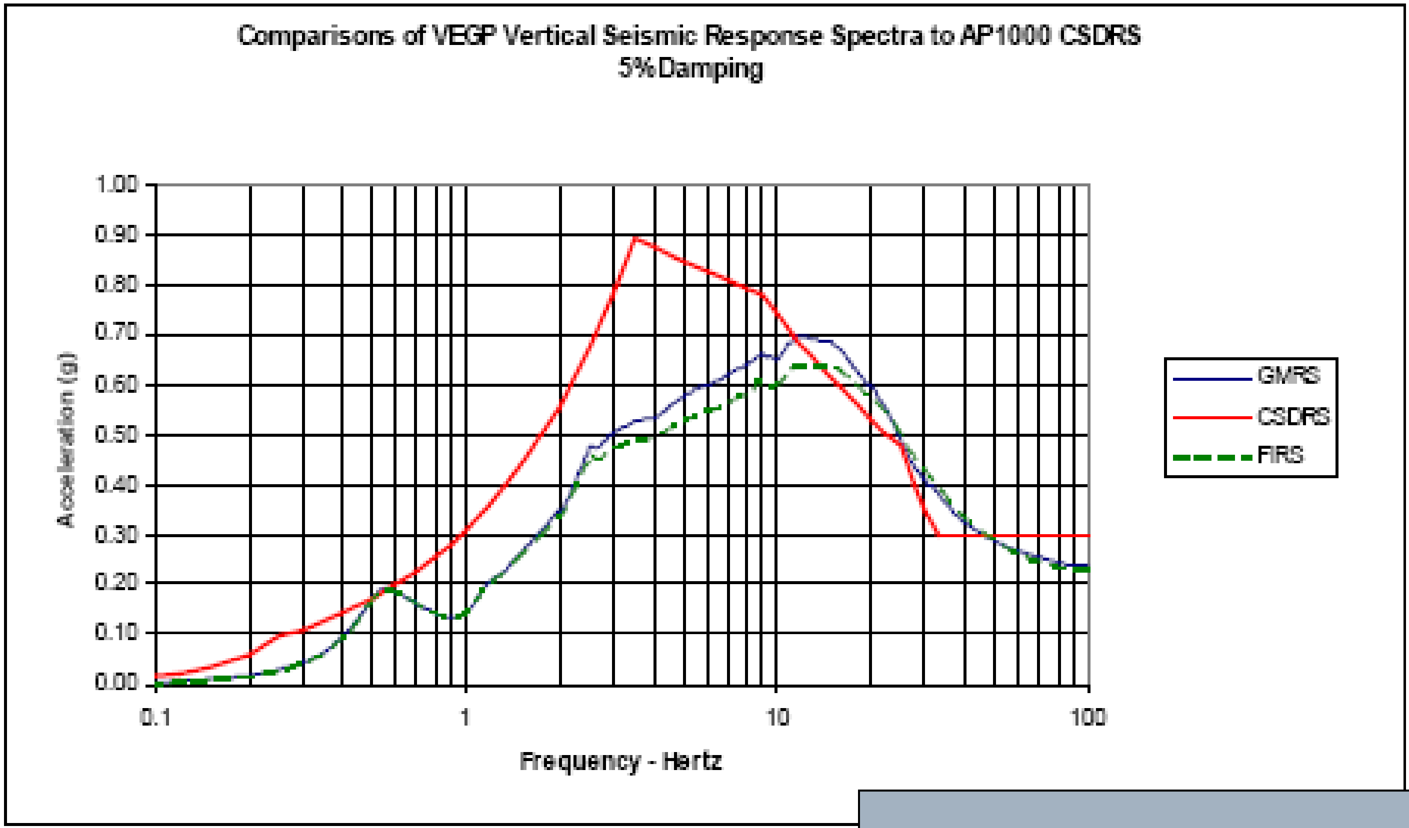


Exhibit SNC 000## Appendix 2.5E, Figure 3-4

Appendix 2.5E
Site-Specific Seismic Evaluation

Comparison of Vogtle Vertical GMRS and FIRS with AP1000 CSDRS



SNC Exhibit 000080 Appendix 2.5E, Figure 3-5

VOGTLE SITE-SPECIFIC SEISMIC EVALUATION (App. 2.5E)

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- Site-specific analysis required
  - Site GMRS exceeds AP1000 CSDRS
  - Site soil profile different from the AP1000 generic soil profiles
- 2D seismic soil structure interaction (SSI) models acceptable for seismic stability
- Vogtle SSI model:
  - AP1000 2D seismic models
  - Vogtle GMRS
  - Vogtle site soil profile (LB, BE, & UB)

