Southern Nuclear
Operating Company, Inc.
42 Inverness Center Parkway
Birmingham, Alabama 35242

MAY 24 2010

SOUTHERN COMPANY

Docket No.: 52-011

ND-10-0964

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, D. C. 20555-0001

Southern Nuclear Operating Company
Vogtle Electric Generating Plant Units 3 and 4
Site Safety Analysis Report License Amendment Request
Revise Backfill Geometry

Ladies and Gentlemen:

In accordance with the provisions of 10 CFR 50.90 and 10 CFR 50.92, Southern Nuclear Operating Company (SNC) proposes to amend the Vogtle Electric Generating Plant (VEGP) Units 3 and 4 Site Safety Analysis Report (SSAR). This amendment changes the classification of backfill over the slopes of Units 3 and 4 excavations from Category 1 and 2 backfill to engineered granular backfill (EGB). The affected volume of backfill includes all side slopes of the excavation area as defined in the ESP and is outside the static foundation analysis zone of influence for the Nuclear Island and associated power block structures. As described in this amendment, seismic sensitivity studies provide assurance that the site specific seismic analyses described in the ESP SSAR remain valid. In addition, the liquefaction and accidental liquid release analyses are not affected.

Enclosure 1 provides a basis for the proposed changes. Enclosure 2 provides a proposed revision to SSAR Sections 2.5.4.5 and 2.5.2.9.

The proposed change to SSAR Sections 2.5.4.5 and 2.5.2.9 are provided for your review and approval. Upon approval, these changes will be incorporated into the appropriate SSAR revision. Because approval of the proposed amendment will conserve limited onsite Category 1 and 2 backfill material resources, reduce the need for offsite source, and reduce the potential for additional environmental impacts and schedule delays associated with expanding borrow areas, approval of the proposed amendment is requested on an expedited basis, but no later than July 9, 2010. Once approved, the amendment shall be implemented within 15 days.

The contents of this letter contain no NRC commitments. The SNC licensing contacts for this amendment request are C. R. Pierce at 205-992-7872 or B. W. Waites at 205-992-7024.

D078
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 24th *day of* May, *2010*

Notary Public: Charlotte A. Graham

My commission expires: 6/9/12

CRP/CHM/dmw

Enclosures:
1. Basis for Proposed Changes
2. SSAR Markup

cc: <u>Southern Nuclear Operating Company</u>
Mr. J. H. Miller, III, President and CEO (w/o enclosures)
Mr. J. A. Miller, Executive Vice President, Nuclear Development (w/o enclosures)
Mr. J. T. Gasser, Executive Vice President, Nuclear Operations (w/o enclosures)
Mr. B. L. Ivey, Vice President, Nuclear Development Support (w/o enclosures)
Mr. D. H. Jones, Site Vice President, Vogtle 3 & 4 (w/o enclosures)
Mr. T. E. Tynan, Vice President - Vogtle (w/o enclosures)
Mr. D. M. Lloyd, Vogtle 3 & 4 Project Support Director
Mr. M. K. Smith, Technical Support Director
Mr. M. J. Ajluni, Nuclear Licensing Manager
Mr. J. D. Williams, Vogtle 3 & 4 Site Support Manager
Mr. J. T. Davis, Vogtle 3 & 4 Site Licensing Manager
Mr. T.C. Moorer, Manager – Environmental Affairs, Chemistry and Radiological Services
Mr. B.W. Waites, Construction Licensing Project Engineer
Document Services RTYPE: AR01.1053
File AR.01.02.06

<u>Nuclear Regulatory Commission</u>
Mr. L. A. Reyes, Region II Administrator
Mr. F.M. Akstulewicz, Deputy Director Div. of Safety Systems & Risk Assess. (w/o encl)
Mr. R. G. Joshi, Lead Project Manager of New Reactors
Ms. T. E. Simms, Project Manager of New Reactors
Mr. B. C. Anderson, Project Manager of New Reactors
Mr. M. M. Comar, Project Manager of New Reactors
Ms. S. Goetz, Project Manager of New Reactors
Mr. J. M. Sebrosky, Project Manager of New Reactors
Mr. D. C. Habib, Project Manager of New Reactors
Ms. D. L. McGovern, Project Manager of New Reactors
Ms. T. L. Spicher, Project Manager of New Reactors
Ms. M. A. Sutton, Environmental Project Manager
Mr. M. D. Notich, Environmental Project Manager
Mr. C. P. Patel, Project Manager of New Reactors
Mr. L. M. Cain, Senior Resident Inspector of VEGP 1 & 2
Mr. J. D. Fuller, Senior Resident Inspector of VEGP 3 & 4

<u>Georgia Department of Natural Resources - Commissioner's Office</u>
Mr. Chris Clark, Commissioner

<u>Georgia Power Company</u>
Mr. T. W. Yelverton, Nuclear Development Director
Ms. A. N. Faulk, Vogtle 3 & 4 Nuclear Regulatory Affairs Manager

<u>Oglethorpe Power Corporation</u>
Mr. M. W. Price, Executive Vice President and Chief Operating Officer
Mr. K. T. Haynes, Director of Contracts and Regulatory Oversight

<u>Municipal Electric Authority of Georgia</u>
Mr. S. M. Jackson, Vice President, Power Supply
Mr. J. E. Fuller, Senior Vice President, Chief Financial Officer

<u>Dalton Utilities</u>
Mr. D. Cope, President and Chief Executive Officer

<u>Bechtel Power Corporation</u>
Mr. J. S. Prebula, Project Engineer (w/o enclosures)
Mr. R. W. Prunty, Licensing Engineer

<u>Tetra Tech NUS, Inc.</u>
Ms. K. K. Patterson, Project Manager

<u>Shaw Stone & Webster, Inc.</u>
Mr. C. A. Fonseca, Vogtle Project Manger (w/o enclosures)
Mr. J. M. Oddo, Licensing Manager
Mr. D. C. Shutt, Licensing Engineer

<u>Westinghouse Electric Company, LLC</u>
Mr. S. D. Rupprecht, Vice President of Regulatory Affairs & Strategy (w/o enclosures)
Mr. N. C. Boyter, Consortium Project Director Vogtle Units 3 & 4 (w/o enclosures)
Mr. S. A. Bradley, Vogtle Project Licensing Manager
Mr. M. A. Melton, Manager, Regulatory Interfaces
Mr. R. B. Sisk, Manager, AP1000 Licensing and Customer Interface
Mr. D. A. Lindgren, Principal Engineer, AP1000 Licensing and Customer Interface

<u>NuStart Energy</u>
Mr. R. J. Grumbir
Mr. E. R. Grant
Mr. P. S, Hastings
Mr. B. Hirmanpour
Mr. N. Haggerty
Ms. K. N. Slays

<u>Other NuStart Energy Associates</u>
Ms. M. C. Kray, NuStart
Mr. S. P. Frantz, Morgan Lewis
Mr. J. A. Bailey, TVA
Ms. A. L. Sterdis, TVA
Mr. J. P. Berger, EDF
Mr. M. W. Gettler, FP&L
Mr. P. Hinnenkamp, Entergy
Mr. G. D. Miller, PG&N
Mr. N. T. Simms, Duke Energy
Mr. G. A. Zinke, NuStart & Entergy
Mr. R. H. Kitchen, PGN
Ms. A. M. Monroe, SCE&G
Mr. T. Beville, DOE/PM

Southern Nuclear Operating Company

ND-10-0964

Vogtle Electric Generating Plant Units 3 and 4
Site Safety Analysis Report License Amendment Request
Revised Backfill Geometry

Enclosure 1

Basis for Proposed Changes

Basis for Proposed Changes

Table of Contents

1.0 Summary Description

Pursuant to 10 CFR 50.90 and 10 CFR 50.92, Southern Nuclear Operating Company (SNC), hereby requests an amendment to Vogtle Electric Generating Plant (VEGP) Units 3 and 4 Site Safety Analysis Report (SSAR) Sections 2.5.4.5, "Excavations and Backfill", and 2.5.2.9, "Sensitivity Studies" (Enclosure 2). This amendment will allow the use of engineered granular backfill (EGB) compacted to a minimum of 95% modified Proctor (ASTM D1557) maximum dry density consisting of sands, silty sands, and clayey sands (SP, SP-SM, SP-SC, SW, SW-SM, SW-SC, SC, SC-SM, or SM) based on the Unified Soil Classification System (ASTM D2487) over the excavation side slopes. EGB placed over the excavation side slopes as defined in the ESP will have no impact on static foundation analysis, settlement analysis, site seismic response evaluations, SSI evaluations of the NI, liquefaction analysis, or the accidental liquid release analysis as evaluated in the SSAR.

2.0 Detailed Description

SSAR Section 2.5.4.5.1, "Extent of Excavations, Fills, and Slopes," describes the extent and geometry of the VEGP 3 and 4 excavations. Excavation includes removal of all the Upper Sand Stratum down to the Blue Bluff Marl (BBM) bearing stratum as shown on SSAR Figures 2.5.4-16, "Power Block Excavation Sections" and 2.5.4-15, "Power Block excavation and Switchyard Borrow Area." The foot print of the excavation is designed to provide a bearing surface for the Nuclear Island (NI) and other major Power Block structures. The sides of the excavation are sloped to no steeper than 2-horizontal to 1-vertical to assure adequate slope stability of the Upper Sands during excavation. The excavated material will be replaced with Seismic Category 1 and 2 backfill material to the grade elevation of approximately 220 ft. Category 1 and 2 backfill material will be placed laterally to at least a plane extending vertically from the edge of the slope of the excavation as shown on SSAR Figure 2.5.4-16. EGB will provide lateral confinement at the interface with the adjacent Category 1 and 2 backfill. This license amendment request allows the placement of EGB material over the slopes of the excavation. Category 1 and 2 backfill and EGB will be placed as depicted on revised SSAR Figures 2.5.4-16 and 2.5.4-17 (Enclosure 2).

SNC has reviewed the proposed amendment pursuant to 10 CFR 50.92 and determined that it does not involve a significant hazards consideration. In addition, there is no significant increase in the quantity or composition of effluents that may be released offsite, and there is no significant increase in individual or cumulative occupational radiation exposure. Using 10 CFR 51.21, Criteria for and identification of licensing and regulatory action requiring environmental assessments, the NRC will determine if an environmental assessment for the license amendment is required. The environmental considerations are summarized in Section 5.0 of this document. A copy of the proposed change has been sent to the Georgia State Designee, Mr. Chris Clark, in accordance with 10 CFR 50.91(b)(1).

3.0 Technical Evaluation

3.1 Proposed Change

This amendment request allows the use of EGB over the slopes of the excavation. SSAR Section 2.5.4.5.1 is revised to describe the use of EGB material over the slopes of the excavation. Figures 2.5.4-16 and 2.5.4-17 are revised to depict the location of use of EGB material over the slopes of the excavation.

Seismic sensitivity studies are described in SSAR Section 2.5.2.9, "Sensitivity Studies". This section is revised to add new SSAR section 2.5.2.9.4 "Study of Engineered Granular Backfill Placed over the Slopes of the Excavation," to describe additional sensitivity studies performed in support of this amendment. New Figures 2.5.2-66 – 76 are added to Section 2.5.2 to support the discussion provided in the new section.

