Vogtle Early Site Permit Seismic Activities

NRC Public Meeting

April 14, 2006

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Meeting Objectives

- Inform the NRC
- Obtain NRC feedback

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Agenda

9:00	**Introductions and Opening Remarks**	**NRC/SNC**
9:10	**ESP Site Location and Description**	**Tom McCallum** SNC ESP Technical PM
9:20	**Ground Motion Program Overview**	**Don Moore** SNC Consulting Engineer
9:40	**Geological and Seismological Investigations**	**Scott Lindvall** William Lettis & Associates
10:00	**Geophysical and Geotechnical Investigations**	**Jose Clemente** Bechtel Corporation

Agenda (continued)

10:20	**Summary of Seismic Hazard for Vogtle Site**	**Robin McGuire** Risk Engineering, Inc
10:40	**Determination of SSE Ground Motion**	**Robin McGuire** Risk Engineering, Inc
11:10	**Plans for AP1000 and Vogtle Site Assessment**	**Don Moore** SNC Consulting Engineer
11:30	**Discussion**	**NRC and SNC**
11:50	**Opportunity for Public Comment**	
12:00	**Adjourn**	

ESP Site Location and Description

Tom McCallum

ESP Technical Project Manager

Southern Nuclear Operating Company

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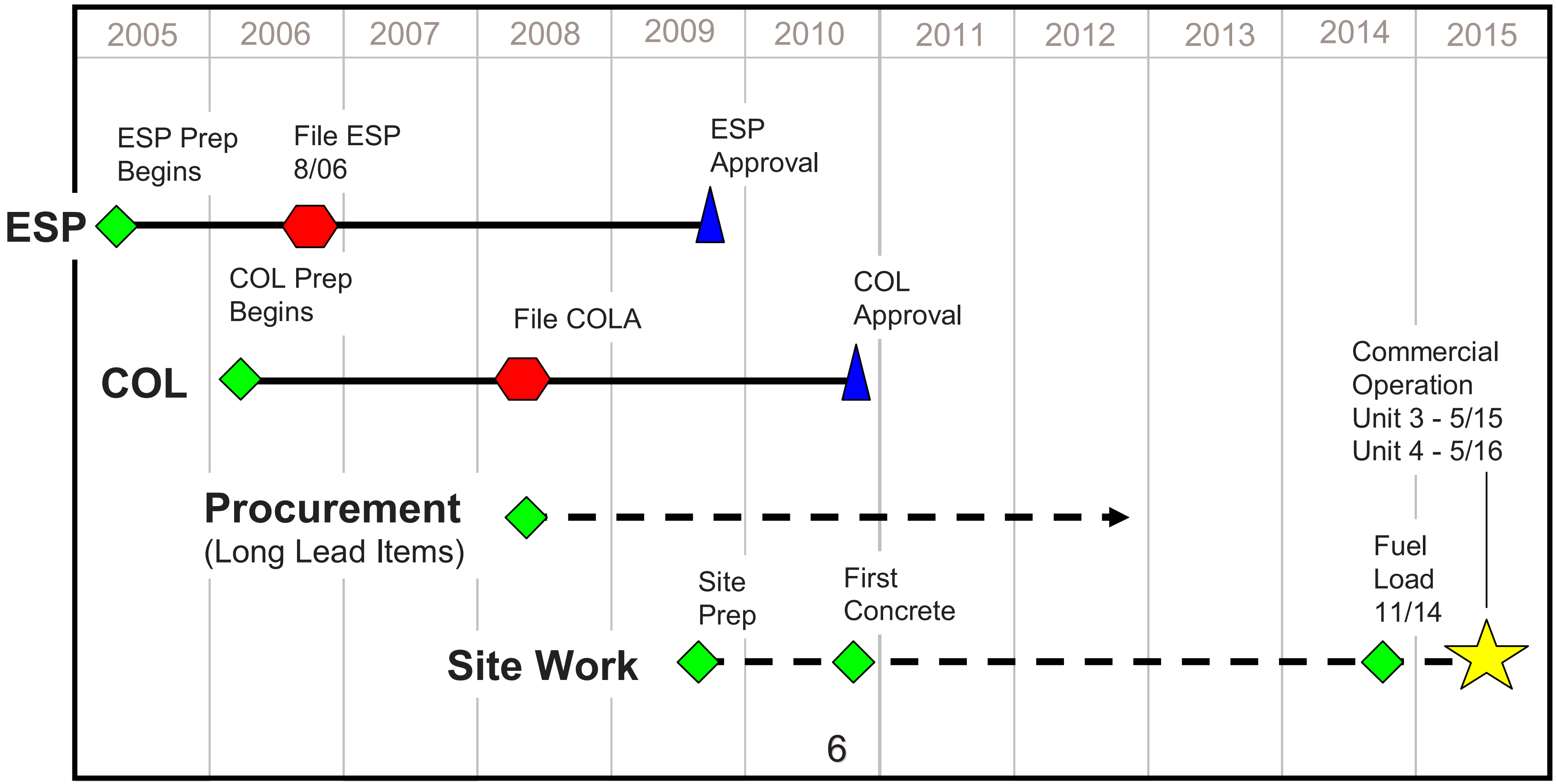
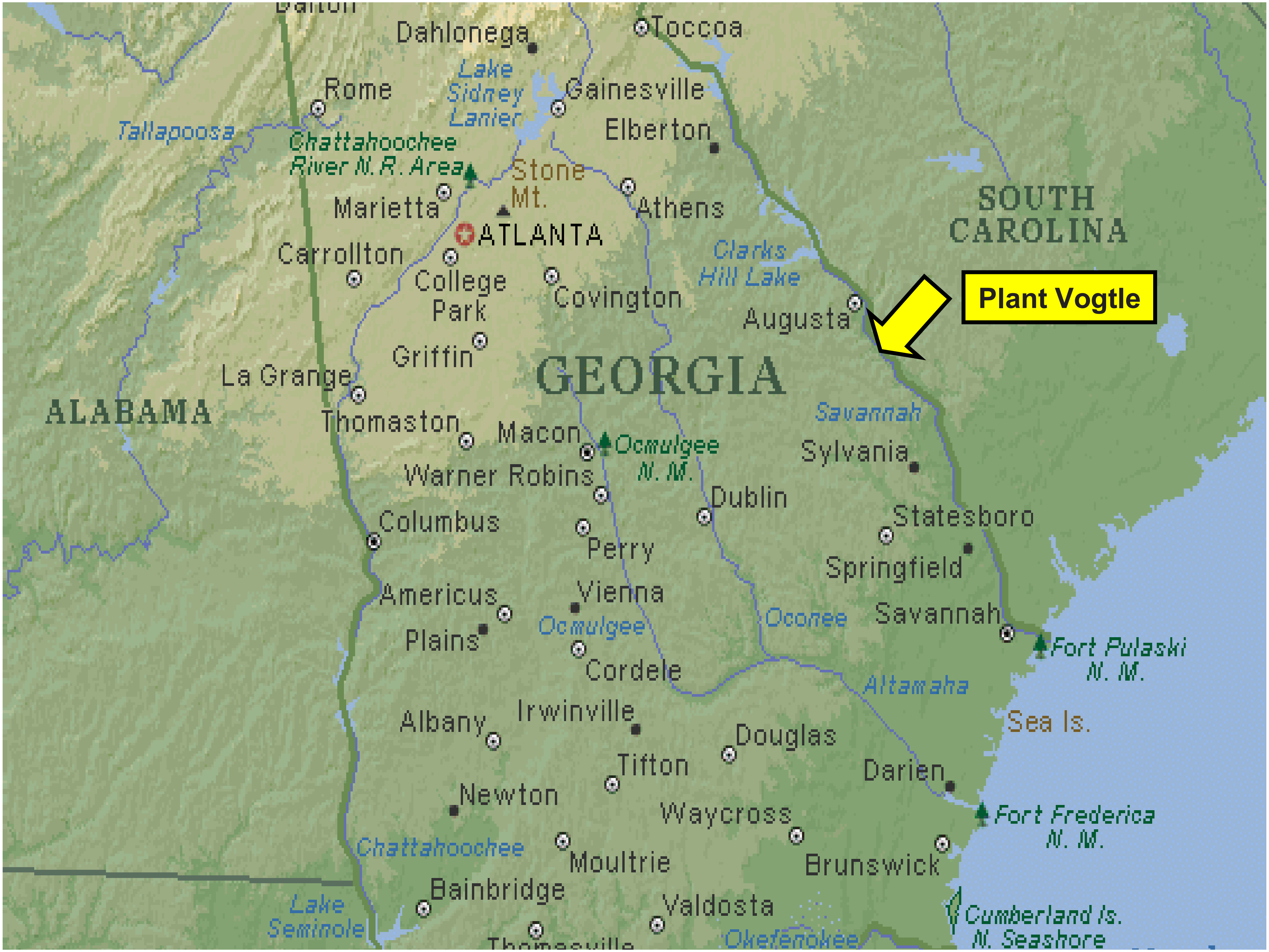
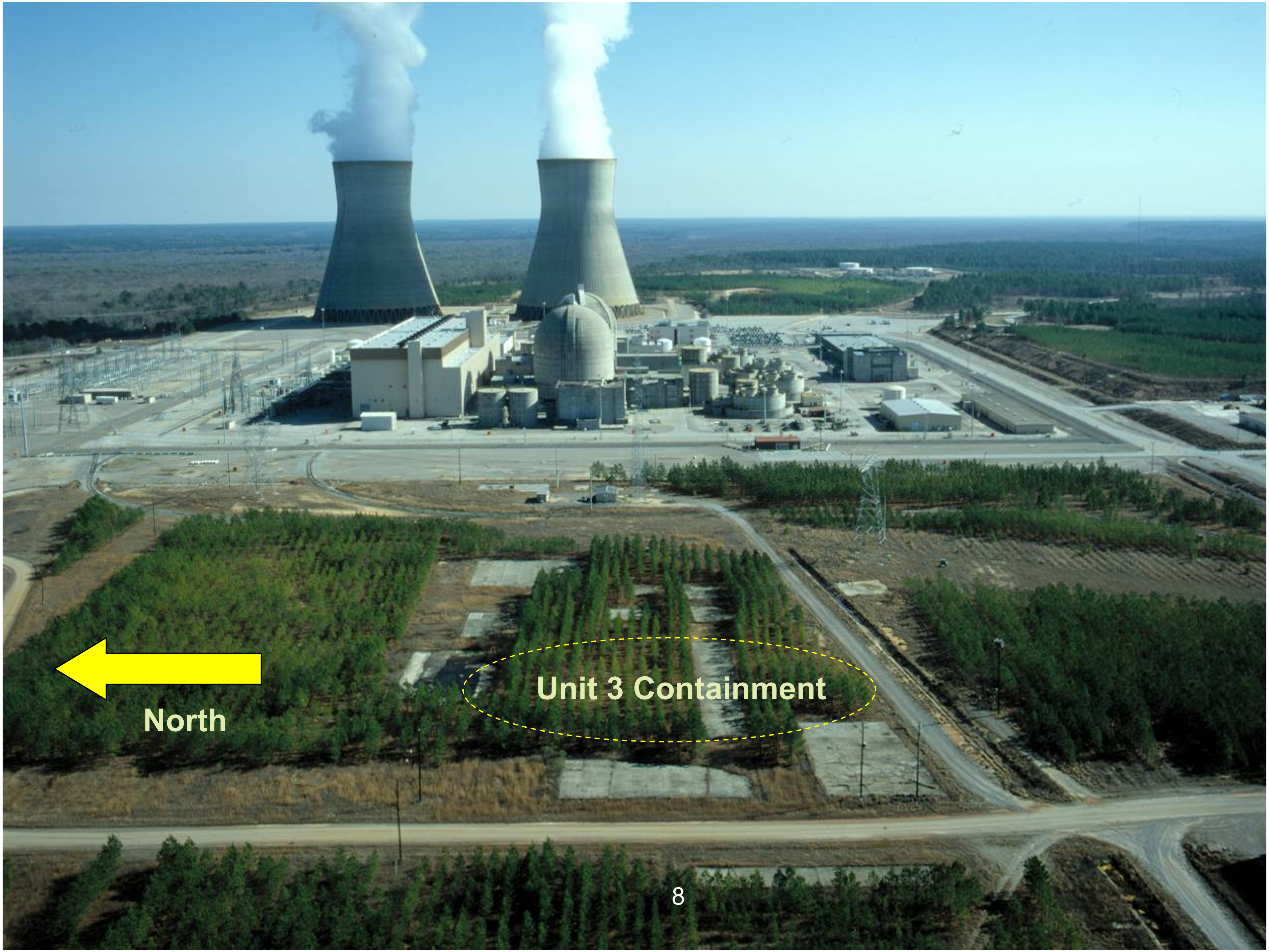
Southern Company Plan

