# Chapter 3 Design of Structures, Components, Equipment, and Systems

## 3.1 Conformance with NRC General Design Criteria

This section of the referenced is incorporated by reference with no departures or supplements.

## 3.2 Classification of Structures, Systems and Components

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

**STD CDI** Add the following sentence at the end of Section 3.2

There are no site specific safety related or non-safety related RTNSS systems beyond the scope of the DCD.

**Table 3.2-1 Classification Summary**

Replace the note for System P73 with the following.

**STD CDI** The site-specific plant design includes the HWCS. See Subsection 9.3.9 for further details.

Replace the note for System P74 with the following.

**STD CDI** The site-specific plant design does not include the Zinc Injection System.

## 3.3 Wind and Tornado Loadings

This section of the referenced DCD is incorporated by reference with no departures or supplements.

## 3.4 Water Level (Flood) Design

This section of the referenced DCD is incorporated by reference with no departures or supplements.

## 3.5 Missile Protection

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

#### 3.5.1.5 Site Proximity Missiles (Except Aircraft)

Add the following sentence after the first sentence in the first paragraph.

**STD SUP 3.5-1** Site-specific missile sources are addressed in Section 2.2.

#### 3.5.1.6 Aircraft Hazards

Add the following at the end of the first paragraph.

**STD SUP 3.5-2** Site-specific aircraft hazard analysis and the site-specific critical areas are addressed in Section 2.2.

## 3.6 Protection Against Dynamic Effects Associated with the Postulated Rupture of Piping

This section of the referenced DCD is incorporated by reference with no departures or supplements.

## 3.7 Seismic Design

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

### 3.7.1 Seismic Design Parameters

#### 3.7.1.1 Design Ground Motion

Add the following at the end of this section.

**EF3 SUP 3.7-1** Figure 3.7.1-228 and Figure 3.7.1-229 provide the Certified Seismic Design Response Spectra (CSDRS), which envelopes the site-specific design ground motions (FIRS) developed in Subsection 3.7.1.1.4 for the Reactor Building/Fuel Building (RB/FB) and Control Building (CB) and is used for design of the ESBWR RB/FB and CB. Figure 3.7.1-238 provides the Fire Water Service Complex (FWSC) CSDRS, which envelopes the site-specific design ground motions (FIRS) for the FWSC and is used for design of the FWSC.

For the Fermi 3 RB/FB and CB, site-specific soil-structure interaction (SSI) analyses were performed to address the following conditions:

- Partial embedment in the Bass Islands Group bedrock of the RB/FB and CB Seismic Category I structures, as shown on Figure 2.5.4-202 and Figure 2.5.4-203, to confirm that the DCD design is applicable for this case.
- To demonstrate that the DCD requirements for the backfill surrounding Seismic Category I structures above the top of bedrock can be neglected for RB/FB and CB with the RB/FB and CB partially embedded in the bedrock at the Fermi 3 site.

Figure 3.7.1-228, Figure 3.7.1-229, and Figure 3.7.1-238 show that the FIRS developed in Subsection 3.7.1.1.4 are enveloped by the CSDRS in both horizontal and vertical directions for the RB/FB, CB, and FWSC. Therefore, the Fermi 3 site-specific SSI analyses were not performed to address any exceedance of the CSDRS; rather, the Fermi 3 site-specific SSI analyses were performed to address the two Fermi 3 site-specific conditions outlined above for the RB/FB and CB.

The FWSC is a surface founded structure in the DCD, Section 3.7.1.1, and there are no embedded walls for the FWSC. Therefore, the DCD requirements for backfill surrounding Seismic Category I structures are not applicable to the FWSC embedded basemat. The FWSC is founded on fill concrete which meets the DCD Table 2.0-1 requirements underneath Seismic Category I structures. Therefore, there is no site-specific SSI analysis performed for the FWSC.

The RB/FB and CB site-specific SSI analyses developed hazard-consistent seismic input for site response and SSI analyses consistent with Interim Staff Guidance DC/COL-ISG-017 and a Nuclear Energy Institute (NEI) developed white paper (Reference 3.7.1-201). The RB/FB and CB design ground motions for the SSI analyses (herein called the enhanced SCOR FIRS) were based on the outcrop FIRS developed in Subsection 3.7.1.1.4 for the full soil column (Soil Column Outcrop Response [SCOR]). Because site-specific SSI analyses are performed for Fermi 3, the site-specific Safe Shutdown Earthquake (SSE) applicable for plant shut down purposes is the lower of the two enhanced SCOR FIRS for the RB/FB or CB. The SSE is defined at the foundation level to match the DCD.

The Operating Basis Earthquake (OBE) is one-third of the SSE. These definitions of the SSE and OBE are used in conjunction with the criteria specified in DCD Section 3.7.4.4 to determine whether a plant shutdown is required following a seismic event.

#### 3.7.1.1.4 Fermi 3 Site-Specific Ground Motions

In the Fermi 3 site-specific SSI analyses (Subsection 3.7.2), the RB/FB and CB are modeled as partially embedded structures that penetrate into the Bass Islands Group bedrock. The elevation of the top of the Bass Islands Group bedrock is 168.1 m (551.7 ft) NAVD 88. The engineered granular backfill surrounding the RB/FB and CB above the Bass Islands Group bedrock is not included in the Fermi 3 site-specific licensing basis SSI analyses to demonstrate that the DCD requirements for the backfill surrounding Seismic Category I structures above the top of bedrock are not required. To confirm that the engineered granular backfill does not adversely impact Seismic Category I structures, site-specific SSI analyses were also performed that included the engineered granular backfill above the top of the Bass Islands Group bedrock.

A consistent set of site-specific seismic inputs were developed to perform the Fermi 3 site-specific SSI analyses with and without engineered granular backfill above the top of the Bass Islands Group bedrock. In order to consider the potential influence of engineered granular backfill above the top of the Bass Islands Group bedrock in the SSI analyses, FIRS were developed for the Fermi 3 site as a SCOR at the RB/FB and CB foundation levels (herein called SCOR FIRS). The SCOR FIRS were enhanced using the procedure described in Section 5.2.1 of Interim Staff Guidance (ISG) DC/COL-ISG-017 and Section 3.2.3 of the NEI developed white paper (Reference 3.7.1-201) to ensure hazard-consistent seismic inputs for the site-specific SSI analyses when compared to the Performance-Based Surface Response Spectra (PBSRS) at the finished ground level grade at Elevation 179.6 m (589.3 ft) NAVD 88. To ensure hazard-consistent seismic inputs for the site-specific licensing basis SSI analyses when compared to the Ground Motion Response Spectra (GMRS) at the top of the Bass Islands Group bedrock at Elevation 168.1 m (551.7 ft) NAVD 88, the general procedure described in Section 5.2.1 of the Interim Staff Guidance DC/COL-ISG-017 and Section 3.2.3 of the NEI developed white paper (Reference 3.7.1-201) was repeated without the engineered granular backfill. The SCOR FIRS are enhanced (herein called the enhanced SCOR FIRS) to ensure hazard-consistent seismic inputs for the site-specific SSI analyses with and without the engineered granular backfill above the top of the Bass Islands Group bedrock when compared to the PBSRS and GMRS, and are used as seismic inputs for Fermi 3 site-specific SSI analyses for the RB/FB and CB.

Development of the enhanced SCOR FIRS and ground motion time histories in three directions (two horizontal and one vertical) compatible with the enhanced SCOR FIRS for the RB/FB and CB are discussed in the following subsections. Development of the FWSC FIRS and the deterministic profiles for the site-specific SSI analyses with and without engineered granular backfill above the top of the Bass Islands Group bedrock are also discussed in the following subsections. The deterministic profiles for the site-specific SSI analyses are the same for all deterministic profiles below the top of the Bass Islands Group bedrock.

#### 3.7.1.1.4.1 Full Soil Column and FWSC Ground Motions

The process described in Section 3.2.3 of the NEI developed white paper (Reference 3.7.1-201) for development of a SCOR FIRS requires the development of the PBSRS at the finished ground level grade. The SCOR FIRS at the RB/FB and CB foundation levels are then computed as outcropping motions from the full soil column site response analysis. The method used to develop the site-specific PBSRS at the finished ground level grade for the Fermi 3 site is the same as that used in Subsection 2.5.2.5 to develop the GMRS with the exception that the soil column is extended to the finished ground level grade instead of being truncated at the top of the Bass Islands Group bedrock. The method in Subsection 2.5.2 employs Approach 2B outlined in NUREG/CR-6728 (Reference 3.7.1-202) to develop hazard-consistent surface spectra at the ground surface and foundation levels from the generic hard rock Uniform Hazard Response Spectra (UHRS) presented in Subsection 2.5.2.4. As described in Subsection 2.5.2.5, the following steps are involved in this approach:

1. Characterize the dynamic properties of the subsurface materials.
2. Randomize these properties to represent their uncertainty and variability across the site.
3. Based on the deaggregation of the rock hazard, define the distribution of magnitudes contributing to the controlling earthquakes for high-frequency (HF) and low-frequency (LF) ground motions and define the response spectra appropriate for each of the deaggregation earthquakes (DEs).

4. Match appropriate rock site time histories to the DE response spectra to be used as input at the base of the subsurface profiles.
5. Compute mean site amplification functions for the HF and LF controlling earthquakes based on the weighted average of the amplification function for the DEs.
6. Scale the response spectra for the controlling earthquakes (defined in the same manner as the reference earthquakes [REs]) and the rock UHRS by the mean amplification functions to obtain surface motions.
7. Envelop these scaled spectra to obtain surface motions at the finished ground level grade that are hazard consistent with the generic Central and Eastern United States (CEUS) hard rock hazard levels.

