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SOUTHERN COMPANY

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Southern Nuclear Operating Company
Vogtle Electric Generating Plant Units 3 and 4 Combined License Application
Second Supplemental Response to Request for Additional Information Letter No. 18

Ladies and Gentlemen:

By letter dated December 15, 2008, the U.S. Nuclear Regulatory Commission (NRC) provided Southern Nuclear Operating Company (SNC) with Request for Additional Information (RAI) Letter No. 018 on the Vogtle Electric Generating Plant (VEGP) Units 3 and 4 Combined License Application. By letter dated January 14, 2009, SNC provided the NRC with a response to RAI Letter No. 018. By letter dated March 2, 2009, SNC provided a supplemental response to RAI Number 03.07.02-1 which included the results of a VEGP site-specific 3D SASSI SSI analysis. Subsequently, the NRC requested SNC to review recent changes to the AP1000 Design Control Document (DCD) relative to SNC's response to RAI 03.07.02-1 and, if necessary, to provide an updated RAI response. Enclosure 1 to this letter provides SNC's updated supplemental response (i.e., second supplemental response) to RAI Number 03.07.02-1. Enclosure 2 provides a proposed revision to COL application Part 2 (Final Safety Analysis Report [FSAR]) Appendix 3GG, including updated Vogtle in-structure response spectra (ISRS).

If you have any questions regarding this letter, please contact Mr. Wes Sparkman at (205) 992-5061.

D092
NRO

Mr. C. R. Pierce states he is the AP1000 Licensing Manager of Southern Nuclear Operating Company, is authorized to execute this oath on behalf of Southern Nuclear Operating Company and to the best of his knowledge and belief, the facts set forth in this letter are true.

Respectfully submitted,

SOUTHERN NUCLEAR OPERATING COMPANY

Charles R. Pierce

Charles R. Pierce

Sworn to and subscribed before me this 15th *day of* October, *2010*

Notary Public: Nancy Louise Henderson

My commission expires: March 23, 2014

CRP/BJS

Enclosures:
1. VEGP Units 3 and 4 COL Application – Second Supplemental Response to RAI 03.07.02-1
2. VEGP Units 3 and 4 COL Application – Revised FSAR Appendix 3GG

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Enclosure 1

VEGP Units 3 and 4 COL Application

Second Supplemental Response to RAI 03.07.02-1

FSAR Section 3.7, Seismic Design

eRAI Tracking No. 1615

NRC RAI Number 03.07.02-1:

ADEQUACY OF 2D SEISMIC RESPONSE ANALYSIS

The FSAR cites the SSAR, Section 2.5E, Subsection 5.1, 2D SASSI Analyses and Parameter Studies, in concluding that the 2D analyses demonstrate that the Vogtle Plant 3&4 seismic design is within the SSE design response spectra level of the certified seismic design response spectra (CSDRS) at Vogtle's plant grade.

The VEGP site-specific ground motion response spectra (GMRS) are applied in the free-field at plant grade and the foundation input response spectra (FIRS) are developed at the foundation depth (40 ft below plant grade). In certain locations, there are exceedances of the CSDRS by the GMRS and FIRS; therefore, the applicant performed a plant-specific seismic evaluation to demonstrate that the AP1000 design is acceptable for the Vogtle site. The FSAR in section 3.7-1 concludes that the 2D site-specific analysis sufficiently demonstrates that the generic AP1000 design is acceptable at the Vogtle site. That conclusion is based on comparisons of in-structure amplified response spectra (ARS) generated by the 2D generic AP1000 CSDRS (Appendix 3G, Section 3G.3) and the site-specific 2D response analyses at critical selected nodes (see Table 5.1-1 of Site-Specific Seismic Evaluation Report SVO-1000-S2R-802).

The generic AP1000 DCD seismic analysis is based on detailed 3D response analysis, while the site-specific analyses are two-dimensional (horizontal and vertical responses). The site-specific report (SVO-1000-S2R-802) cites Westinghouse Report APP-GW-S2R-010, "Extension of Nuclear Island Seismic Analyses to Soil Sites," hereafter referred to as TR3. Section 6.1 of TR3 states that using 2D models is adequate and conservative for horizontal response comparisons. However, using the shell model (3D) allows the development of design response spectra that reflect the seismic response across an elevation (floor) that is more realistic; consequently, using the shell model produces more realistic vertical seismic response spectra.

DCD Section 2.5.2.1 states that 2D SASSI results should be compared to the 2D CSDRS results in DCD Appendix 3G; however, Appendix 3G does not give any 2D-based vertical response spectra. In addition, this section [of the DCD] concludes that if the 2D results are not clearly enveloped, then a 3D analysis is indicated. The figures in Section 6.1 of TR3 indicate that the vertical responses for the 2D response analysis are not enveloped in selected frequency ranges in the vertical (Z) direction when compared to the 3D response analysis.

Please justify the adequacy of the 2D SASSI response analysis in light of the magnitude of the vertical response in the 3D SASSI detailed response analysis models.

SNC Second Supplemental Response:

The original response to this RAI was provided on January 14, 2009 (SNC letter ND-09-0001) and supplemented with letter provided on March 2, 2009 (SNC letter ND-09-0331). Following those responses, Westinghouse revised their NI20 SASSI model to incorporate the recent Shield Building design changes and make corrections to the NI20 SASSI model. Westinghouse subsequently re-ran the NI10 ANSYS and the SASSI NI20 models and developed revised AP1000 CSDRS broadened envelope in-structure response spectra (ISRS). Westinghouse standard COLA technical report APP-GW-S2R-010, Rev. 4 (Ref. 1) describes the dynamic models, corrects the NI20 SASSI model, and provides the revised AP1000 CSDRS broadened envelope ISRS.

Due to the changes to the AP1000 NI20 SASSI model now identified as NI20r and the revised AP1000 CSDRS broadened envelope ISRS, SNC has updated the Vogtle NI15 SASSI model accordingly, re-run the Vogtle SASSI analyses using the updated Vogtle NI15 SASSI model to generate revised Vogtle ISRS at the six key locations for the Vogtle soil profile (Lower Bound, Best Estimate, and Upper Bound soil cases), and developed a comparison of the revised Vogtle ISRS to the new AP1000 CSDRS broadened envelope ISRS.

Changes to the description of the Vogtle NI15 SASSI model, provided in the Supplemental Response to RAI 03.07.02-1 (SNC letter ND-09-0331, dated March 2, 2009), to account for the modeling changes to the NI20 SASSI model (Ref. 1) are as follows:

1. The properties of the Shield Building walls and air-inlet were updated to reflect the Shield Build design changes.
2. Modeling corrections to the Westinghouse AP1000 NI20 SASSI, as described in Ref. 1 Section 4.2.3 "Corrections to NI20 SASSI Model," were not required for the Vogtle NI15 SASSI model. These corrections to the SASSI NI20 model were to address modeling concerns with beam to solid element connectivity and improve the stress distribution in the basemat. The Vogtle NI15 SASSI model beam to solid element connectivity already properly modeled the connections between the solid elements and beam elements. Unlike the NI20 SASSI model that modeled the Auxiliary Building portion of the basemat of the Nuclear Island as shell elements, the Vogtle NI15 SASSI model used solid elements for the entire basemat. Therefore, there was no issue with the stress distribution at the basemat interface between the Auxiliary Building and the Containment Internal Structure (CIS).
3. The original NI20 SASSI model was revised to account for stiffness due to out-of-plane flexure where the walls, which are modeled as shell elements, connect to the floors, which are modeled as solid elements. Therefore, the Vogtle NI15 SASSI model was revised by extending the wall shell elements the depth of one solid element to capture the effect of out-of-plane flexural stiffness. This modeling change showed no significant effect on response since in-plane wall stiffness was the controlling contributor to overall lateral structural stiffness.

The Vogtle SASSI analyses were re-run using the updated Vogtle NI15 SASSI model to generate revised Vogtle ISRS at the six key locations for the Vogtle soil profile (Lower Bound, Best Estimate, and Upper Bound soil cases). The 5% damped Vogtle ISRS were then compared to the revised AP1000 CSDRS broadened envelope ISRS (Ref. 1).

Enclosure 2 to this letter provides a proposed FSAR Appendix 3GG revision, which shows the 5% damped Vogtle ISRS compared to the revised AP1000 CSDRS broadened envelope ISRS at the six key locations. For a point of reference, the comparisons also include the original AP1000 CSDRS broadened envelope ISRS to aid in understanding the differences in the revised ISRS comparisons. This proposed FSAR revision will be incorporated into a future version of the VEGP Units 3 and 4 COL Application.

The following observations are made concerning those revised ISRS comparisons:

1. The revised Vogtle NI15 SASSI ISRS are almost identical to the original Vogtle NI15 SASSI ISRS provided in the supplemental response to RAI 3.7.2-1, especially in the lower frequency range below 10 Hz.
2. The revised AP1000 CSDRS broadened envelope ISRS at the six key locations (Ref. 1) has changed such that above 1 Hz there are now no exceedances of these AP1000 CSDRS broadened envelope ISRS by the revised Vogtle NI15 SASSI ISRS. Below 1 Hz, there is exceedance near 0.55 Hz as before; but now the amount of the exceedance is much less and primarily only in the X direction.
3. The exceedances near 0.55 Hz have been addressed previously where they were shown to have no impact on the AP1000 design.

Reference:

1. AP1000 Standard Combined License Technical Report: Extension of Nuclear Island Seismic Analyses to Soil Sites; APP-GW-S2R-010, Revision 4, March 2010, Docket No. 52-006, Westinghouse letter dated April 21, 2010 (DCP_NRC_002855).

Enclosure 2

VEGP Units 3 and 4 COL Application

Revised FSAR Appendix 3GG

Note: Enclosed is a 35-page document.

3-D SSI ANALYSIS OF AP1000 AT VOGTLE SITE USING NI15 MODEL

FOR

VEGP UNITS 3 AND 4

October 2010

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1 Introduction

This report presents the results of the three-dimensional soil-structure interaction (SSI) analysis of the AP1000 plant at the Vogtle site to confirm the applicability of the AP1000 design to the site.

This report supplements the two-dimensional site-specific SSI analysis previously submitted as Appendix 2.5E in the Vogtle Early Site Permit Application.

Site-specific SSI analysis is required since the site specific design response spectra exceed the certified seismic design response spectra (CSDRS) at some limited frequency range and the Vogtle soil profile is significantly different than the AP1000 generic soil profiles in shear wave velocity versus depth and overall soil depth.

Reference 1 describes changes to the AP1000 NI20 SASSI model now identified as NI20r and provides revised AP1000 CSDRS broadened envelope ISRS. This report reflects those changes and consists of updating the Vogtle NI15 SASSI model, rerunning the Vogtle SASSI analyses using the updated Vogtle NI15 SASSI model to generate revised Vogtle ISRS at the six key locations for the Vogtle soil profile (Lower Bound, Best Estimate, and Upper Bound soil cases), and providing a comparison of the revised Vogtle ISRS to the new AP1000 CSDRS broadened envelope ISRS.

2 Methodology

The free-field analyses are performed using the Bechtel Computer Program SHAKE2000. The SSI analyses are performed using the Bechtel Computer Program SASSI2000.

3 Vogtle Site Profile

A detailed description of the site geology and soil stratigraphy, including the extent and characteristics of the backfill materials, is contained in the Early Site Permit Application and is not repeated in this report. For the three-dimensional SSI analysis, the same soil profiles used for the two-dimensional SSI analysis are used. The strain-compatible soil shear-wave velocity and damping profiles for the three soil cases, (upper bound (UB), median (BE) and lower bound (LB)) are shown in Figure 1 and Figure 2. Note that the UB shear-wave velocity profile is combined with the LB damping profile to form the UB SSI soil profile. Likewise, the LB velocity profile is combined with the UB damping profile to form the LB SSI soil profile. The BE shear wave velocity and damping profiles are for the BE SSI soil profile. These profiles are obtained from the group of simulated soil profiles used for development of the soil amplification factors and site specific ground motions by considering the median and one standard deviation of the range of data and incorporating the NUREG-0800 requirement of the minimum soil shear modulus variation of 1.5. For SSI analysis, the rock was modeled at the depth of about 1000 ft corresponding to the approximate depth of the rock at the site.

For comparison purposes, the strain-compatible generic soil profiles used for certified design of AP1000 are compared with the strain-compatible Vogtle UB, BE and LB site-specific soil profiles in Figure 3. As shown, the Vogtle site-specific soil profiles are softer than the lower-bound generic Soft Soil profile in the upper 50 ft. In addition, the Vogtle site-specific soil profiles extend to the depth of about 1000 ft whereas the generic soil profiles are only 120 ft deep overlying a bedrock layer assumed to be a halfspace layer below 120 ft depth.

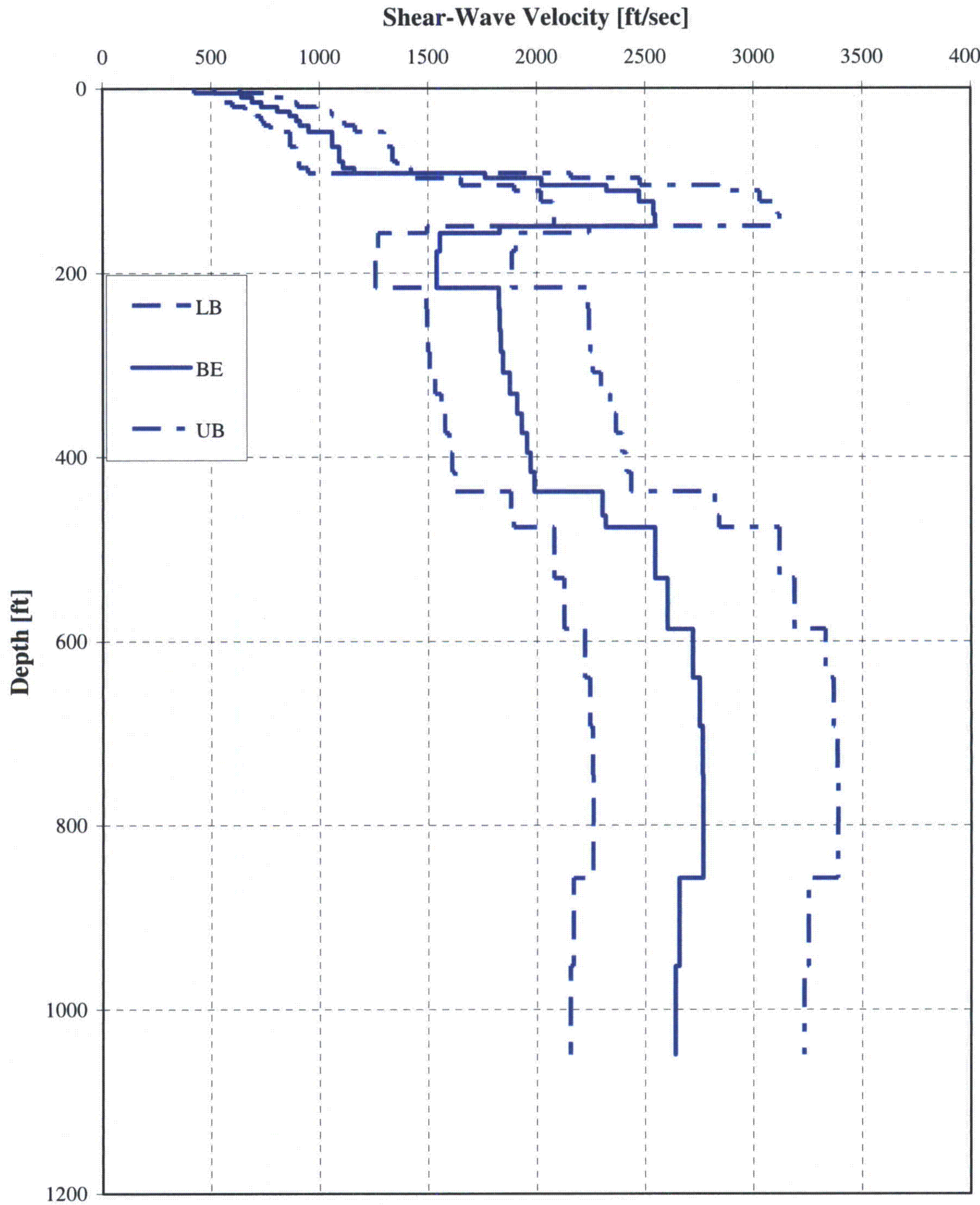

Figure 1. Vogtle Strain-Compatible Soil Shear Wave Velocity Profiles Used in SSI Analysis