3.2 Impact of Proposed Change

SSAR Section 2.5.2.9.2 describes sensitivity studies performed to show the effects of backfill geometry on the modeling assumption that backfill layers would be free-field soil layers in the modeling of the soil profile for both the soil response analyses for development of the Ground Motion Response Spectra (GMRS), Foundation Input Response Spectra (FIRS), and the site-specific seismic SSI (Soil Structure Interaction) analysis of the AP1000. To verify the validity of this assumption, a two-dimensional site response analysis followed by a two-dimensional SSI analysis of the AP1000 model were used to evaluate the effect of the extent of backfill on the site response and on the SSI response of the NI. The plant layout is shown in SSAR Figure 2.5.2-52. For the 2D analysis, the East-West cross section direction shown in SSAR Figure 2.5.2-53 was used. The analysis consists of two parts: site response (Part I) and SSI (Part II), both of which used 2D SASSI bathtub models where the backfill within the excavation was explicitly modeled.

In Part I, comparison of the 1D SHAKE results to the 2D SASSI bathtub model results confirmed that the 1D SHAKE analyses, where the backfill layers are treated as free-field soil layers, is adequate for the development of the ground motion given the geometry of the backfill at the site. In Part II, the 2D SASSI bathtub model was modified to include the NI. The response spectra were then compared to the standard 2D SASSI model where the backfill was assumed to extend infinitely in the lateral direction. The comparisons confirmed that the extent and geometry of the backfill has negligible effects on GMRS and FIRS and has small effects on the structural response (SSI) of the NI, which are well within the range of the margin of the design.

To evaluate the change in backfill geometry proposed in this amendment request, the effect of various backfill materials placed directly over the slopes was assessed with regards to the study of backfill geometry provided in SSAR Section 2.5.2.9.2. This was accomplished by comparing the original 2D SASSI bathtub model results of Section 2.5.2.9.2 to results of the same 2D SASSI bathtub models and inputs while varying the backfill properties, primarily stiffness, directly over the slopes of the excavation. Figure 2.5.2-54 and Figure 2.5.2-58 from Section 2.5.2.9.2 show the 2D SASSI bathtub models for site response and the site seismic SSI analysis, respectively. These same models were used for this study except the backfill properties over the slopes were varied. A range of material properties for backfill over the slopes was considered while maintaining the best estimate Early Site Permit (ESP) backfill properties (properties used in the 2.5.2.9.2 2D SASSI bathtub models) directly above the BBM. These comparisons of the 2D SASSI bathtub model results for different cases of backfill over the slopes were shown to be very similar to the 2D SASSI bathtub model results of Section 2.5.2.9.2. Therefore, backfill other than Category 1 and 2 backfill placed over the slopes would not invalidate the results and conclusions provided in Section 2.5.2.9.2.

As described in SSAR Section 2.5.4, the removal of the Upper Sands is required since this in-situ material is variable, contains dissolution features, is susceptible to liquefaction, and is not a competent bearing stratum. Directly below the approximately 90 ft of Upper Sands is the first competent in-situ stratum, the BBM. SSAR Figures 2.5.4-15 and 2.5.4-16 show the width and length of the exposed BBM surface which is approximately 347 ft by 812 ft, respectively, producing a bearing surface area of approximately 282,000 sq ft. This width and length is based on a zone of influence forming from the foundation of the power block structures extending down to the BBM at approximately 45 degrees. Directly above this bearing surface area of the BBM, Category 1 and 2 backfill is placed to provide:

- A uniform bearing subsurface for the foundations of the major power block structures.
- Adequate static and dynamic bearing capacities (SSAR Section 2.5.4.10.1),
- Acceptable settlement and minimum differential settlement (SSAR Section 2.5.4.10.2),
- No potential for liquefaction due to earthquake ground motion (SSAR Section 2.5.4.8).

Figures 2.5.4-15 and 2.5.4-16 show that the actual amount of excavation of the upper sands is significantly larger than required to simply expose the BBM surface to provide an adequate bearing subsurface for the power block structure foundations. This is due to construction safety reasons, which dictate excavation of a 2-horizontal to 1-vertical slope in the upper sands on the perimeter of the excavation. The slopes of the excavation are for construction purposes only, and not a foundation design requirement, and are not needed to assure the safety performance of the NI. Therefore, use of EGB in this area will have no effect on reported foundation bearing capacities, estimated settlements, differential settlements, or liquefaction.

While the EGB over the slopes does not support any safety related structures, this amendment does place requirements on the selection and compaction of this material. This amendment requires that the EGB consist of sands, silty sands, and clayey sands (SP, SP-SM, SP-SC, SW, SW-SM, SW-SC, SC, SC-SM, or SM) based on the Unified Soil Classification System (ASTM D2487) and be compacted to a minimum of 95% modified Proctor (ASTM D1557) maximum dry density. The purpose of these requirements is to provide a competent interface for the Category 1 and 2 backfill. The following paragraphs discuss the characteristics of the EGB material as they relate to providing a competent interface with Category 1 and 2 backfill.

The liquefaction potential of the Category 1 and 2 compacted backfill, which will be compacted to a minimum of 95% of ASTM D1557, was assessed in SSAR Section 2.5.4.8.3.3. The results of that assessment concluded that the Category 1 and 2 compacted backfill would have sufficient resistance (in terms of standard penetration test N-values and shear wave velocity) to preclude any liquefaction of the compacted backfill during a design basis earthquake.

The proposed EGB includes clayey and silty sands as well as clean sands (well-graded and poorly-graded). These materials are generally consistent with Category 1 and 2 backfill, except that they can contain a higher percentage of fines and contain plastic fines instead of silt fines. Given that the EGB will also be compacted to a minimum of 95% of ASTM D1557, and can contain plastic fines instead of silt fines, the liquefaction potential of the EGB is expected to be equal to or less than that of Category 1 and 2 backfill. Thus, it is concluded that EGB compacted to the same requirements as Category 1 and 2 backfill will not liquefy during a design basis earthquake.

There are no safety-related structures bearing on or in contact with the EGB. However, from a strength perspective, EGB compacted to a minimum of 95% of ASTM D1557 will have strength parameters similar to, but slightly less than, the strength parameters of compacted Category 1 and 2 backfill. Effective stress strength parameters of similarly compacted backfill, reported in

DM7 **(Naval Facility Engineering Command 1986)**, range from 31° for clayey sand (SC) to 38° for well-graded sand (SW), and would therefore result in a competent structural backfill.

ESP SSAR Sections 2.4.12 and 2.4.13 discuss the water table aquifer and the transport of a postulated accidental recycle holdup tank release through the groundwater to Mallard Pond and then the Savannah River (total travel time of 6+ years). The ESP SSAR analysis took no credit for any backfill over the slopes of the excavation. The ESP SSAR model is described in the following paragraphs.

The postulated accidental release of liquid from the auxiliary building is assumed to travel vertically downward (instantaneously) through the unchanged Category 1 and 2 backfill (approximately 25 ft) until it reaches the water table surface. The release then moves to the northwest (the groundwater flow direction) and then exits the backfill along the western side of the backfill. The release then follows the groundwater flow northerly through the native subsurface materials to Mallard Pond.

The 2-D groundwater flow model, upon which the calculated travel times for the releases are based, did not take credit for the sloped areas containing additional backfill. Instead, a more conservative assumption was made that the natural soils existed outside of the excavation. A hydraulic conductivity of 32 ft/day was applied to the first ~1,200 ft of travel distance through the Barnwell Sands. This hydraulic conductivity is within the medium to high range for clean sand. A hydraulic conductivity of 3.3 ft/day was applied to the Category 1 and 2 backfill and is within the lower range for clean sand.

The use of compacted EGB for the side slopes would correspond to a small area at the edge of the excavation which is represented in the groundwater model as Barnwell Sand. The accidental release would travel through the inverted wedge of EGB for an average distance that is proportional to the depth of the water table at the edge of the backfill (about 20 ft to 25 ft).

The proposed EGB may have a wide range of properties and composition. However, due to the compaction requirements (minimum of 95% of ASTM D1557) the hydraulic conductivity of the EGB is expected to be equal to or less than the Barnwell Sands and result in no reduction of the 3.2 year travel time through the Barnwell Sands.

3.3 Discussion of Technical Evaluation

Based on the technical evaluation provided in the new SSAR Section 2.5.2.9.4 that demonstrates that the results and conclusions in the VEGP ESP SSAR Section 2.5.2.9.2 remain valid, variations in the backfill material placed over the slopes of the excavation would not affect the VEGP site response analysis used to define the VEGP GMRS and FIRS or the VEGP SASSI SSI seismic analyses of the Nuclear Island (NI). Therefore, reclassifying backfill over the slopes of the excavation would not invalidate the VEGP site-specific seismic analyses, including the site response for the GMRS and the VEGP site-specific SSI seismic analyses of the NI.

The slopes of the excavation are for construction purposes only, and not a foundation design requirement, and therefore, are not needed to assure the safety performance of the NI. Therefore, reclassification of the backfill in this area will have no effect on reported foundation bearing capacities, estimated total or differential settlements, or liquefaction potential.

While the EGB over the slopes does not support any safety related structures, this amendment does place requirements on the selection and compaction of this material to provide a reasonable assurance of competent interface with the Category 1 and 2 backfill. The following discusses the characteristics of the EGB material as they relate to providing a competent interface with Category 1 and 2 backfill. The EGB will be compacted to a minimum of 95% of ASTM D1557, it will have strength parameters similar to, but slightly less than, the strength parameters of compacted Category 1 and 2 backfill. Effective stress strength parameters of similarly compacted backfill, reported in DM7 **(Naval Facility Engineering Command 1986),** range from 31° for clayey sand (SC) to 38° for well-graded sand (SW), and would therefore result in a competent structural backfill. Also, since the EGB will be compacted to a minimum of 95% of ASTM D1557and can contain a higher percentage of fines and plastic fines instead of silt fines, it is concluded that the EGB would have no potential for liquefaction during the design basis earthquake, and would therefore maintain lateral confinement for the Category 1 and 2 backfill.

Because EGB is expected to have a hydraulic conductivity that is equal to or lower than the hydraulic conductivity assumed for Barnwell Sands in the hydrologic analysis described in SSAR Section 2.4.13, it is concluded the 3.2 year travel time through the Barnwell Sands is not reduced, and the accidental liquid release analysis is not affected.

4.0 Regulatory Evaluation

Results of the Technical evaluation demonstrate that previously submitted information for backfill material will not be affected by use of EGB over the slopes of the excavation. All results continue to meet the acceptance criteria as described in the SSAR for safe construction. To ensure regulatory compliance, the following evaluations were performed.

4.1 No Significant Hazards Consideration

The impacts of the proposed Site Safety Analysis Report (SSAR) change from Category 1 and 2 backfill to engineered granular backfill (EGB), over sloped areas of the excavation were evaluated to determine whether or not a significant hazards consideration is involved by focusing on the three standards set forth in 10 CFR 50.92(c) as discussed below:

1. Does the proposed amendment involve a significant increase in the probability or consequences of an accident previously evaluated?

   Response: No.

   The technical evaluation provided in the new SSAR section 2.5.2.9.4, "Study of Engineered Granular Backfill Placed over the Slopes of the Excavation", demonstrates that the results and conclusions in the Vogtle Electric Generating Plant (VEGP) ESP SSAR 2.5.2.9.2, "Study of the Effects of Backfill Geometry," remain valid; backfill material placed over the slopes of the excavation does not affect the VEGP site response analysis used to define the VEGP Ground Motion Response Spectra (GMRS) and Foundation Input Response Spectra (FIRS) or the VEGP SASSI SSI seismic analyses of the Nuclear Island (NI). Reclassifying backfill over the slopes of the excavation does not invalidate the VEGP site-specific seismic analyses. The placement of EGB is outside the zone of influence. Use of EGB will have no effect on reported foundation bearing capacities, estimated total or differential settlements, or liquefaction potential. Because the hydraulic conductivity of EGB material is conservative relative to the values used in the hydrological analysis, the hydrological analysis will be unaffected. As such, the use of EGB material over the slopes of the excavation does not affect the accidental radiation release to groundwater evaluated in the SSAR. Therefore, the proposed SSAR change does not significantly increase the probability or consequences of an accident previously evaluated.

