REGULATORY INFORMATION CONFERENCE 2012

Challenges and Lessons Learned in Design and Analysis of Civil Structures for New Reactors

Vogtle COL Applicant Perspective of Challenges and Lessons Learned

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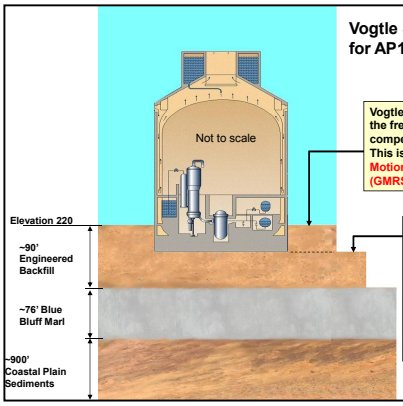
1

VOGTLE UNITS 3 & 4

Westinghouse AP1000
Southeast Georgia, USA

2

Vogtle Site-Specific Model for AP1000 Nuclear Island



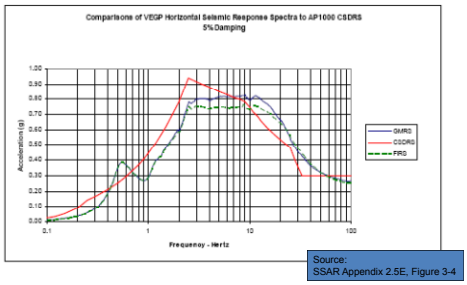
Vogtle ESP/COL SSE defined at the free ground surface of competent structural backfill. This is the Site Specific Ground Motion Response Spectrum (GMRS)

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)

3

Vogtle 3 & 4
Site-Specific Seismic Evaluation

Comparison of Vogtle Horizontal GMRS and FIRS with AP1000 CSDRS



Source:
SSAR Appendix 2.5E, Figure 3-4

4

Limited Work Authorization

Backfill, MSE Wall, Mud-mat,& Waterproof Membrane

5

<u>Some</u> of the Challenges & Lessons Learned

1. Backfill Requirements
2. Site-specific Seismic Soil-Structure Interaction Analyses
3. Inspection, Testing, Analysis, Acceptance Criteria (ITAAC)

6

BACKFILL

- Extensive amount of excavation & backfill:
  Used Limited Work Authorization (LWA) under Early Site Permit
- Backfill properties required to support ESP/LWA & Combined Construction License (COL):
  Required to calculate GMRS, site-specific seismic analyses, bearing capacity, soil liquefaction potential
- Backfill sources and properties:
  Based on soil boring program, resonance column torsional shear testing, & constructed a test fill.
  Needed license amendments to expand the sources and reclassification of backfill over slopes.
- DCD Tier 1 requirement for shear wave velocity > 1000 fps @ foundation depth and below: Backfill material Specifications and ITAACs for backfill density and shear wave velocity
- Insight: Use of ESP to obtain LWA allowed site prep "construction" before COL
- Insight: Early characterization of backfill properties needed.
- Insight: ESP/COL needs to allow a sufficiently broad range of backfill properties (quality) & sources (quantity)

7

Vogtle Site-Specific 3D Seismic Analysis Results:

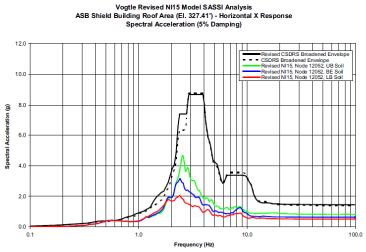


Figure 27 Horizontal X Response Spectra at ASB Shield Building Roof Area (El. 327.41 ft, Node 12052)

8

SITE-SPECIFIC SEISMIC ANALYSIS REQUIRED

- Site-specific 2D seismic soil-structure interaction analysis:
  Used in ESP to receive LWA for placement of backfill
- Site-specific 3D seismic soil-structure interaction analysis:
  Used in COL for final demonstration that AP1000 seismic demand significantly envelops Vogtle seismic demand
- Site-specific 3D model different than std AP1000 3D model:
  Needed to account for: softer side soil, frequency range of exceedance, and stress dependent structural damping
- Insight: Use of 2D analyses limited to evaluations like seismic stability; but 3D analyses required for structural response used for design.
- Insight: Certified Design is an envelope of many generic site conditions and SSI analyses; therefore, seismic responses from Vogtle site-specific analysis were bounded.
- Insight: In general due to site-specific soil profile, seismic ground motion, etc., site-specific seismic evaluations should be expected to demonstrate compliance to a DCD

9

Inspection, Testing, Analysis, and Acceptance Criteria (ITAAC)

- First implementation of ITAAC (Learning curve)
- COL conditional on satisfying ITAAC
- Under LWA three ITAACs required
  - Waterproof Membrane Coefficient of friction > 0.7
  - Backfill placement meets compaction density requirements
  - Backfill shear wave velocity at foundation and below > 1000 fps
- Issue with interpretation wording of ITAAC versus intent of ITAAC
- Need consistent interpretation between licensee, constructor, and NRC
- Southern (licensee) has formed a dedicated group to assure proper closure of ITAAC

- Insight: Careful description and wording of ITAAC can reduce problems with interpretation and implementation
- Insight: ITAAC associated with as built conditions; engineering judgment needed.

10