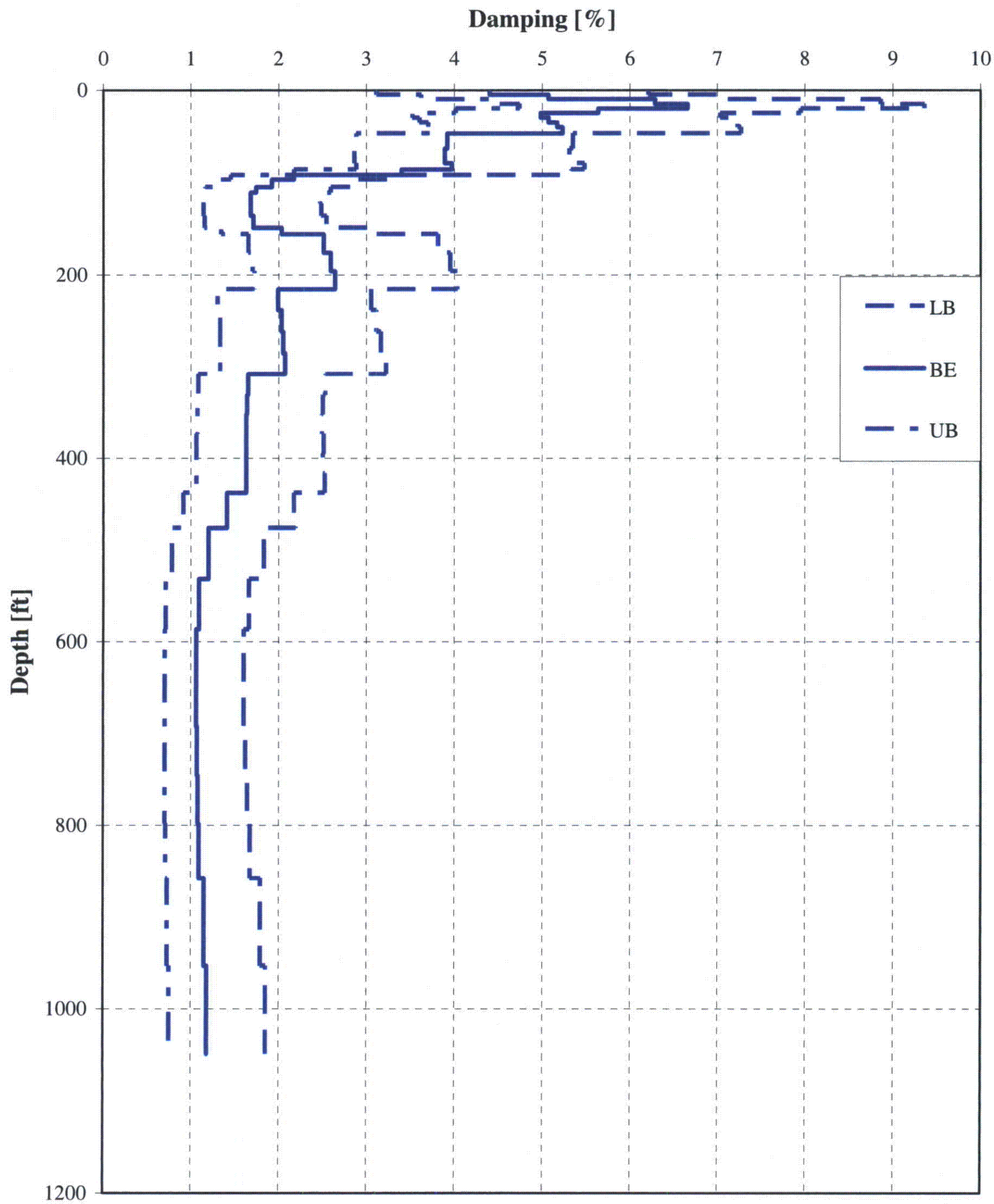

Figure 2. Vogtle Strain-Compatible Soil Damping Profiles Used in SSI Analysis

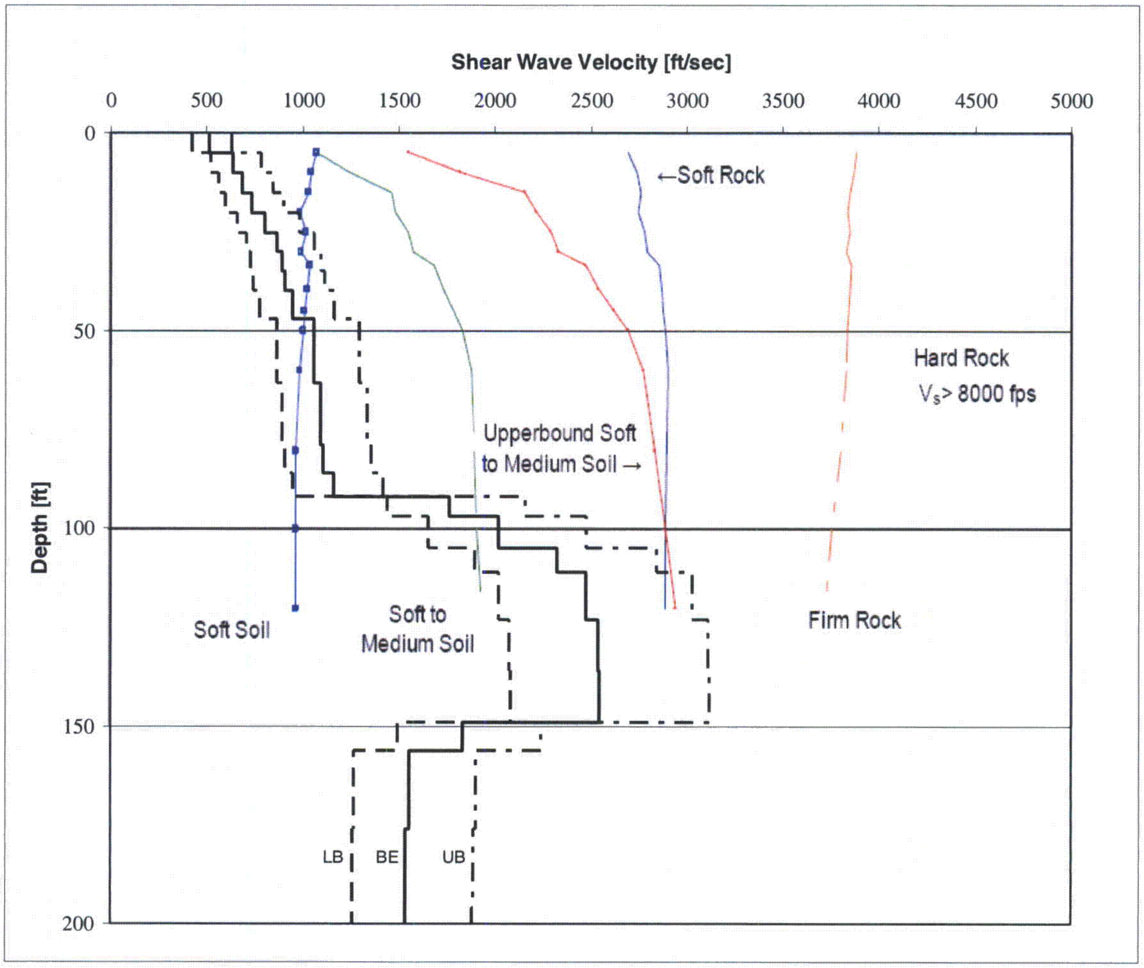

Figure 3. Vogtle Site-Specific and AP1000 Generic Strain-Compatible Soil Profiles

4 Vogtle Site Specific Seismic Motion

As described in the ESP application, the ground motion response spectra (GMRS) at the Vogtle site are defined at the finished grade at the top of the backfill. The foundation input response spectra (FIRS) is at the foundation horizon at the depth of 40 ft below the finished grade. FIRS and GMRS are compared with CSDRS in Figure 4 and Figure 5 for the horizontal and vertical motions, respectively. Note that the FIRS is an outcrop motion at the foundation level obtained from the soil column analysis of the site full soil column extending to top of the backfill.

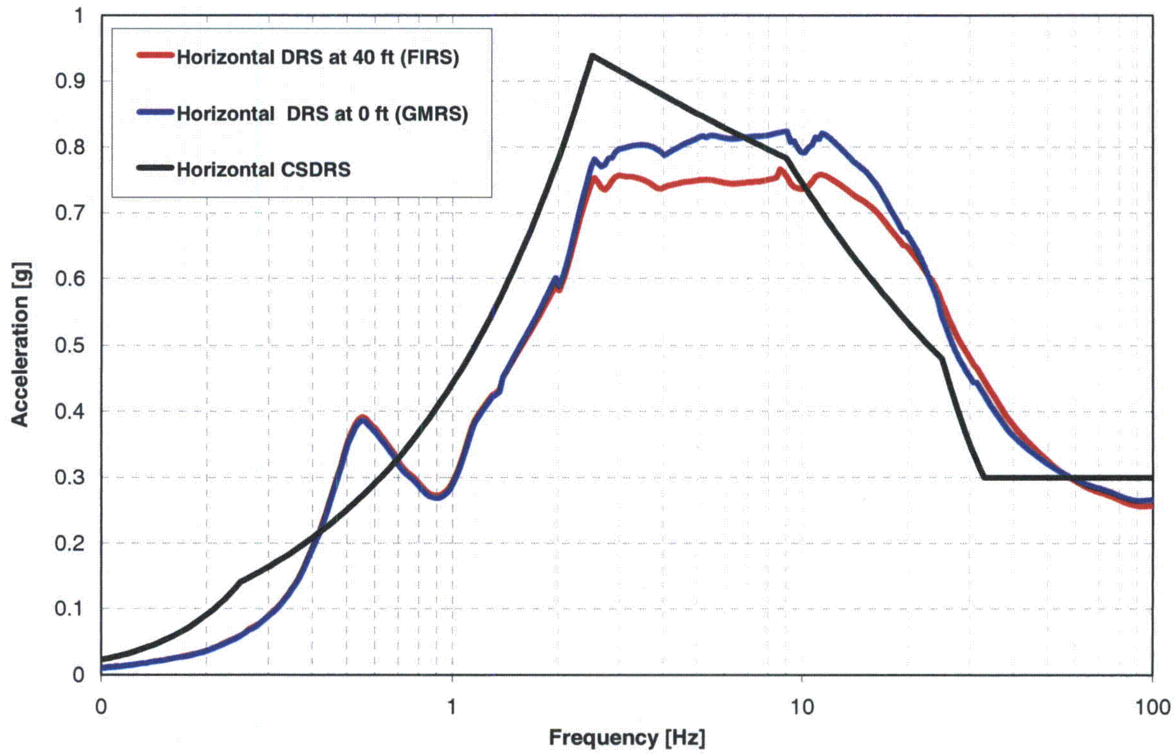

Figure 4. AP1000 CSDRS and Vogtle GMRS and FIRS - Horizontal Motion (5% Damping)

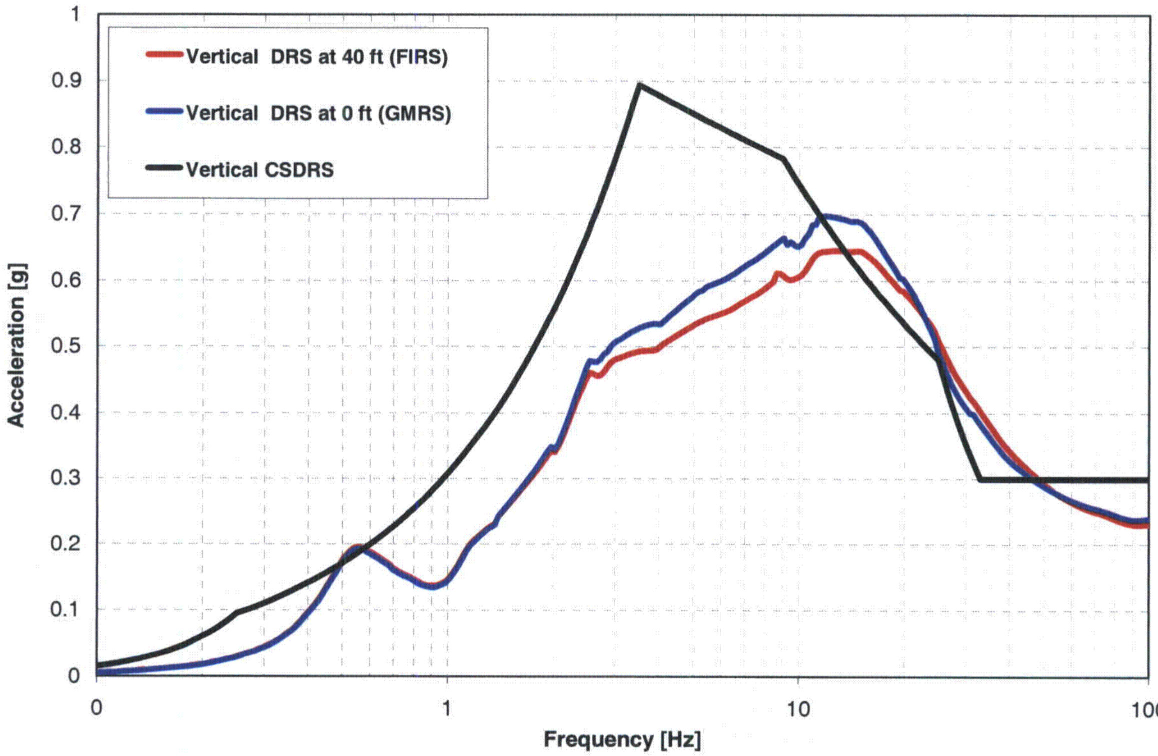

Figure 5. AP1000 CSDRS and Vogtle GMRS and FIRS - Vertical Motion (5% Damping)

As shown in the above figures, both the horizontal and vertical Design Response Spectra (DRS) at both GMRS and FIRS levels exceed the CSDRS at a limited frequency range.