The Fermi 3 site-specific PBSRS at the finished ground level grade and the SCOR FIRS were developed by repeating the analysis steps presented above using the full soil column. Analysis steps 1 and 2 are described in Subsection 3.7.1.1.4.1.1. Analysis steps 3 and 4 are based on the rock hazard for the Fermi 3 site and are the same as those performed for the GMRS in Subsection 2.5.2.4 and Subsection 2.5.2.5. The input rock acceleration time histories for the site response analyses presented in Subsection 2.5.2.5 are used in the full soil column analysis without modification. Step 5 is described in Subsection 3.7.1.1.4.1.2. Steps 6 and 7 are described in Subsection 3.7.1.1.4.2.

In addition to the PBSRS and SCOR FIRS for the RB/FB and CB, FIRS are needed at the base of the FWSC. DCD Section 3.7.1.1 states that the FWSC is essentially a surface founded structure. Therefore, the FIRS for the FWSC were developed as a Truncated Soil Column Response (TSCR) in accordance with Section 3.2.1 of the NEI developed white paper (Reference 3.7.1-201). The method used to develop the site-specific FWSC FIRS at the Fermi 3 site is the same as that used above to develop the PBSRS with the exception that the soil column is extended from the top of the Bass Islands Group bedrock to the bottom of the FWSC foundation using fill concrete with a mean compressive strength of 31 MPa (4,500 psi) (Subsection 2.5.4.5.4.2). The elevation of the bottom of the FWSC foundation basemat is 177.3 m (581.6 ft) NAVD 88, which is about 2.35 m (7.7 ft) below the finished ground level grade.

#### 3.7.1.1.4.1.1 Dynamic Properties for the Full Soil Column and FWSC Profile

The PBSRS is defined at Elevation 179.6 m (589.3 ft) NAVD 88, the finished ground level grade for the Fermi 3 site. This elevation will be achieved by excavating and removing the existing overburden to the top of the Bass Islands Group bedrock at Elevation 168.1 m (551.7 ft) NAVD 88, and backfilling with engineered granular backfill to the finished ground level grade. This process results in an average engineered granular backfill thickness of approximately 11.5 m (37.6 ft). Beneath the FWSC, the existing overburden will also be excavated to the top of the Bass Islands Group bedrock, but will be backfilled with fill concrete instead of engineered granular backfill to the bottom of the FWSC foundation basemat. Additional fill concrete will also be placed between the embedded foundation walls of Seismic Category I structures and the adjacent bedrock. Subsection 2.5.2.5.1 discusses the development of the dynamic engineering properties for the in-situ bedrock material. The dynamic engineering properties for the in-situ bedrock material used in the site response analysis for computing the PBSRS at the finished ground level grade, the SCOR FIRS for the RB/FB and CB, and the FWSC FIRS are the same as those in Subsection 2.5.2.5.1. Table 3.7.1-201 through Table 3.7.1-204 provide the dynamic engineering properties for the in-situ bedrock material below layer number 10.

Above the top of the Bass Islands Group bedrock, the shear wave velocity ($V_S$) for the engineered granular backfill is estimated in order to define lower-range (LR), intermediate-range (IR), and upper-range (UR) site response analysis profiles for the PBSRS and SCOR FIRS to represent the range in fill material properties that may be used. The values of $V_S$ are based on empirical relationships for angular-grained material from Richart et al. (Reference 3.7.1-203) and for sandy and gravelly soils from Menq (Reference 3.7.1-204).

The empirical relationship for shear wave velocity from Richart et al. (Reference 3.7.1-203) for angular-grained material is:

$$V_S = [159 - (53.5)e](\overline{\sigma}_0)^{0.25} \qquad \text{[Eq. 1]}$$

Where:

$V_S$ is the shear wave velocity in ft/sec

$e$ is the void ratio

$\overline{\sigma_0}$ is the average effective confining pressure in lb/ft$^2$ defined as

$$\overline{\sigma_0} = \frac{1}{3}(\sigma'_V + 2\sigma'_H) \quad \text{[Eq. 2]}$$

Where:

$\sigma'_V$ is the effective vertical stress in lb/ft$^2$

$\sigma'_H$ is the effective horizontal stress in lb/ft$^2$ with $\sigma'_H = k_0\sigma'_V$

$k_0$ is the at-rest earth pressure coefficient defined as $k_0 k_0 = \sin\phi'\sin\phi'$

$\phi'$ is the effective angle of internal friction of the soil

A range of material properties were considered in estimating two shear wave velocity profiles using the empirical relationship for angular-grained material from Richart et al. (Reference 3.7.1-203). Moist unit weights for granular soils up to 22.9 kN/m$^3$ (146 pcf) were considered, and a lower range value of 18.7 kN/m$^3$ (119 pcf) was selected to evaluate below the DCD requirement of 20 kN/m$^3$ (125 pcf). The void ratio was estimated assuming an average condition of 50 percent saturation. The $\phi$ value was allowed to vary from the DCD requirement of 35 degrees up to 50 degrees, the maximum value for dense coarse-grained material in Reference 3.7.1-205. The two shear wave velocity profiles used the following material properties to estimate an UR and LR of shear wave velocities:

- A void ratio of 0.18, a $\phi'$ of 50 degrees to calculate $k_0$, and a soil unit weight of 22.9 kN/m$^3$ (146 pcf) to calculate the average effective confining pressure for an UR estimate (a constant effective lateral earth pressure of 500 psf is used for the UR estimate to a depth of 15.7 feet to account for compaction).
- A void ratio of 0.54, a $\phi'$ of 35 degrees to calculate $k_0$, and a soil unit weight of 18.7 kN/m$^3$ (119 pcf) to calculate the average effective confining pressure for a LR estimate.

The empirical relationship for small-strain shear modulus ($G_{max}$) from Menq (Reference 3.7.1-204) for sandy and gravelly soils is:

$$G_{max} = C_{G3} \times C_u^{b1} \times e^x \times \left(\frac{\overline{\sigma_0}}{P_a}\right)^{n_G} \quad \text{[Eq. 3]}$$

Where:

$C_{G3}$ is a coefficient equal to 67.1 MPa (1400 ksf)

$C_U$ is the uniformity coefficient of the granular soil

$b1$ is an empirical coefficient equal to -0.20

$e$ is the void ratio

$x$ is a value dependent on the median grain size at 50 percent passing ($D_{50}$), in mm, defined as:

$$X = -1 - \left(\frac{D_{50}}{20}\right)^{0.75} \quad \text{[Eq. 4]}$$

$\overline{\sigma_0}$ is the average effective confining pressure

$P_a$ is atmospheric pressure

$n_G$ is a value dependent on $C_U$ defined as $n_G = 0.48 \times C_u^{0.09}$

The shear wave velocity is then estimated from $G_{max}$ using the relationship (Reference 3.7.1-206):

$$V_S = \sqrt{\frac{G_{max}}{\rho}} \quad \text{[Eq. 5]}$$

Where:

ρ is the soil density in units of mass per volume

Again, a range of values were used to estimate four different profiles of $G_{max}$ and shear wave velocity for the engineered granular backfill using the empirical relationship from Menq (Reference 3.7.1-204). The values of $C_U$ and $D_{50}$ for two of the profiles were based on the MDOT 21A and 21AA gradations (Reference 3.7.1-207). The $C_U$ values for the two other profiles ($C_U$ = 3 and 200) were based on the larger range of values from reconstituted granular samples presented in Menq (Reference 3.7.1-204) and a range of void ratios from 0.18 to 0.54 were considered. The larger range of $C_U$ values used a $D_{50}$ of 8 mm (0.3 inches) based on the average of the MDOT gradations. The four $G_{max}$ and shear wave velocity profiles with the empirical relationship from Menq (Reference 3.7.1-204) used the following material properties:

- A $C_U$ of 52.31, a $D_{50}$ of 12.7 mm (0.5 inches), a unit weight of 22.9 kN/$m^3$ (146 pcf), and a void ratio of 0.3 (including effects of compaction).

- A $C_U$ of 71.43, a $D_{50}$ of 3.3 mm (0.13 inches), a unit weight of 22.9 kN/$m^3$ (146 pcf), and a void ratio of 0.26 (including effects of compaction).
- A $C_U$ of 3, a $D_{50}$ of 8 mm (0.3 inches), a unit weight of 18.7 kN/$m^3$ (119 pcf), and a void ratio of 0.54.
- A $C_U$ of 200, a $D_{50}$ of 8 mm (0.3 inches), a unit weight of 22.9 kN/$m^3$ (146 pcf), and a void ratio of 0.18 (including effects of compaction).

The LR profile represents the smallest shear wave velocity for each depth interval from the six shear wave velocity profiles described above for the empirical relationships of Richart et al. (Reference 3.7.1-203) and Menq (Reference 3.7.1-204). The UR profile represents the largest shear wave velocity for each depth interval from the six shear wave velocity profiles described above for the empirical relationships of Richart et al. (Reference 3.7.1-203) and Menq (Reference 3.7.1-204). The IR shear wave velocity profile represents the average of the LR and UR shear wave velocity profiles. Figure 3.7.1-201 shows the three estimated shear wave velocity profiles (LR, IR, and UR) for the engineered granular backfill used as input to the site response analysis for computing the PBSRS and SCOR FIRS. A range of values for the engineered granular backfill is used to assess the potential variability of the fill shear wave velocities in the full soil column site response analyses. The three shear wave velocity profiles for the engineered granular backfill are provided in layers 1 through 10 in Table 3.7.1-201, Table 3.7.1-202, and Table 3.7.1-203 for the LR, IR, and UR profiles, respectively. As stated in Subsection 2.5.2.5.1, a single velocity profile is appropriate for the in situ material at the Fermi 3 site; therefore, the velocity profile does not change below the engineered granular backfill. The groundwater table is assumed to be at the maximum historical groundwater elevation of 175.6 m (576.11 ft) NAVD 88 (Subsection 2.4.1.2) for estimating the shear wave velocities of the engineered granular backfill.