2. Does the proposed amendment create the possibility of a new or different kind of accident from any accident previously evaluated?

   Response: No

   The sensitivity analyses described in this amendment provide a basis for concluding that the ESP SSAR seismic analyses are not sensitive to the properties of the material over the slopes of the excavation. Also, the material over the side slopes of the excavation is outside the static zone of influence of the AP1000 power block structures, and thus cannot impact the safety performance of any safety related structure. Consequently, no new accident scenarios, failure mechanisms or limiting single failures are introduced as a result of the proposed changes. The changes have no adverse effects on any safety-related system and do not challenge the performance or integrity of any safety-related system. Therefore, all accident analyses criteria continue to be met and these changes do not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. Does the proposed amendment involve a significant reduction in a margin of safety?

   Response: No.

   The technical evaluation provided in the new SSAR section 2.5.2.9.4, "Study of Engineered Granular Backfill Placed over the Slopes of the Excavation," demonstrates that the results and conclusions in the VEGP ESP SSAR 2.5.2.9.2, "Study of the Effects of Backfill Geometry", remain valid, backfill material placed over the slopes of the excavation does not affect the VEGP site response analysis used to define the VEGP GMRS and FIRS or the VEGP SASSI SSI seismic analyses of the Nuclear Island (NI). Reclassifying backfill over the slopes of the excavation does not invalidate the VEGP site-specific seismic analyses. In addition, the design function of Category 1 and 2 backfill related to bearing capacity, settlement, and liquefaction is unaffected. The evaluations and analysis results demonstrate applicable acceptance criteria are met. Therefore, the proposed changes do not involve a reduction in a margin of safety.

Based on the above, SNC concludes that the proposed change presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of "no significant hazards consideration" is justified.

4.2 Applicable Regulatory Requirements/Criteria

The regulatory bases and guidance documents associated with the change discussed in this amendment application include the following:

10 CFR 100.20(c) requires the Commission to consider the physical characteristics of the site, including seismology, meteorology, geology, and hydrology when determining the acceptability of the site.

10 CFR 100.23 establishes the principal geologic and seismic considerations that guide the Commission in its evaluation of the suitability of a proposed site and adequacy of the design bases established in consideration of the geologic and seismic characteristics of the proposed site.

GDC-1 requires that a quality assurance program be established and implemented to ensure structures, systems, and components important to safety shall be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed.

GDC-2 requires that structures, systems, and components important to safety be designed for protection against natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions.

Regulatory Guide 1.29 discusses an acceptable method of satisfying GDC-2 regarding the design bases for protection to withstand the effects of earthquakes without loss of capability to perform safety functions.

There will be no changes to the backfill design or characteristics approved in the ESP such that compliance with any of the regulatory requirements and guidance documents above would come into question. Therefore, the site will continue to comply with all applicable regulatory requirements.

4.3 Conclusions

SNC proposes this amendment to obtain NRC permission to use EGB material over the slopes of the excavation. The proposed amendment has a minimal effect on the site seismic and hydrological analyses and does not affect the site static stability analysis or liquefaction analysis described in the SSAR.

5.0 Environmental Considerations

The SNC environmental staff has evaluated the proposed amendment and has determined no adverse impacts will result from the utilization of engineered backfill along the side slopes of the excavation in lieu of Category 1 and 2 as originally proposed in the SSAR. This reclassification of backfill material is essentially an administrative exercise and will not alter the conclusions stated in the ESP Final Environmental Impact Statement (FEIS) or result in any New and Significant information related to the COL. This activity has no net impact on the quantity or placement of backfill required for the project.

6.0 References

(Naval Facility Engineering Command 1986) Design Manual 7.02, Foundations and Earth Structures, Table 1, Naval Facility Engineering Command, Alexandria, Virginia, September 1986

Southern Nuclear Operating Company

ND-10-0964

Vogtle Electric Generating Plant Units 3 and 4
Site Safety Analysis Report License Amendment Request
Revised Backfill Geometry

Enclosure 2

SSAR Markup

2.5.2.9.4 Study of Engineered Granular Backfill Placed Over the Slopes of the Excavation

Backfill within the defined excavation permits using an engineered granular backfill (EGB) material over the slopes of the excavation as shown in Figure 2.5.4-16. This is an alternate backfill geometry to that considered in Section 2.5.2.9.2. This section discusses the significance of backfill material, other than Category 1 and 2, placed over the slopes and demonstrates that the results and conclusions provided in 2.5.2.9.2 remain valid.

As described in 2.5.4 the removal of the Upper Sands is required since this in-situ material is variable, contains dissolution features, is susceptible to liquefaction, and is not a competent bearing stratum. Directly below the approximately 90 feet of Upper Sands is the first competent in-situ stratum called the Blue Bluff marl (BBM). Figures 2.5.4-15 and 2.5.4-16 show the defined width and length of the exposed BBM surface for each excavation, which is approximately 347 ft by 812 ft, respectively producing a bearing surface area of approximately 282,000 sq ft per unit. This width and length is based on a zone of influence forming from the bottom of the foundations of the power block structures extending down to the BBM at approximately 45 degrees. Directly above this bearing surface area of the BBM, Category 1 and 2 backfill is placed to provide:

- A uniform bearing subsurface for the foundations of the major power block structures.
- Adequate static and dynamic bearing capacities (2.5.4.10.1).
- Acceptable total settlement and minimum differential settlement (2.5.4.10.2).
- No potential for liquefaction due to earthquake ground motion (2.5.4.8).

Figures 2.5.4-15 and 2.5.4-16 show that the actual amount of excavation of the upper sands is significantly larger than required to simply expose the BBM surface to provide an adequate bearing surface for the power block structure foundations. This is due to the need for a safe excavation of the upper sands, which dictate 2-horizontal to 1-vertical slopes. The slopes of the excavation are for construction purposes only and not a foundation design requirement nor needed to assure the safety performance of the Nuclear Island (NI).

For analytical purposes it was assumed the lateral extent of backfill can be considered infinite for site response and seismic SSI analyses. To demonstrate the reasonableness of this assumption a sensitivity study of the backfill geometry is provided in Section 2.5.2.9.2. In this sensitivity analyses, 2D SASSI bathtub models are used to represent the ESP defined excavation cross section including the slopes. The Best Estimate ESP Category 1 and 2 backfill properties were used for this sensitivity study.

Since Category 1 and 2 backfill over the defined slopes is not a foundation design requirement, this section evaluates the importance of backfill placed directly over the slopes with regard to the study of backfill geometry provided in 2.5.2.9.2. This is accomplished by comparing the 2D SASSI bathtub model results of 2.5.2.9.2 to results of the same 2D SASSI bathtub models and inputs while varying the backfill properties, primarily stiffness, directly over the slopes of the excavation. Figure 2.5.2-54 and Figure 2.5.2-58 from 2.5.2.9.2 shows the 2D SASSI bathtub models for site response (Part I) and the site seismic SSI analysis (Part II) respectively. These same models are used for this study herein except the backfill properties over the slopes are varied. A range of material properties for backfill over the slopes was considered while maintaining the Best Estimate ESP backfill properties directly above the BBM. A comparison that shows no significant differences between the 2D SASSI bathtub model results for different cases of backfill over the slopes with the 2D SASSI bathtub model results of section 2.5.2.9.2 will demonstrate that the results and conclusions in 2.5.2.9.2 are still valid and therefore will support the use of backfill other than Category 1 and 2 backfill over the slopes.

For this evaluation three cases are considered for material other than Category 1 and 2 backfill placed over the excavation slopes:

Case 1 is a hypothetical case of no excavation slopes (a vertical cut) with the full depth of the Upper Sands brought up to the bottom toe of the exposed BBM. This is considered an extreme contrast to the Best Estimate Category 1 and 2 backfill modeled above the BBM and would represent the most limiting lateral extent of the backfill possible.

Case 2 is a hypothetical lower bound of well-compacted engineered granular backfill. It is considered an extreme lower bound for engineered backfill, with shear wave velocities less than 1000 fps at the NI foundation elevation.

Case 3 is a hypothetical upper bound of well-compacted engineered granular backfill. It is considered an extreme upper bound for engineered granular backfill, with shear wave velocities well over 1000 fps at the NI foundation elevation.

The well-compacted engineered granular backfill would have a similar parabolic shear wave velocity profile as the ESP Category 1 and 2 backfill, but with possibly a larger potential range of values.

The three cases provide a significant range of shear wave velocity over the slopes, which create various contrasting boundaries to the adjacent best estimate ESP backfill shear wave velocity modeled directly above the BBM. Therefore, the comparison of the 2D SASSI bathtub model results for these different cases of material over the slopes to the 2D SASSI bathtub model results of 2.5.2.9.2 is sufficient to demonstrate that engineered backfill other than Category 1 and 2 backfill placed over the slopes would not invalidate the results and conclusions provided in 2.5.2.9.2.

Figure 2.5.2-66 is a plot of the Lower Bound (LB), Best Estimate (BE), and Upper Bound (UB) low strain profiles for the ESP Category 1 and 2 backfill, Case 1, Case 2, and Case 3. This figure demonstrates the breadth of the variation of the shear wave velocity profiles considered for backfill material over the slopes of the excavation in order to assess the significance of material placed over the slopes on the results and conclusions provided in 2.5.2.9.2. Figure 2.5.2-67 is a comparison of the strain compatible BE shear wave velocity profiles for ESP Category 1 and 2 backfill used in the sensitivity analysis of 2.5.2.9.2 (identified as Base Case in the figure) along with Cases 1, 2, and 3 used in the 2D SASSI SSI bathtub models.

Part I of 2.5.2.9.2 provides the sensitivity study for seismic site response. The same 2D SASSI bathtub model shown in Figure 2.5.2-54 was used, except the material over the slopes was changed. Three cases described above were considered, the results of Cases 1, 2, and 3 are compared to the 2D SASSI bathtub results of 2.5.2.9.2 identified as "SASSI-BF-IS." The results in the form of spectral amplification factors versus frequency are shown in Figures 2.5.2-68, 2.5.2-69, and 2.5.2-70 at three horizons: at a depth of 0 ft (GMRS Horizon), at 40 ft depth (FIRS horizon), and at 86 ft depth (top of Blue Bluff Marl) respectively. As shown in these figures the differences are very small confirming that backfill with shear wave velocities lower and higher than Category 1 and 2 backfill can be placed over the slopes without invalidating the results and conclusions provided in 2.5.2.9.2.

Part II of 2.5.2.9.2 provides the sensitivity study for site seismic SSI analyses. The same 2D SASSI SSI bathtub model shown in Figure 2.5.2-58 was used here except the material over the slopes was changed Three cases described above were considered, the results of cases 1, 2, and 3 are compared to the 2D SASSI SSI bathtub results of 2.5.2.9.2. These results are the horizontal in-structure response spectra at the six key locations in the NI and are shown on Figures 2.5.2-71 through 2.5.2-76. The 2D SASSI SSI bathtub results of 2.5.2.9.2 with the Best Estimate Category 1 and 2 backfill properties used throughout the excavation are identified as "Bathtub Model-d5." The generic AP1000 standard 2D design response spectra are plotted for comparison purposes as was done in 2.5.2.9.2. As shown in these figures the differences are very small confirming that backfill with shear wave velocities lower and higher than Category 1 and 2 backfill can be placed over the slopes without invalidating the results and conclusions provided in 2.5.2.9.2.