4.1 SSI Input Motion

The development of SSI input motion follows the procedure outlined in the recent NRC position on this subject (ADAMS Accession Numbers ML083580072 and ML083020171). The development of SSI input motion is consistent with the development of FIRS and the required check has been made at the ground surface to evaluate the adequacy of the SSI input motion. Using the three SSI soil profiles defined above, acceleration time histories compatible with the FIRS are generated and applied as outcrop input motion at the depth of 40 ft, and the response motions at the surface are computed using Bechtel Program SHAKE2000. The resulting three spectra are compared with the surface design spectra (GMRS) in Figure 6 through Figure 8 for the horizontal H1, H2 and the Vertical component of the motion, respectively. As shown in these figures, the envelope of the three horizontal SSI input motions (LB, BE and UB) adequately envelops the GMRS in the two horizontal directions (H1 and H2) and no further modification of the horizontal motion is warranted. The vertical motions, however, are slightly less than the vertical GMRS in the frequency range 2.5 to 7 Hz. For this reason the vertical time history associated with the lower bound soil profile analysis was increased uniformly by a factor of 1.11. Figure 9 shows the comparison for the vertical motion confirming the enveloping spectra from the three soil profiles envelop the vertical GMRS at the ground surface.

For SASSI SSI analysis and for each SSI soil profile, the outcrop motions were converted to in-column motions at the depth of 40 ft and the in-column motions are subsequently used in the SSI analysis. For each of the three soil profiles, three in-column time histories are developed resulting in total of nine in-column time histories for SSI analysis. As described above, the vertical in-column time history corresponding to the LB soil profile was increased by a factor of 1.11 to meet the enveloping requirement at the surface.

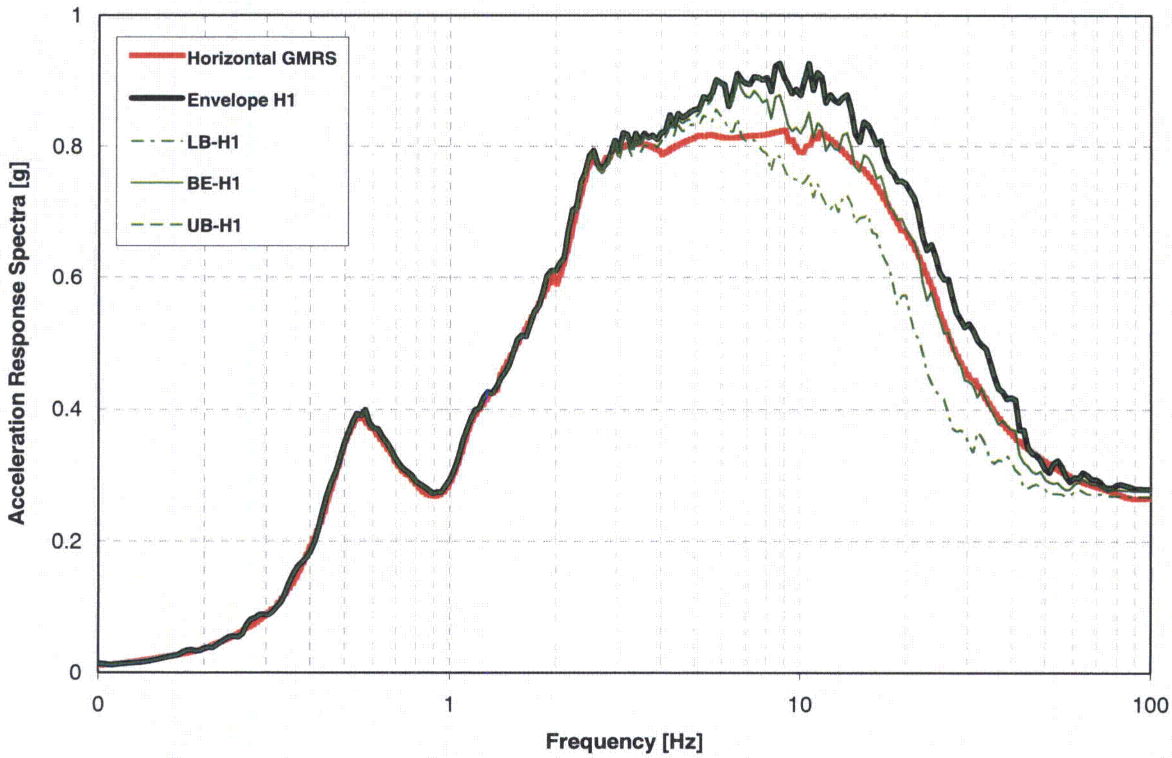

Figure 6. Comparison of H1 Response Motion and GMRS at the Ground surface Level (5% Damping)

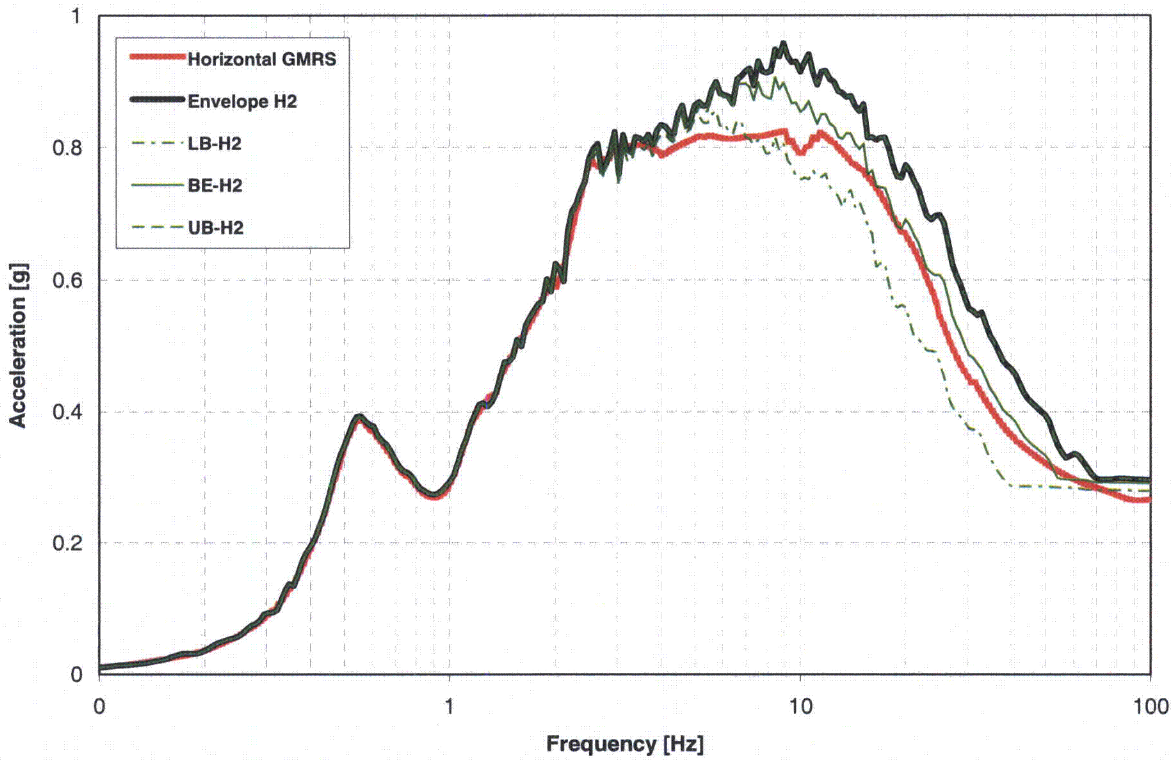

Figure 7. Comparisons of the H2 Response Motions with the GMRS at the Ground Surface Level (5% Damping)

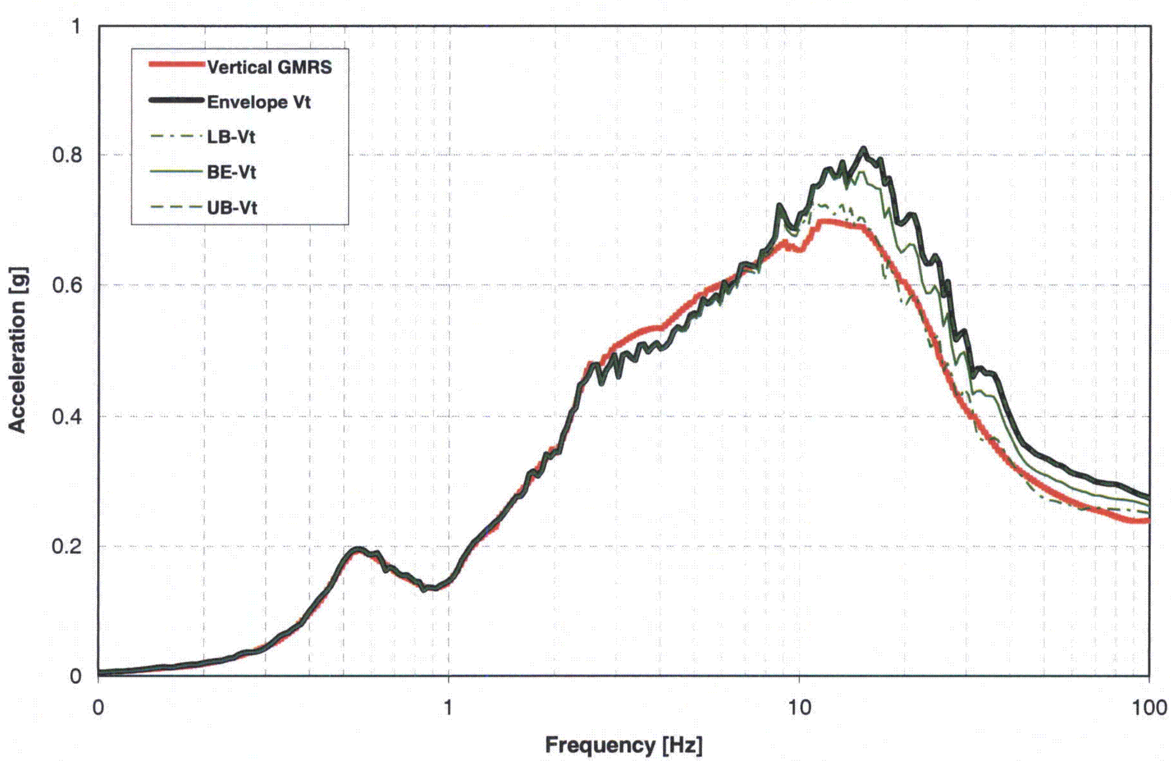

Figure 8. Comparisons of the Vertical Response Motions with the GMRS at the Ground Surface Level (5% Damping)

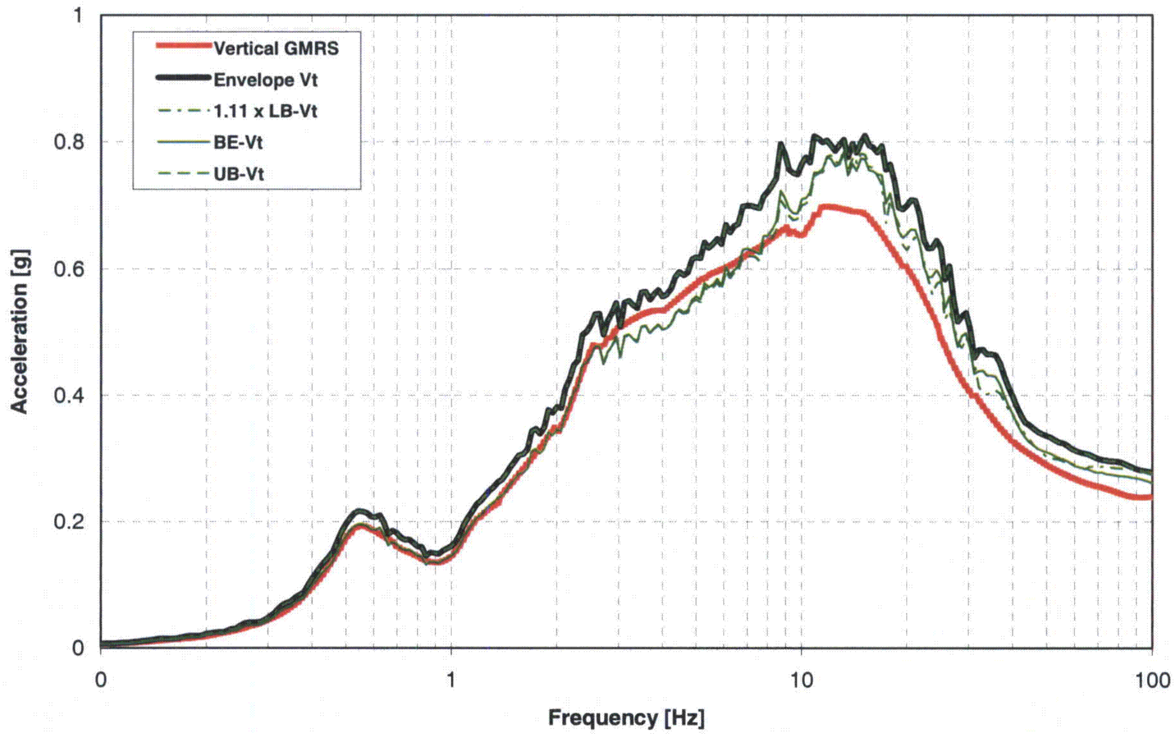

Figure 9. Comparisons of the Modified Vertical Response Motions with the GMRS at the Ground Surface Level (5% Damping)

5 Structural Model

The AP1000 model used for Vogtle site-specific SSI analysis is a three-dimensional finite element model defined as NI15 model that is developed by Westinghouse. This model was developed specifically for the Vogtle site to incorporate additional refinement in order to capture the Vogtle high frequency exceedance beyond CSDRS as shown in Figure 4 and Figure 5. In addition as shown in Figure 3, the Vogtle soil profile is softer than the generic profiles in the upper 50 ft and significantly deeper with an inverted impedance mismatch below the Blue Bluff marl requiring site specific modeling and analysis to evaluate applicability of the design.

The AP1000 Nuclear Island consists of the Auxiliary and Shield building (ASB), Containment Internal Structure (CIS), Reactor Coolant Loop and Steel Containment Vessel (SCV). The ANSYS NI15 Model, averaging 15' by 15' for solid and shell elements in the ASB, is shown in Figure 10. The structure model has over 6300 nodes and 7500 elements. The embedded part of NI is modeled with 5 layers of elements for a total embedment depth of 39.5 ft. Solid elements and Beam elements for SCV, CIS including Reactor Coolant Loop, Pressurizer, and polar crane are shown in Figure 11.

The NI15 was verified by Westinghouse by assuring that the mass distribution, the modal behavior and the floor response spectra results were consistent in ANSYS with WEC's most detailed model which is the model used for Hard Rock (NI10). The mass, centroid, and moment of inertia analysis determined the geometric and material properties were consistent with the finite element model NI10. The dynamic behavior of the Nuclear Island building is identified by means of a modal analysis, and a floor response spectra comparison of the two models.