The FWSC is to be founded on fill concrete with shear dowels (i.e., steel reinforcing) extending to the top of the Bass Islands Group bedrock. The site response analysis profile for the FWSC FIRS was constructed by placing approximately 9.1 m (29.9 ft) of fill concrete between the bottom of the FWSC foundation basemat and the top of the Bass Islands Group bedrock. The estimated shear wave velocity of the fill concrete is 2,180 m/s (7,140 ft/s) based on an unconfined compressive strength of 31 MPa (4,500 psi) (see Subsection 2.5.4.5.4.2). Figure 3.7.1-202 shows the shear wave velocity profile used as input to the site response analysis for computing the FWSC FIRS. The shear wave velocity profile for the fill concrete beneath the FWSC is provided in layers 1 through 10 in Table 3.7.1-204. The dynamic engineering properties for the in-situ bedrock material used in the site response analysis are provided in Table 3.7.1-204 below layer number 10.

#### 3.7.1.1.4.1.1.1 Density

Unit weights for the LR, IR, and UR site response analysis profiles are provided in Table 3.7.1-201, Table 3.7.1-202, and Table 3.7.1-203, respectively, for engineered granular backfill and bedrock. A range of values for the engineered granular backfill is used to assess the potential variability of density in the full soil column site response analyses.

Table 3.7.1-204 presents the unit weights for the fill concrete and the bedrock beneath the FWSC. The fill concrete beneath the FWSC basemat is assumed to have a unit weight of 22.8 kN/m$^3$ (145 pcf).

#### 3.7.1.1.4.1.1.2 Shear Modulus Reduction and Damping

The upper 11.5 m (37.6 ft) of the Fermi 3 full soil column site response analysis profile consists of engineered granular backfill. The modulus reduction and damping relationships for the engineered granular backfill used in the site response analyses are based on the EPRI generic sand curves (Reference 3.7.1-208) and the relationship of Menq (Reference 3.7.1-204). The LR modulus reduction and damping relationship was developed using the methodology of Menq (Reference 3.7.1-204) and the gradation properties of MDOT 21A and 21AA aggregates (Reference 3.7.1-207), and represent the largest considered shear modulus reduction and damping for the engineered granular backfill. Specifically, the LR modulus reduction and damping curves represent a $C_U$ of 71.43 and a $D_{50}$ of 3.3 mm, which corresponds to the parameters of the shear wave velocity profiles that controlled most of the LR shear wave velocity profile. The LR modulus reduction and damping curves also used the LR unit weight of 18.7 kN/m$^3$ (119 pcf) to define effective confining stresses to represent the 0 to 6.1 m (20 ft) and 6.1 m to 11.5 m (20 to 37.6 ft) depth ranges. Modulus reduction and damping curves based on the relationship of Menq (Reference 3.7.1-204) were developed for these depth ranges to allow comparison to the EPRI generic sand curves for the 0 to 6.1 m (20 ft) and 6.1 m to 15.2 m (20 to 50 ft) depth ranges (Reference 3.7.1-208). The EPRI generic sand curves were used as the

UR shear modulus reduction and damping curves, since they produced the least shear modulus reduction and damping. The IR shear modulus reduction and damping curves were developed by averaging the UR and LR curves.

The shear modulus reduction and damping relationships of Menq (Reference 3.7.1-204) are preferred over other recently published relationships since they incorporate the influence of gradation parameters based on tested samples of nonplastic sandy and gravelly soils that are anticipated to be similar to the engineered granular backfill. Similarly, the EPRI generic sand curves (Reference 3.7.1-208) were considered for the Fermi 3 site since they provide modulus reduction and damping relationships suitable for generic site response studies in Eastern North America, and are intended to represent soils in the general range of gravelly sand to low plasticity silty clays or sandy clays. The use of both the Menq (Reference 3.7.1-204) modulus reduction and damping relationships and the EPRI generic sand curves (Reference 3.7.1-208) resulted in a range of modulus reduction and damping curves used to establish the LB and UB profiles.

Figure 3.7.1-203 presents the modulus reduction and damping relationships for the 0 to 6.1 m (20 ft) and 6.1 m to 11.5 m (20 to 37.6 ft) depth ranges. The damping ratio curves were limited to a maximum of 15 percent damping for site response analyses as recommended in Appendix E of Regulatory Guide (RG) 1.208. The modulus reduction and damping relationship assigned to the various layers of the engineered granular backfill in the LR, IR, and UR site response analysis profiles are listed in Table 3.7.1-201, Table 3.7.1-202, and Table 3.7.1-203, respectively.

The fill concrete with shear dowels (i.e., vertical steel reinforcement) between the bottom of the FWSC foundation basemat and the top of the Bass Islands Group bedrock is anticipated to have a damping of 4 percent based on the OBE damping value for reinforced concrete consistent with RG 1.61. However, a sensitivity analysis was completed using a lower damping of 0.5 percent due to the low effective dynamic stresses in the fill concrete and the relatively high shear wave velocities. This sensitivity analysis indicated a small difference of only 0.4 to 3 percent between the responses computed using damping values of 0.5 and 4 percent for the concrete fill; therefore, the lower damping value of 0.5 percent was used to develop the FWSC FIRS, as its use produced slightly higher response. The planned fill concrete with shear dowels is anticipated to remain essentially linear under the anticipated ground motion levels. Thus, the shear modulus reduction values for the fill concrete were set to 0.9999 for strain levels less than 3 percent and to 0.999 at higher strain levels.

Below the engineered granular backfill and fill concrete, the remaining portion of the full soil column and FWSC site response analysis profiles consists of dolomite and claystone bedrock, as discussed in Subsection 2.5.2.5.1.2. The bedrock is expected to remain essentially linear at low to moderate levels of shaking. Damping within the in-situ dolomite and claystone bedrock is characterized by a high-frequency attenuation parameter $\kappa$ that ranges from 0.001 and 0.003 seconds (Subsection 2.5.2.5.1). The values of $\kappa$ established in Subsection 2.5.2.5.1 were used to develop the site response analysis for the Fermi 3 site. As part of the development of the SSI inputs, the representation of damping in the in-situ bedrock was simplified from the seven different damping layers indicated in FSAR Table 2.5.2-213 and Table 2.5.2-214 to the four different damping layers listed in FSAR Table 3.7.1-201, Table 3.7.1-202, and Table 3.7.1-203. Sensitivity studies indicated that this simplification in the number of layers produces less than 0.1 percent difference in the mean amplification functions.

#### 3.7.1.1.4.1.1.3 **Randomization of Dynamic Properties**

Site response analyses for the full soil column and FWSC profiles were conducted using randomized dynamic soil properties following the methods described in Subsection 2.5.2.5.1.3. The randomized dynamic properties included shear wave velocity, modulus reduction, and damping. Additionally, the locations of velocity layer boundaries were randomized to vary uniformly within the range of layer thickness observed in the site borings.

Sixty randomized $V_S$ profiles were generated for each of the LR, IR, and UR site response analysis profiles (a total of 180 randomized $V_S$ profiles for development of the PBSRS and SCOR FIRS). Sixty randomized $V_S$ profiles were also generated for the FWSC site response analysis profile. The statistics of the randomized profiles are summarized by comparing to the input target values for median velocity and standard deviation (sigma) of ln($V_S$) for the LR, IR, UR, and FWSC profiles. As an example of this process, Figure 3.7.1-204 to Figure 3.7.1-206 show the 60 randomized velocity profiles and the statistics of the randomized shear wave velocity profiles for the IR site response analysis profile.

The modulus reduction and damping relationships associated with the LR, IR, and UR full column site response analysis profiles were also randomized as shown on Figure 3.7.1-207, Figure 3.7.1-208, and Figure 3.7.1-209, respectively. The standard deviation in the modulus reduction and damping were set so that the randomized relationships fell within recommended bounds provided by Silva (Reference 3.7.1-209). The damping ratio curves were limited to a maximum of 15 percent damping as recommended in Appendix E of RG 1.208.

The shear modulus reduction curve for the fill concrete described in Subsection 3.7.1.1.4.1.1.2 was also randomized using a standard deviation of 0.01 to maintain a value near unity. The randomized values of shear modulus reduction were greater than 0.9999 at all strain levels, which is consistent with shear wave velocities of at least 99.5 percent of the initial value and the interpretation that the fill concrete will behave as an essentially linear material.

The damping in the sedimentary bedrock beneath the engineered granular backfill was computed using the randomized sedimentary bedrock layer velocities and thicknesses, and the selected values of $\kappa$ described in Subsection 2.5.2.5.1.

#### 3.7.1.1.4.1.2 **Site Ampflication Functions**

A process similar to the description for developing the GMRS site amplification functions in Subsection 2.5.2.5.3 was repeated to produce mean site amplification functions for the PBSRS at the finished ground level grade, the SCOR FIRS for the RB/FB and CB foundation levels, and the FWSC FIRS.