In summary, the seismic models for VEGP 3 and 4 are based on an assumption of infinite lateral extent of backfill. The sensitivity study described in Section 2.5.2.9.2 demonstrated that the ESP-defined lateral extent of the excavation is adequate to support the infinite backfill assumptions of the seismic models. The results from the sensitivity studies described above show that this conclusion remains valid when the Category 1 and 2 backfill over the slopes is replaced with backfill with conservatively low shear wave velocities, backfill with conservatively higher shear wave velocities, and no backfill at all (in situ material). Thus it can be concluded that an engineered fill other than Category 1 and 2 backfill can be used over the slopes of the excavation without invalidating the results and conclusions of Section 2.5.2.9.2.

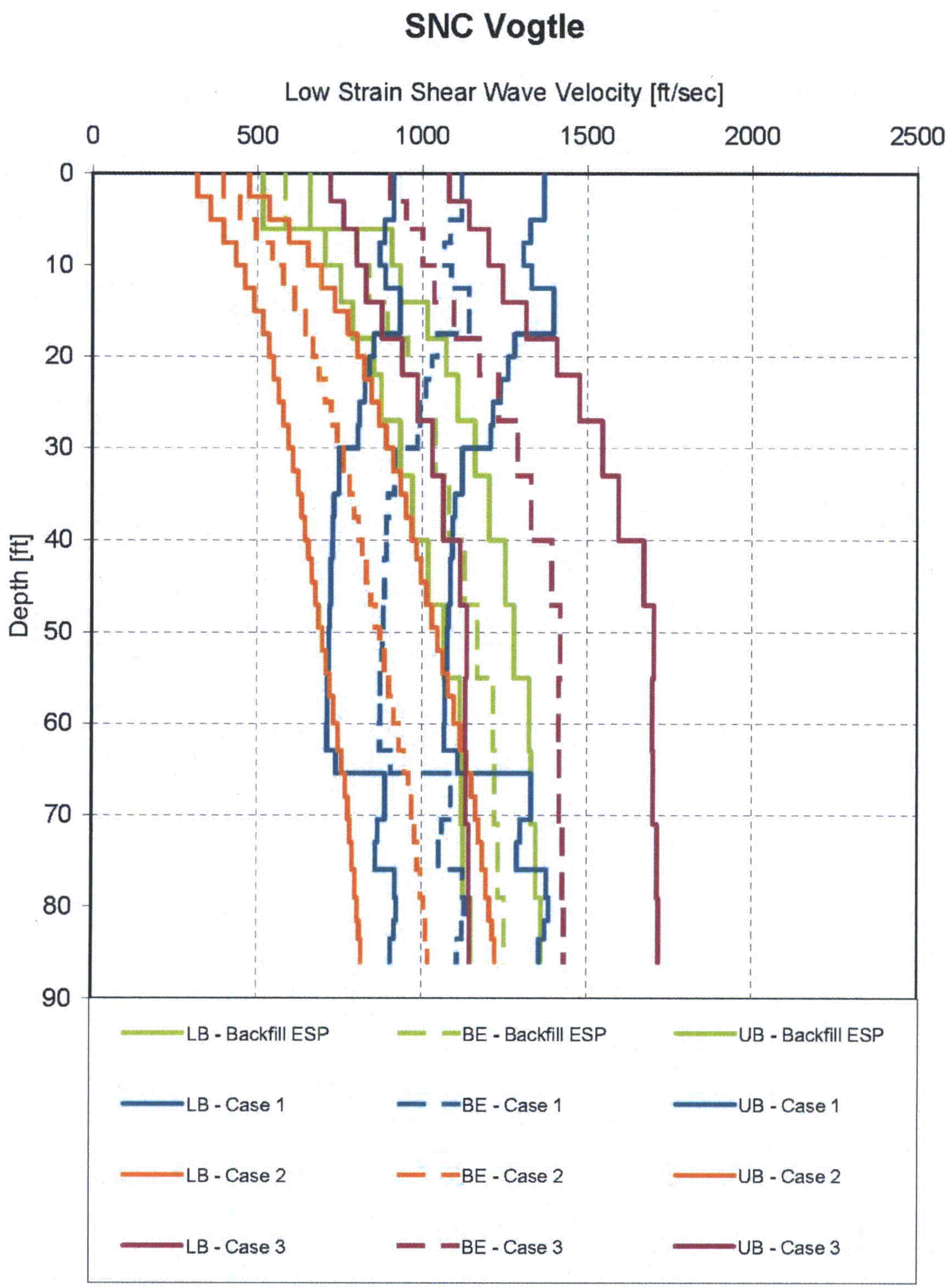


Figure 2.5.2-66 Low Strain Shear Wave Velocity Profile Cases (LB, BE, UB) - Study for Material Over Excavation Slopes

SNC Vogtle

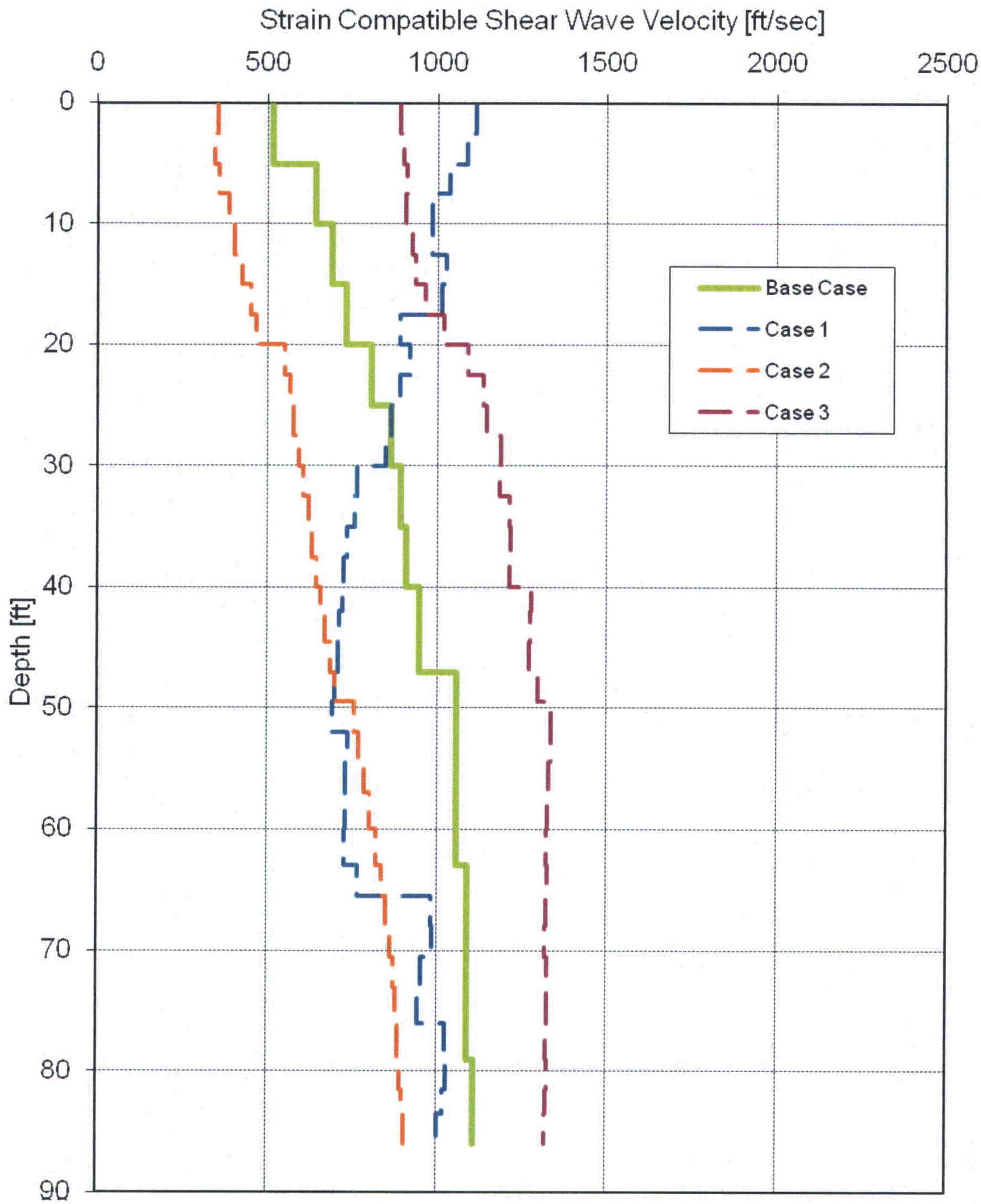


Figure 2.5.2-67 Strain Compatible BE Shear Wave Velocity Profiles Cases-for Material Over Excavation Slopes (2D SASSI SSI Bathtub Analyses)

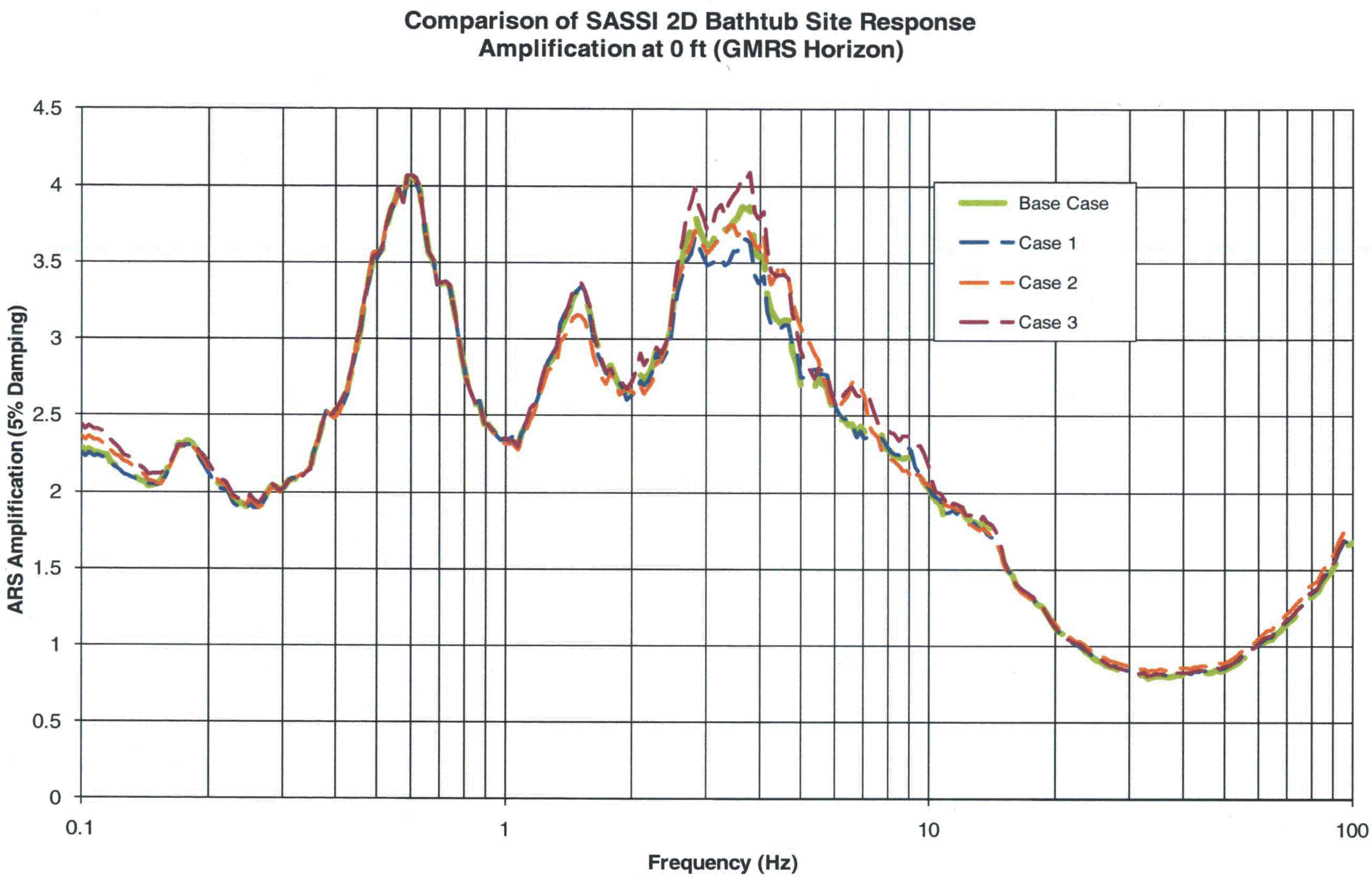


Figure 2.5.2-68 Comparison of SASSI 2D Bathtub Model Site Response: Amplification at 0 ft (GMRS horizon)