The ANSYS NI15 model is converted into the SASSI NI15 Model where excavated soil elements are added. The SASSI NI15 model is used in the Soil Structure Interaction (SSI) analysis.

Due to the changes to the AP1000 NI20 SASSI model now identified as NI20r as described in Reference 1, the Vogtle NI15 SASSI model was revised from that described above as follows:

1. The properties of the Shield Building walls and air-inlet were updated to reflect the Shield Building design changes.

2. Modeling corrections to the Westinghouse AP1000 NI20 SASSI, as described in Reference 1, Section 4.2.3 "Corrections to NI20 SASSI Model", were not required for the Vogtle NI15 SASSI model. These corrections to the SASSI NI20 model were to address modeling concerns with beam to solid element connectivity and improve the stress distribution in the basemat. The Vogtle NI15 SASSI model beam to solid element connectivity already properly modeled the connections between the solid elements and beam elements. Unlike the NI20 SASSI model that modeled the Auxiliary Building portion of the basemat of the Nuclear Island as shell elements, the Vogtle NI15 SASSI model used solid elements for the entire basemat. Therefore, there was no issue with the stress distribution at the basemat interface between the Auxiliary Building and the Containment Internal Structure (CIS).

3. The original NI20 SASSI model was revised to account for stiffness due to out-of-plane flexure where the walls, which are modeled as shell elements, connect to the floors, which are modeled as solid elements. Therefore, the Vogtle NI15 SASSI model was revised by extending the wall shell elements the depth of one solid element to capture the effects of out-of-plane flexural stiffness. This modeling change showed no significant effect on the response since in-plane wall stiffness was the controlling contributor to overall lateral structural stiffness.

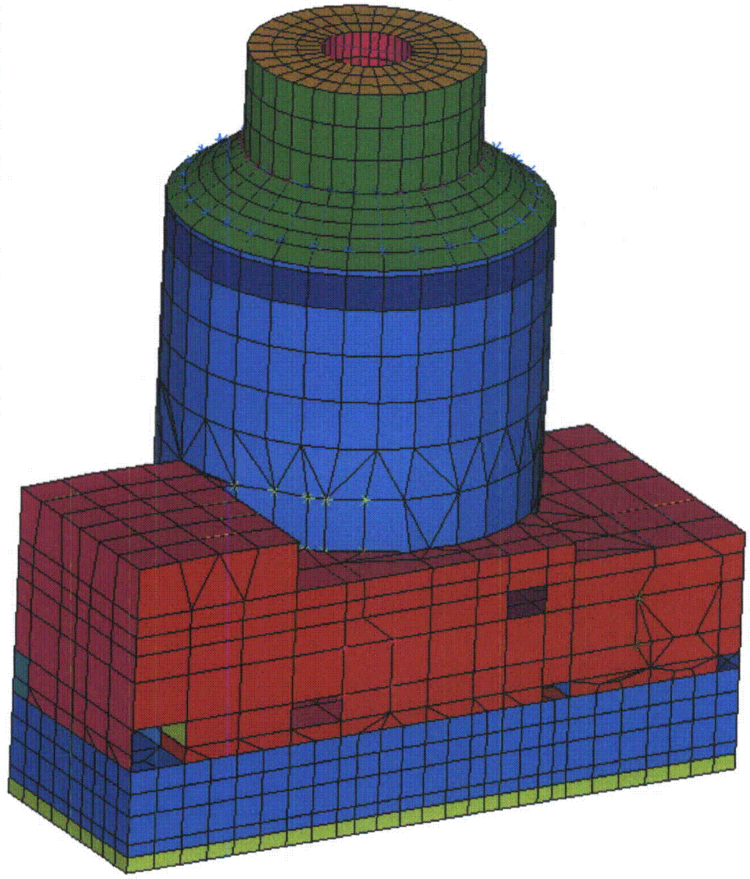

Figure 10. NI15 Finite Element Model

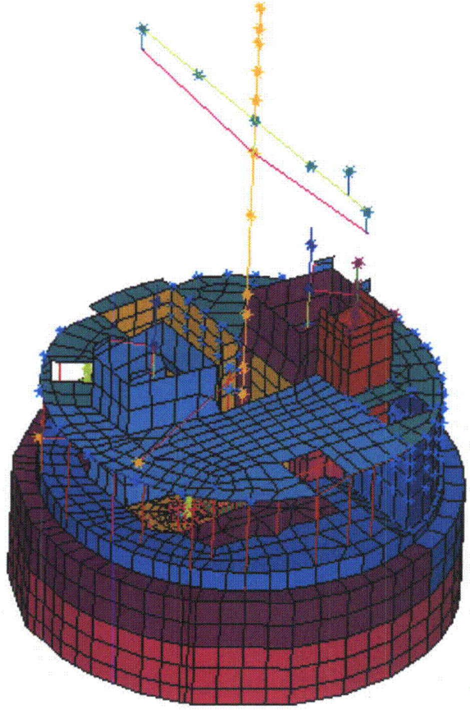

Figure 11. NI15 CIS, RCL, and SCV Elements

6 SSI Analysis and Results

Using the above structural model, the Vogtle site-specific SASSI SSI model of AP1000 was constructed by modeling the soil profile and the soil foundation model for the embedded part of the nuclear island (NI). For all structural members, 4% material damping was used. This damping is considered to be conservative and is representative of the lower bound value for damping compatible to structural response per RG 1.61. For each soil profile, the respective in-column motions were used as input at the depth of the foundation level with excitation in all three (North-South, East-West, and Vertical) directions. The results in terms of in-structure response spectra (ISRS) at 5% damping at the six key locations in the NI (Table 1) are computed. The coupling responses are combined using the SRSS method. The analyses are performed to 30 Hz (15 Hz for LB, 17 Hz for BE, 30 Hz for UB) to cover all frequencies of interest for the given design motion.

Table 1: Key Location for ISRS Comparison with DCD

Node	X* [ft]	Y* [ft]	Z [ft]	Location
10115	1116.5	948.5	116.5	ASB NE Corner at Control Room Floor
11111	929	1000	179.19	ASB Corner of Fuel Building Roof at Shield Building
12052	956.5	1000	327.41	ASB Shield Building Roof Area
10471	1008	1014	134.25	CIS Operating Deck
9007	1000	1000	100	CIS at Reactor Vessel Support Elevation
11224	1000	1000	224	SCV Near Polar Crane

*Note: X=Y=1000 ft at center of ASB and SCV

The results at these six locations are compared with the CSDRS-based design envelops in Figure 12 through Figure 29. In these figures, X denotes plant North, Y denotes plant West and, Z denotes vertical direction.

For a point of reference, the comparisons also include the original AP1000 CSDRS broadened envelope ISRS to aid in understanding the differences in the revised ISRS comparison.

As shown in these figures, the "design envelope" exceeds the site specific response motions basically over the entire range of frequencies and by a large margin. This margin is particularly large at the zero period acceleration level indicating a large margin for seismic member forces. At a very limited frequency range, small exceedances beyond the design envelops are observed. The exceedance at about 0.55 Hz is consistent with the previous two-dimensional SSI results and has no design consequence since there are no structural members at this frequency.

7 Conclusion

The results of the three dimensional SSI analysis of a refined AP1000 NI model at the Vogtle site show a large margin against the design envelops. This study confirms the applicability of the AP1000 design to the Vogtle site.

8 Reference

1. AP1000 Standard Combined License Technical Report: Extension of Nuclear Island Seismic Analyses to Soil Sites; APP-GW-S2R-010, Revision 4, March 2010, Docket No. 52-006, Westinghouse letter dated April 21, 2010 (DCP_NRC_002855).

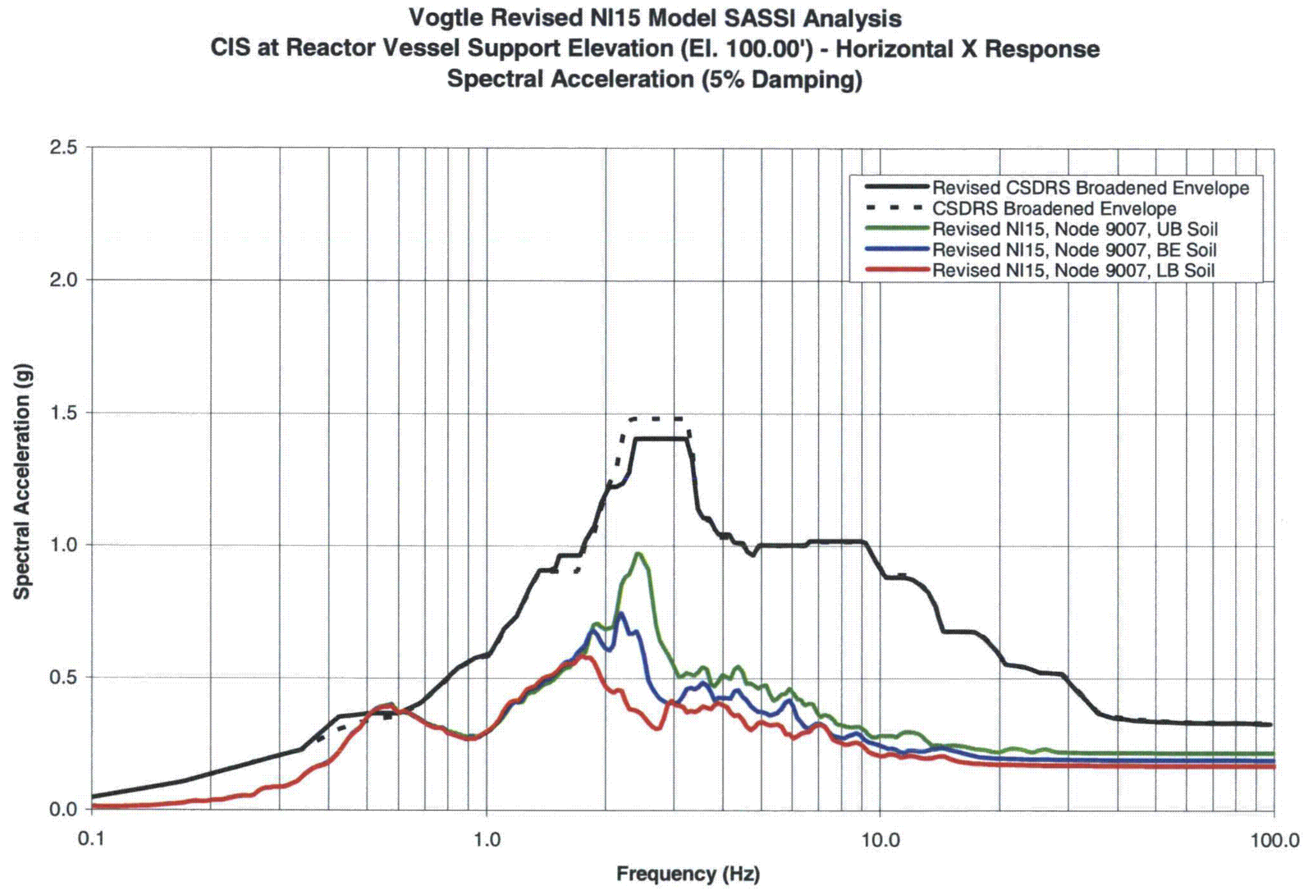

Figure 12. Horizontal X Response Spectra at CIS at Reactor Vessel Support Elevation (El. 100.00 ft, Node 9007)

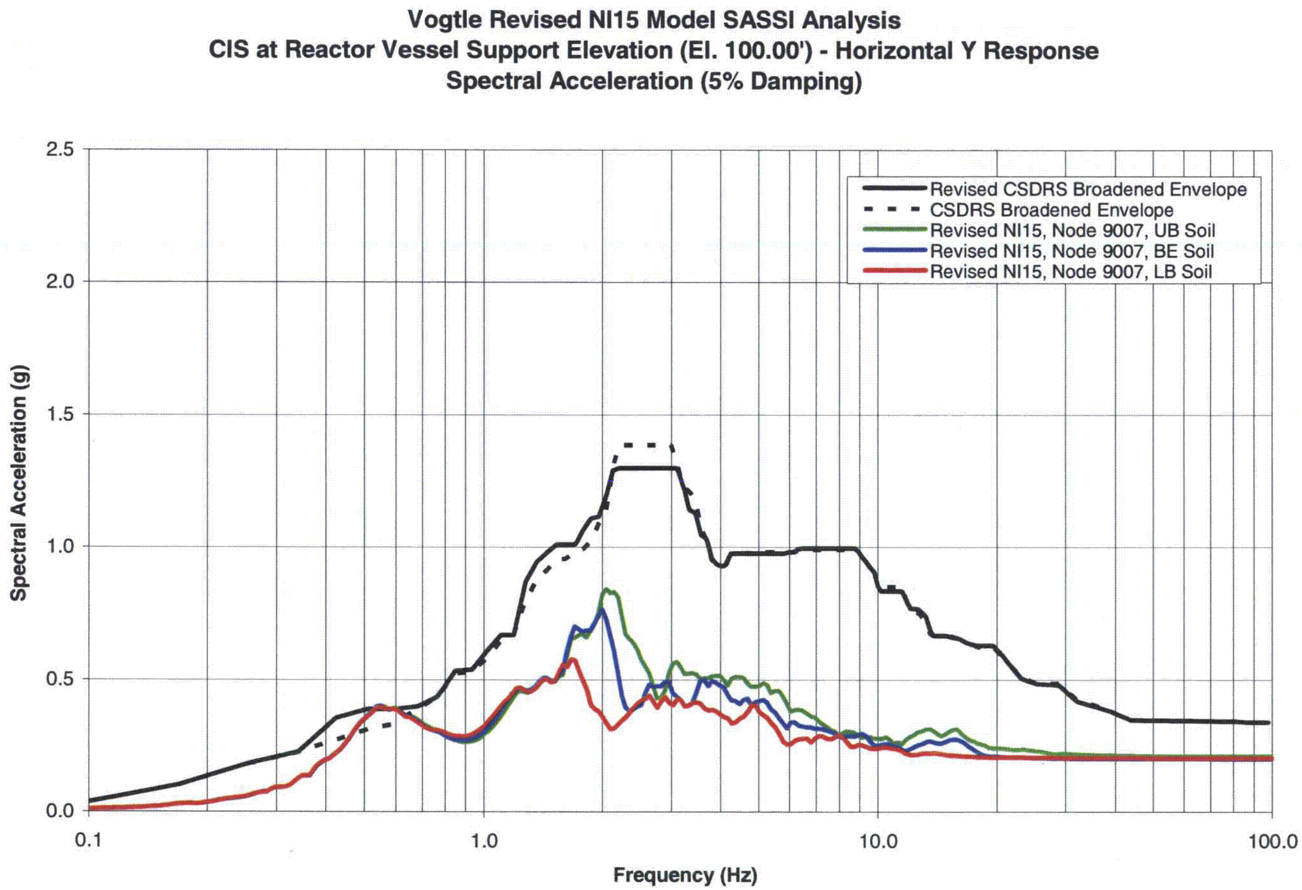

Figure 13. Horizontal Y Response Spectra at CIS at Reactor Vessel Support Elevation (El. 100.00 ft, Node 9007)