Figure 3.7.1-210 shows the site response logic tree used to compute the controlling earthquake or RE mean amplification function and the weights assigned to the bedrock damping values and the subsurface profiles. This logic tree is similar to Figure 2.5.2-276; however, Figure 3.7.1-210 also includes the LR, IR, and UR site response analysis profiles to assess uncertainty in the dynamic properties of the engineered granular backfill. For each DE, mean amplification functions were computed using three bedrock damping values ($\kappa$) and the LR, IR, and UR profiles. The results obtained for the three DEs are then combined to produce a weighted mean amplification function for the RE. The weights assigned to the results for each DE are given in Table 2.5.2-212.

The mean amplification functions were then smoothed to remove small dips and peaks considered artifacts of the finite number of analyses. Linear interpolation in logarithmic space (log-log interpolation) was used to smooth the HF and LF amplification function above 1 Hz and below 7 Hz, respectively.

Figure 3.7.1-211 shows the mean PBSRS site amplification functions at the finished ground level grade for the $10^{-4}$and $10^{-5}$ exceedance levels of input ground motion. Both the unsmoothed and smoothed PBSRS site amplification functions are presented. Because of the non-linear behavior of the engineered granular backfill, the site amplification is sensitive to the level of input ground motion for most frequencies.

The SCOR site amplification functions at the RB/FB and CB foundation levels were obtained from the results of the site response analyses for the full soil column profile. Again, the mean amplification functions were smoothed to remove small features considered artifacts of the analyses. Figure 3.7.1-212 and Figure 3.7.1-213 show both the mean and smoothed SCOR site amplification functions for $10^{-4}$ and $10^{-5}$ exceedance levels of input ground motions at the RB/FB and CB foundation levels, respectively. The amplification functions for the RB/FB and CB SCOR FIRS show little sensitivity to the two different levels of motions because both foundations are founded in the same bedrock unit that has a relatively high and uniform shear wave velocity.

The site amplification functions at the FWSC foundation level used a logic tree similar to Figure 2.5.2-276. For each DE, mean amplification functions were computed using three bedrock damping values ($\kappa$). The results obtained for the three DEs are then combined to produce a weighted mean amplification function for the RE. The weights assigned to the results for each DE are given in Table 2.5.2-212. Mean amplification functions for the FWSC were determined for $10^{-4}$ and $10^{-5}$ exceedance levels of input ground motions at the FWSC foundation level. Again, the mean amplification functions were smoothed to remove small features considered artifacts of the analyses.

To incorporate the effect of the lateral contrast in dynamic properties between the fill concrete beneath the FWSC basemat and the adjacent engineered granular backfill, two dimensional (2D) site response analyses were completed using an equivalent linear, 2D finite element program for modeling the seismic response of soil masses. The program QUAD4MU (Reference 3.7.1-210), an updated version of QUAD4M (Reference 3.7.1-211) and the original program QUAD4 (Reference 3.7.1-212), was used to complete the 1D and 2D site response analyses. The 2D analyses were compared to equivalent one-dimensional (1D) analyses that assumed a uniform layer of concrete above the top of the Bass Islands Group bedrock to construct 2D/1D spectral ratios. Figure 3.7.1-214 presents the mean 2D/1D response spectral ratio for the $10^{-4}$ and $10^{-5}$ exceedance levels of input ground motions for both FWSC foundation dimensions (20 m [66 ft] by 52 m [171 ft]) and the IR engineered granular backfill properties. Figure 3.7.1-214 also presents smoothed envelopes used in the initial development of the 2D-to-1D spectral ratio envelopes. The smoothed envelope was then modified as needed to include the effects of the IR, LR, and UR engineered granular backfill properties. Figure 3.7.1-215 presents the final 2D/1D response spectral ratio envelopes for the $10^{-4}$ and $10^{-5}$ exceedance levels of input ground motions. These 2D/1D response spectral ratio envelopes indicate that the limited extent of the fill concrete beneath the FWSC produces an increase in the mean site amplification functions above 5 Hz compared to that obtained from 1D site response. The increase is generally greater for the $10^{-5}$ exceedance level of input ground motion than for the$10^{-4}$ exceedance level of input ground motions. The $10^{-4}$ and $10^{-5}$ exceedance levels of input ground motions produce 2D/1D response spectral ratio envelopes with an increase of up to 45 percent and 90 percent, respectively. Figure 3.7.1-216 shows the smoothed mean site amplification functions for $10^{-4}$ and $10^{-5}$ exceedance levels of input ground motions at the FWSC foundation level for the 1D site response compared with those incorporating the 2D effects due to the limited extent of the fill concrete.

#### 3.7.1.1.4.2 Surface Hazard Spectra for PBSRS, SCOR FIRS, and FWSC FIRS

The surface UHRS at the finished ground level grade and at the RB/FB, CB, and FWSC foundation levels were constructed following the procedures described in Subsection 2.5.2.6 for the GMRS at the top of the Bass Islands Group bedrock. The appropriate site amplification functions were used to scale the generic hard rock UHRS and the LF and HF RE spectra to obtain the surface UHRS at the finished ground level grade and for the RB/FB, CB, and FWSC foundation levels. For the generic hard rock UHRS, the HF amplification function is used for frequencies above 5 Hz and the LF amplification function is used for frequencies below 2.5 Hz. Frequencies between 2.5 and 5 Hz use a weighted combination of the HF and LF amplifications.

Figure 3.7.1-217 shows the surface spectra for the scaled LF and HF RE, the scaled hard rock UHRS, and the envelop spectrum for the $10^{-4}$ exceedance level ground motions at the finished ground level grade using the mean PBSRS site amplification functions. The amplification functions and the corresponding surface spectrum show a slight dip in the frequency range of 5 to 20 Hz. The dip was conservatively removed in constructing the enveloped surface UHRS for the $10^{-4}$ exceedance level ground motions. As a result, the final spectra will be conservative in the frequency range of approximately 5 to 20 Hz.

Figure 3.7.1-218 shows the surface spectra for the scaled LF and HF RE, the scaled hard rock UHRS, and the envelop spectrum for the $10^{-4}$ exceedance level ground motions at the RB/FB foundation level using the mean SCOR site amplification functions. The SCOR UHRS at the RB/FB foundation level was developed using the same process described for the surface UHRS at the finished ground level grade, including smoothing through the dip in the spectrum between approximately 4 and 25 Hz.

Similar operations were performed to develop the UHRS for the $10^{-4}$ exceedance level ground motions at the CB and FWSC foundation levels and the $10^{-5}$ exceedance level motions at the finished ground level grade surface and the RB/FB, CB, and FWSC foundation levels. Since the amplification functions for the FWSC FIRS included the 2D effect of the fill concrete, the UHRS at the FWSC foundation level includes the 2D effect of the limited extent of the fill concrete discussed in Subsection 3.7.1.1.4.1.2.

### 3.7.1.1.4.3 PBSRS at the Finished Ground Level Grade

#### 3.7.1.1.4.3.1 Horizontal PBSRS

Development of the horizontal PBSRS at the finished ground level grade follows the same processes for development of the GMRS provided in RG 1.208 and Subsection 2.5.2.6. Figure 3.7.1-219 shows the $10^{-4}$ and $10^{-5}$ horizontal UHRS and the resulting horizontal PBSRS at the finished ground level grade. As described in Subsection 2.5.2.6.2.1, RG 1.208

specifies two approaches for calculating performance based ground motion response spectra, a design factor (DF) times the $10^{-4}$ UHRS and the minimum value of 0.45 times the $10^{-5}$ UHRS when the ratio of the $10^{-5}$ UHRS to the $10^{-4}$ UHRS exceeds 4.2. Both results are shown on Figure 3.7.1-219. The final PBSRS is the envelope of the two. Table 3.7.1-205 presents the resulting horizontal PBSRS values.

#### 3.7.1.1.4.3.2 **Vertical PBSRS**

The vertical GMRS developed in Subsection 2.5.2.6 used vertical to horizontal (V/H) spectral ratios recommended by NUREG/CR-6728 (Reference 3.7.1-202) for CEUS bedrock sites. The vertical PBSRS at the finished ground level grade was also constructed using V/H spectral ratios; however, the full soil column profile consists of a thin layer of soil over bedrock. This profile is somewhat different than the generic rock conditions for which the V/H ratios shown on Figure 2.5.2-285 were developed. At present, there are no published V/H ratios for ground motions in the CEUS for the conditions represented by the full soil column profile, a profile with a thin soil layer over bedrock. Therefore, the V/H ratios for the vertical PBSRS were developed by examining differences between bedrock and shallow soil site V/H ratios for Western US (WUS) data and using the differences to adjust the CEUS hard rock V/H values.

The WUS V/H ratios recommended in NUREG/CR-6728 (Reference 3.7.1-202) were based on ground motion relationships for a generic bedrock site classification. More recently, Campbell and Bozorgnia (Reference 3.7.1-213) developed empirical ground motion prediction equations for bedrock sites that contained explicit categorization for firm bedrock ($V_{S30}$ 830 m/s ± 339 m/s [2,720 ft/s ± 1,110 ft/s]) and soft rock ($V_{S30}$ 421 m/s ± 109 m/s [1,380 ft/s ± 358 ft/s]) sites, where $V_{S30}$ is the average shear wave velocity in the upper 30 m (100 ft). The soft bedrock V/H ratios are used to indicate the potential behavior of a shallow stiff soil site. The results obtained using Campbell and Bozorgnia (Reference 3.7.1-213) suggest that the peak in the V/H ratios for soft bedrock shifts slightly towards lower frequencies compared to the peak for firm bedrock sites. The V/H ratios are also lower on soft bedrock for frequencies less than about 3 Hz.