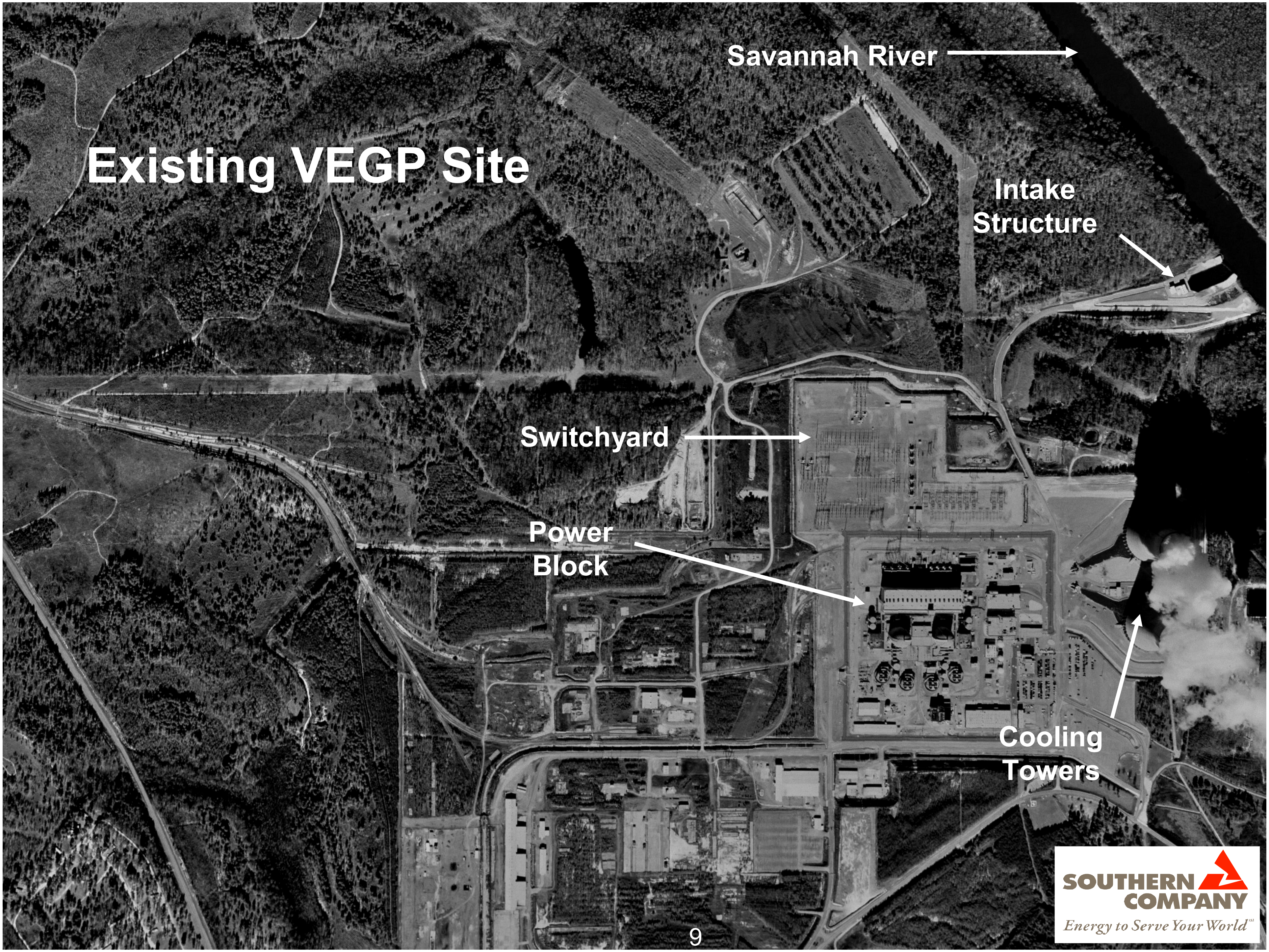
- Two Units at VEGP Site
- Westinghouse AP-1000 Technology
- Decision to construct pending




Plant Vogtle
GEORGIA
ALABAMA
SOUTH CAROLINA
Dahlonega
Toccoa
Lake Sidney Lanier
Gainesville
Rome
Tallapoosa
Chattahoochee River N.R. Area
Elberton
Stone Mt.
Athens
Marietta
ATLANTA
Carrollton
College Park
Covington
Clarks Hill Lake
Augusta
Griffin
La Grange
Savannah
Thomaston
Macon
Ocmulgee N. M.
Sylvania
Warner Robins
Dublin
Columbus
Statesboro
Perry
Springfield
Americus
Vienna
Savannah
Ocmulgee
Oconee
Plains
Fort Pulaski N. M.
Cordele
Altamaha
Sea Is.
Albany
Irwinville
Douglas
Tifton
Darien
Newton
Waycross
Fort Frederica N. M.
Chattahoochee
Moultrie
Brunswick
Bainbridge
Lake Seminole
Valdosta
Cumberland Is. N. Seashore
Okefenokee


Unit 3 Containment
North

Existing VEGP Site



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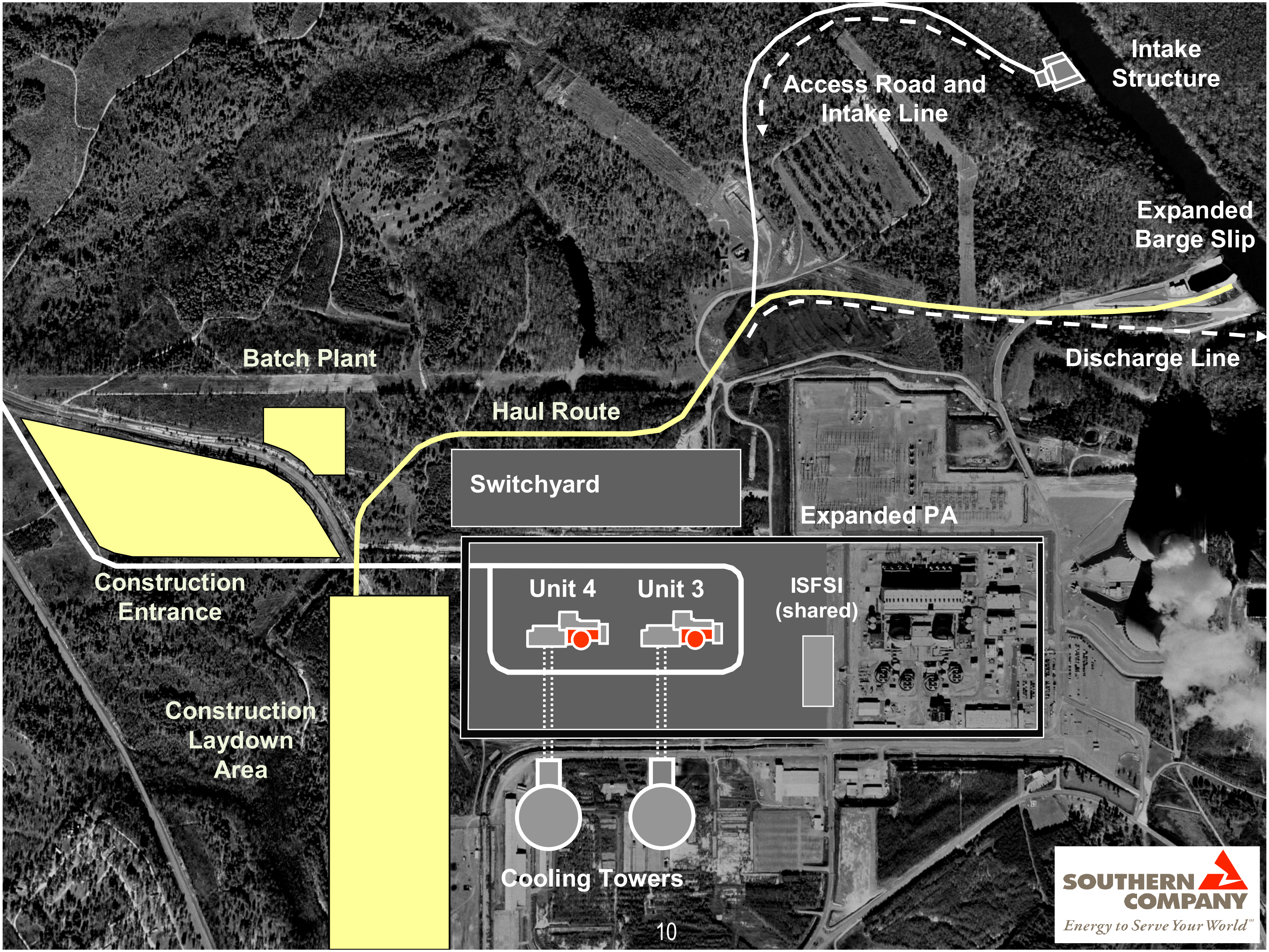

Intake
Structure
Access Road and
Intake Line
Expanded
Barge Slip
Discharge Line
Batch Plant
Haul Route
Switchyard
Expanded PA
Construction
Entrance
Unit 4
Unit 3
ISFSI
(shared)
Construction
Laydown
Area
Cooling Towers
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Ground Motion Program Overview

Don Moore
Consulting Engineer
Southern Nuclear Operating Company

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Seismic Program Overview

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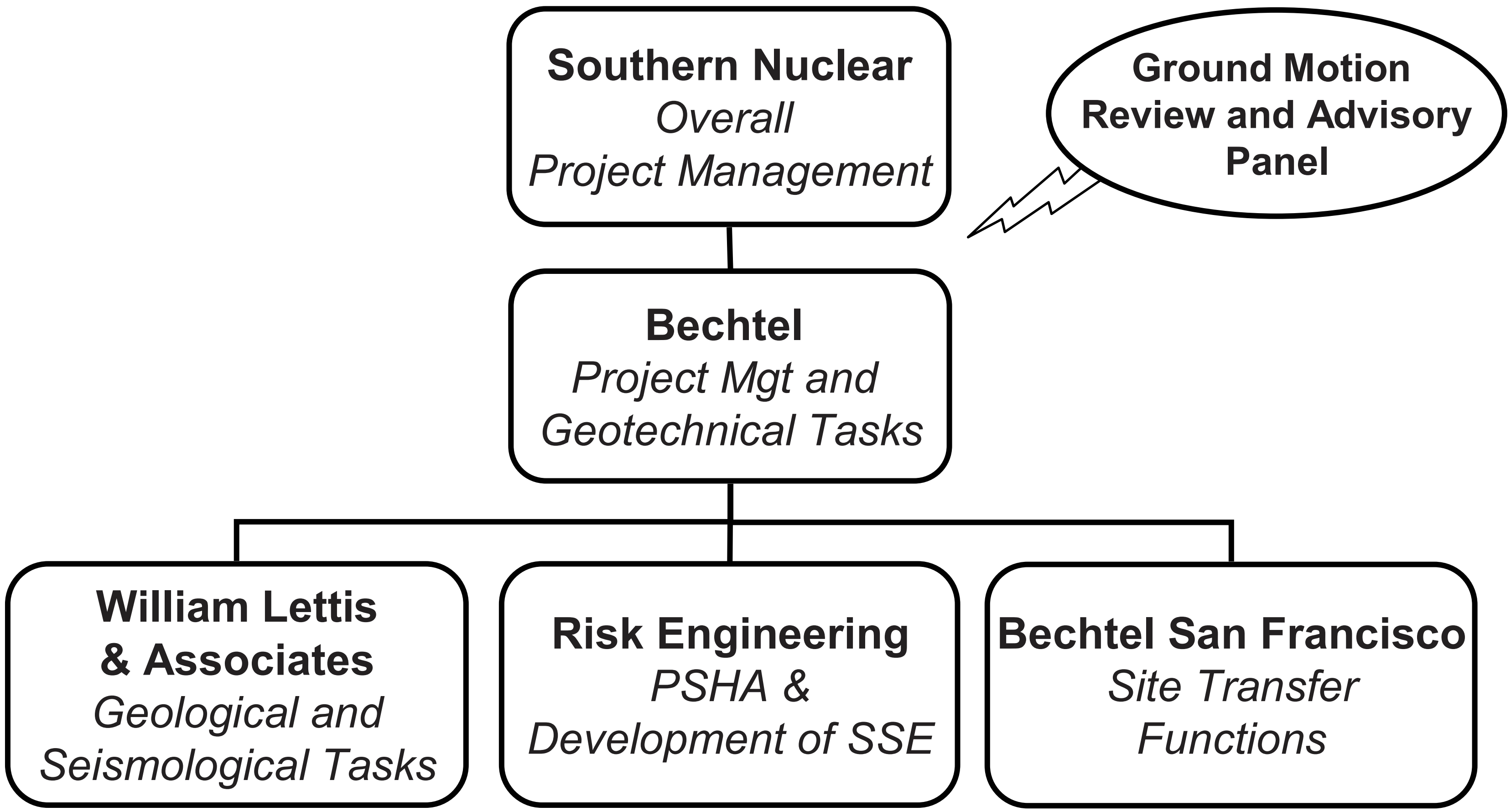
Seismic Program Organization



Seismic Program Overview

Ground Motion Review and Advisory Panel

Reasons for Formation:

- Seismic hazard considerations are significant
- Approach to developing SSE is being updated
- Seismic ground motion issues are complex and require multi-disciplined effort
- Review by outside experts to ensure defensible approach

Seismic Program Overview

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Ground Motion Review and Advisory Panel

Panel Members

Member	Area of Expertise
Dr. Martin Chapman	**Southeastern US seismicity**
Dr. Robert P. Kennedy	**Seismic ground motion for design**
Dr. Carl Stepp	**Probabilistic Seismic Hazard Analysis (PSHA)**
Dr. Robert Youngs	**Site response to seismic input at rock**

Seismic Program Overview

Ground Motion Review and Advisory Panel

Activities

- Two panel meetings have been held to review tasks and comment
- Provided ongoing review and comment on specific tasks, e.g., Charleston Update

Seismic Program Overview

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Other Outside Assistance

Savannah River Site

- Provided technical staff support for seismic survey and other tasks
- Provided significant amount of data from SRS geotechnical investigations

Seismic Program Status

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Activity	Schedule
Geological, seismological, and geotechnical investigations for ESP	Complete
Update of EPRI-SOG per RG 1.165 including update of Charleston Source	Complete
Rock hazard characterization	April 2006
Soil/rock profile development and site transfer function development	May 2006
Site-specific SSE	June 2006
Submit ESP application	August 2006
Interactions with Westinghouse on AP1000	COLA

Geological and Seismological Investigations

William Lettis & Associates, Inc.