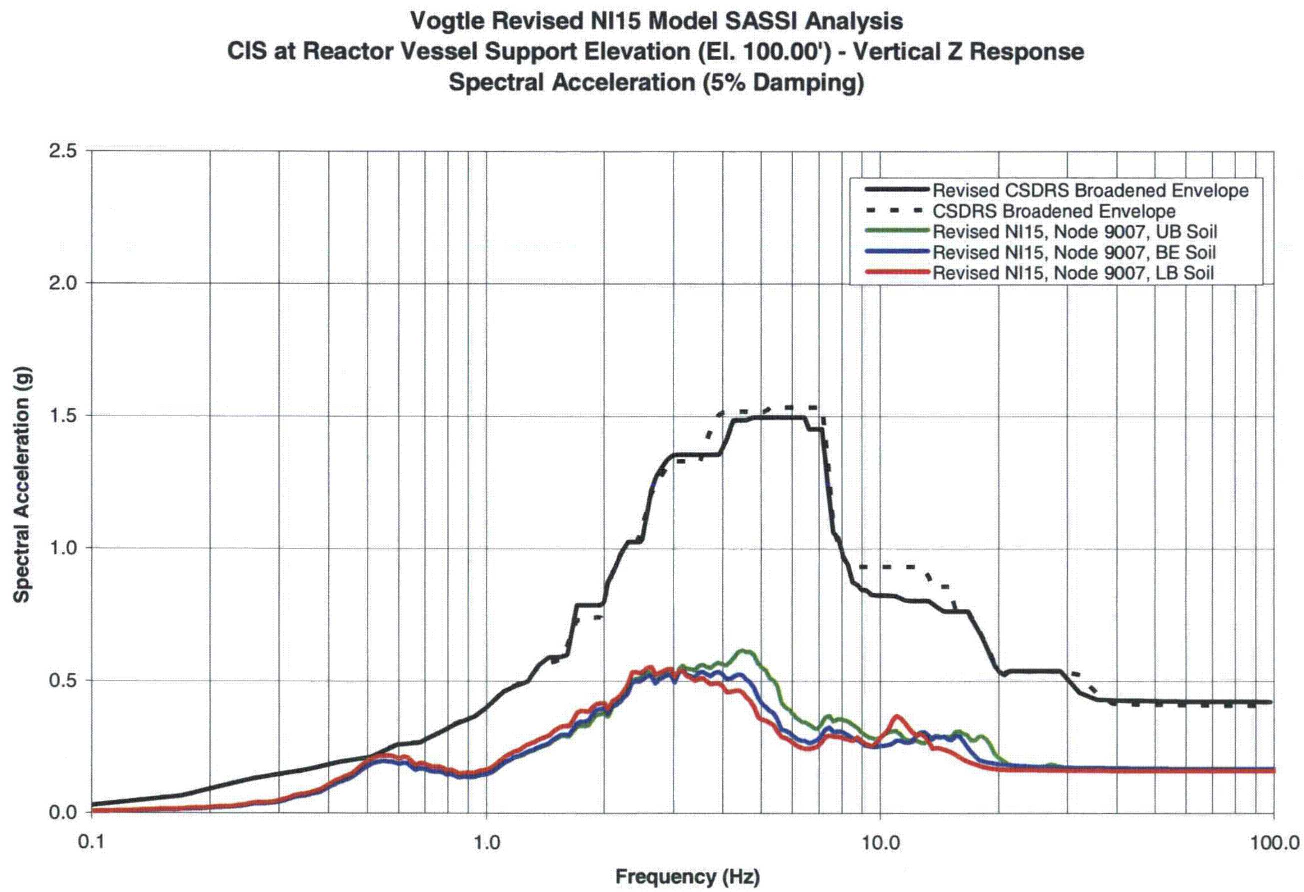

Figure 14. Vertical Z Response Spectra at CIS at Reactor Vessel Support Elevation (El. 100.00 ft, Node 9007)

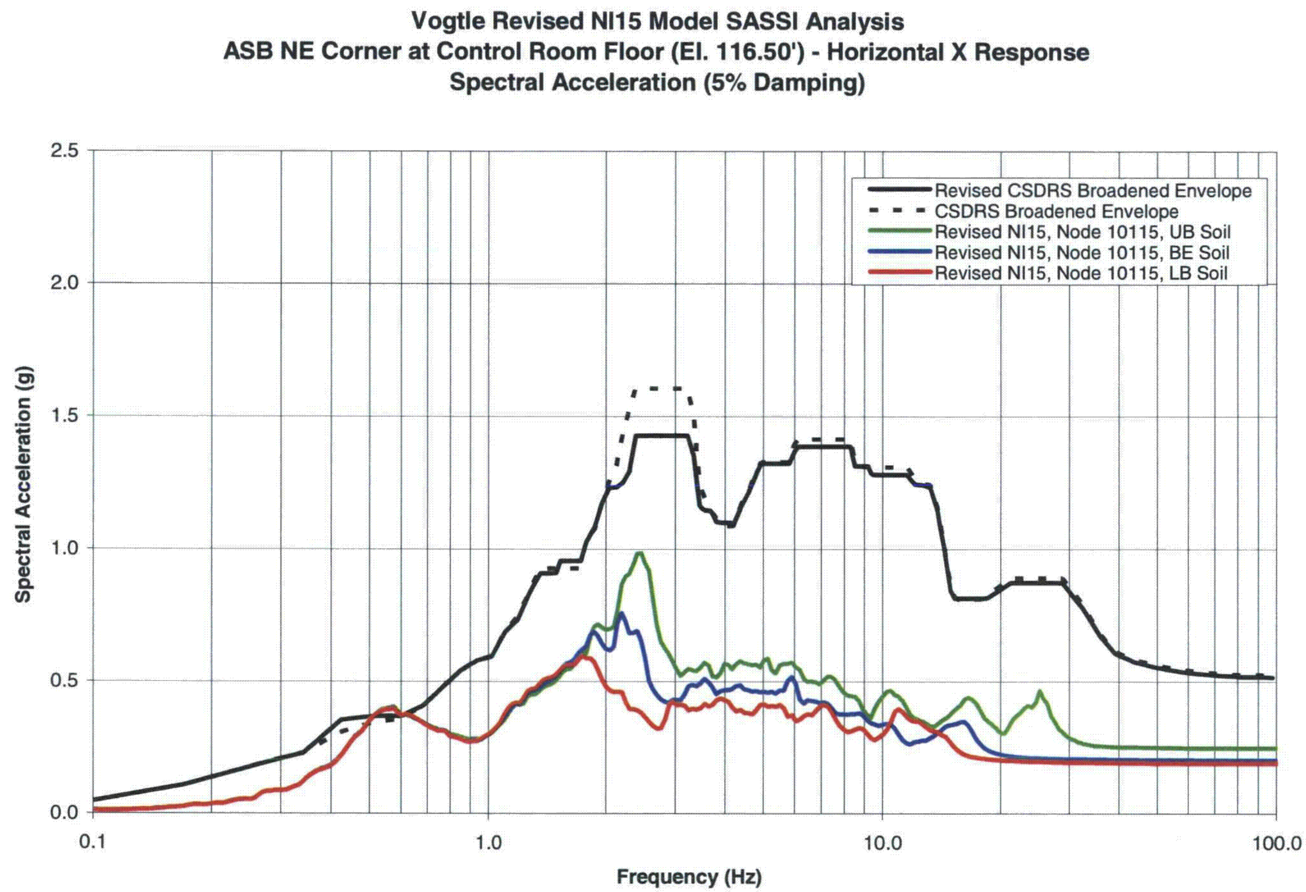

Figure 15. Horizontal X Response Spectra at ASB NE Corner at Control Room Floor (El. 116.50 ft, Node 10115)

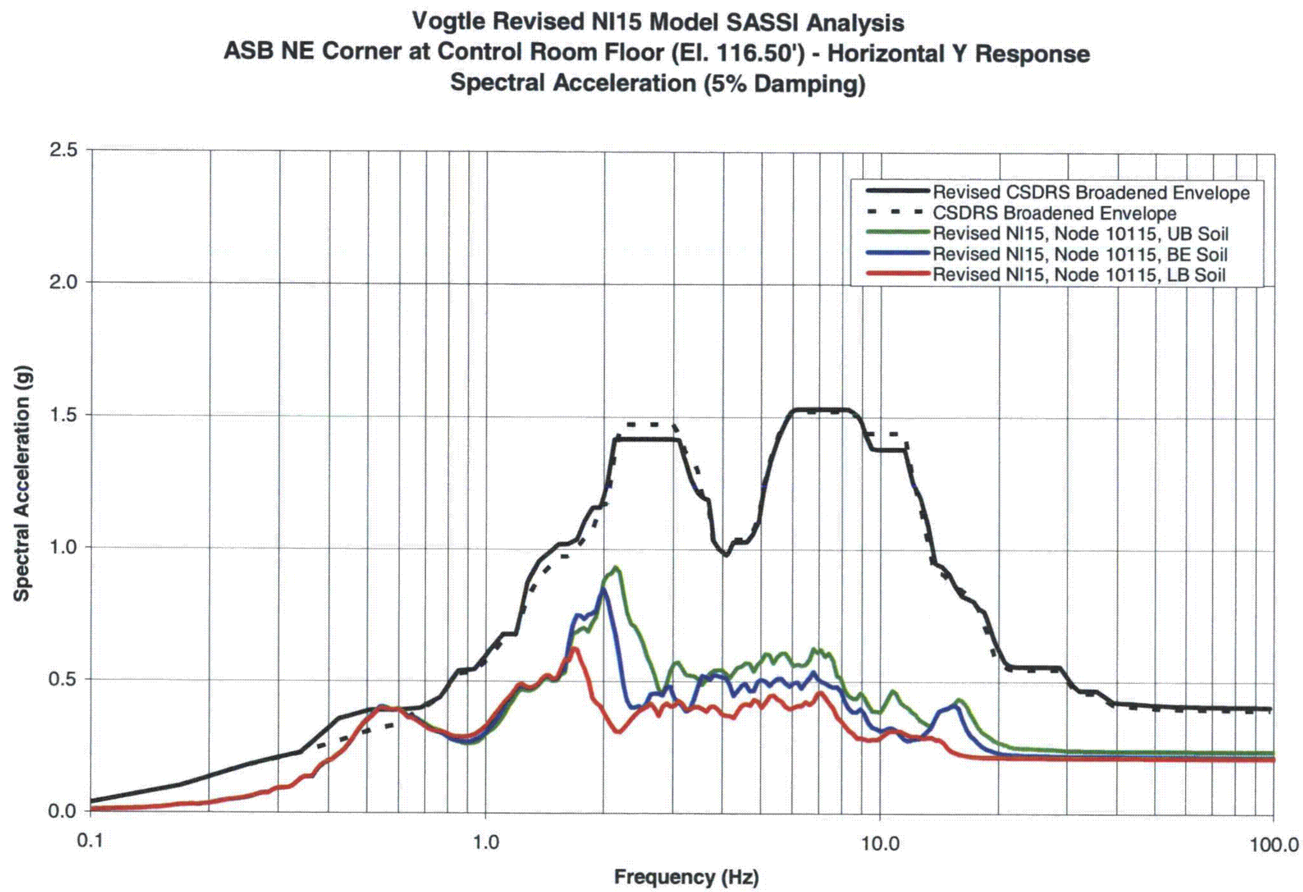

Figure 16. Horizontal Y Response Spectra at ASB NE Corner at Control Room Floor (El. 116.50 ft, Node 10115)

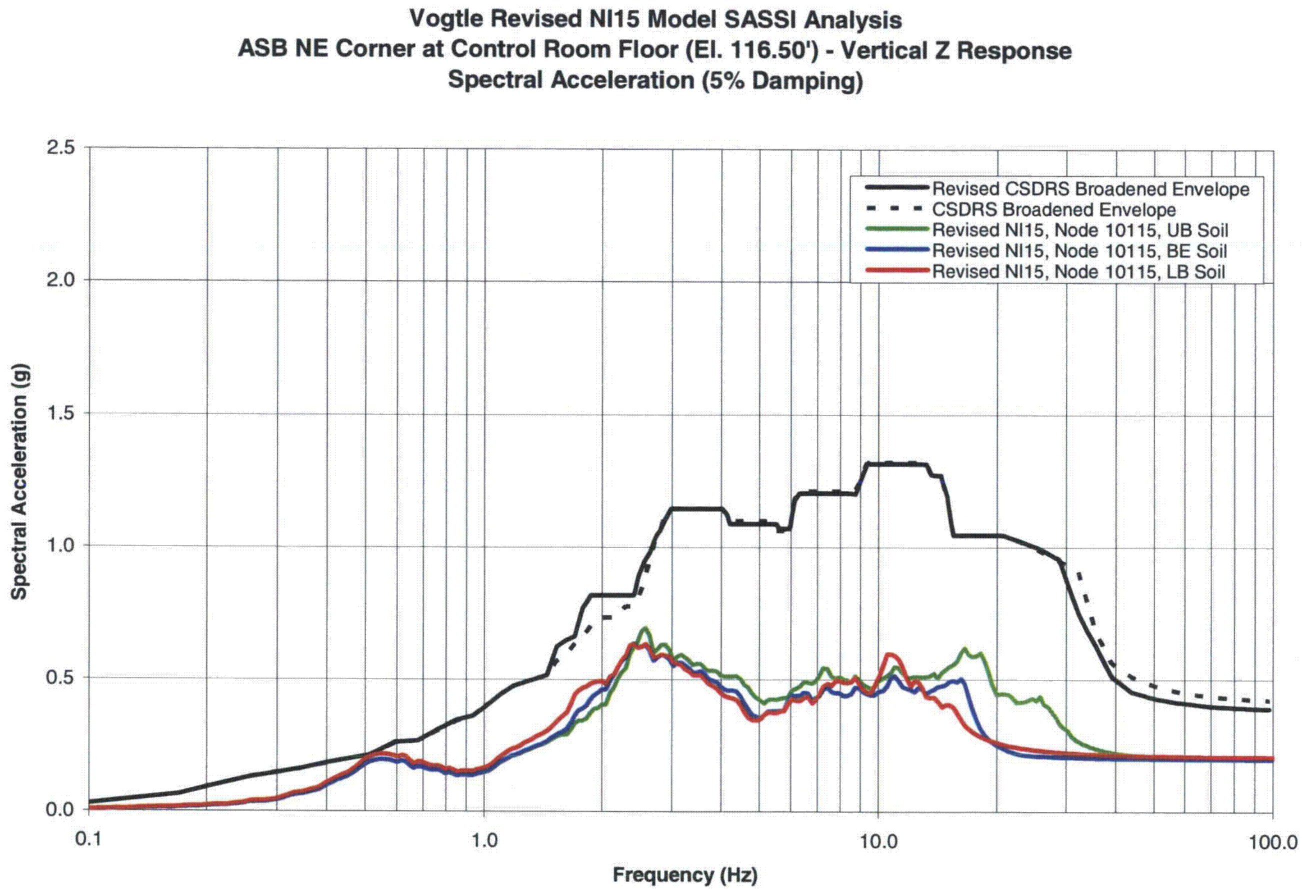

Figure 17. Vertical Z Response Spectra at ASB NE Corner at Control Room Floor (El. 116.50 ft, Node 10115)