The Pacific Earthquake Engineering Research (PEER) Center’s Next Generation Attenuation (NGA) Project (Reference 3.7.1-214) developed an extensive database of strong motion records from active tectonic environments. The records from Reference 3.7.1-214 were analyzed by Gülerce and Abrahamson (Reference 3.7.1-215) to develop a model for V/H ratios based on $V_{S30}$ values. In order to compare the model of Gülerce and Abrahamson (Reference 3.7.1-215) to the site categories of Campbell and Bozorgnia (Reference 3.7.1-213), V/H ratios were computed using the Gülerce and Abrahamson (Reference 3.7.1-215) model for $V_{S30}$ values of 830 m/s (2,720 ft/s) and 421 m/s (1,380 ft/s). These $V_{S30}$ values corresponded to the firm rock and soft rock categories of Campbell and Bozorgnia (Reference 3.7.1-213). The result suggests a trend similar to the Campbell and Bozorgnia (Reference 3.7.1-213) result.

Figure 3.7.1-220 shows V/H spectral ratios as a function of frequency used for generating the vertical PBSRS at the finished ground level grade, and the V/H spectral ratios recommended by NUREG/CR- 6728 (Reference 3.7.1-202) for CEUS bedrock sites with a PGA between 0.2 g and 0.5 g. The V/H spectral ratios used for generating the vertical PBSRS are based on the V/H spectral ratios recommended by NUREG/CR-6728 (Reference 3.7.1-202) for CEUS bedrock sites with a shift in the frequencies above 10 Hz to represent the shift in the peak V/H spectral ratios towards lower frequencies in the Campbell and Bozorgnia (Reference 3.7.1-213) and Gülerce and Abrahamson (Reference 3.7.1-215) comparisons. Additionally, at frequencies below 9 Hz, the V/H spectral ratio is reduced slightly to reflect the differences observed in the Campbell and Bozorgnia (Reference 3.7.1-213) and Gülerce and Abrahamson (Reference 3.7.1-215) comparisons. The resulting vertical PBSRS is listed in Table 3.7.1-205 along with the values of V/H. Figure 3.7.1-221 shows the horizontal and vertical PBSRS (5 percent damping) at the finished ground level grade.

#### 3.7.1.1.4.3.3 **Deterministic Profiles for SSI Analyses**

Three deterministic profiles, the best estimate (BE), lower bound (LB), and upper bound (UB), were developed from the full soil column site response analysis following the requirements of Standard Review Plan (SRP) 3.7.2 and guidance from the Interim Staff Guidance DC/COL-ISG-017. These profiles were based on the statistics of the iterated soil properties for the randomized full soil column profile described in Subsection 3.7.1.1.4.1.1.3, and include the engineered granular backfill above the top of the Bass Islands Group bedrock. The

60 randomized full soil column profiles were developed for each of the nine alternative sets of dynamic properties (three alternative sets of engineered granular backfill properties and three alternative sets of damping values in the in-situ bedrock). These 540 profiles were then used in site response analyses with the time histories matched to the $10^{-4}$ and $10^{-5}$ HF and LF DEL, DEM, and DEH response spectra. The results of these calculations produced a total of 1,620 profiles of strain-compatible dynamic properties for each of the $10^{-4}$ and $10^{-5}$ HF and LF exceedance levels of input motion. Each strain-compatible profile was assigned a weight equal to the product of the weights on the corresponding branches of the site response logic tree shown in Figure 3.7.1-210 times 1/60 for each randomization case. The resulting values of shear wave velocity and damping in each soil layer were then ranked in increasing order and the empirical 16$^{th}$, 50$^{th}$, and 84$^{th}$ percentile values were identified for the four loading levels.

The deterministic BE profile with engineered granular backfill above the top of the Bass Islands Group bedrock was set equal to values interpolated between the median iterated soil properties for the $10^{-4}$ and $10^{-5}$ exceedance level ground motions using linear interpolation based on the PGA values for the $10^{-4}$ and $10^{-5}$ UHRS and the PGA for the PBSRS. The 50$^{th}$ percentile properties for the HF and LF input motions were averaged to produce the BE profile. The resulting subsurface layers and the corresponding strain compatible dynamic engineering properties for the full soil column BE profile are listed in Table 3.7.1-206.

The deterministic LB profile with engineered granular backfill above the top of the Bass Islands Group bedrock was set equal to the 16$^{th}$ percentile of the distribution of randomized soil properties interpolated between the $10^{-4}$ and $10^{-5}$ exceedance level ground motions, and the deterministic UB profile with engineered granular backfill above the top of the Bass Islands Group bedrock was set equal to the 84$^{th}$ percentile of the distribution of randomized soil properties interpolated between the $10^{-4}$ and $10^{-5}$ exceedance level ground motions. To maximize the range of values, the minimum values from the LF and HF ground motions were used for the 16$^{th}$ percentile and the maximum of the LF and HF ground motions were used for the 84$^{th}$ percentile. The range in the UB and LB shear wave velocities was increased where necessary to maintain the minimum variation from the shear modulus for the deterministic BE profile ($G_{BE}$) required in SRP 3.7.2. The minimum variation is defined by a multiplicative factor of 1 plus the minimum coefficient of variation (COV) in shear modulus such that $G_{UB}$ is greater than or equal to the $G_{BE}$ x $(1+COV_{min})$ and $G_{LB}$ is less than or equal to $G_{BE}$ / $(1+COV_{min})$. SRP 3.7.2 specifies that the minimum COV for well studied sites is 0.5 and for sites less well investigated the minimum COV should be at least 1.0. The in-situ subsurface materials have been well investigated at the Fermi 3 site and a COV of 0.5 was used to establish the minimum variation in G between the LB, BE, and UB profiles in these materials. However, properties of the engineered granular backfill are estimates based on a range of possible characteristics. Therefore, a minimum COV of 1.0 was used in establishing the minimum variation in G between the LB, BE, and UB profiles in the engineered granular backfill. Table 3.7.1-207 and Table 3.7.1-208 list the resulting subsurface layers and the corresponding strain compatible dynamic engineering properties for the LB and UB deterministic profiles, respectively, with engineered granular backfill above the top of the Bass Islands Group bedrock.

Figure 3.7.1-222 shows the full soil column LB, BE, and UB subsurface shear wave velocity profiles with engineered granular backfill above the top of the Bass Islands Group bedrock for the Fermi 3 site. The corresponding damping ratios were obtained from the statistics of the iterated profiles assuming negative correlation between shear wave velocity ($V_S$) and damping: that is, the 16$^{th}$ percentile damping for the full soil column UB profile and the 84$^{th}$ percentile damping for the full soil column LB profile. The compression wave velocities were based on the shear wave velocities in the LB, BE, and UB shear wave velocity profiles with engineered granular backfill above the top of the Bass Islands Group bedrock, the recommend Poisson's ratios in Table 2.5.4-202, and the relationship from Kramer (Reference 3.7.1-206) presented as follows:

$$\frac{V_P}{V_S} = \sqrt{\frac{2-2v}{1-2v}} \qquad \text{[Eq. 6]}$$

Where:

$V_P$ is the compression wave velocity

$V_S$ is the shear wave velocity

$v$ is the Poisson's ratio

The bedrock and portions of the engineered granular backfill are below the groundwater table at the Fermi 3 site. The compression wave velocities in the bedrock exceeded the 1,460 m/s (4,790 ft/sec) the compression wave velocity of water from the DCD; therefore, a minimum compression wave velocity of 1,460 m/s (4,790 ft/sec) for the bedrock below the groundwater table was not imposed. In the engineered granular backfill, the compression wave velocities were less than the minimum value of 1,460 m/s (4,790 ft/sec) below the anticipated groundwater table. However, the compression wave velocities were not increased to the minimum value of 1,460 m/s (4,790 ft/sec) in the engineered granular backfill. Instead, the compression wave velocities were increased to the lower value of either 1,460 m/s (4,790 ft/sec) or the compression wave velocity that resulted in a maximum Poisson's ratio of 0.48 for the corresponding LB, BE, and UB shear wave velocity.

Figure 3.7.1-223 shows the LB, BE, and UB subsurface shear wave velocity profiles without engineered granular backfill above the top of the Bass Islands Group bedrock for the Fermi 3 site near the RB/FB and CB. Table 3.7.1-209, Table 3.7.1-210, and Table 3.7.1-211 present the BE, LB, and UB deterministic profiles without the engineered granular backfill above the top of the Bass Islands Group bedrock. The deterministic profiles without the engineered granular backfill above the top of the Bass Islands Group bedrock are the same as the deterministic profiles for the full soil column below the top of the Bass Islands Group bedrock.

#### 3.7.1.1.4.4 **SCOR FIRS for the RB/FB and CB**

The process described in Subsection 3.7.1.1.4.3 was used to develop the SCOR FIRS at the RB/FB and CB foundation levels. The SCOR FIRS are shown on Figure 3.7.1-224 and Figure 3.7.1-225 for the RB/FB and CB, respectively. The spectral accelerations for the RB/FB and CB SCOR FIRS are provided in Table 3.7.1-212 and Table 3.7.1-213, respectively. Also shown on Figure 3.7.1-224 and Figure 3.7.1-225 are the ESBWR CSDRS. The SCOR FIRS for the RB/FB and CB are enveloped by the ESBWR CSDRS.

Since the RB/FB and CB foundation levels are within the bedrock units, the vertical SCOR FIRS were generated using the V/H spectral ratios for hard rock recommended by NUREG/CR-6728 (Reference 3.7.1-202) for CEUS bedrock sites. The recommended CEUS hard rock V/H spectral ratios for 0.2 g ≤ PGA ≤ 0.5 g are shown on Figure 3.7.1-220. Because the vertical PBSRS was based on modified V/H spectral ratios for a PGA between 0.2 g and 0.5 g, use of the rock V/H spectral ratios for this PGA range to develop the vertical SCOR FIRS maintains consistent vertical to horizontal spectral ratios between the PBSRS and SCOR FIRS. Table 3.7.1-212 and Table 3.7.1-213 provide the V/H ratios used to develop the vertical SCOR FIRS for the RB/FB and CB.