Scott Lindvall

William Lettis & Associates, Inc

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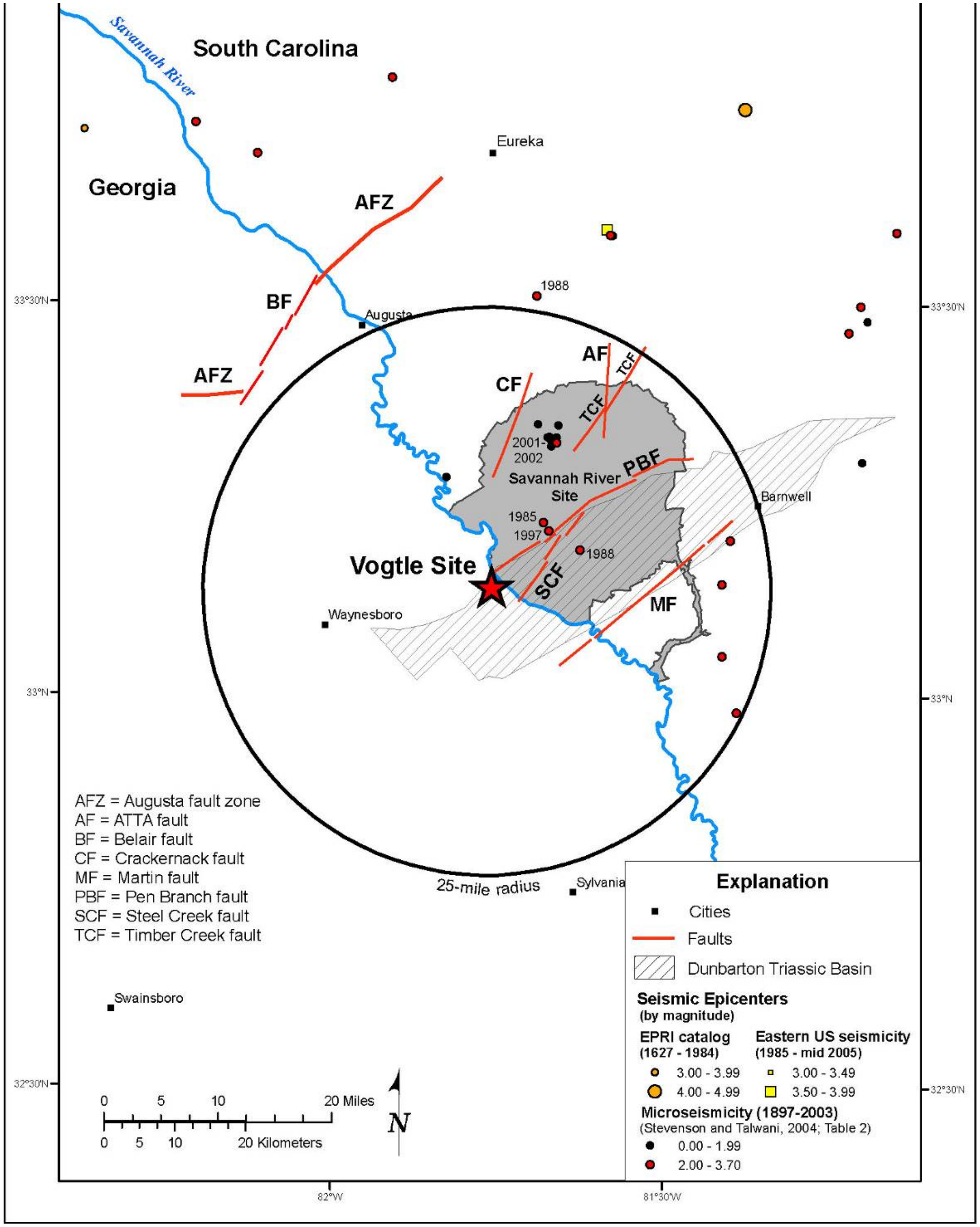
Evaluation of Tectonic Features within 25 miles

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



Site Vicinity Tectonic Features and Seismicity (25-mile radius)

Summary of Geological and Seismological Investigations

- None of the Site Vicinity (25 miles) or Site Area (5 miles) Tectonic Features are Capable Tectonic Sources

- Non-tectonic deformation and related features mitigated by removal of strata overlying Blue Bluff marl

Pen Branch Fault

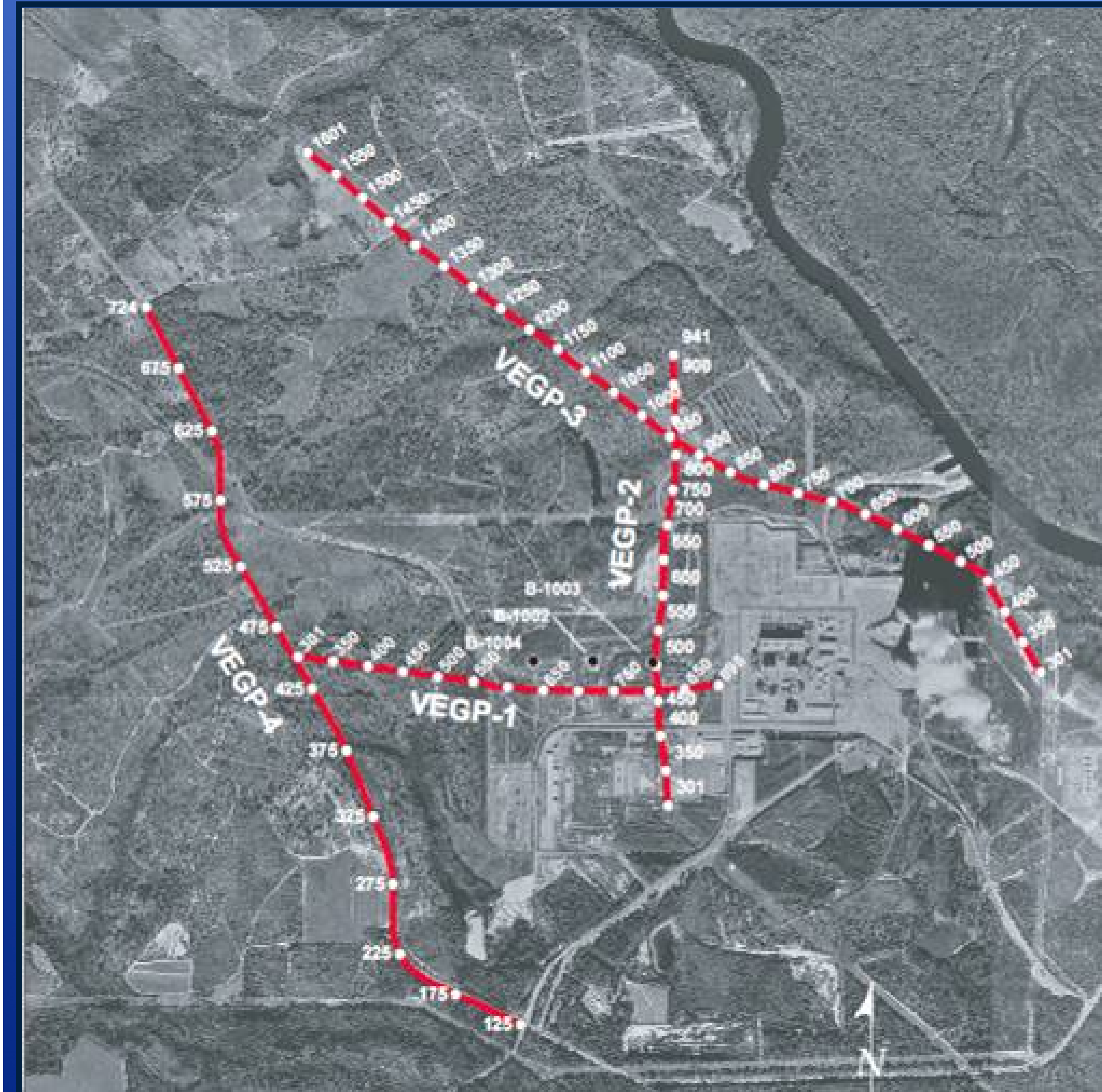
- Triassic Basin normal fault that separates Paleozoic crystalline basement from Triassic basin sediments
- Reactivated as a SE-side-up reverse fault in Cenozoic
- Youngest deformed unit is late Eocene
- Non-capable PBF associated with similar, non-capable faults of the Atlantic Coastal Plain that exhibit a lack of post-Miocene activity
- No geomorphic expression in Pleistocene Savannah River terraces or older landscape

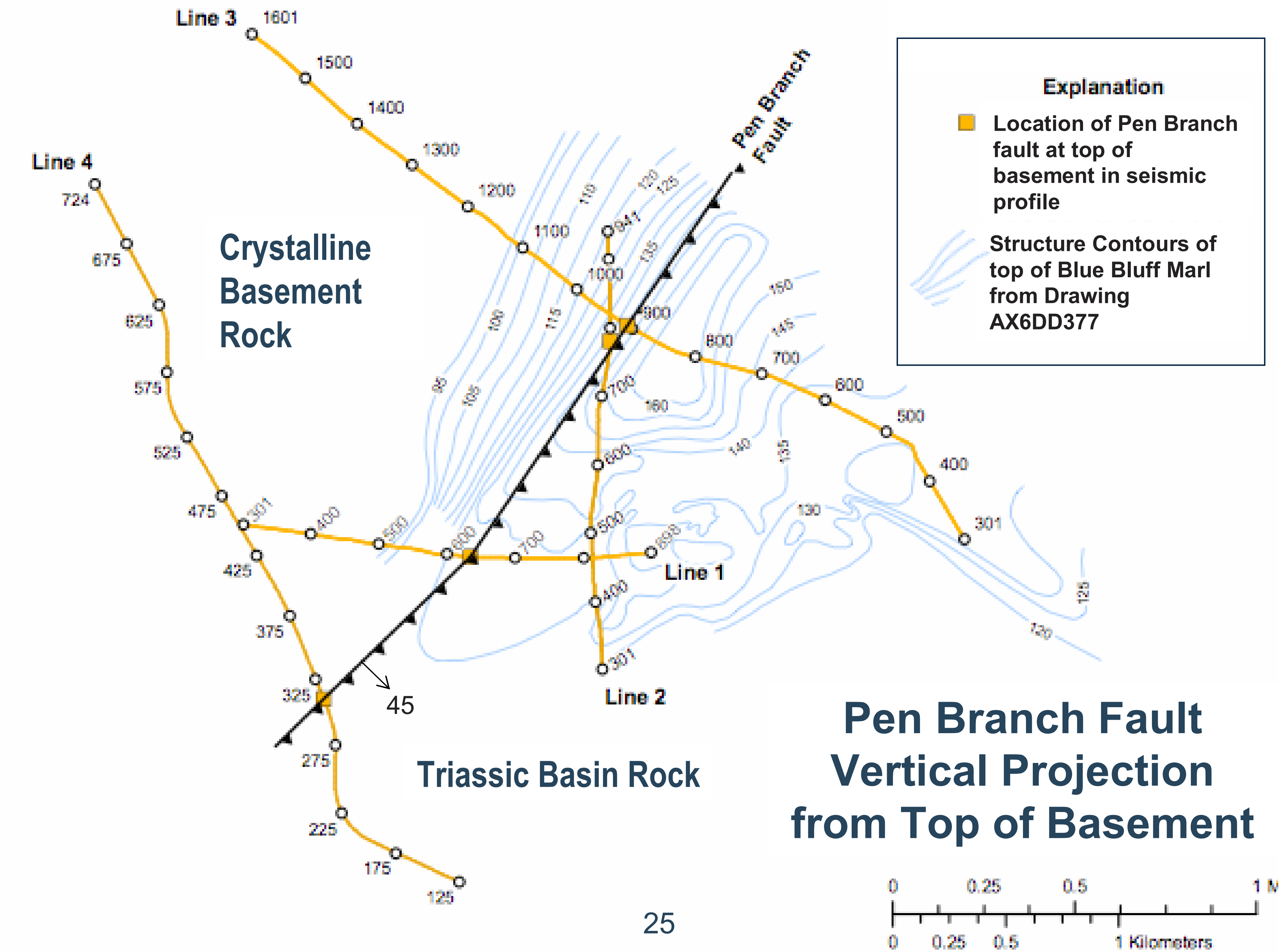
Reasons for Seismic Reflection Survey

- Vogtle ESP geologic investigation indicated the location of the Pen Branch fault and basin boundary could be close to the ESP site
- The PBF is non-capable, but separates rocks of different velocities
- Seismic survey was performed to determine:

1. If PBF is close to the site, and
2. The geometry of the Dunbarton Basin boundary to help constrain velocity profile

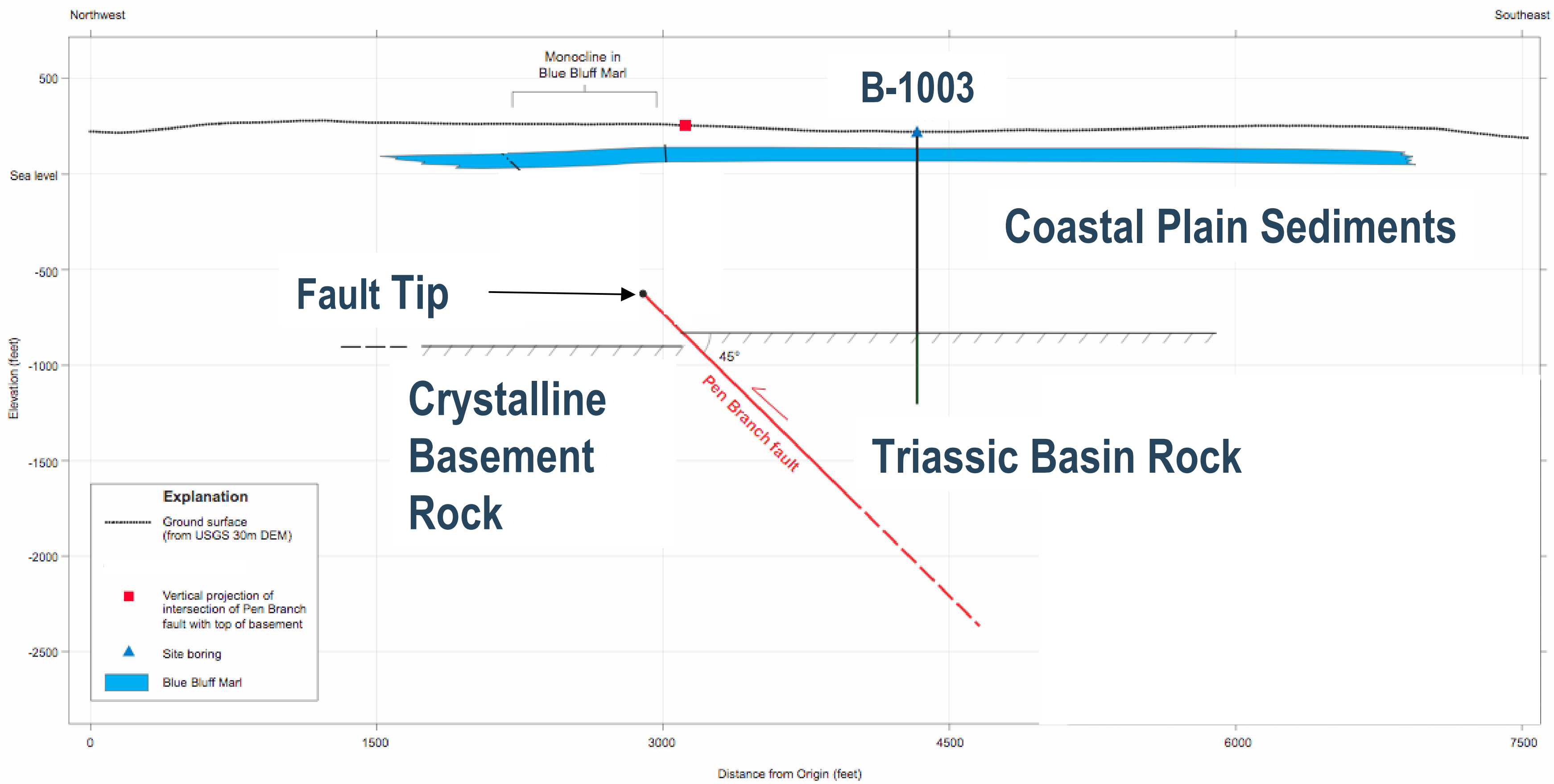
Seismic Reflection Profiles





Pen Branch Fault Vertical Projection from Top of Basement

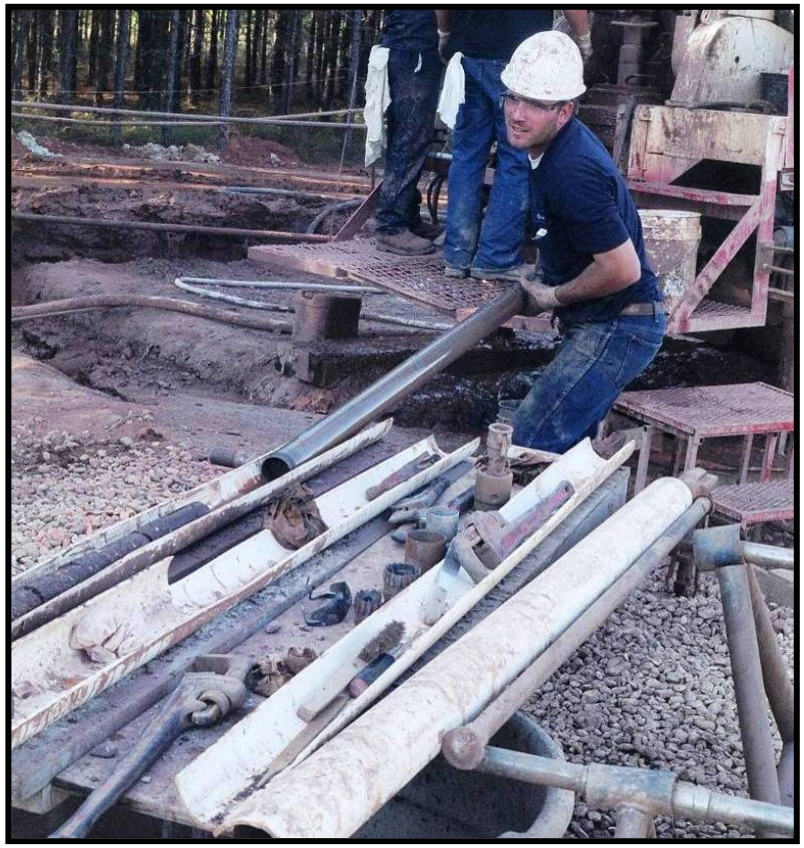
NW Section through Site



Results of Reflection Survey

- Non-Capable Pen Branch fault imaged
- Strikes N34E to N45E and dips 45SE
- Juxtaposes Triassic basin rocks against higher velocity Paleozoic crystalline rocks to NW
- Basement rocks vertically separated across fault (SE-side-up) and consistent with separations and sense of slip observed at SRS
- Triassic basin rock underlies two proposed units

Geophysical and Geotechnical Investigations



Jose Clemente

Principal Geotechnical Engineer

Bechtel Corporation

BECHTEL

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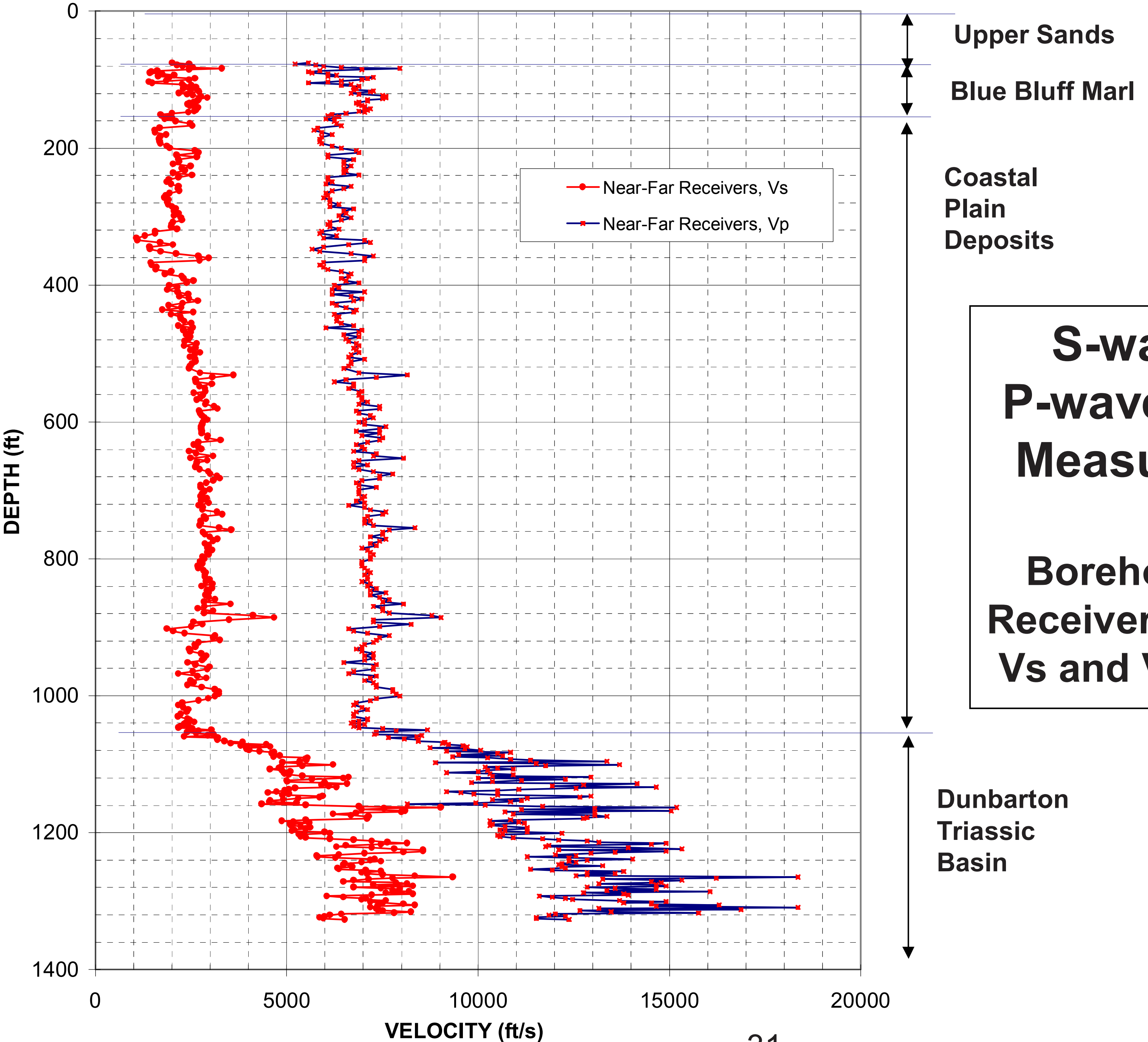
ESP Subsurface Investigation

- 12 borings, including 1 to a depth of 1,338 ft (290 ft into rock)
- 11 CPTs, including 3 seismic CPTs
- Geophysical testing of 3 boreholes, including:
  - Suspension P-S Velocity Logging (p-wave and s-wave velocity measurements)
  - Caliper/Natural Gamma Measurements
  - Resistivity/Spontaneous Potential Measurements
  - Boring Deviation Measurements
- 15 new ground water observation wells (10 above and 5 below the Blue Bluff Marl)
- Laboratory testing

General Subsurface Profile

Coastal Plain Sediments

- **Upper sand stratum-Barnwell Group:**
  - Depth ranging from 78 to 154 ft-Average of 94 ft
  - Very loose to very dense
- **Blue Bluff marl stratum - Lisbon Formation:**
  - Thickness ranging from 63 to 95 ft (3 boreholes)-About 76 ft average thickness
  - Very hard, slightly sandy, cemented, calcareous silt/clay
- **Lower sand strata-Coastal Plain Deposits;**
  - Dense sands
  - Thickness of 900 ft (at B-1003)
- **Dunbarton Triassic Basin Bedrock (1,049 ft below grade at B-1003)**
- **Ground water elevation is 165 ft (55-60 ft below grade)**



S-wave and P-wave Velocity Measurements

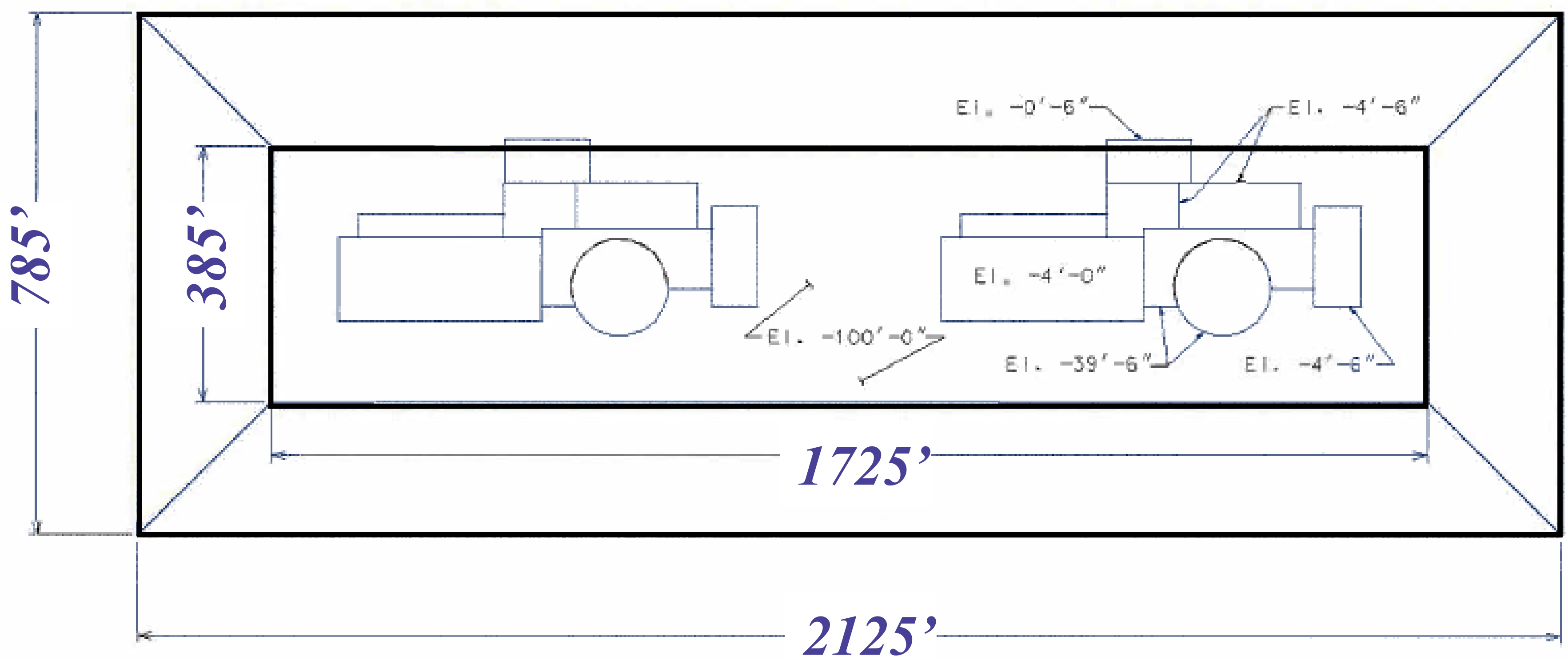
Borehole B-1003 Receiver to Receiver Vs and Vp Analysis