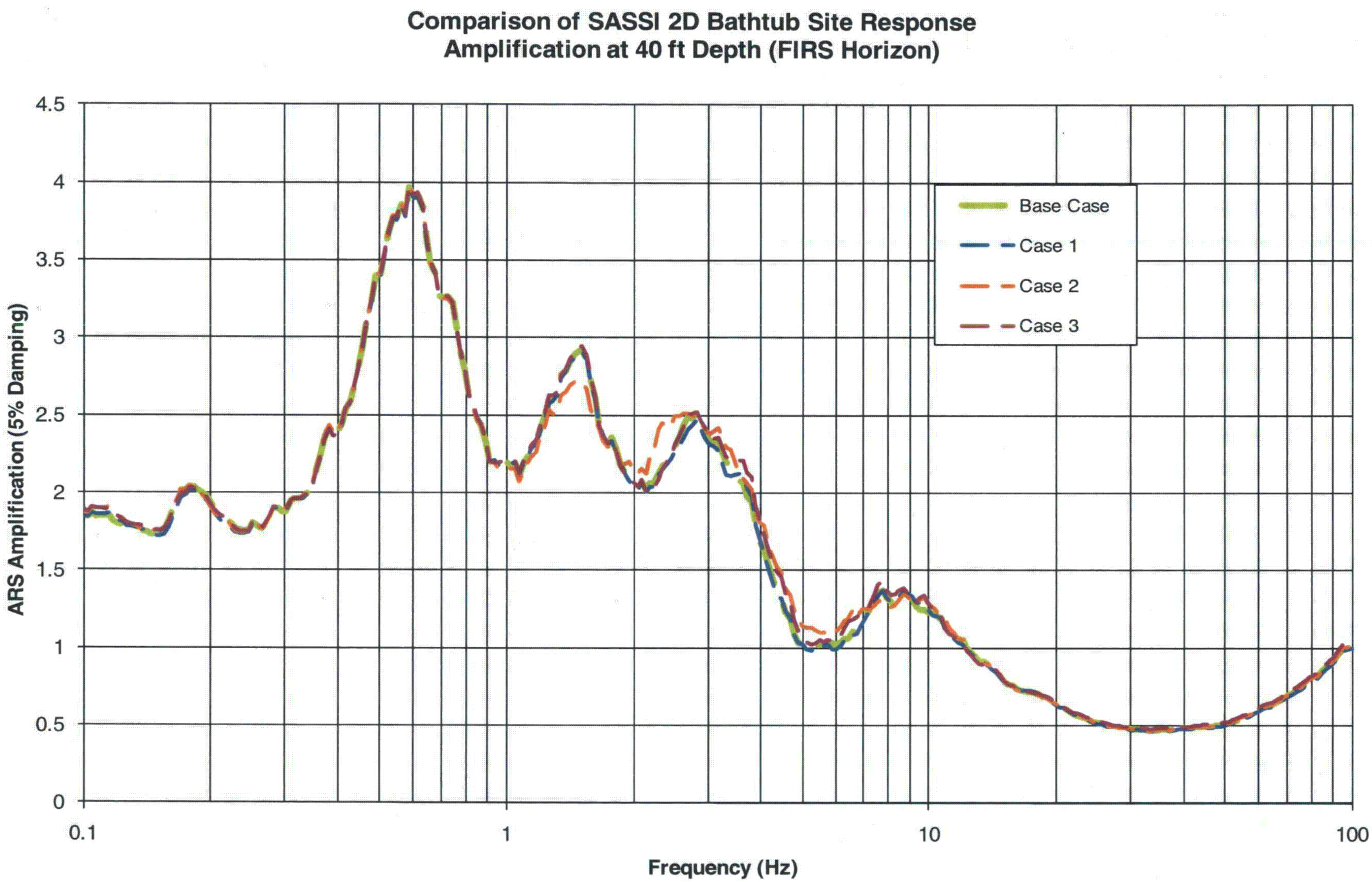


Figure 2.5.2-69 Comparison of SASSI 2D Bathtub Model Site Response: Amplification at 40 ft depth (FIRS horizon)

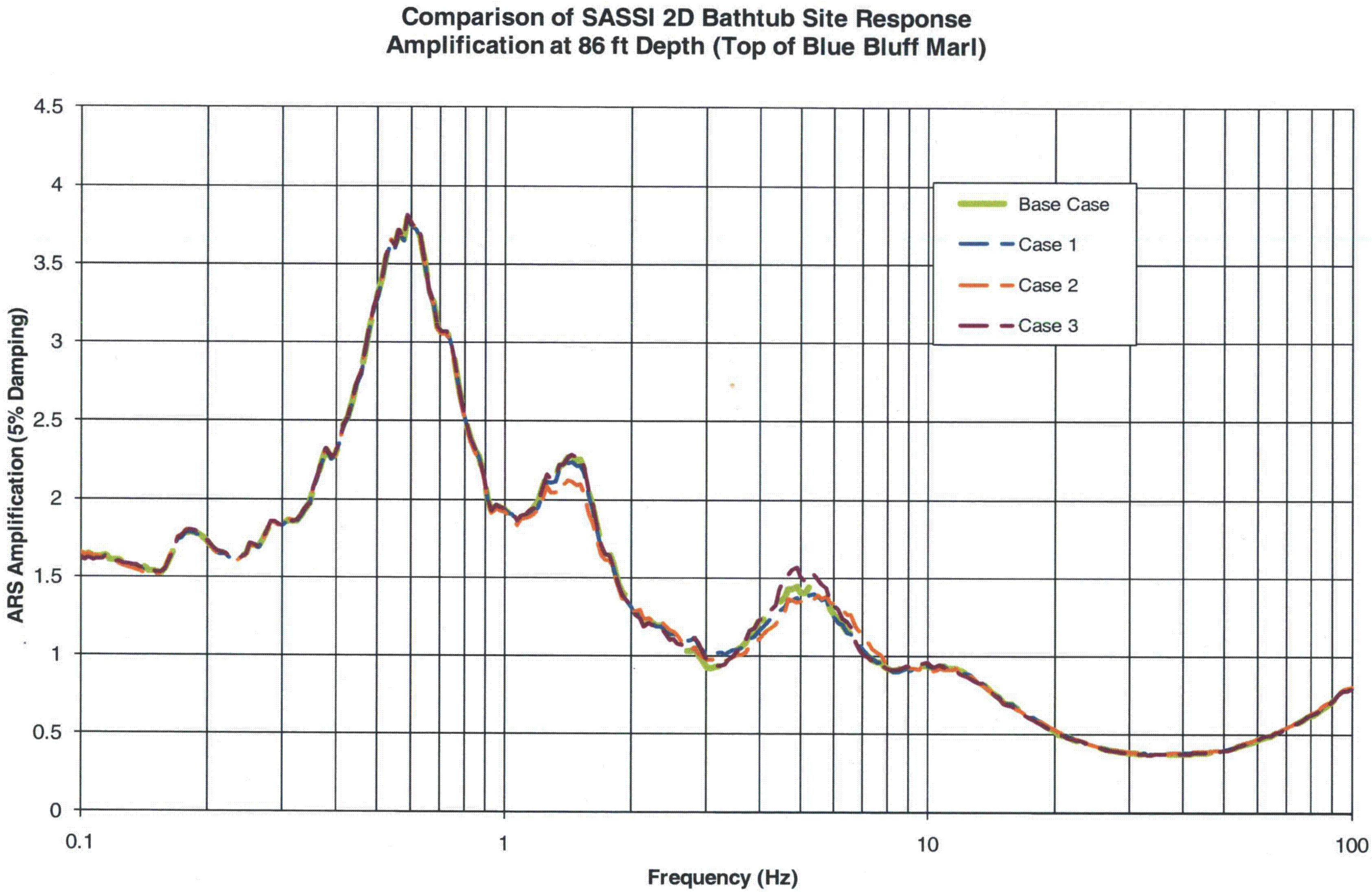


Figure 2.5.2-70 Comparison of SASSI 2D Bathtub Model Site Response: Amplification at 86 ft depth (Top of Blue Bluff Marl)

SSAR Markup

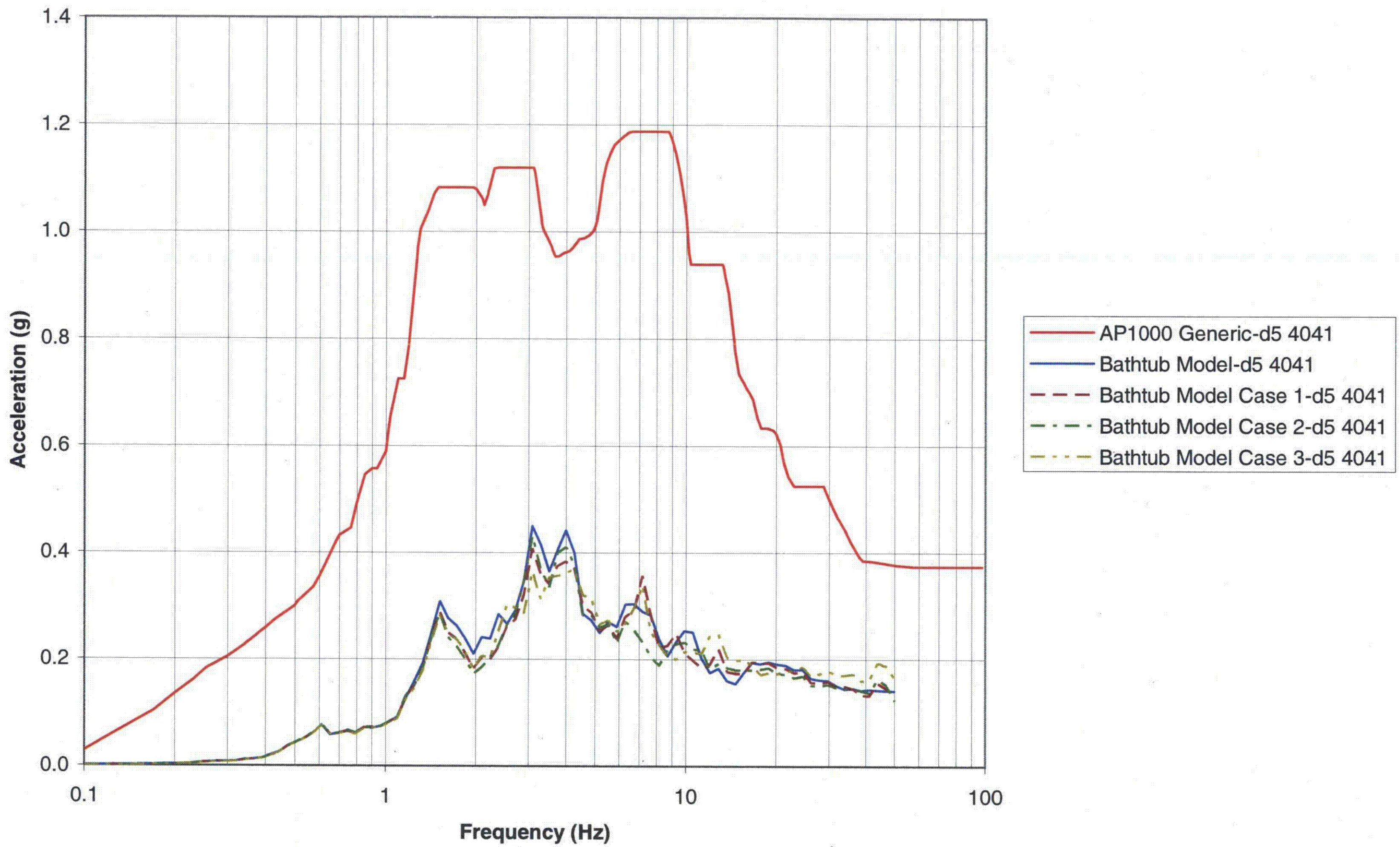


Figure 2.5.2-71 Comparison of SASSI 2D Bathtub NI Model SSI Responses: Node 4041-EL 99 NI at Reactor Vessel Support Elevation