The SCOR FIRS were compared to appropriate site-independent spectral shapes scaled to the minimum PGA of 0.1g specified in 10 CFR Part 50, Appendix S. The RB/FB and CB are to be founded on relatively hard rock. The median rock spectral shape defined in NUREG/CR-0098 (Reference 3.7.1-216) has been used in NUREG-1407 (Reference 3.7.1-217) to specify ground motions for safety evaluations of CEUS nuclear power plants. Figure 3.7.1-226 and Figure 3.7.1-227 show that the SCOR FIRS without enhancement for the RB/FB and CB, respectively, do not envelop the median rock site spectral shape from NUREG/CR-0098 (Reference 3.7.1-216) scaled to 0.1g PGA between about 0.8 and 2 Hz. Alternatively, as discussed in NUREG/CR-6926 (Reference 3.7.1-218), NUREG/CR-6728 (Reference 3.7.1-202) developed appropriate spectral shapes for ground motions on CEUS rock sites. The CEUS rock site spectral relationships presented in NUREG/CR-6728 (Reference 3.7.1-202) were used to develop rock spectral shapes for the DEs presented in Table 3.7.1-212 and to construct the single enveloping spectral shape presented on Figure 3.7.1-226 and Figure 3.7.1-227. Figure 3.7.1-226 and Figure 3.7.1-227 show that the SCOR FIRS without enhancement for the RB/FB and CB, respectively, envelop the enveloping CEUS rock site spectral shapes scaled to the minimum PGA of 0.1g in NUREG/CR-6728 (Reference 3.7.1-202). The comparisons shown on Figure 3.7.1-226 and Figure 3.7.1-227 show that a small enhancement of the SCOR FIRS is needed in the frequency range of 0.8 to 2 Hz in order to envelop NUREG/CR-0098 (Reference 3.7.1-216) broad band spectral shape scaled to the minimum PGA of 0.1g.

Figure 3.7.1-226 and Figure 3.7.1-227 also compare the SCOR FIRS without enhancement to the horizontal spectral shape from RG 1.60 scaled to the minimum PGA of 0.1g. The RG 1.60 spectral shape is based on statistical analyses that included recordings on soil sites and, therefore, produces higher ground motion levels at intermediate to low frequencies. The SCOR FIRS without enhancement do not envelop the RG 1.60 shape scaled to a PGA of 0.1g in the frequency range of about 0.2 to 3 Hz. To conservatively meet the requirements of the minimum ground motions specified in 10 CFR Part 50, Appendix S, the SCOR FIRS were initially enhanced in the frequency range of about 0.2 to 3 Hz to envelop the RG 1.60 spectrum scaled to a PGA of 0.1g. The resulting initially enhanced SCOR FIRS also envelop the median rock spectral shape defined in NUREG/CR-0098 (Reference 3.7.1-216). Figure 3.7.1-226 and Figure 3.7.1-227 present the initially enhanced SCOR FIRS for the RB/FB and CB, respectively, the RG-1.60 spectrum scaled to the minimum PGA of 0.1g, and the ESBWR CSDRS. The horizontal initially enhanced SCOR FIRS for the RB/FB and CB envelop or equal the appropriate site-independent spectral shapes scaled to the minimum PGA of 0.1g, meet the requirements specified in Appendix S of 10 CFR Part 50 and SRP 3.7.1, and are enveloped by the horizontal ESBWR CSDRS.

Interim Staff Guidance DC/COL-ISG-017 and the NEI developed white paper (Reference 3.7.1-201) state that time histories matched to the outcrop FIRS should be convolved from the foundation level up to the finished ground level grade using the full soil column LB, BE, and UB subsurface profiles, and that the resulting envelope of the three surface spectra from the time histories should envelop the PBSRS at the finished ground level grade. This comparison was made by matching the seed time histories using the methods discussed in Subsection 3.7.1.1.5 to the initially enhanced SCOR FIRS. The matched time histories compatible with the initially enhanced SCOR FIRS were then input at the appropriate foundation level into the three deterministic profiles (LB, BE, and UB) for the full soil column with engineered granular backfill above the top of the Bass Islands Group bedrock (Table 3.7.1-206, Table 3.7.1-207, and Table 3.7.1-208), and convolved to the PBSRS level at the finished ground level grade with SHAKE analyses (Reference 3.7.1-222). Comparison of the resulting envelope of the three surface spectra from the horizontal time histories and the horizontal PBSRS showed that the resulting envelope did not envelop the horizontal PBSRS at frequencies below 0.2 Hz. Comparison of the resulting envelope of the three surface spectra from the vertical time histories and the vertical PBSRS showed that the envelope did not envelop the vertical PBSRS at frequencies below 0.2 Hz and at frequencies between about 1.5 Hz and 5 Hz.

Interim Staff Guidance DC/COL-ISG-017 and the NEI developed white paper (Reference 3.7.1-201) do not describe the development of hazard consistent seismic input for site response and SSI analyses for partially embedded structures. However, since the time histories matched to the SCOR FIRS will be used in the SSI analyses without engineered granular backfill above the top of the Bass Islands Group bedrock, the time histories were also convolved from the foundation level up to the top of the Bass Islands Group bedrock using the deterministic profiles without engineered granular backfill above the top of the Bass Islands Group bedrock in Table 3.7.1-209, Table 3.7.1-210, and Table 3.7.1-211. The matched time histories compatible with the initially enhanced SCOR FIRS were input at the appropriate foundation level into the three deterministic profiles (LB, BE, and UB) without engineered granular backfill above the top of the Bass Islands Group bedrock and convolved to the GMRS level at the top of the Bass Islands Group bedrock with SHAKE analyses (Reference 3.7.1-222). Comparison of the resulting envelope of the three surface spectra from the horizontal and vertical time histories and the horizontal and vertical GMRS showed that the resulting envelope fell below the GMRS at frequencies above 4 Hz. Comparison with the GMRS is considered appropriate since the GMRS represents a surface response spectra at the top of the deterministic profiles without engineered granular backfill above the top of the Bass Islands Group bedrock. The result of comparison of the surface spectra with the GMRS is similar to the comparison results for the PBSRS using the deterministic profiles with engineered granular backfill above the top of the Bass Islands Group bedrock.

The initially enhanced SCOR FIRS were then enhanced further by increasing the overall level of ground motion in the frequency ranges identified during the comparison of the resulting envelope of the three surface spectra from the time histories to the PBSRS and the GMRS. Figure 3.7.1-228 and Figure 3.7.1-229 show the horizontal SCOR FIRS without any enhancement and the horizontal enhanced SCOR FIRS for the RB/FB and CB, respectively. Also shown on Figure 3.7.1-228 and Figure 3.7.1-229 are the horizontal ESBWR CSDRS. The enhanced horizontal SCOR FIRS for the RB/FB and CB are enveloped by the horizontal ESBWR CSDRS.

Time histories matched to the enhanced SCOR FIRS were then convolved from the foundation level up to the finished ground level grade using the full soil column LB, BE, and UB deterministic profiles for comparison to the PBSRS at the finished ground level grade. Figure 3.7.1-230 and Figure 3.7.1-231 show the comparison of the PBSRS at the finished ground level grade with the envelope of the surface response spectra obtained from SHAKE analyses (Reference 3.7.1-222) using the LB, BE, and UB full soil column deterministic profiles with engineered granular backfill above the top of the Bass Islands Group bedrock and the matched time histories compatible with the RB/FB and CB enhanced SCOR FIRS, respectively. The envelope of the three response spectra at the ground surface exceeds the PBSRS at the finished ground level grade for each component of motion, satisfying Interim Staff Guidance DC/COL-ISG-017 and the NEI developed white paper (Reference 3.7.1-201). The time histories matched to the enhanced SCOR FIRS were also convolved from the foundation level up to the top of the Bass Islands Group bedrock using the LB, BE, and UB deterministic profiles without the engineered granular backfill above the top of the Bass Islands Group bedrock for comparison to the GMRS. Figure 3.7.1-232 and Figure 3.7.1-233 show the comparison of the GMRS with the envelope of the surface response spectra obtained from SHAKE analyses (Reference 3.7.1-222) using the deterministic profiles without the engineered granular backfill above the top of the Bass Islands Group bedrock and the matched time histories compatible with the RB/FB and CB enhanced SCOR FIRS, respectively. The envelope of the three response spectra at the top of the Bass Islands Group bedrock exceeds the GMRS for each component of motion. The horizontal RB/FB and CB enhanced SCOR FIRS values are provided in Table 3.7.1-214 and Table 3.7.1-215, respectively.