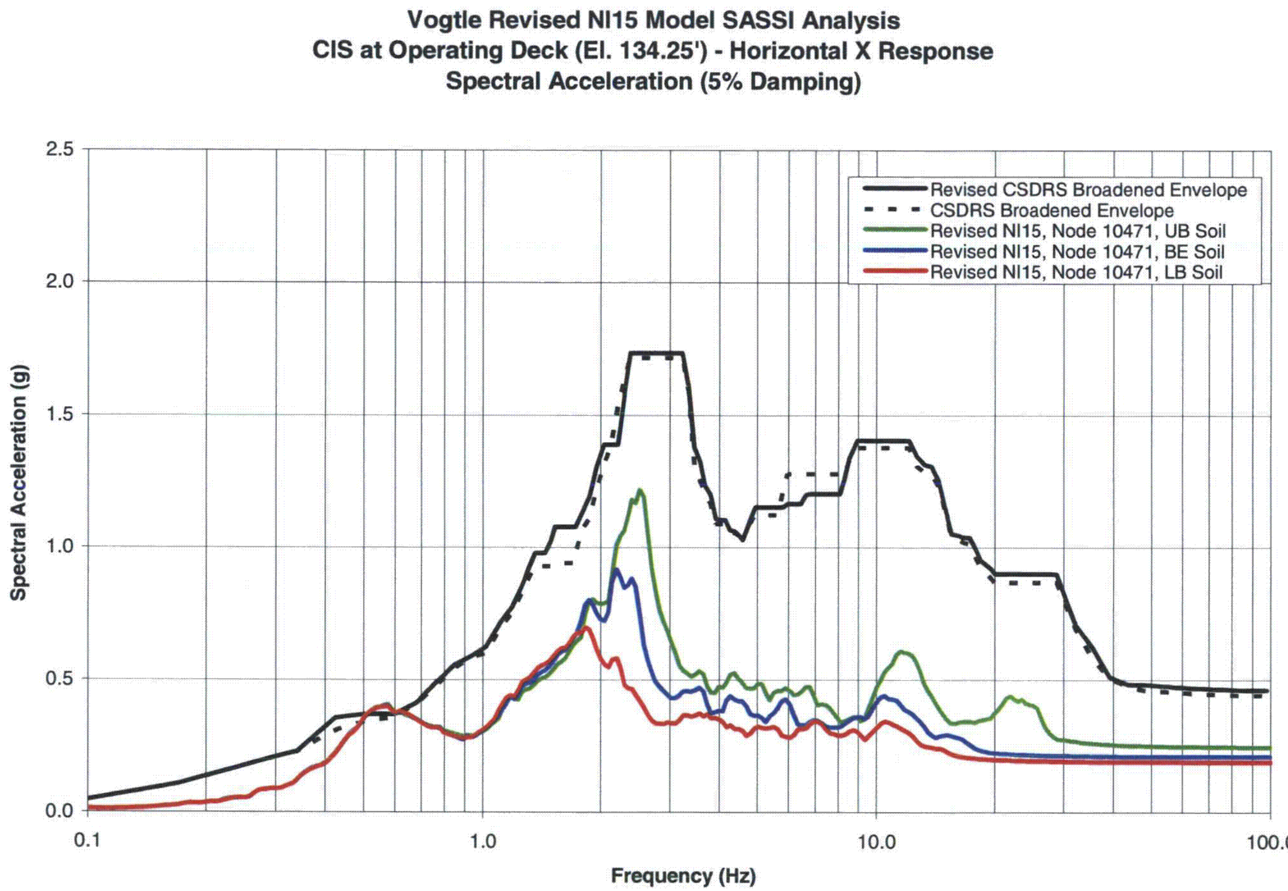

Figure 18. Horizontal X Response Spectra at CIS at Operating Deck (El. 134.25 ft, Node 10471)

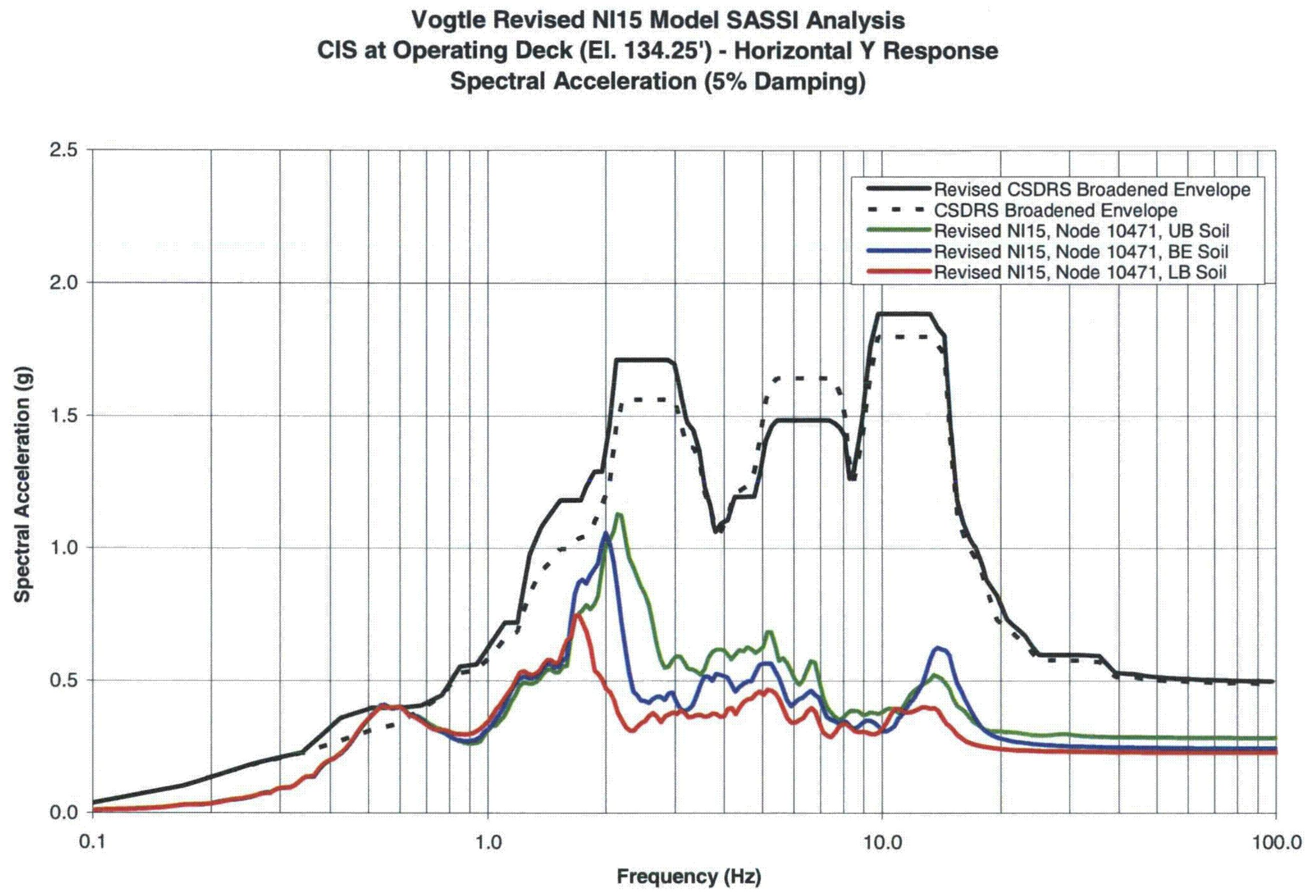

Figure 19. Horizontal Y Response Spectra at CIS at Operating Deck (El. 134.25 ft, Node 10471)

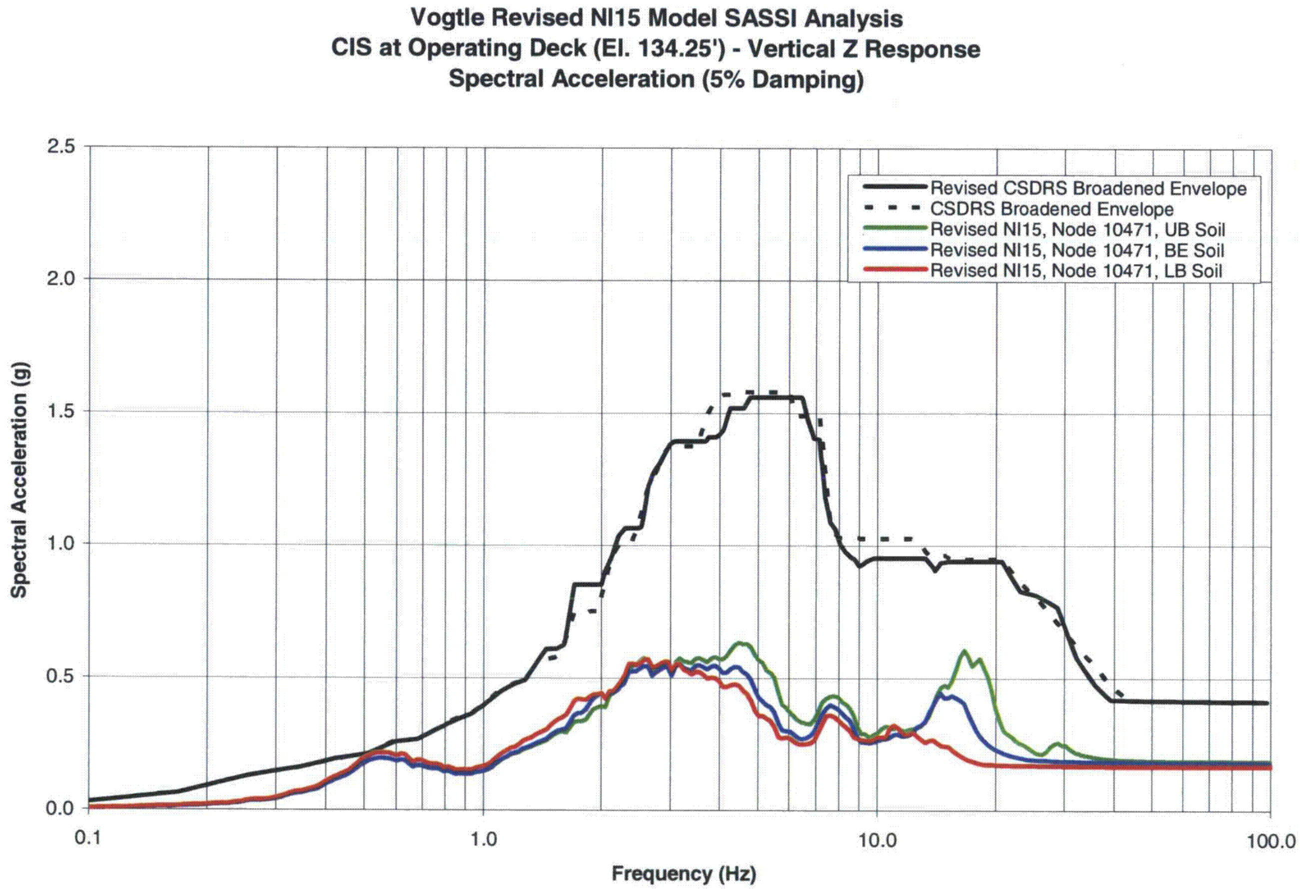

Figure 20. Vertical Z Response Spectra at CIS at Operating Deck (El. 134.25 ft, Node 10471)

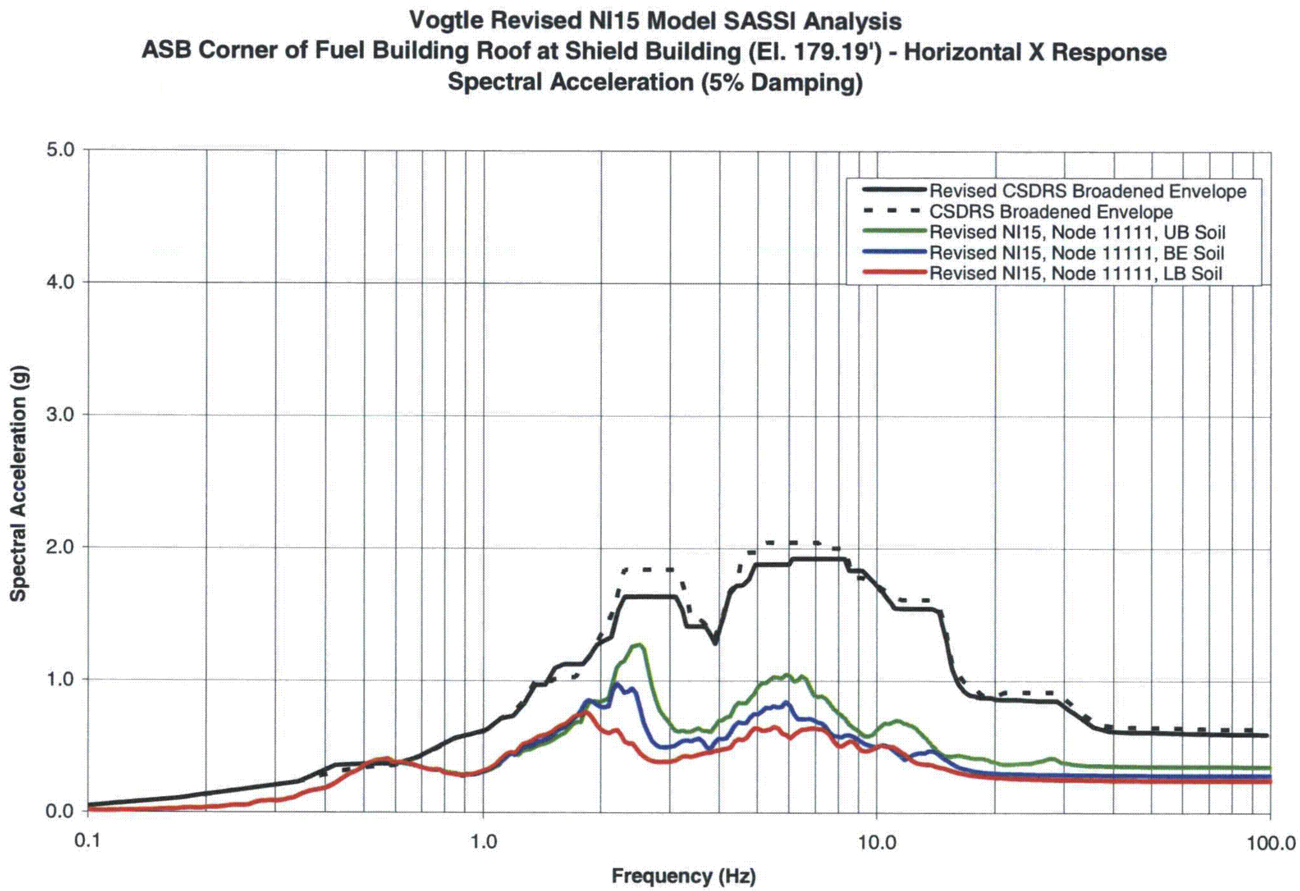

Figure 21. Horizontal X Response Spectra at ASB Corner of Fuel Building Roof at Shield Building (El. 179.19 ft, Node 11111)