SSAR Markup

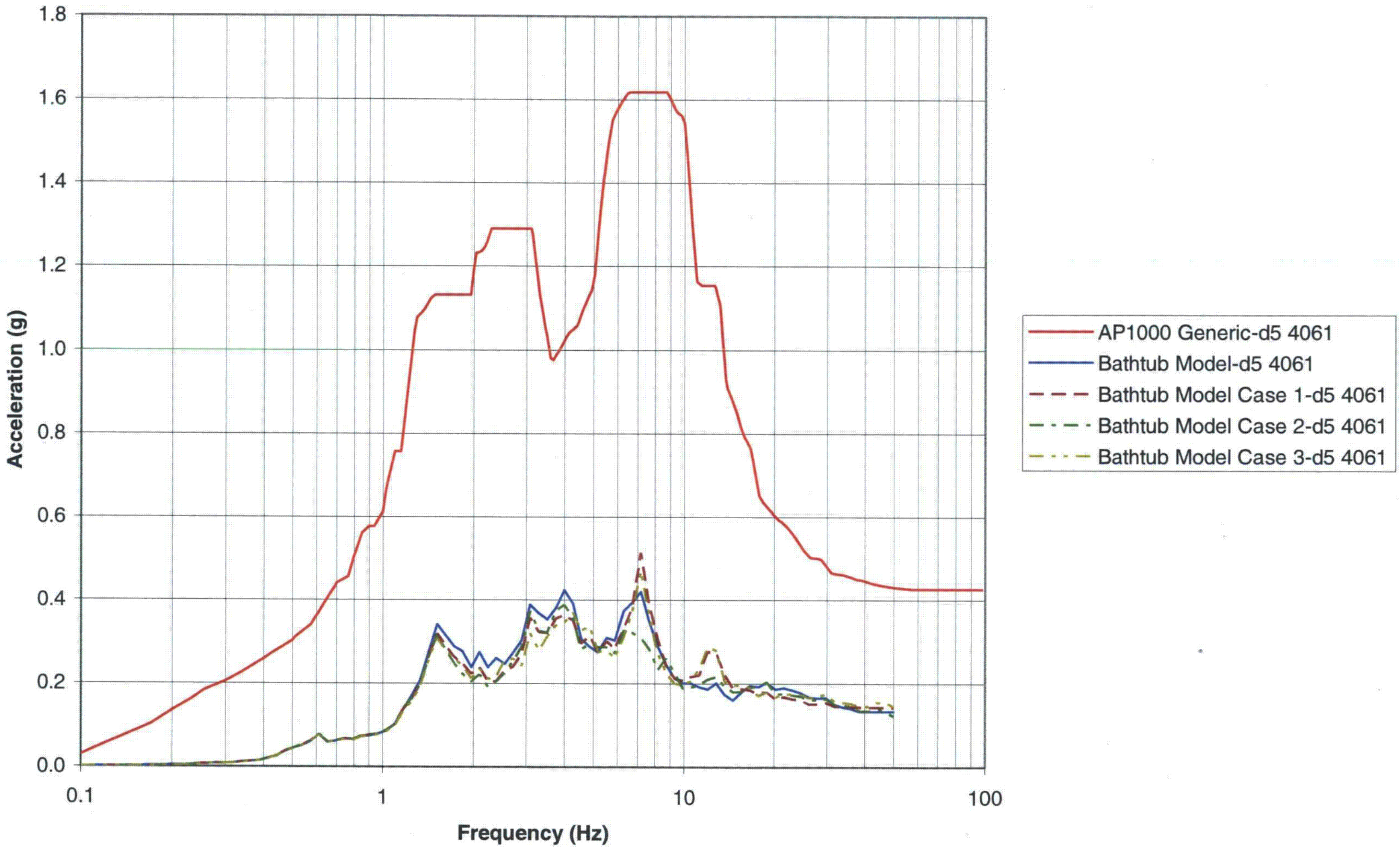


Figure 2.5.2-72 Comparison of SASSI 2D Bathtub NI Model SSI Responses: Node 4061-EL 116.5 Auxiliary Shield Building at Control Room Floor

SSAR Markup

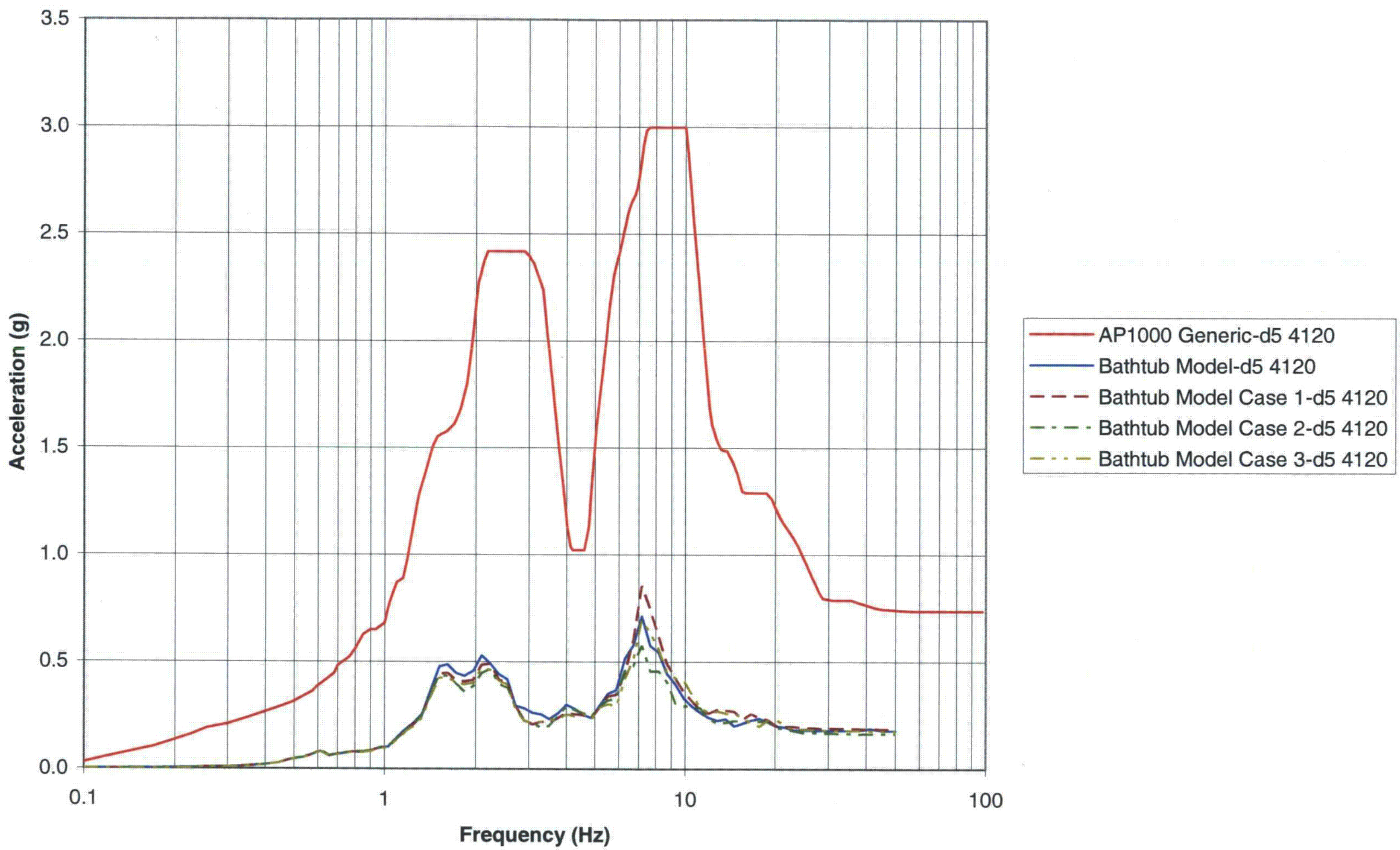


Figure 2.5.2-73 Comparison of SASSI 2D Bathtub NI Model SSI Responses: Node 4120-EL 179.56 ASB Auxiliary Building Roof Area