The vertical SCOR FIRS was also enhanced in the identified frequency ranges. Figure 3.7.1-228 and Figure 3.7.1-229 also show the vertical SCOR FIRS and the vertical enhanced SCOR FIRS for the RB/FB and CB, respectively. Also shown on Figure 3.7.1-228 and Figure 3.7.1-229 are the vertical ESBWR CSDRS. The vertical enhanced SCOR FIRS for the RB/FB and CB are enveloped by the vertical ESBWR CSDRS. Vertical component time histories matched to the vertical enhanced SCOR FIRS were convolved from the foundation level up to the finished ground level grade using the deterministic profiles with engineered granular backfill above the top of the Bass Islands Group bedrock for comparison to the PBSRS at the finished ground level grade. Figure 3.7.1-234 and Figure 3.7.1-235 show the comparison of the vertical PBSRS at the finished ground level grade with the envelope of the surface response spectra obtained from SHAKE analyses (Reference 3.7.1-222) using the deterministic profiles with engineered granular backfill above the top of the Bass Islands Group bedrock and the matched time histories compatible with the vertical RB/FB and CB enhanced SCOR FIRS, respectively. The envelope of the three response spectra at the ground surface exceeds the vertical PBSRS at the finished ground level grade for each component of motion, satisfying Interim Staff Guidance DC/COL-ISG-017 and the NEI developed white paper (Reference 3.7.1-201). The vertical component time histories matched to the vertical enhanced SCOR FIRS were also convolved from the foundation level up to the top of the Bass Islands Group bedrock using the deterministic profiles without engineered granular backfill above the top of the Bass Islands Group bedrock for comparison to the vertical GMRS. Figure 3.7.1-236 and Figure 3.7.1-237 show the comparison of the vertical GMRS with the envelope of the surface response spectra obtained from SHAKE analyses (Reference 3.7.1-222) using the deterministic profiles without engineered granular backfill above the top of the Bass Islands Group bedrock and the matched time histories compatible with the vertical RB/FB and CB enhanced SCOR FIRS, respectively. The envelope of the three response spectra at the top of the Bass Islands Group bedrock exceeds the GMRS for each component of motion. The vertical RB/FB and CB enhanced SCOR FIRS values are provided in Table 3.7.1-214 and Table 3.7.1-215, respectively.

Table 3.7.1-214 and Table 3.7.1-215 provide the PGA values – listed as the 100 Hz values – for the horizontal RB/FB and CB enhanced SCOR FIRS. The PGA values for the horizontal RB/FB and CB enhanced SCOR FIRS are higher than the minimum 0.1g requirement of SRP 3.7.1.

#### 3.7.1.1.4.5 FWSC FIRS

The process described in Subsection 3.7.1.1.4.4 was used to develop the FIRS at the FWSC foundation level. The horizontal FWSC FIRS is shown on Figure 3.7.1-238. The spectral accelerations for the horizontal FWSC FIRS are provided in Table 3.7.1-216. The FWSC FIRS includes the 2D effect of the fill concrete by incorporating the 2D/1D response spectral ratio envelopes discussed in Subsection 3.7.1.1.4.1.2 in the amplification functions for the FWSC. Also shown on Figure 3.7.1-238 is the curve for 1.35 times the ESBWR CSDRS, which is the appropriate comparison for the FWSC FIRS, as described in DCD Section 3.7.1.1. The FWSC FIRS is enveloped by 1.35 times the ESBWR CSDRS.

Since the FWSC foundation level is on top of fill concrete and bedrock units with relatively high shear wave velocities, the vertical FWSC FIRS was generated using the V/H spectral ratios for hard rock recommended by NUREG/CR-6728 (Reference 3.7.1-202) for CEUS bedrock sites. The recommended CEUS hard rock V/H spectral ratios for 0.2 g ≤ PGA ≤ 0.5 g are shown on Figure 3.7.1-220. The vertical FWSC FIRS is shown on Figure 3.7.1-238. The spectral accelerations and V/H ratios for the vertical FWSC FIRS are provided in Table 3.7.1-216.

#### 3.7.1.1.5 Site-Specific Design Ground Motion Time Histories

Sets of three orthogonal time histories (two horizontal and one vertical component) were generated to match the horizontal and vertical enhanced SCOR FIRS (Subsection 3.7.1.1.4.4) for the RB/FB and CB, respectively, in accordance with the criteria of NUREG/CR-6728 (Reference 3.7.1-202). The selected seed time histories are those of the 1999 Chi-Chi Taiwan Earthquake, TAP078 recording, chosen from the CEUS record library provided in NUREG/CR-6728 (Reference 3.7.1-202). These time histories represent a distant recording of a large magnitude (moment magnitude 7.6) earthquake, consistent with the large contribution of the New Madrid source to the hazard at the Fermi 3 site. Details of this record are provided in Table 3.7.1-217.

A single set of time histories (two horizontal and one vertical component) was developed for both the RB/FB and CB foundation levels following the requirements of Option 1, Approach 2 of SRP 3.7.1 Section II (Acceptance Criteria), Revision 3. Per paragraph 2(d) of Approach 2, in lieu of the power spectrum density (PSD) requirement, the requirement that the computed 5 percent damped response spectrum of the time history does not exceed the target response spectrum at any frequency by more than 30 percent was met at frequencies between 0.1 and 50 Hz. A few frequencies above 50 Hz do exceed the target spectrum by more than 30 percent; however, a check of the PSD for frequencies above 50 Hz that exceed the target spectrum by more than 30 percent is not required for CEUS sites by Appendix B of SRP 3.7.1. Table 3.7.1-218 presents the cross correlation coefficients between each combination of time history components (two horizontal and one vertical). The cross correlation coefficients all fall below the criteria of 0.16 in SRP 3.7.1 Section II (Acceptance Criteria), Revision 3.

Spectral matching was performed using the time-domain spectral matching procedure proposed by Lilhanand and Tseng (Reference

3.7.1-219) and later modified by Abrahamson (Reference 3.7.1-220). Figure 3.7.1-239 through Figure 3.7.1-244 show the comparison of the response spectrum in the two horizontal and one vertical direction for the following:

- The enhanced SCOR FIRS at the RB/FB and CB levels.
- 1.3 times (30 percent greater) the enhanced SCOR FIRS.
- 0.9 times (10 percent less) the enhanced SCOR FIRS.
- Response spectrum for the spectrally matched time history

The response spectra for the spectrally-matched time histories were calculated for comparison with the enhanced SCOR FIRS at 301 spectral frequency points (or 100 frequencies per spectral frequency decade). As shown in Figure 3.7.1-239 through Figure 3.7.1-244, the 5 percent damped response spectra of the spectrally-matched time histories are within the range of 0.9 to 1.3 times the enhanced SCOR FIRS at frequencies between 0.1 and 50 Hz. Therefore, the criteria of Option 1, Approach 2 of SRP 3.7.1 Section II (Acceptance Criteria), Revision 3, are satisfied.

The time step and duration of the matched time histories are 0.005 seconds and 80 seconds, respectively. The duration of the time histories for Arias Intensity to rise from 5 to 75 percent is greater than the minimum 6 second duration identified in SRP 3.7.1, Section II (Acceptance Criteria), Revision 3, and are consistent with the characteristic earthquake duration of NUREG/CR-6728 (Reference 3.7.1-202). Details of the matched time histories including the PGA, peak ground velocity (PGV), and peak ground displacement (PGD) are presented in Table 3.7.1-219. Figure 3.7.1-245 to Figure 3.7.1-250 present the matched time histories (outcropping motions) compatible with the RB/FB and CB enhanced SCOR FIRS at the foundation levels. The duration and the value of PGV/PGA (Table 3.7.1-219) are generally consistent with the characteristic values reported in NUREG/CR-6728 (Reference 3.7.1-202); however, the values of $PGA*PGD/PGV^2$ are larger. The hard rock UHRS for the Fermi 3 site represents a combination of hazard from large, distant earthquakes and smaller, closer earthquakes. Thus, it is expected that the PGA is enriched to represent smaller magnitude, closer earthquakes. Spectral matching of the time histories to response spectra extended to a period of 10 seconds also enriches the PGD values, leading to an increase in the values of $PGA*PGD/PGV^2$.

To demonstrate that there are no significant gaps in power for the spectrally-matched time histories, power spectral densities (PSD) were calculated for the frequency range of 0.3 to 50 Hz following the guidance in SRP 3.7.1, Appendix B. The equivalent stationary duration, $T_D$, used to calculate the PSD for the spectrally-matched time histories was established in general accordance with SRP 3.7.1 and the additional guidance in NUREG/CR-5347 (Reference 3.7.1-221). Figure 3.7.1-251 presents the normalized Arias intensities for the horizontal components, H1 and H2, of the spectrally matched time histories compatible with the RB/FB enhanced SCOR FIRS. The normalized Arias intensity plots for the spectrally matched time histories compatible with the CB enhanced SCOR FIRS are not presented since they are essentially identical to Figure 3.7.1-251.

The PSD was evaluated using the following two approaches for computing the Fourier amplitudes:

- Using the full duration of the spectrally matched time histories.
- Using only the portion of the spectrally matched time histories corresponding to the equivalent stationary duration.

Appendix B of NUREG/CR-5347 (Reference 3.7.1-221) indicates that $T_D$ is estimated by identifying the portion of the time history where the slope (power) of a cumulative energy plot (represented by normalized Arias intensity) is nearly constant and near maximum. Figure 3.7.1-251 provides a range of estimates of constant power slopes for the two horizontal RB/FB components.

The Fermi 3 FIRS represent the combined effects of two distinct earthquakes, a nearby moderate magnitude earthquake and a distant large earthquake (New Madrid). The seed time history for spectral matching was selected to represent the long duration expected in a distant recording of a large magnitude earthquake. As illustrated by the spectrally matched acceleration and velocity time histories on Figure 3.7.1-245 and Figure 3.7.1-246, the time histories exhibit non-stationarity that results in high frequency energy more prominent in the early portion of the records and low frequency energy more prominent in the latter portion of the records. Because of the long duration and non-stationarity of the recording, longer values of $T_D$ are needed to better represent the energy content of the recordings. Therefore, the time for the Arias intensities to rise from 0 to 100 percent is used to establish $T_D$ instead of the more commonly used time to rise from 5 to 75 percent Arias intensity. This time was established by extending the constant power slopes to 0 percent and 100 percent Arias intensity, as shown on Figure 3.7.1-251, and the time between the intersection with the 0 and 100 percent Arias intensity levels was used to establish a value of $T_D$.