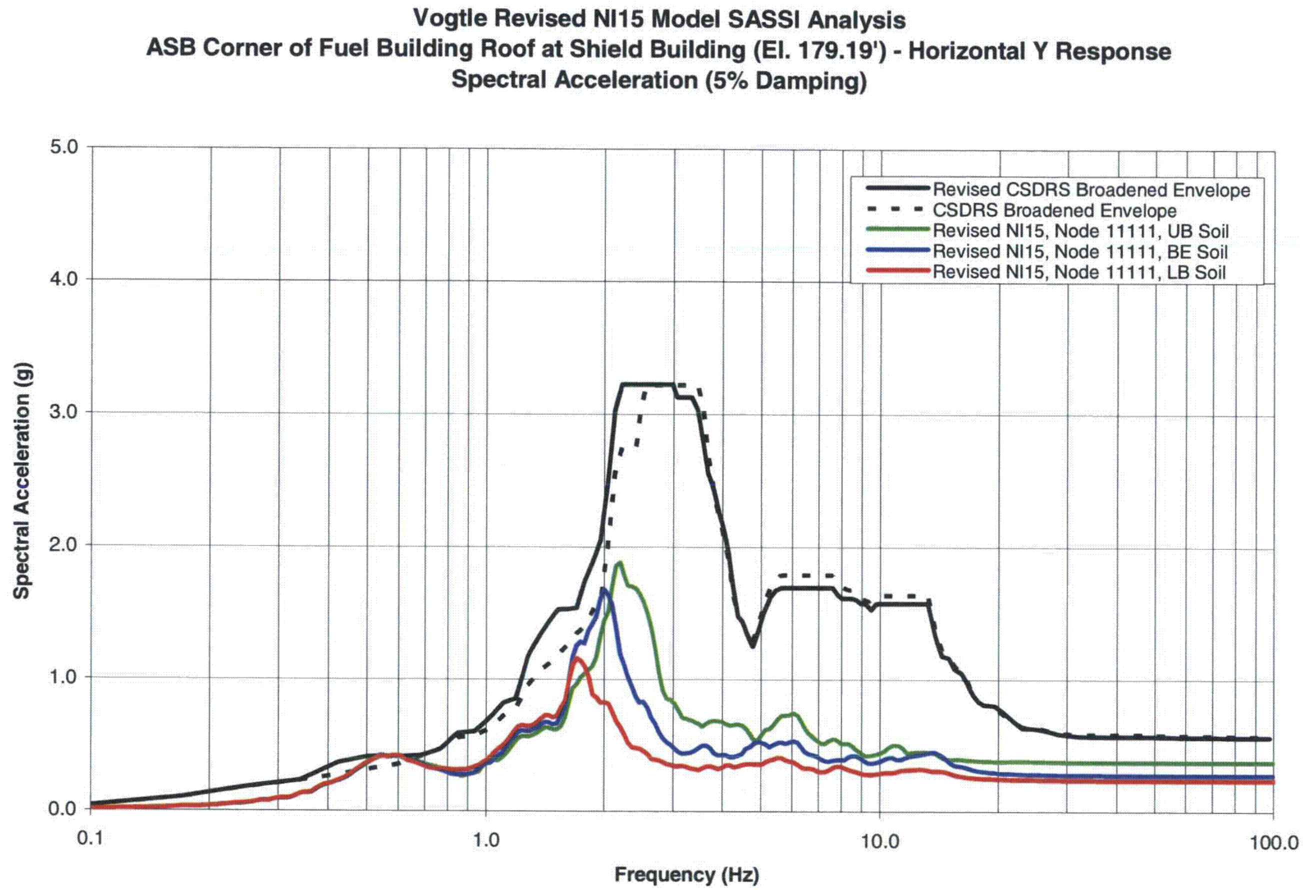

Figure 22. Horizontal Y Response Spectra at ASB Corner of Fuel Building Roof at Shield Building (El. 179.19 ft, Node 11111)

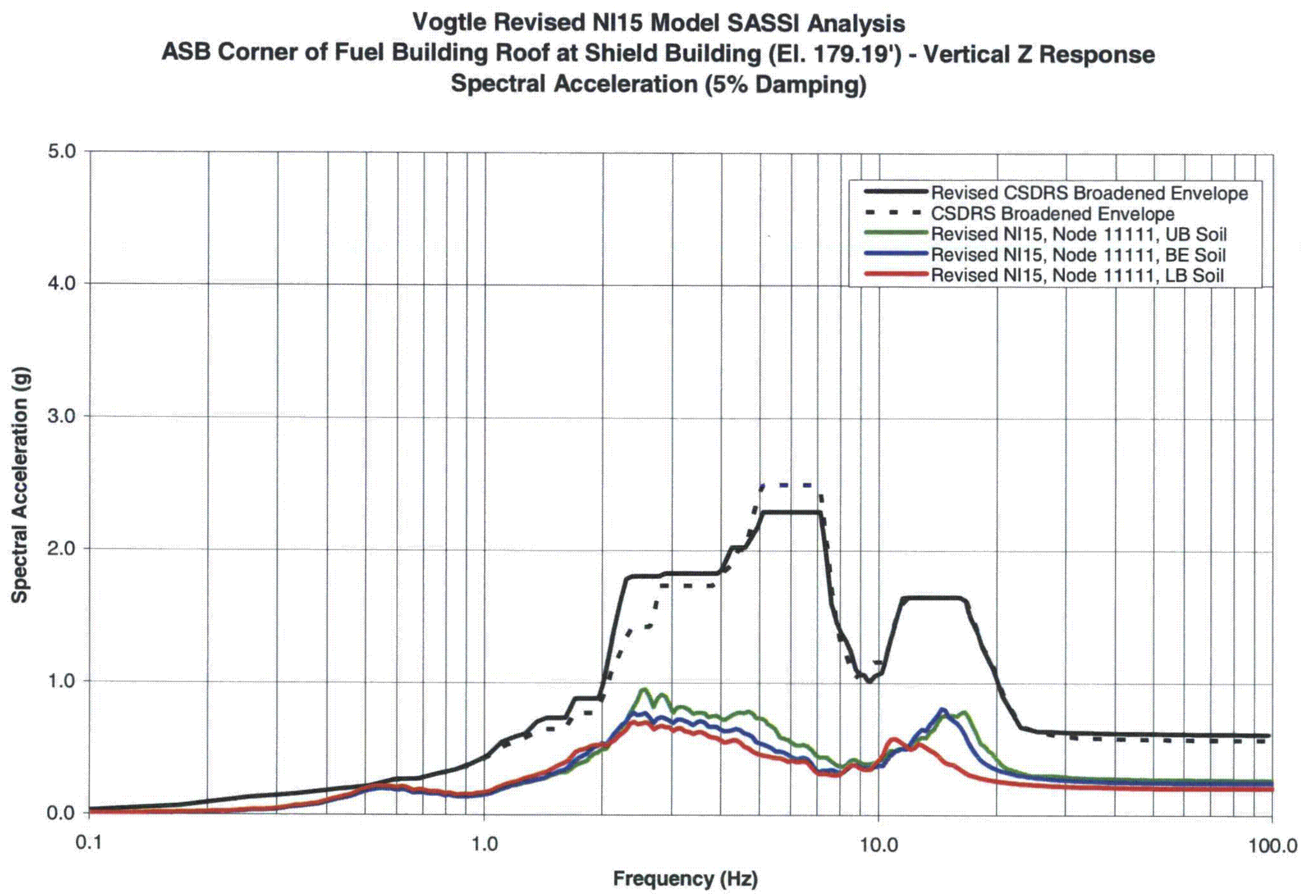

Figure 23. Vertical Z Response Spectra at ASB Corner of Fuel Building Roof at Shield Building (El. 179.19 ft, Node 11111)

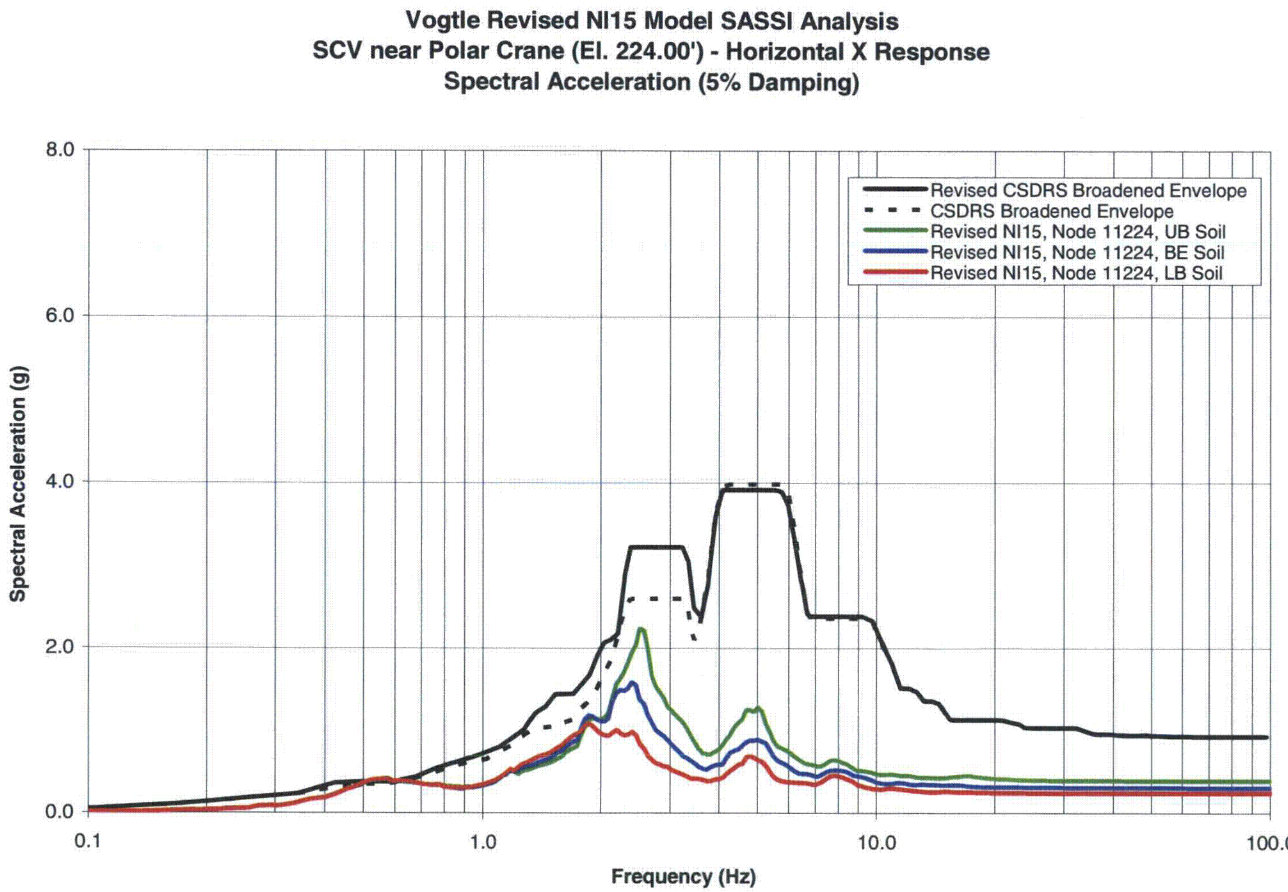

Figure 24. Horizontal X Response Spectra at SCV near Polar Crane (El. 224.00 ft, Node 11224)

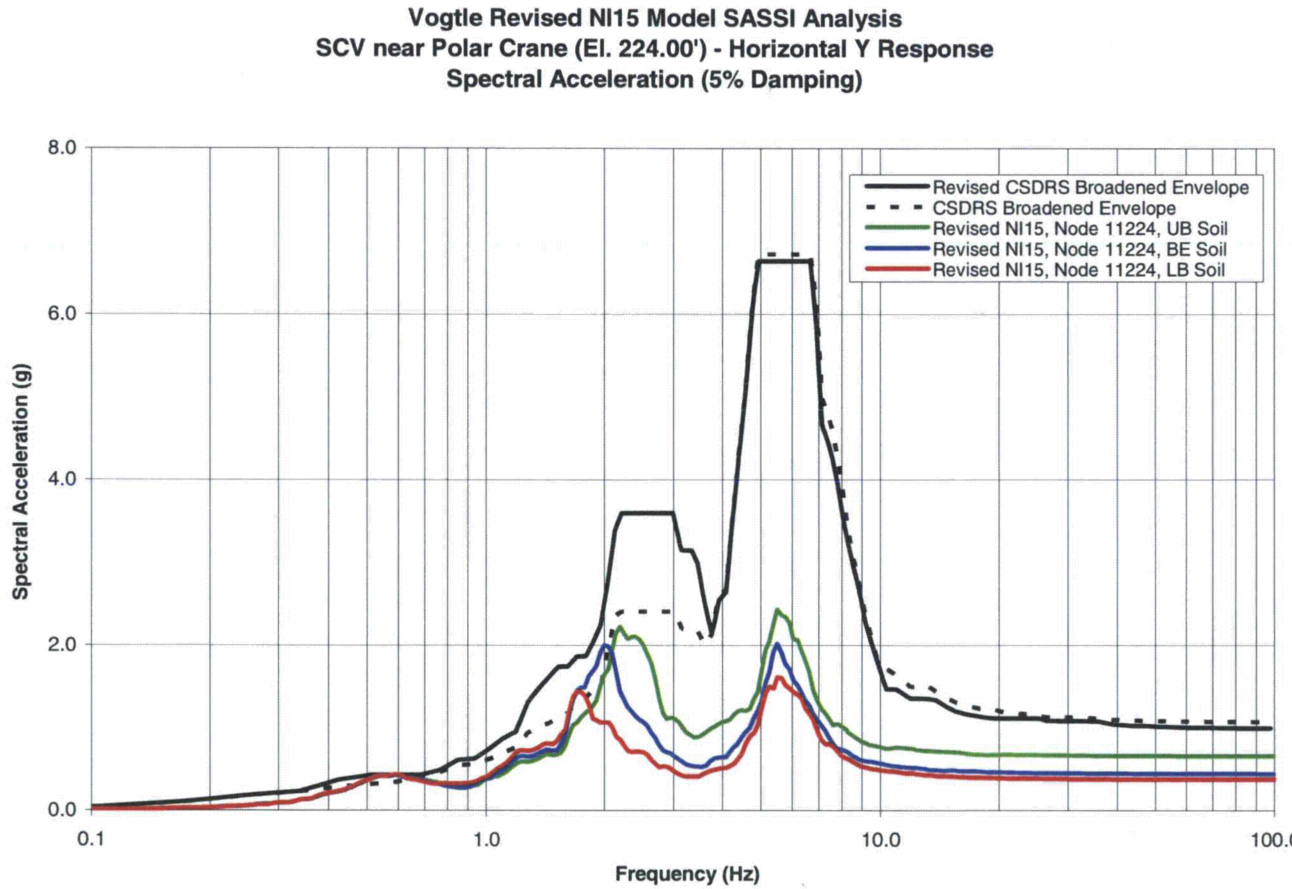

Figure 25. Horizontal Y Response Spectra at SCV near Polar Crane (El. 224.00 ft, Node 11224)