SSAR Markup

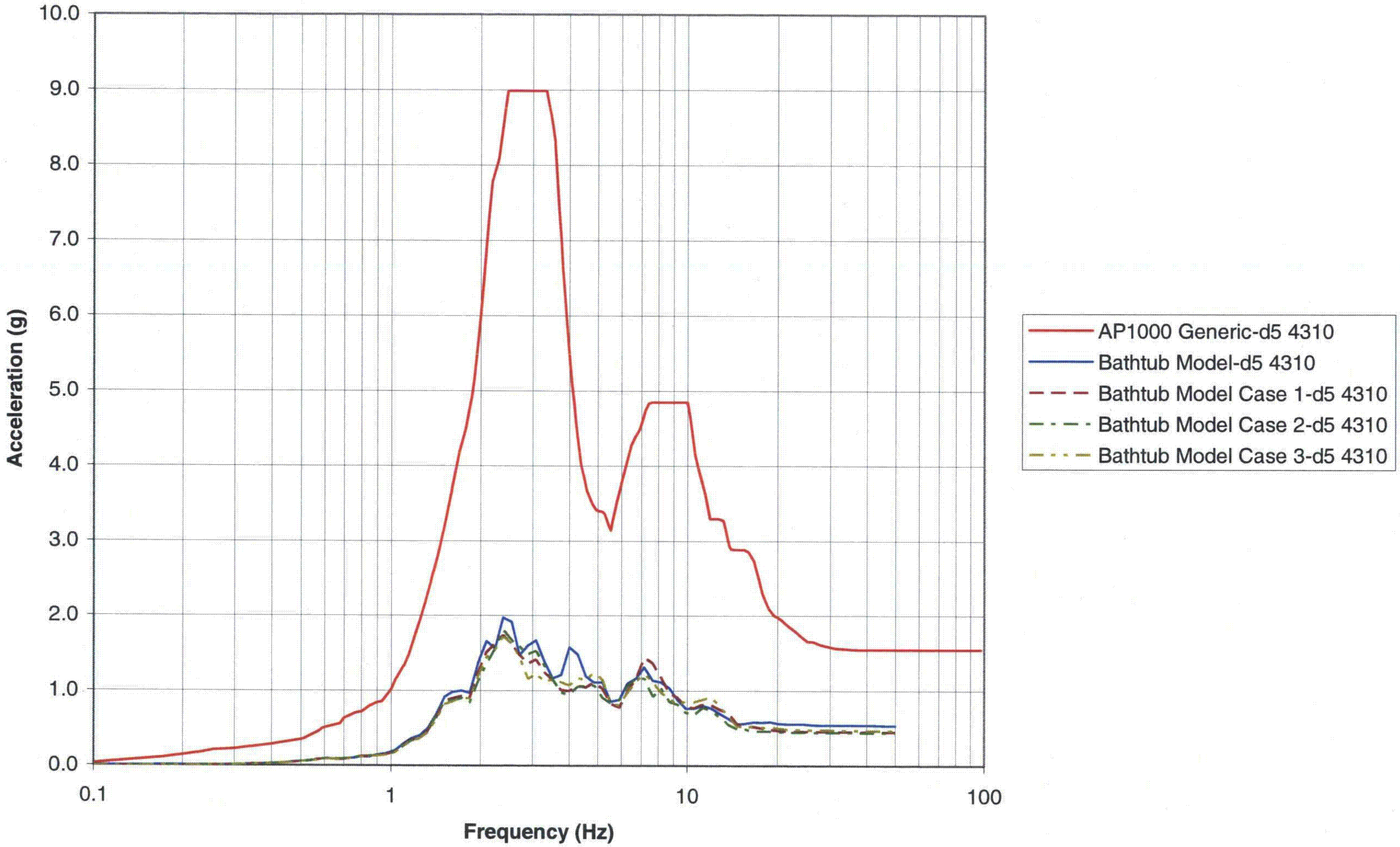


Figure 2.5.2-74 Comparison of SASSI 2D Bathtub NI Model SSI Responses: Node 4310-EL 327.41 ASB Shield Building Roof Area

SSAR Markup

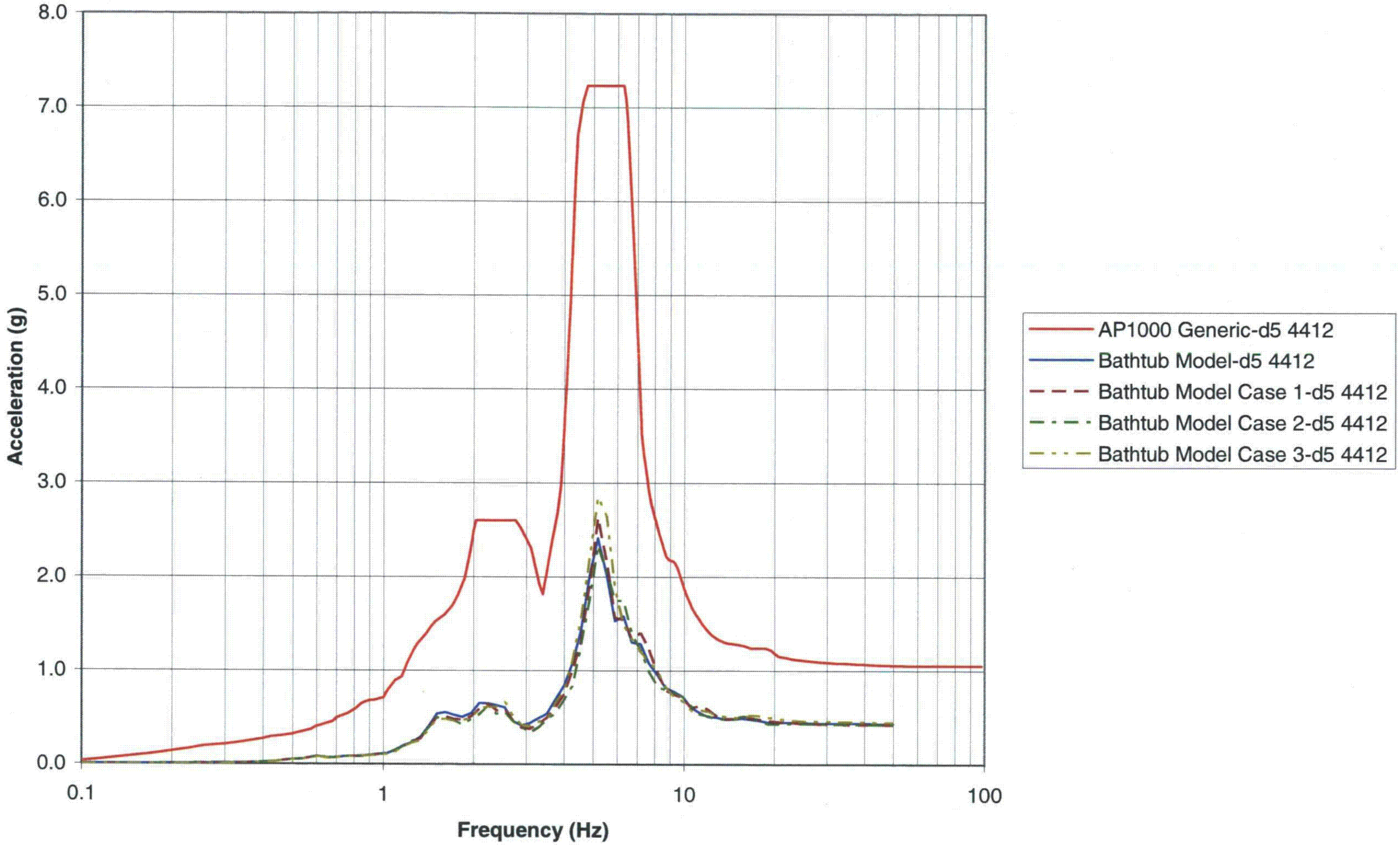


Figure 2.5.2-75 Comparison of SASSI 2D Bathtub NI Model SSI Responses: Node 4412-EL 224 Steel Containment Vessel Near Polar Crane

SSAR Markup

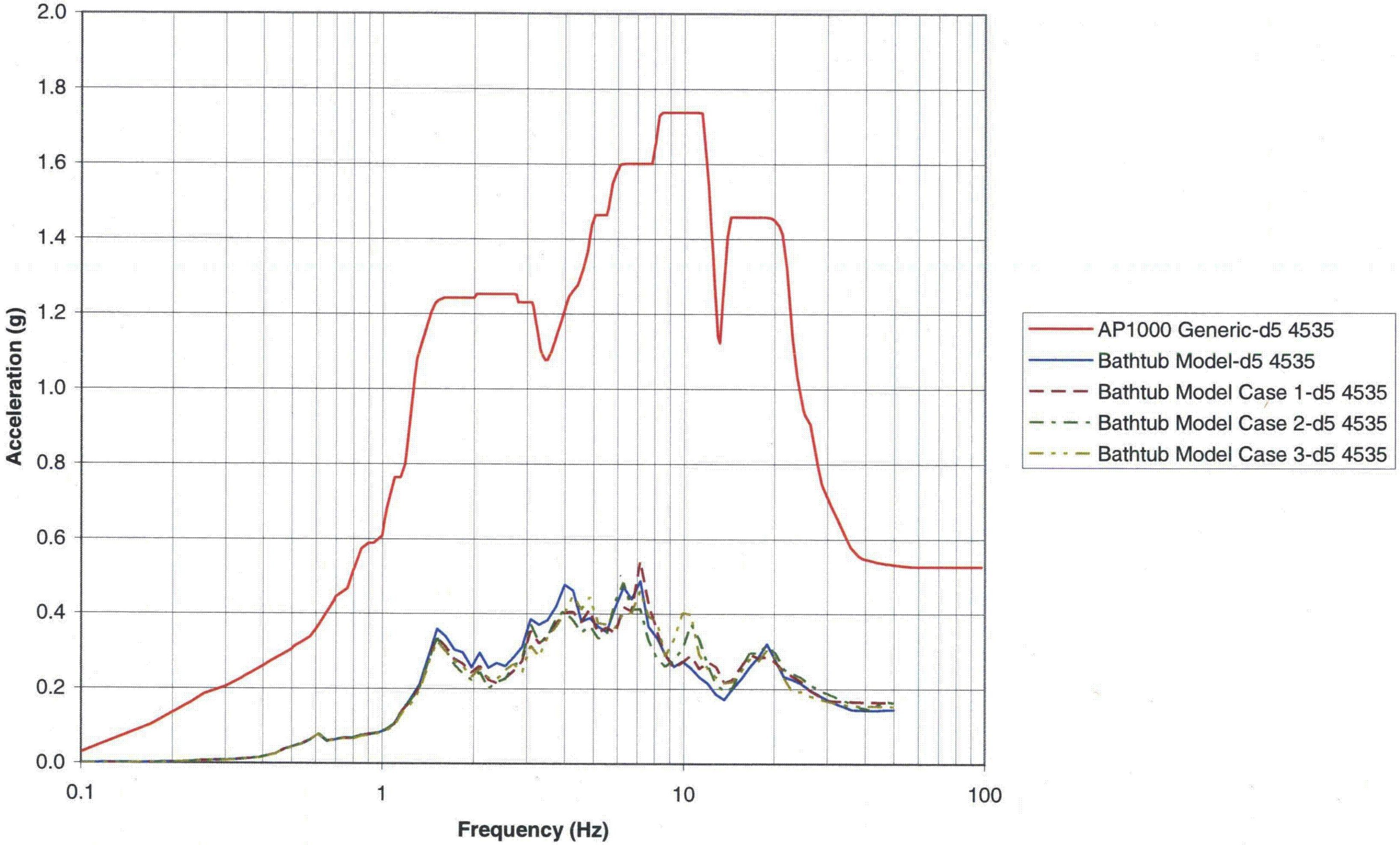


Figure 2.5.2-76 Comparison of SASSI 2D Bathtub NI Model SSI Responses:Node 4535-EL 135.25 Containment Internal Structure at Operating Deck

2.5.4.5.1 Extent of Excavations, Fills, and Slopes

Within the VEGP Units 3 and 4 footprint (Figure 2.5.4-1) that will contain all safety-related structures, existing ground elevations are about El. 220 ft msl. The subsurface profiles in Figures 2.5.4-3, 2.5.4-4, and 2.5.4-5 provide an impression of the grade elevation range across the VEGP ESP site. Plant grade for the proposed VEGP Units 3 and 4 will be at El. 220 ft msl. The base of the Nuclear Island foundations for the new units will be about El. 180 ft msl. This level corresponds to a depth of approximately 40 ft below final grade (below El. 220 ft msl), or approximately 50 to 60 ft above the top of the Blue Bluff Marl bearing stratum based on the borings completed during the ESP and COL subsurface investigations. Other foundations in the power block area will be placed at nominal depths near final grade.

Construction of the new units will require a substantial amount of excavation. The excavation will be necessary to completely remove the Upper Sand Stratum. Excavation total depth to the Blue Bluff Marl bearing stratum will range from approximately 80 to 90 ft below existing grade, based on the borings completed during the ESP and COL subsurface investigations. Deeper localized excavations will be required to remove shelly, porous, or weathered material that may be encountered near the top surface of the Blue Bluff Marl.

Seismic Category 1 backfill will be placed from the top of the Blue Bluff Marl to the bottom of the Nuclear Island (NI) foundation at a depth of about 40 ft below final grade. Seismic Category 2 backfill will be placed above the NI foundation level. The lateral extent of the Category 1 and 2 backfill is defined in Figure 2.5.4-16. A retaining wall will be constructed along the perimeter of the NI as described in Section 2.5.4.5.7 to facilitate backfilling and construction. Category 2 backfill will be placed behind the retaining wall to final grade or foundation elevation of non NI structures. Category 1 and 2 backfill material will meet the same criteria and consist of granular materials, selected from portions of the excavated Upper Sand Stratum and from other acceptable onsite borrow sources. Category 1 and 2 backfill material properties and source locations are described in more detail in Sections 2.5.4.5.3 and 2.5.4.5.4.