Construction Excavation

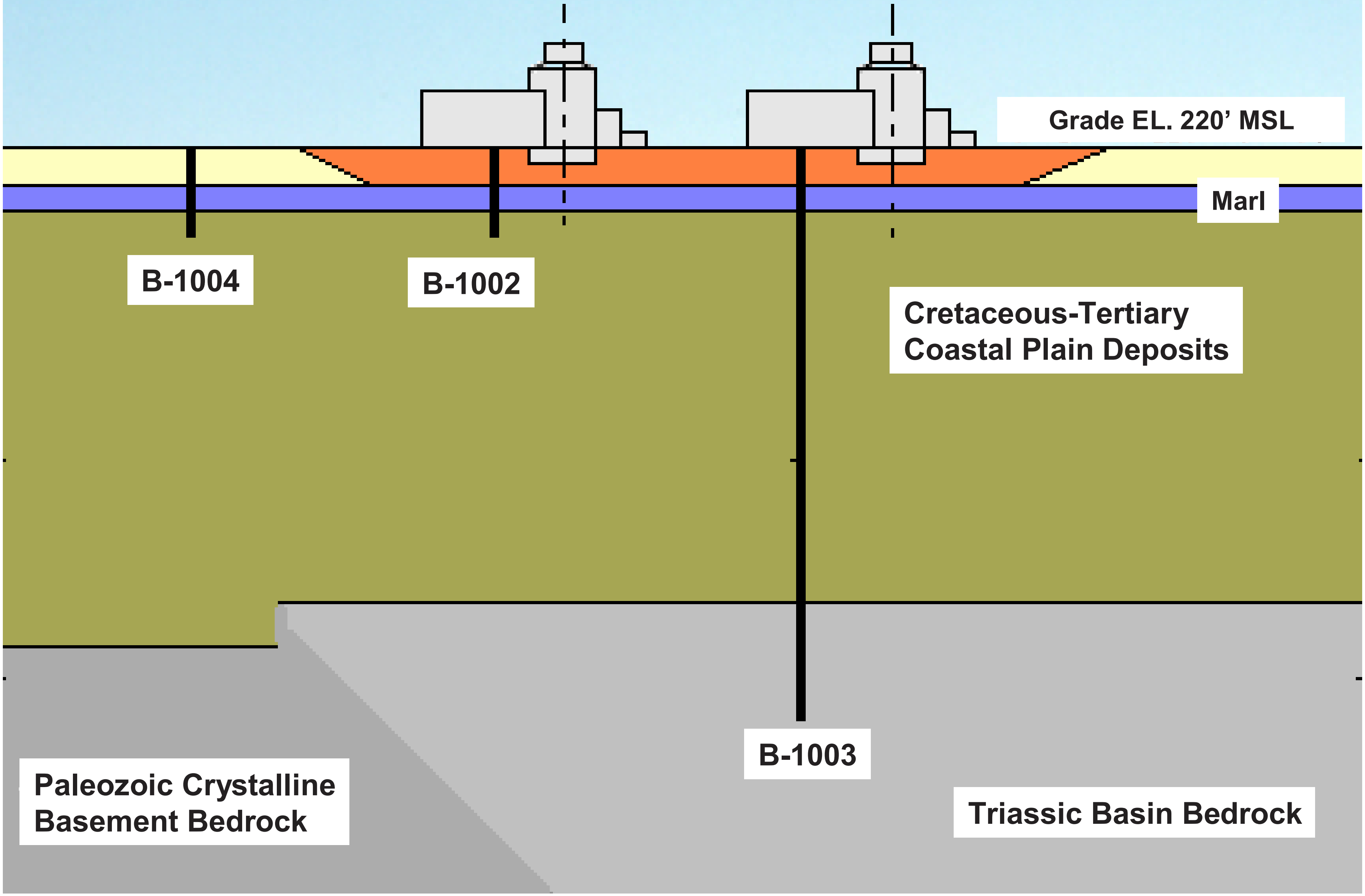
The upper sands - Barnwell Group:

- Have highly variable density along the depth and from borehole to borehole
- A shelly, very porous material was encountered at the bottom of the Barnwell Group/top of Blue Bluff Marl that caused severe drilling fluid losses
- These soils were completely removed and replaced with compacted granular fill for construction of existing Units 1 and 2.
- For these reasons, these soils will be removed

Preliminary Powerblock Excavation Plan



Cross Section Normal to PBF



Summary of Seismic Hazard at Vogtle

Risk Engineering, Inc.
Robin K. McGuire
NRC Meeting, Rockville
April 14, 2006

Steps taken to meet RG1.165

- Effect of additional seismicity, 1985 through mid-2005
- Update of EPRI-SOG seismic sources to account for new source information
- Update of EPRI-SOG ground motion models (using EPRI 2004)
- Update of EPRI 2004 ground motion standard deviations using EPRI Task G1.3 results

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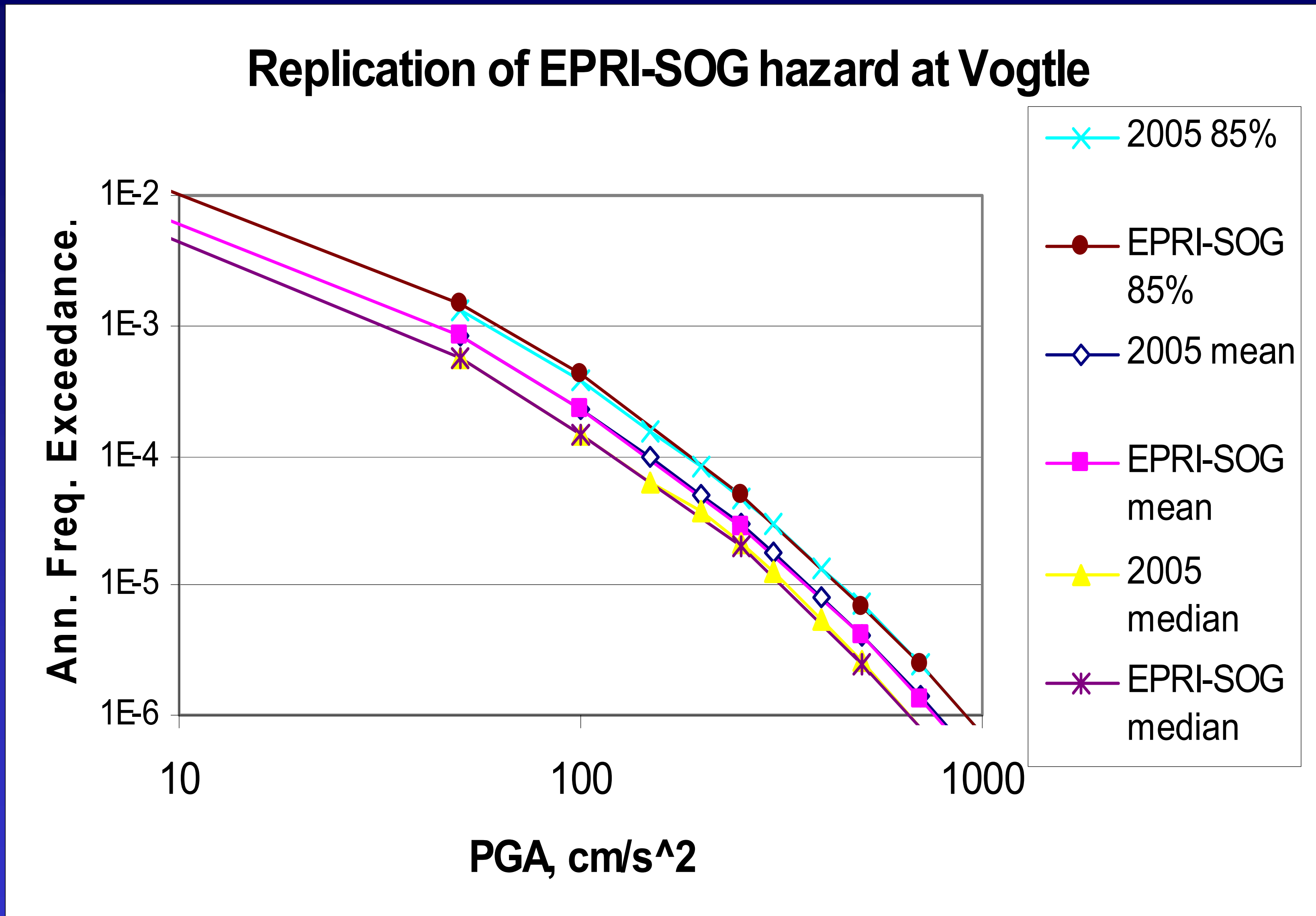
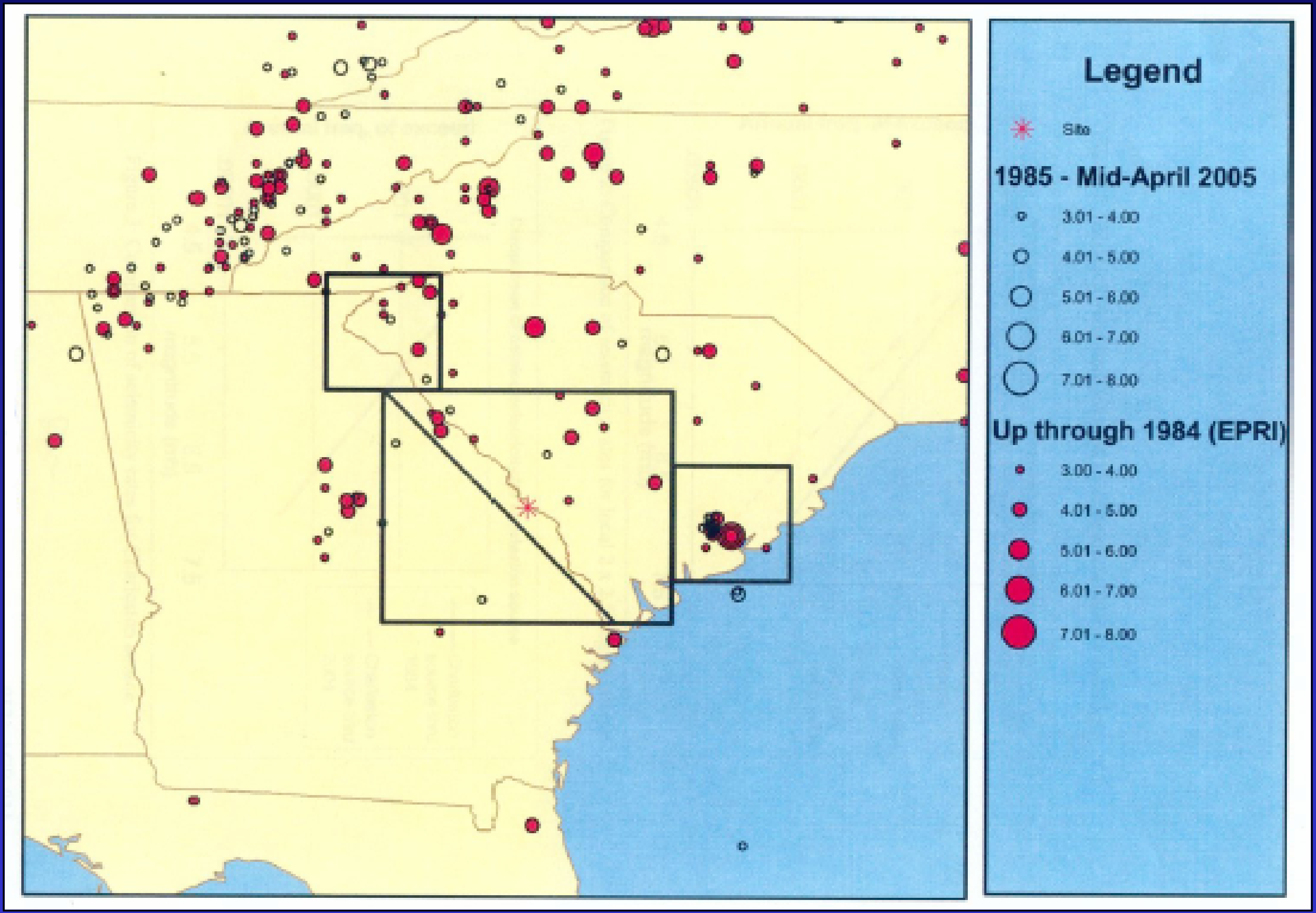

Replication of EPRI-SOG hazard at Vogtle
Ann. Freq. Exceedance.
1E-2
1E-3
1E-4
1E-5
1E-6
10
100
1000
PGA, cm/s^2
2005 85%
EPRI-SOG 85%
2005 mean
EPRI-SOG mean
2005 median
EPRI-SOG median