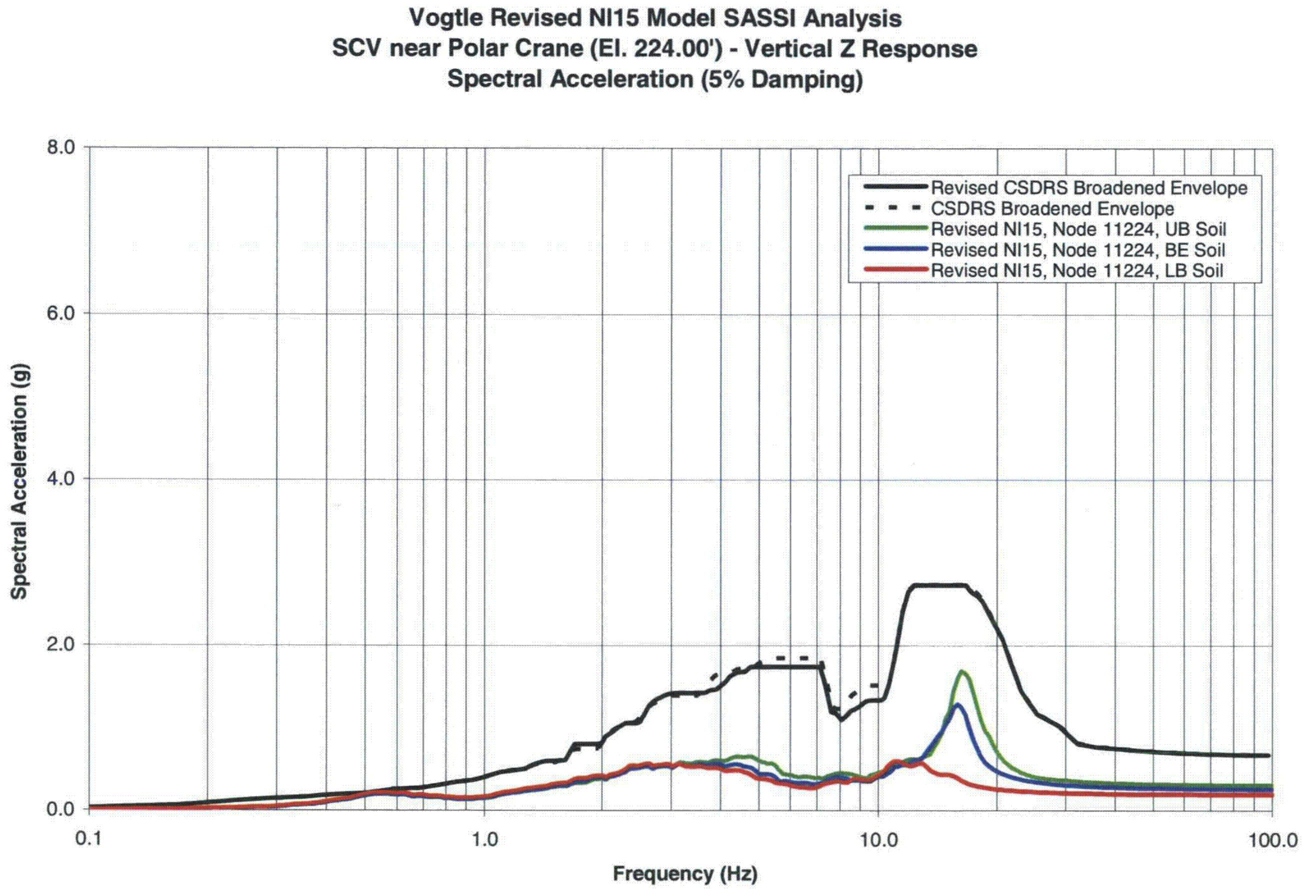

Figure 26. Vertical Z Response Spectra at SCV near Polar Crane (El. 224.00 ft, Node 11224)

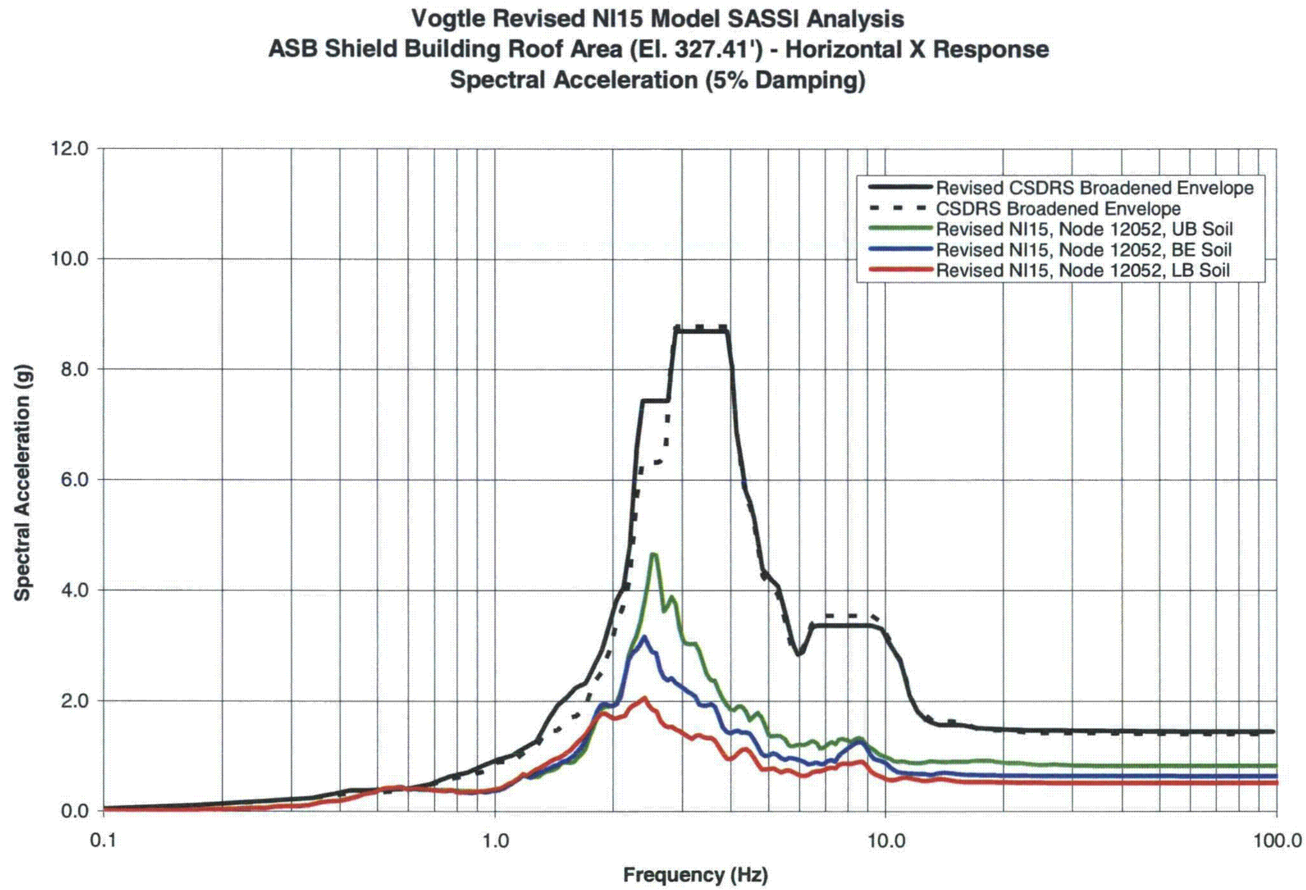

Figure 27. Horizontal X Response Spectra at ASB Shield Building Roof Area (El. 327.41 ft, Node 12052)

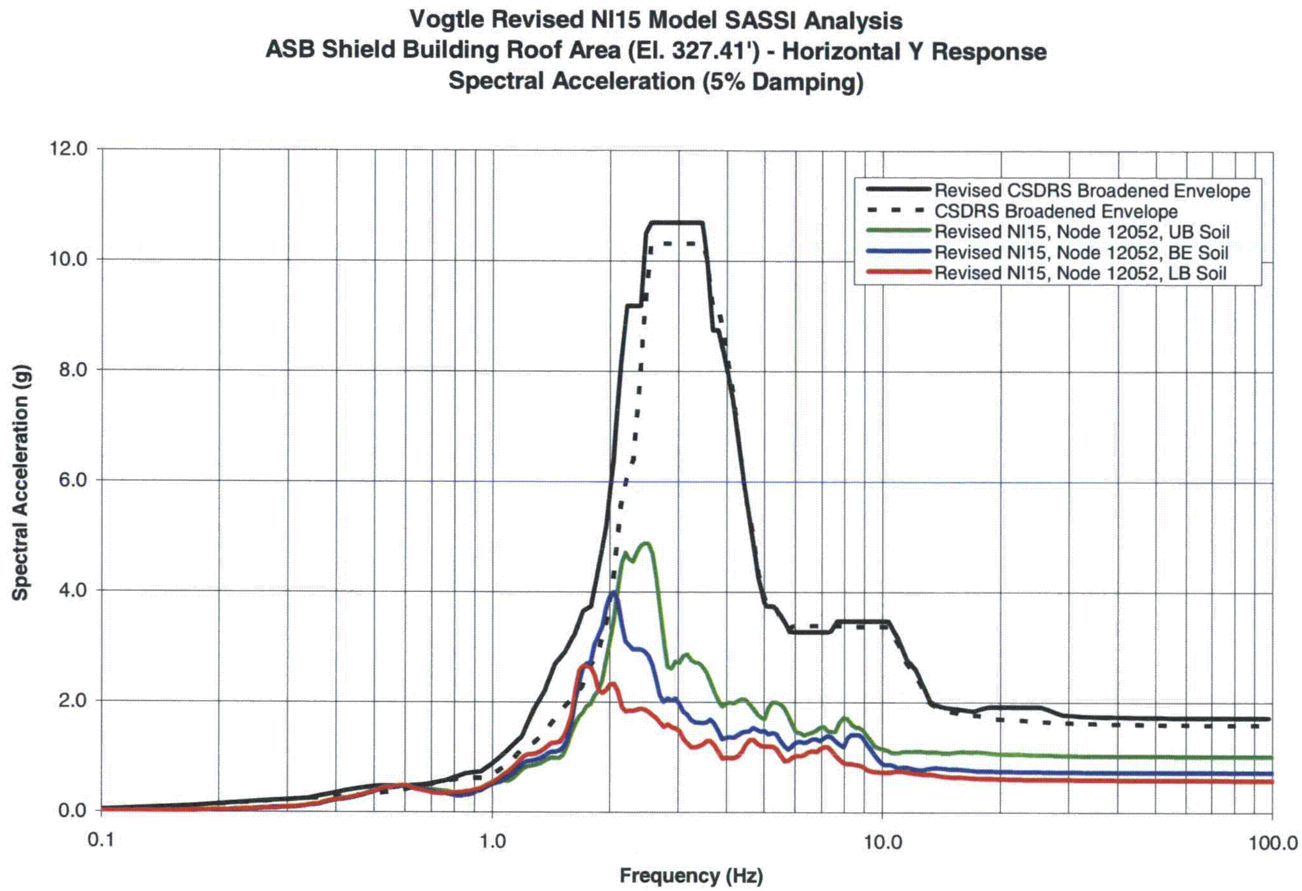

Figure 28. Horizontal Y Response Spectra at ASB Shield Building Roof Area (El. 327.41 ft, Node 12052)

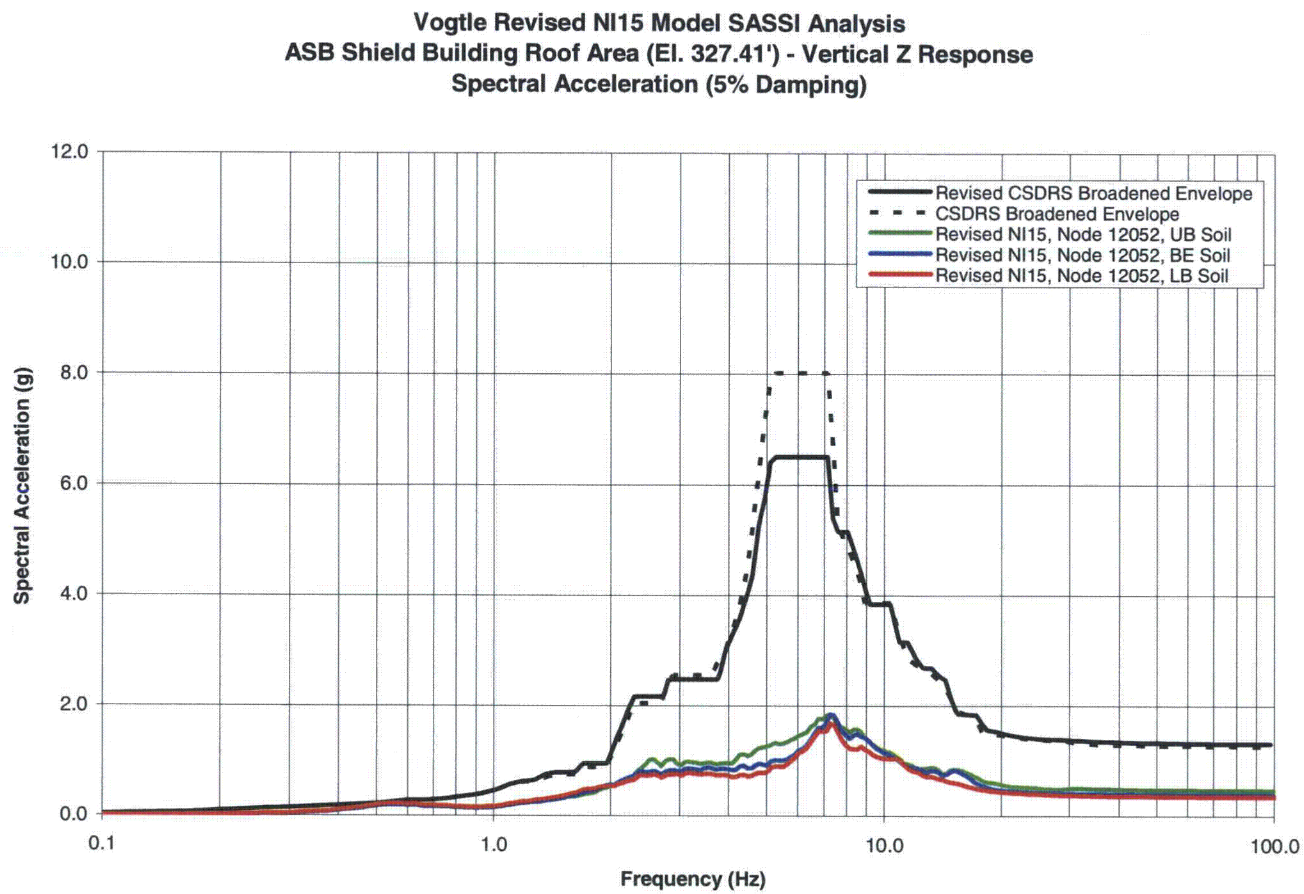

Figure 29. Vertical Z Response Spectra at ASB Shield Building Roof Area (El. 327.41 ft, Node 12052)