Engineered granular backfill (EGB) will be placed above the slopes, outside the specified lateral extent of the Category 1 and 2 backfill, as defined in Figure 2.5.4-16. The areas where EGB will be placed will not affect the static or seismic performance of the safety-related facilities. The EGB will be well-compacted granular backfill meeting the following requirements;

- Compacted to a minimum of 95% of modified Proctor (ASTM D1557) maximum dry density value
- Consist of sands, silty sands and clayey sands (SP, SP-SM, SP-SC, SW, SW-SM, SW-SC, SC, SC-SM, or SM based on the Unified Soil Classification System (ASTM D2487)

2.5.4.5.4 Backfill Sources

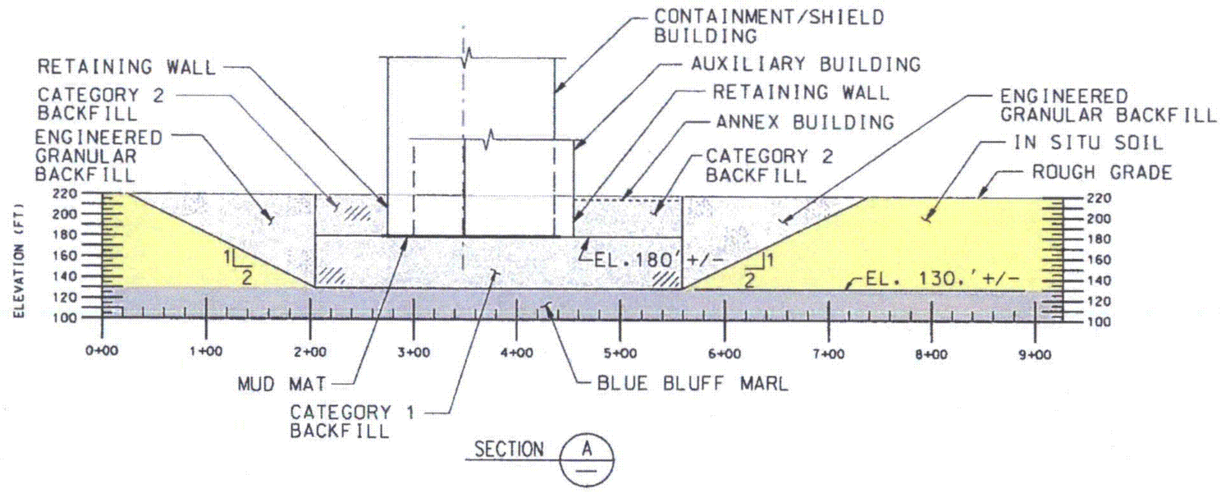
Sufficient sources of backfill have been identified on the Vogtle site through the boring and laboratory testing programs and analysis of their results as described below. Flowable fill may also be used as backfill in small restricted areas where adequate compaction cannot be achieved. The flowable fill mix will be designed to have similar strength characteristics as the compacted backfill.

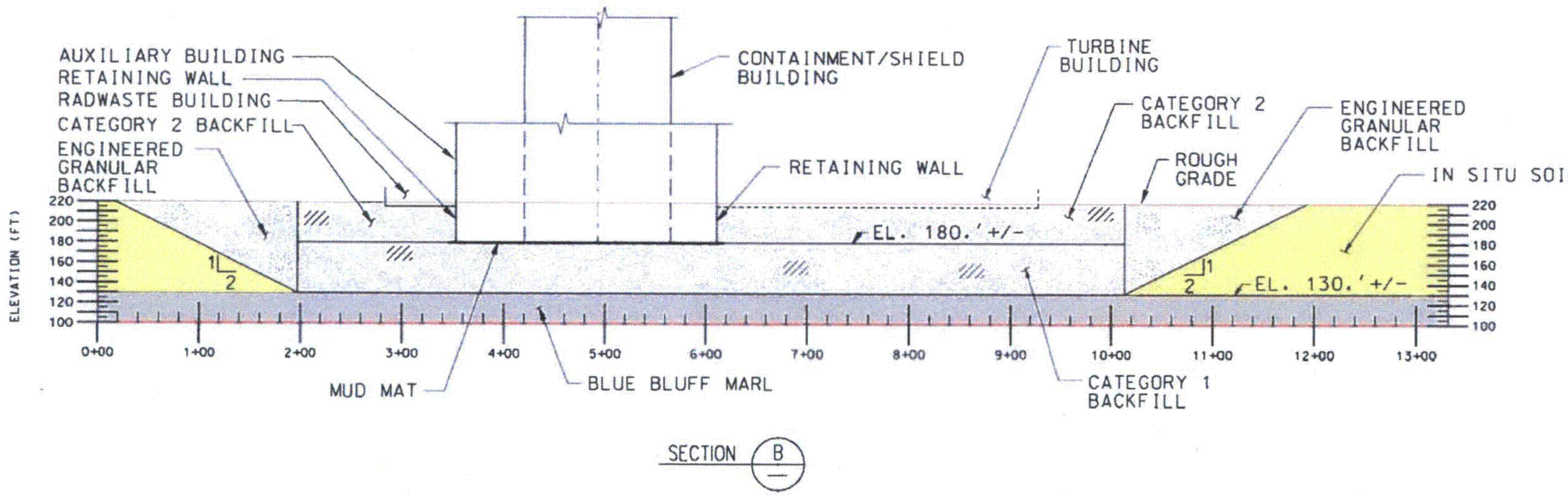
Identified onsite sources of borrow material for the proposed backfill include acceptable materials from the Upper Sand stratum excavated from the power block and a borrow area (switchyard) north of the power block. An alternative borrow area is located about 4,000 feet north of the power block. This alternative location (Borrow Area 4) was also identified and investigated during construction of VEGP Units 1 and 2.

Approximately 3,900,000 cubic yards of material (including an allowance for ramps) will be excavated for the Units 3 and 4 power blocks. Approximately 3,600,000 cubic yards of material will be required to backfill these excavations, of which approximately 2,000,000 cubic yards of material must meet Category 1 and 2 requirements. Based on a review of the 70 SPT boring logs and laboratory test results on selected samples from the COL subsurface investigation, approximately 50 percent of the material excavated from the power block areas will qualify for reuse as Seismic Category 1 or 2 backfill. However, because a portion of the excavated material may be difficult to segregate, an estimated 30–50 percent of the excavated material is designated for borrow. This quantity accounts for approximately 1,200,000–2,000,000 cubic yards.

Additional backfill for the power blocks, approximately 1,600,000 cubic yards, is available from a borrow source located immediately north of the power blocks (Units 3 and 4 switchyard area). See Figures 2.5.4-15 and 2.5.4-16 for plan and section views, respectively. The switchyard borrow source was explored with 15 SPT borings and five test pits during the COL investigation. The engineering properties of these materials were evaluated with laboratory tests on disturbed, undisturbed, and bulk samples. The COL laboratory testing program (Appendix 2.5.C) included sieve analyses of 27 samples that disclosed an average value of 15 percent fines and a median value of 15 percent. Based on the subsurface data, suitable backfill materials at the switchyard borrow source were identified. These materials were classified according to ASTM D 2488 as silty sands (SM) and poorly graded sands (SP). Clayey sands (SC) were also encountered in some samples. Compaction tests (ASTM D 1557) were conducted on five bulk samples taken from representative soils. Test results disclosed a range of 111 pcf to 125 pcf for the maximum dry density with an average value of 116 pcf.

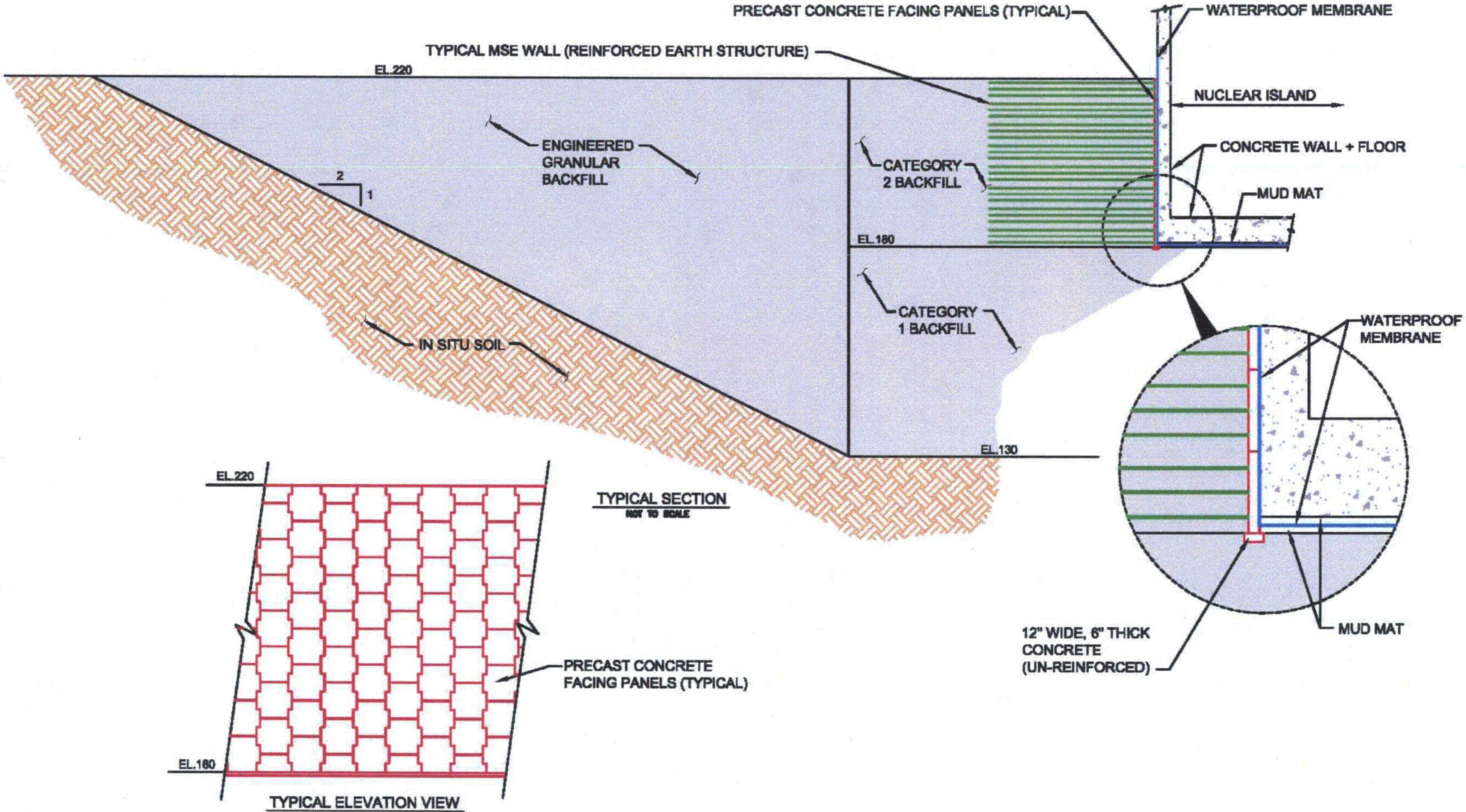
SSAR Markup





Revised Figure 2.5.4-16 Power Block Excavation Sections

SSAR Markup



Revised Figure 2.5.4-17 Nuclear Island Temporary Retaining Wall