Exhibit SNC 000080, Appendix 2.5E

VOGTLE 2D Site-Specific SSI Response Example

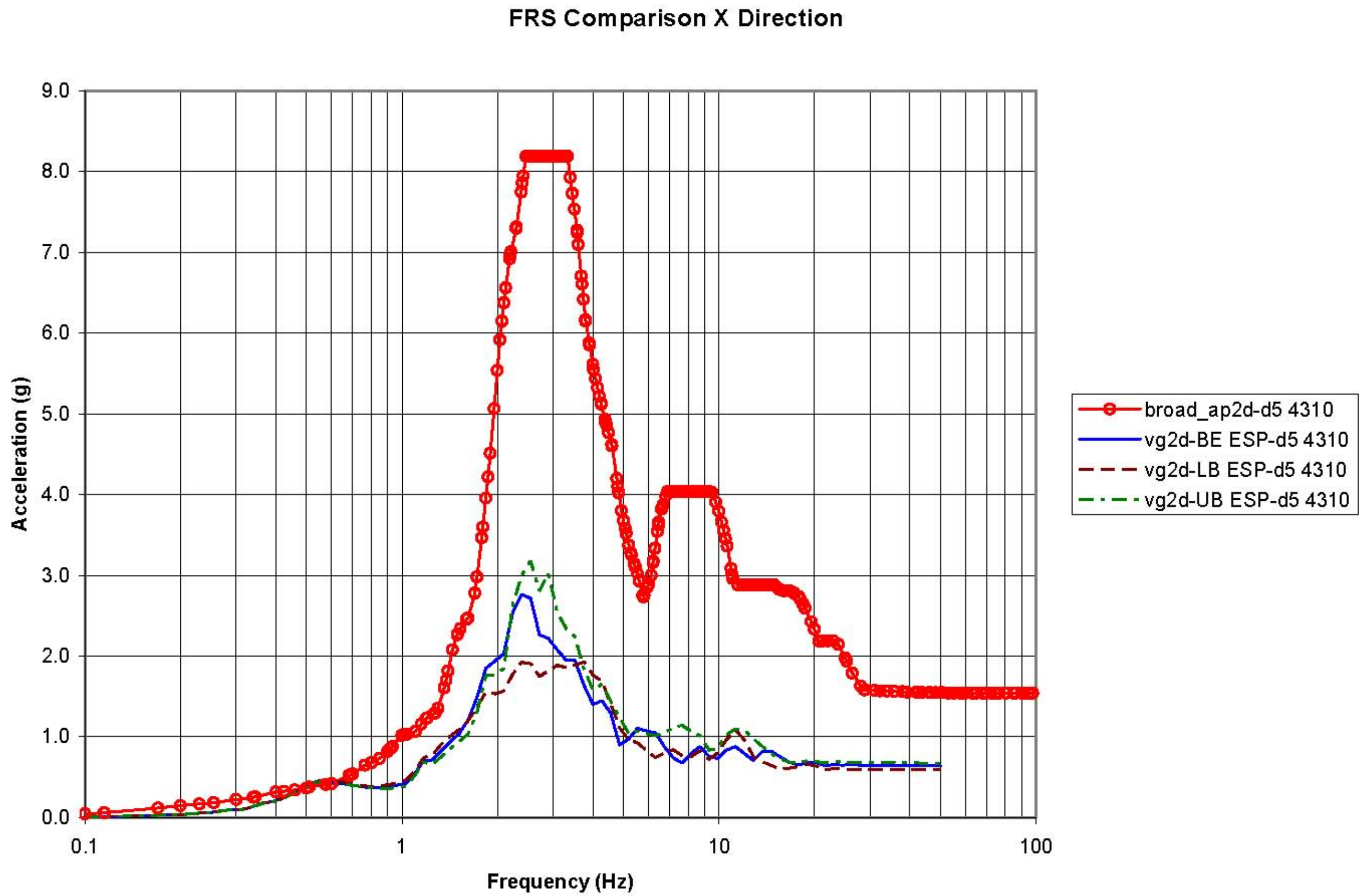

Figure 5.1-10 - Comparison of Node 4310 ESP to AP1000 SSI Envelope, NS Dir

Exhibit SNC 000080, Appendix 2.5E

VOGTLE Seismic Stability Results
Factors of safety = Cap./Demand

- Minimum Sliding C/D = 1.83 > 1.1
- Minimum Overturning C/D = 2.45 > 1.1
- Static Bearing C/D = 11.9 >> ~ 3.0
- Dynamic Bearing C/D = 5.6 > ~2.25
- No Soil Liquefaction

Exhibit SNC000080, 2.5.4 & Appendix 2.5E

- Conclusion: Vogtle site-specific seismic analysis supports LWA activities