Historical Earthquakes



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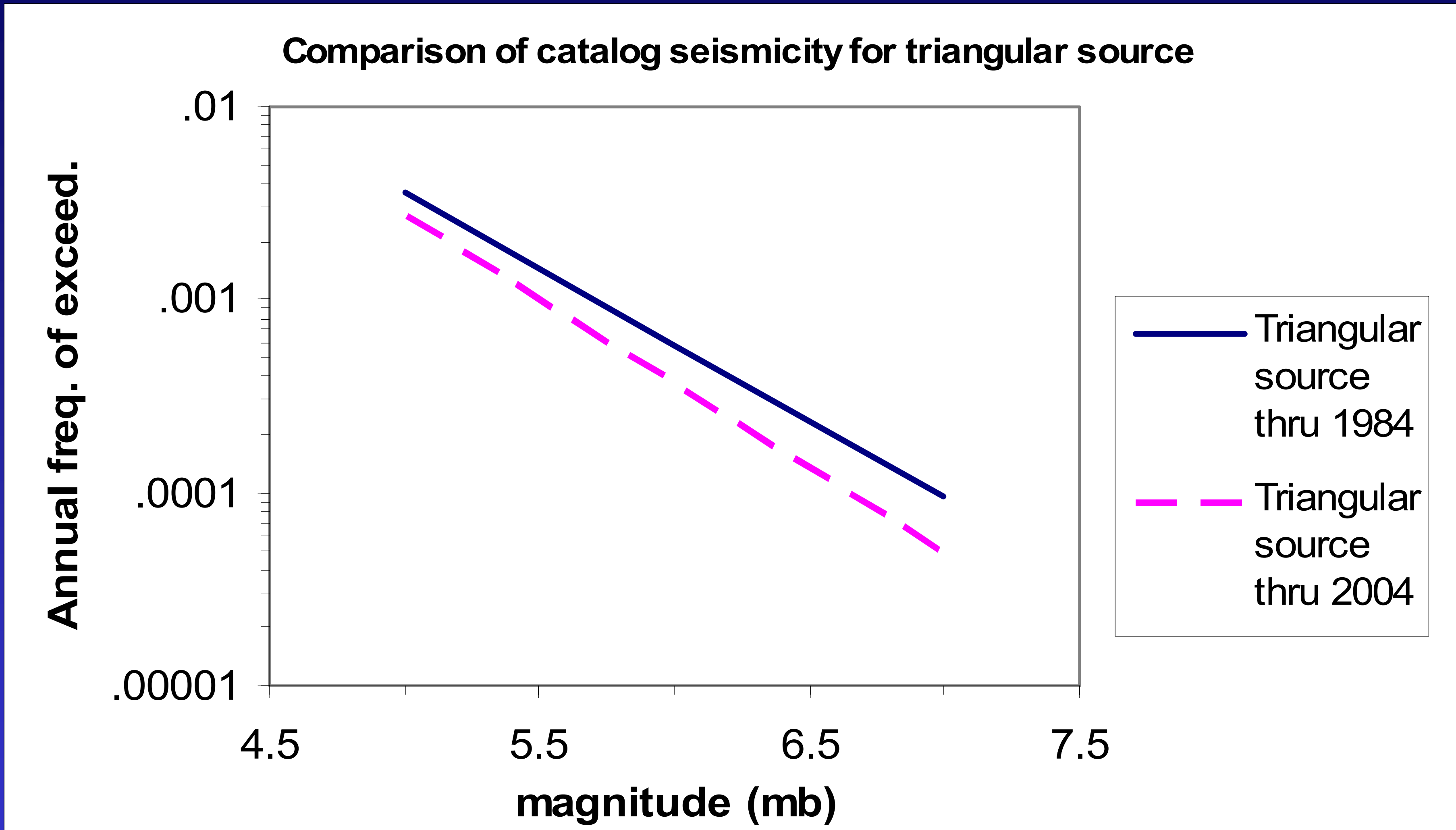
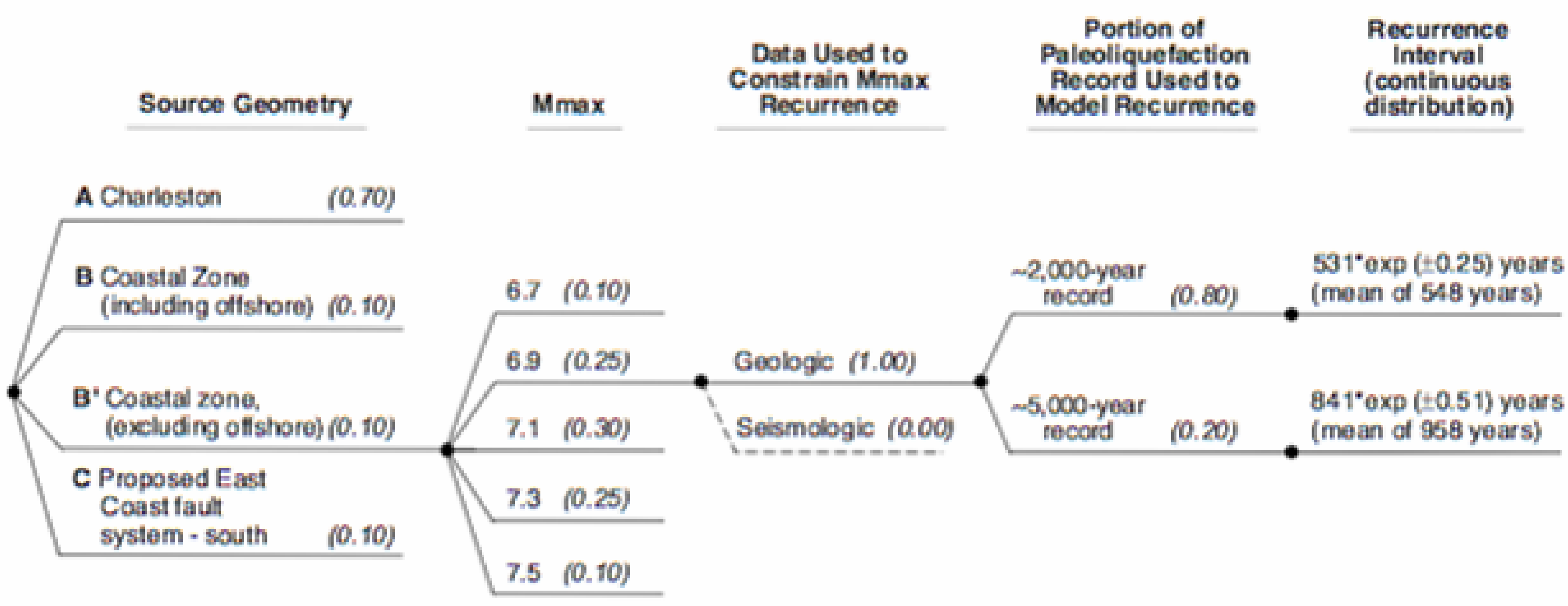

Comparison of catalog seismicity for triangular source
.01
.001
.0001
.00001
4.5
5.5
6.5
7.5
magnitude (mb)
Annual freq. of exceed.
Triangular source thru 1984
Triangular source thru 2004

Updated Charleston Seismic Source
- Logic Tree -



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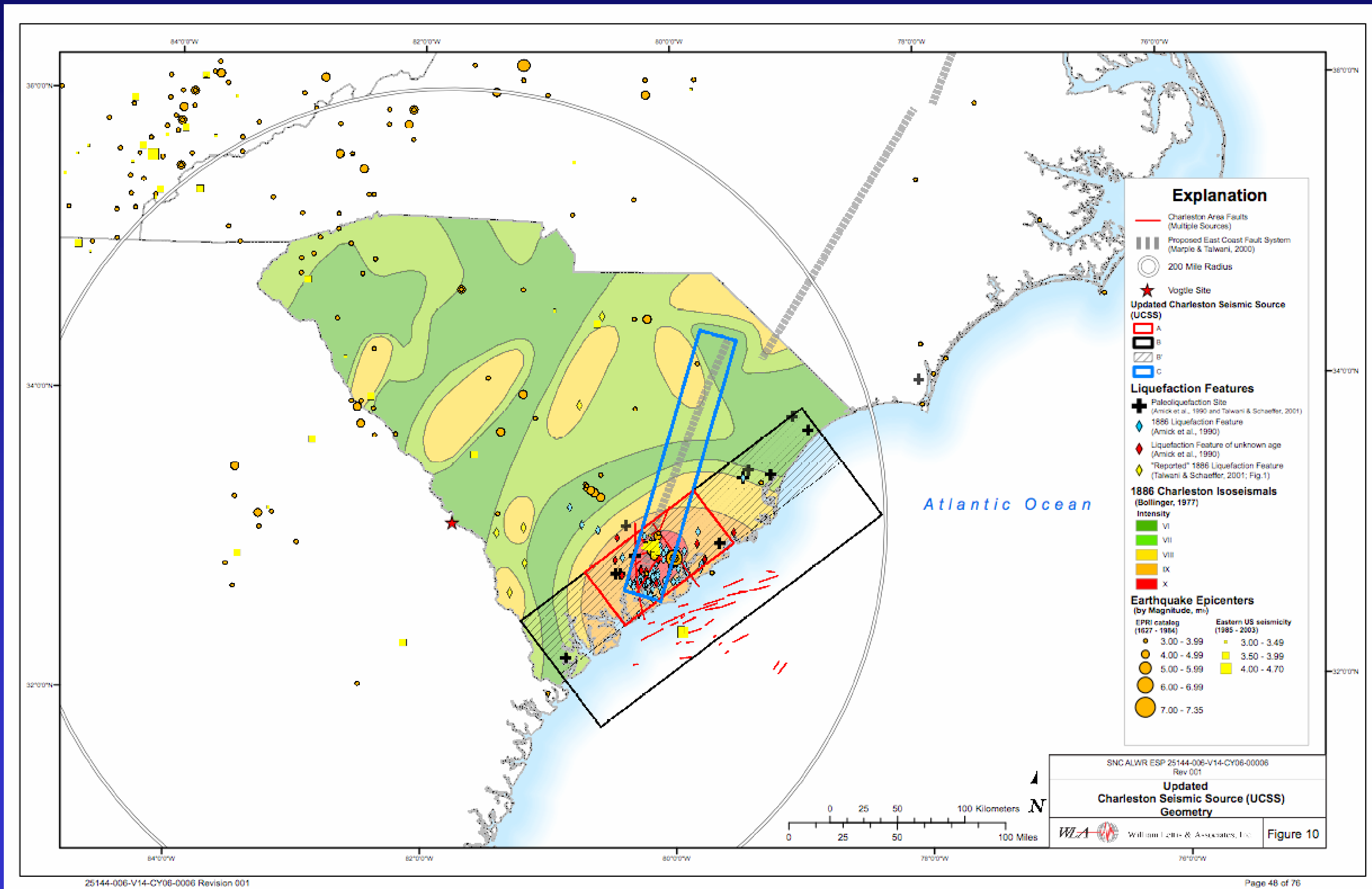
Updated Charleston Seismic Source (UCSS)



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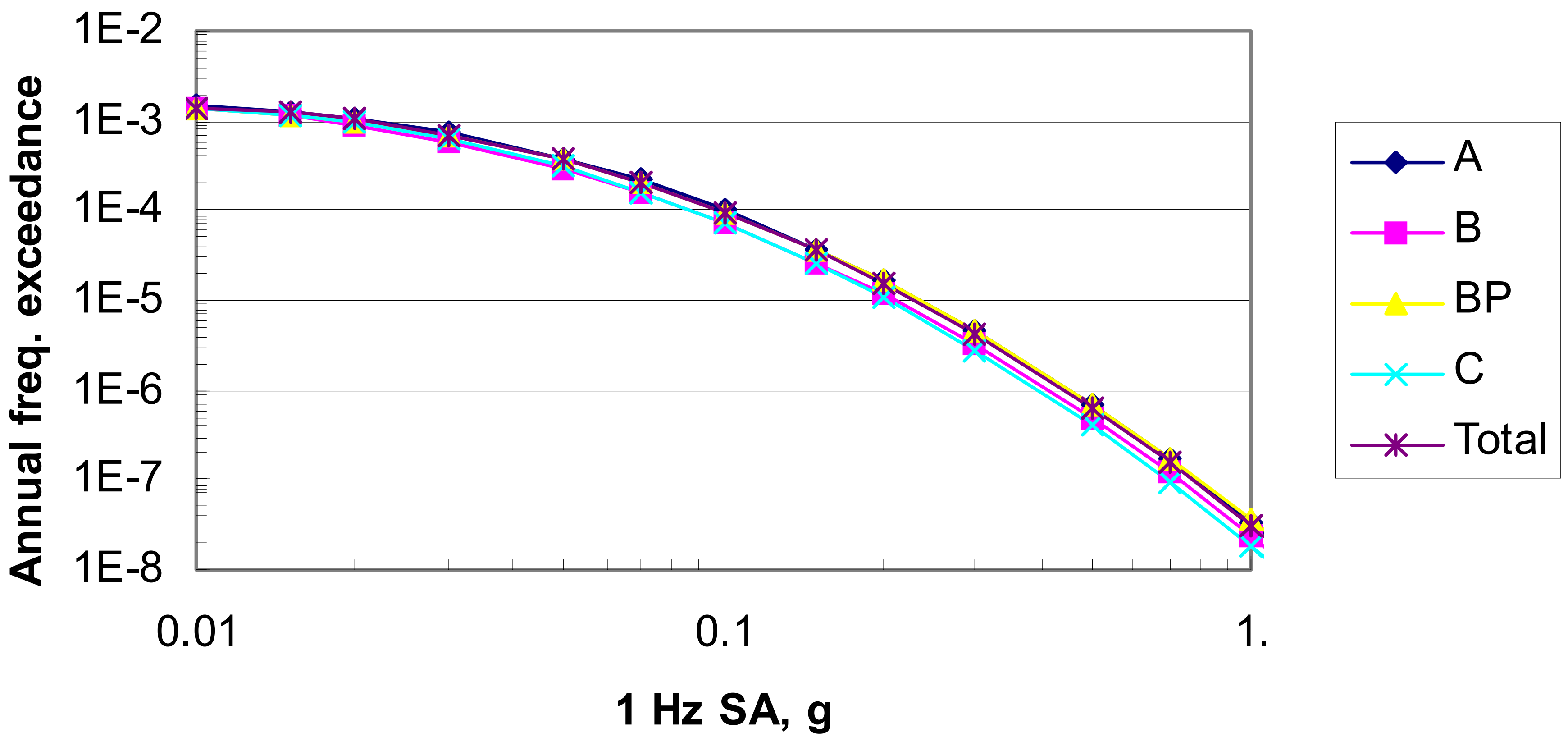
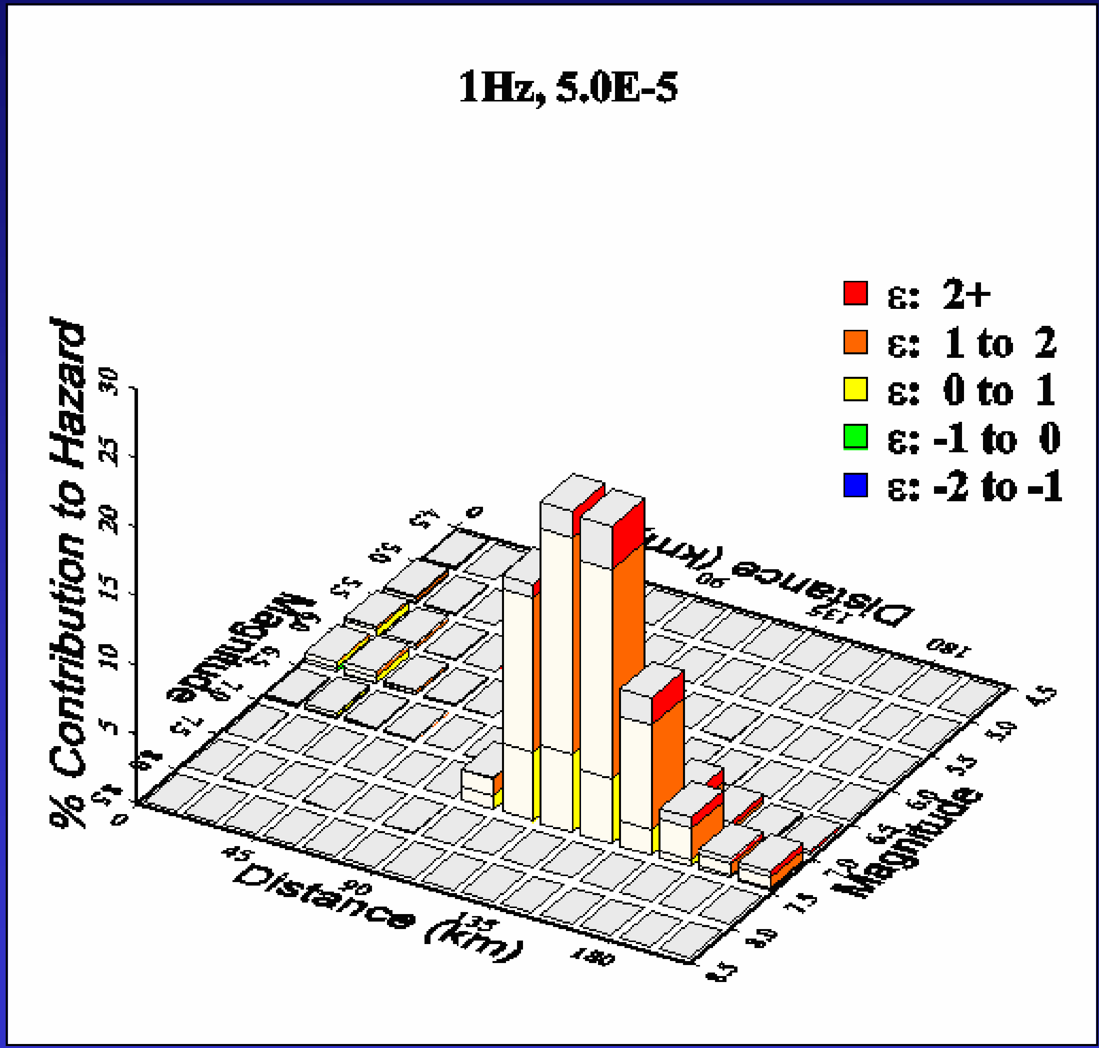
Seismic hazard from Charleston, 1 Hz



Deaggregation of 1Hz, 5E-5 hazard



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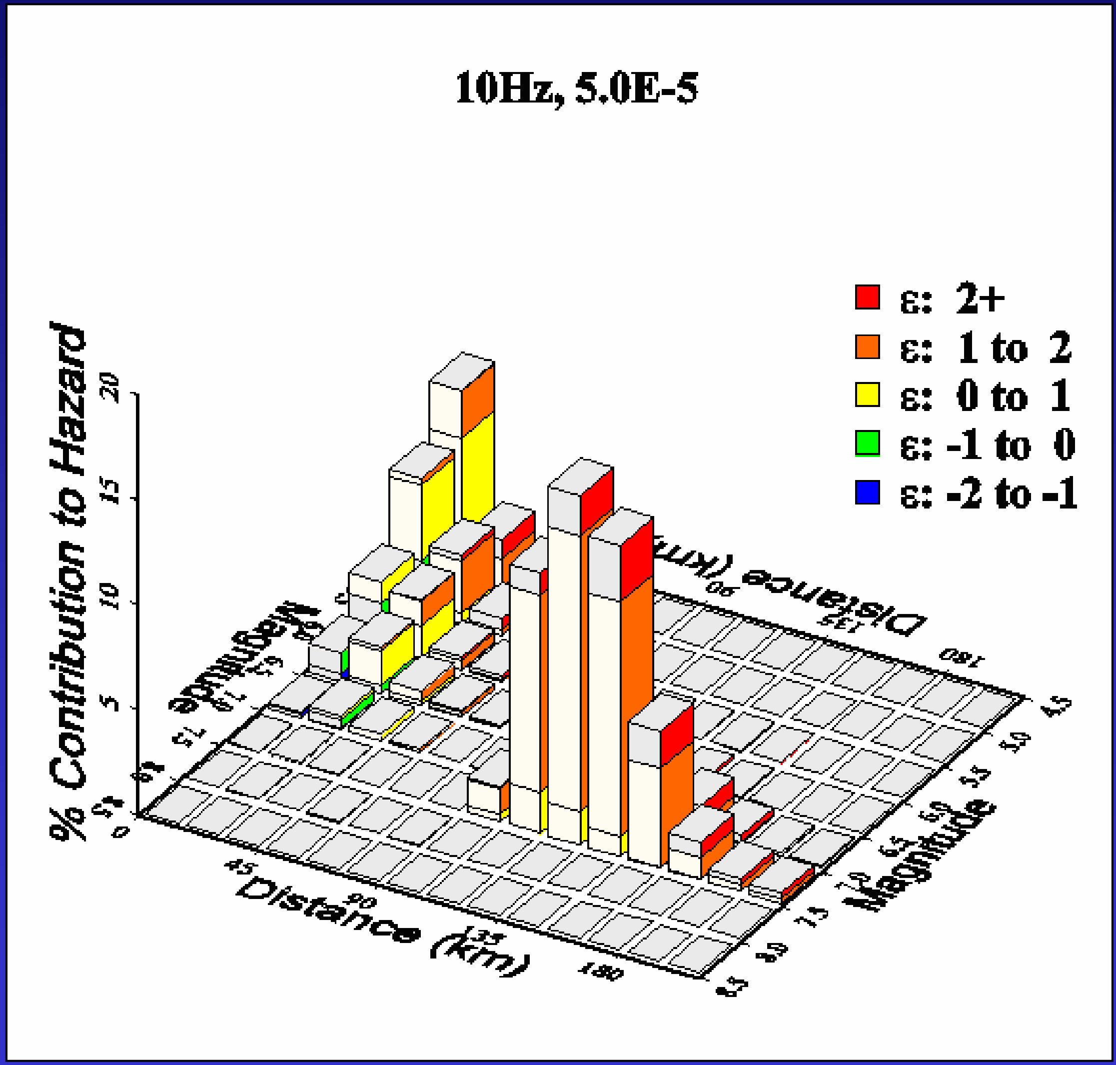
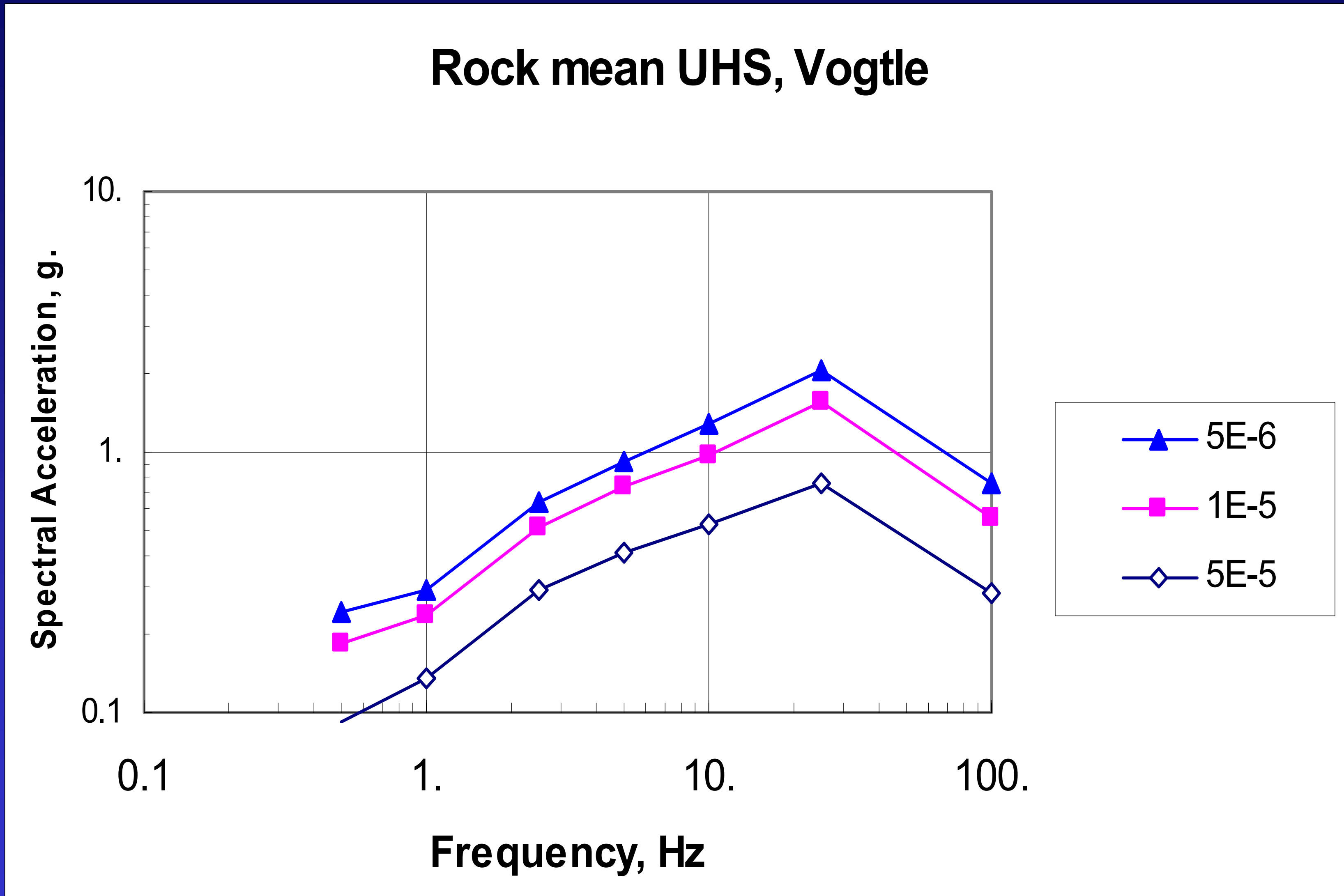
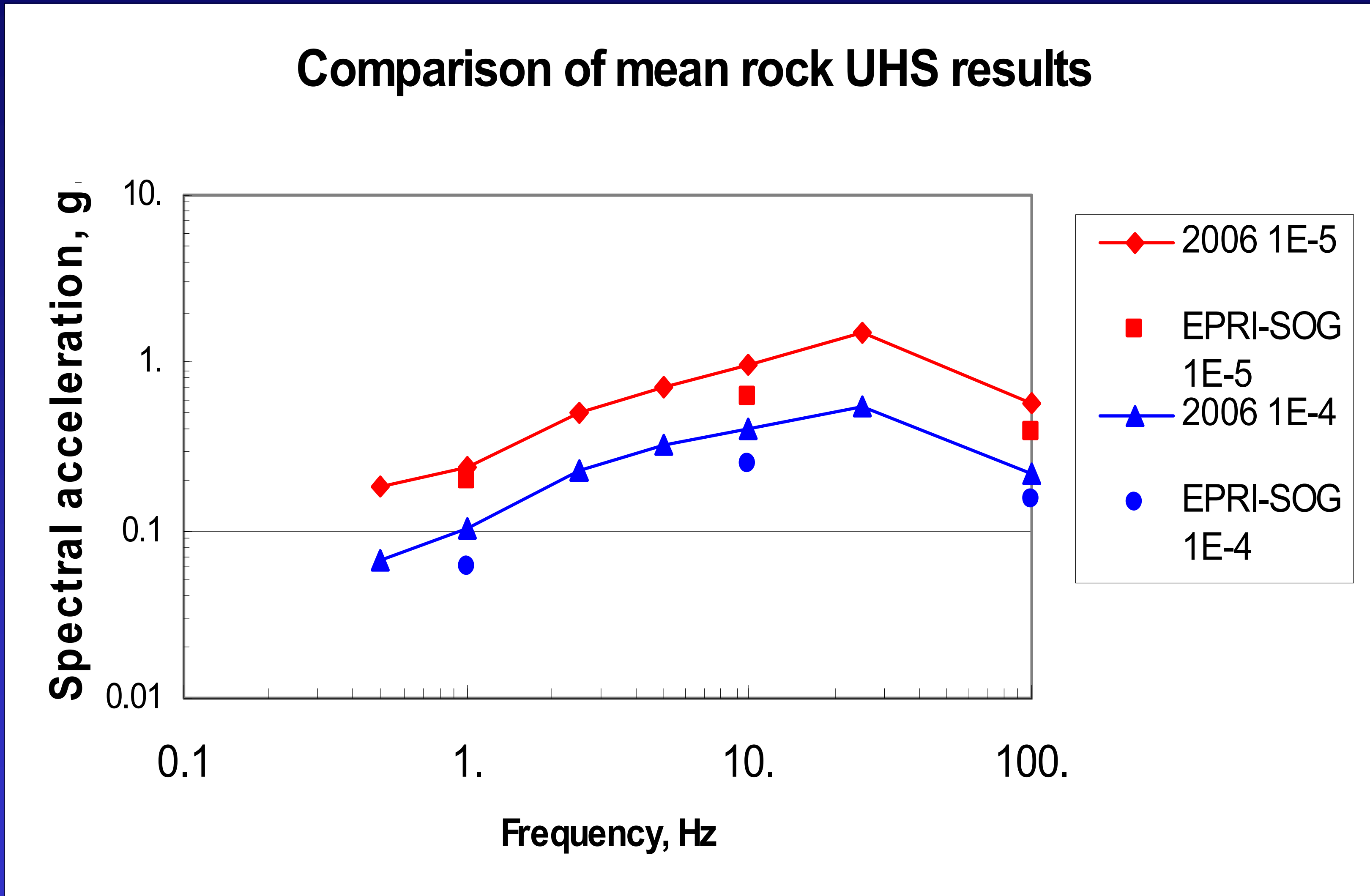
Deaggregation of 10Hz, 5E-5 hazard



Mean rock UHS, 2006 results



Hazard comparison for Vogtle: 2006 results and EPRI-SOG



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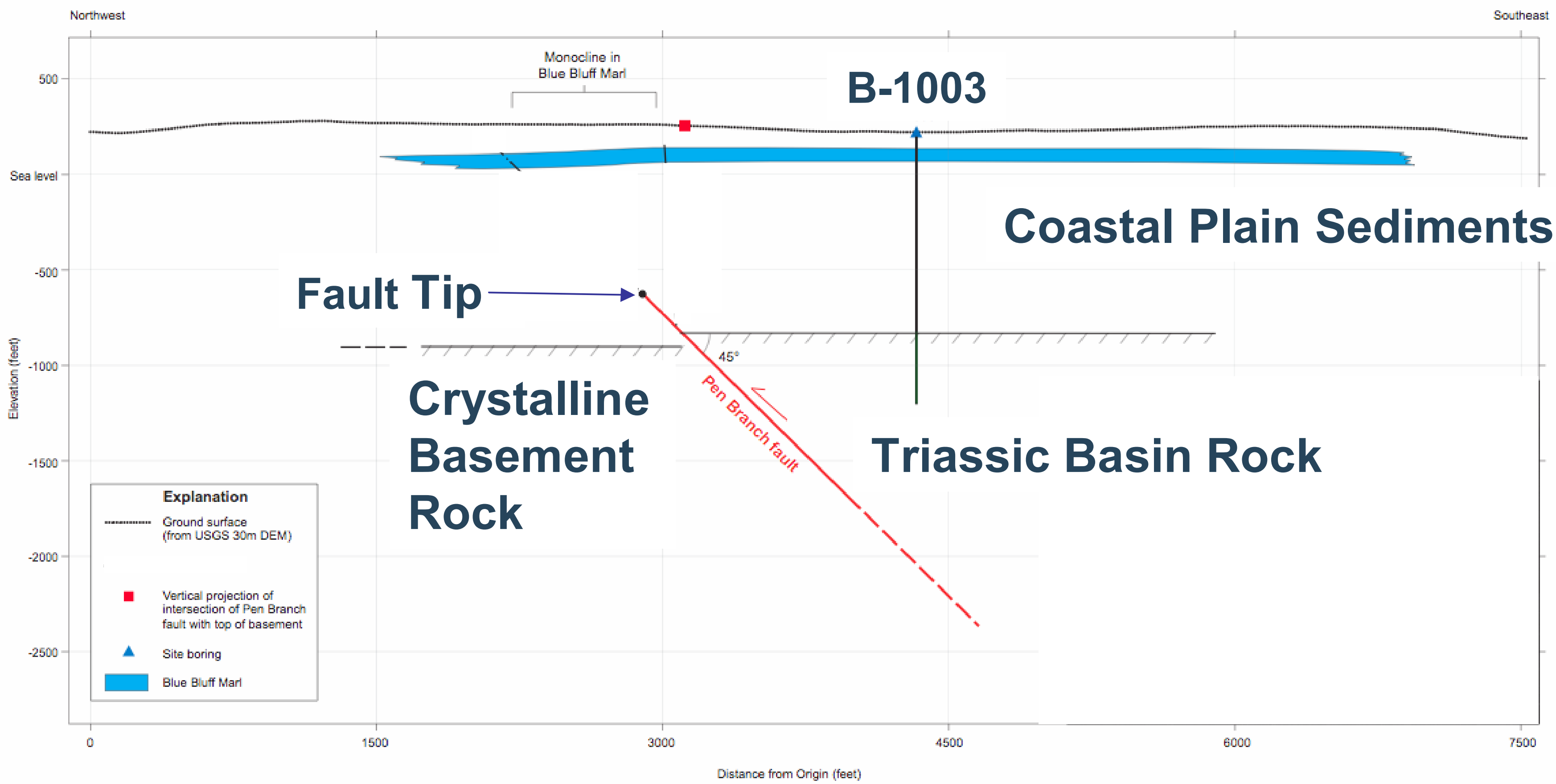
Calculation of soil hazard

- Develop soil profile with properties
- Determine 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)
- Convolve rock hazard with site amplification (including uncertainties in input motion and soil properties) to obtain soil UHS for multiple annual frequencies (NUREG/CR-6728 Approach 2A)
- Develop vertical spectra using V/H ratios (NUREG/CR-6728)

Illustrative cross-section at location of new units



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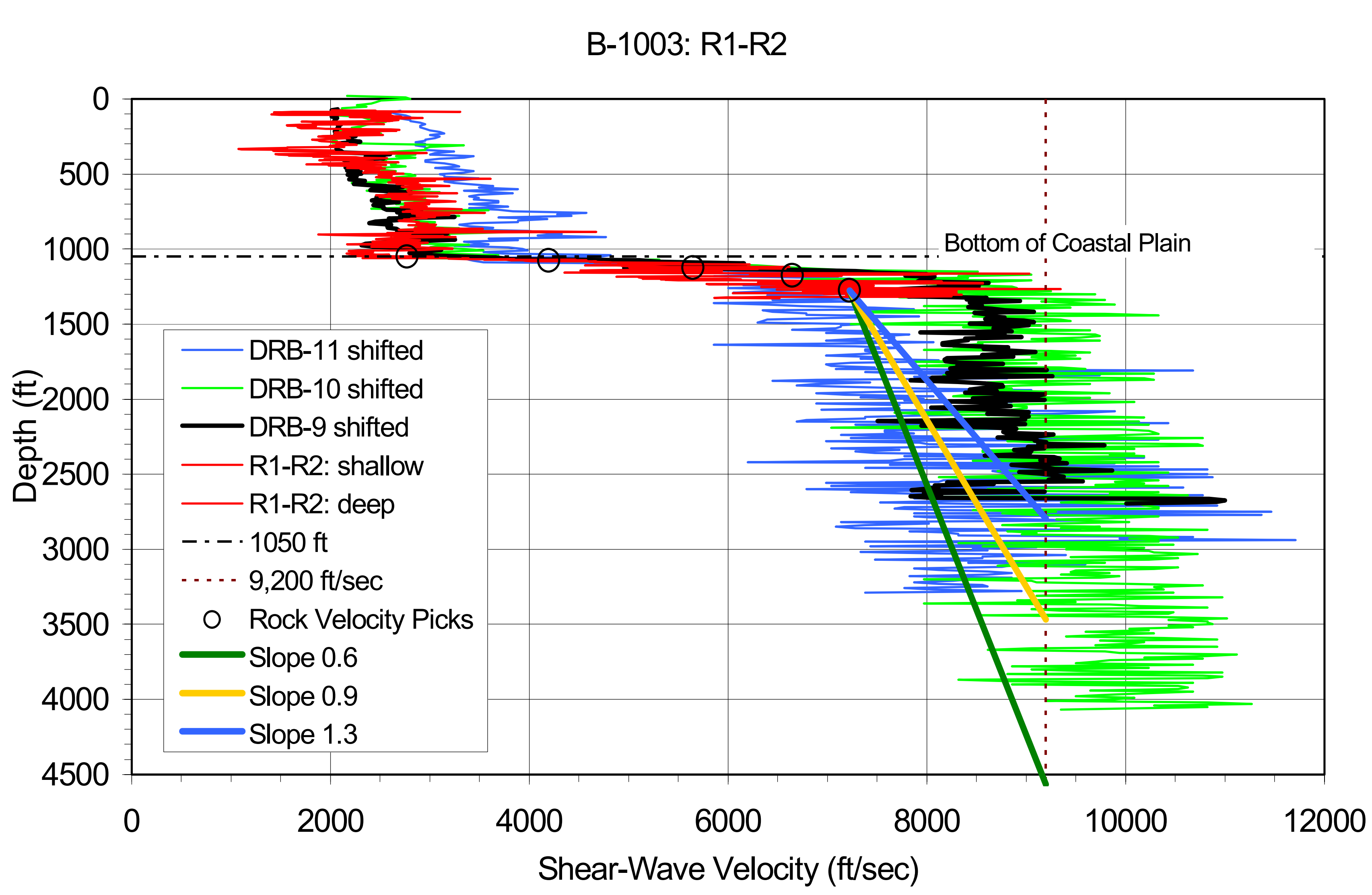
Shear-wave velocity measurements at Vogtle and SRS



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Determination of SSE Ground Motion

Risk Engineering, Inc.
Robin K. McGuire

NRC Meeting, Rockville
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Definition of SSE

- “SSE” is defined here as the site-specific, risk-informed, response spectrum that represents the ground motion that meets regulatory criteria.
- The SSE is a free-field ground motion defined at a specified control point.
- The SSE will subsequently be modified by structure-specific analyses (accounting for foundation size, etc) to define a “Design Response Spectrum” (DRS)

Method for calculating Vogtle SSE

- Risk (performance-goal) based approach is aimed at achieving a Seismic Core Damage Frequency (SCDF) less than a target SCDF goal.
- The target SCDF goal is the industry-proposed value of mean 5E-6/yr (Ref: NEI letter, Heymer to Imbro dated 3/30/06)
- Table 2.2 of NUREG 1742 summarizes existing plant seismic PRA results using EPRI-type hazard curves; overall results:
  - Median value 1.2E-5/yr
  - Mean value 2.5E-5/yr
- Target SCDF goal of 5E-6/yr provides additional margin compared to existing plants.
- SSE response spectrum will be defined to meet this target goal.

Control point for Vogtle ESP SSE

- Per SRP 3.7.1 and 3.7.2: *"…for profiles consisting of one or more thin soil layers overlaying competent material, the control motion should be located at an outcrop…at the top of the competent material."*
- Approximately 90' of existing soil above the Blue Bluff marl unit will be removed and replaced with engineered backfill.
- Therefore, the SSE will be specified at the top of the Blue Bluff marl unit.

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Plans for AP1000 / Vogtle Site Assessment

Don Moore

Consulting Engineer

Southern Nuclear Operating Company

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Plans for AP1000 Assessment

- Exchange of information started with Westinghouse
  - AP1000 soil site parameters
  - Vogtle site soil conditions
- Monitor Westinghouse/NRC interactions on soil technical report APP-GW-GLR-015, “Extension of Nuclear Island Seismic Analyses to Soil Sites”
- Perform evaluations to demonstrate Vogtle site compatibility with AP1000 design

Summary of Key Points

- Purpose of seismic survey was to identify rock type/profile below ESP site
- Using EPRI-SOG seismic hazard model with update of Charleston Seismic Source
- Using EPRI 2004 ground motion model incorporating EPRI Task G1.3 standard deviation
- Developing site transfer functions using NUREG/CR-6728 method 2A
- Developing SSE based on target performance goal of mean 5E-6 SCDF
- Defining control point of SSE at top of competent material (Blue Bluff Marl)

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Discussion

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