Use of the full duration of the spectrally matched time history records to compute the Fourier amplitudes for the PSD captures the full frequency content of the records, which is consistent with the SSI analyses that also use the full duration time history records. Values of $T_D$ of 30 seconds for the H1 component and 31.5 seconds for the H2 component were selected from the range of estimated values for the PSD calculation using the full duration of the spectrally matched time histories. The resulting PSDs for the horizontal spectrally matched time histories are shown on Figure 3.7.1-252, Figure 3.7.1-253, Figure 3.7.1-254, and Figure 3.7.1-255 for the RB/FB H1 component, the RB/FB H2 component, the CB H1 component, and CB H2 component, respectively. As demonstrated in these figures, with the full duration considered, the spectrally matched time histories have no significant gaps in power over the frequency range of 0.3 to 50 Hz.

Appendix B of SRP 3.7.1 indicates the PSD is calculated using the portion of the spectrally matched time history corresponding to $T_D$. The effect of using only the $T_D$ portion of the time histories to compute the PSD is illustrated on Figure 3.7.1-252 through Figure 3.7.1-255. On each figure, the different PSD are calculated using the portion of the spectrally matched time history windowed to the different $T_D$ values shown on Figure 3.7.1-251. Outside of the $T_D$ window, a two second duration cosine taper was applied to reduce the time history amplitude to zero.

For the RB/FB H1 component shown on Figure 3.7.1-252, the PSD for the windowed time histories are similar to the PSD computed using the full duration time history. There is a decrease in amplitude at frequencies above 30 Hz and below 1 Hz. The observed decreases reflect the fact that some of the energy content at these frequencies occurs outside of the selected $T_D$ time window. For the shortest $T_D$ of 30 seconds, a narrow dip in power occurs in the low frequency range near 0.4 Hz. However, the PSD for the windowed time histories are generally similar to the PSD using the full duration time history and show no significant gaps in power.

Figure 3.7.1-253 shows the results for the RB/FB H2 component. The PSD for the windowed time histories are also similar to the PSD computed using the full duration time history. There is a decrease in amplitude at frequencies above 25 Hz, and between about 0.7 and 1 Hz, again reflecting that some of the energy content at these frequencies occurs outside of the selected $T_D$ time window. As was the case for the H1 component, the PSD for the windowed time histories are generally similar to the PSD using the full duration time history and show no significant gaps in power.

Figure 3.7.1-254 and Figure 3.7.1-255 show the corresponding comparisons for the CB H1 and CB H2 components, respectively. The results are similar to those shown for the corresponding RB/FB components.

In summary, the PSDs computed using the full duration, spectrally matched time histories show that there are no significant gaps in power over the frequency range of 0.3 to 50 Hz. PSDs computed using the windowed portion of the spectrally matched time histories corresponding to $T_D$ also show no significant gaps in power. There is a narrow dip in power near 0.4 Hz using the window corresponding to a $T_D$ of 30 seconds for the H1 component for both the RB/FB and CB. However, extending TD to 32, 34, or 36 seconds eliminates this narrow dip. The PSD computed using the windowed time histories show a decrease in power compared to PSD computed using the full duration time histories above 25 Hz. This difference indicates a degree of non-stationarity in the time histories, but does not produce significant gaps in the frequency range of 0.3 to 50 Hz.

In accordance with Interim Staff Guidance DC/COL-ISG-017 and the NEI developed white paper (Reference 3.7.1-201), the spectrally-matched time histories compatible with the RB/FB and CB enhanced SCOR FIRS were then input as outcropping motions at the foundation level into the LB, BE, and UB deterministic profiles without engineered granular backfill above the top of the Bass Islands Group bedrock to compute the resulting in-column motions at the RB/FB and CB foundation levels using the program SHAKE (Reference 3.7.1-222). A total of 18 SHAKE analyses were performed using combinations of the LB, BE, and UB deterministic profiles without engineered granular backfill above the top of the Bass Islands Group bedrock, the three time history components (two horizontal and one vertical components) and the two foundation levels (RB/FB and CB). The SHAKE analyses were performed using the LB, BE, and UB deterministic profiles in Table 3.7.1-209, Table 3.7.1-210, and Table 3.7.1-211 without iteration of soil properties to generate in-column motions at the foundation levels for input into the Fermi 3 site specific SSI analysis without engineered granular backfill above the top of the Bass Islands Group bedrock.

In-column motions at the foundation levels were also generated for the LB, BE, and UB deterministic profiles with engineered granular backfill above the top of the Bass Islands Group bedrock in Table 3.7.1-206, Table 3.7.1-207, and Table 3.7.1-208. The SHAKE analyses were performed using the spectrally-matched time histories compatible with the RB/FB and CB enhanced SCOR FIRS and without iteration of soil properties to generate 18 additional in-column motions at the foundation levels for the Fermi 3 site specific SSI analysis with engineered granular backfill above the top of the Bass Islands Group bedrock.

To evaluate the energy present at different frequencies in the 36 in-column acceleration time histories, power spectra were computed for each of the time histories. The cumulative power was then calculated from 0 to 100 Hz to determine what percentage of power is below 50 Hz in the in-column acceleration time histories. As an example, Figure 3.7.1-256 presents the power spectrum and cumulative power plots for the horizontal (H1 and H2) in-column acceleration time history compatible with the BE deterministic profile without engineered granular backfill above the top of the Bass Islands Group bedrock. Table 3.7.1-220 presents the percentage of the cumulative power below 50 Hz for each in-column acceleration time history. The horizontal components include between 92 and 100 percent of the total power at frequencies below 50 Hz. The vertical components include between 88 and 95 percent of the total power at frequencies below 50 Hz.

### 3.7.1.2 **Percentage of Critical Damping Values**

Add the following at the end of Subsection 3.7.1.2.

Table 3.7.1-206 through Table 3.7.1-208 provide the damping ratios for subsurface material properties used in Fermi 3 site-specific SSI analyses with engineered granular backfill above the top of the Bass Islands Group bedrock for the RB/FB and CB. Table 3.7.1-209 through Table 3.7.1-211 provide the damping ratios for subsurface material properties used in Fermi 3 site-specific SSI analyses without engineered granular backfill above the top of the Bass Islands Group bedrock for the RB/FB and CB. The damping ratios in Table 3.7.1-206 through Table 3.7.1-211 are the same for layers below the top of the Bass Islands Group bedrock at an elevation of 168.1 m (551.7 ft) NAVD 88.

### 3.7.1.3 Supporting Media for Category I Structures

Add the following at the end of the first paragraph.

Subsection 2.5.4 provides site-specific properties of subsurface materials.

Subsection 2.5.4 provides engineering properties of subsurface materials at the Fermi 3 site. The design groundwater elevation assumed for development of the deterministic profiles is provided in Subsection 3.7.1.1.4.1.1. Table 3.7.1-209 through Table 3.7.1-211 provide the strain compatible dynamic engineering properties of subsurface material for the deterministic profiles used for the Fermi 3 site-specific SSI analyses for the RB/FB and CB without the engineered granular backfill above the top of the Bass Islands Group bedrock. Table 3.7.1-206 through Table 3.7.1-208 provide the strain compatible dynamic engineering properties of subsurface material for the deterministic profiles used for the Fermi 3 site-specific SSI analyses for the RB/FB and CB with the engineered granular backfill above the top of the Bass Islands Group bedrock. The LB, BE, and UB profiles with and without engineered granular backfill above the top of the Bass Islands Group bedrock are identical with the exception of approximately 11.5 m (37.6 ft) of engineered granular fill material above the top of the Bass Islands Group bedrock. Figure 3.7.1-223 shows the LB, BE, and UB subsurface shear wave velocity profiles for the Fermi 3 site-specific SSI analysis without the engineered granular backfill above the top of the Bass Islands Group bedrock. Figure 3.7.1-222 shows the LB, BE, and UB subsurface shear wave velocity profiles for the Fermi 3 site-specific SSI analysis with the engineered granular backfill above the top of the Bass Islands Group bedrock.

### 3.7.1.4 References

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## Table 3.7.1-201 Full Soil Column Site Response Analysis Profile: Lower Range [EF3 COL 2.0-27-A, EF3 SUP 3.7-1]

| Layer Number | Thickness (ft.) | Shear wave Velocity (fps) | Unit Weight (kips/ft.$^3$) | Material Curves | Soil/Rock Type |
|---|---|---|---|---|---|
| Finished Ground Level Grade, Top of Profile Elevation 589.3 ft. | | | | | |
| 1 | 2.9 | 397 | 0.119 | MENQ 0-20 feet | Backfill |
| 2 | 2.9 | 525 | 0.119 | MENQ 0-20 feet | Backfill |
| 3 | 4.2 | 578 | 0.119 | MENQ 0-20 feet | Backfill |
| 4 | 3.2 | 626 | 0.119 | MENQ 0-20 feet | Backfill |
| 5 | 2.5 | 653 | 0.119 | MENQ 0-20 feet | Backfill |
| 6 | 4.3 | 679 | 0.119 | MENQ 0-20 feet | Backfill |
| 7 | 5.0 | 718 | 0.119 | MENQ 20-50 feet | Backfill |
| 8 | 5.0 | 755 | 0.119 | MENQ 20-50 feet | Backfill |
| 9 | 3.45 | 789 | 0.119 | MENQ 20-50 feet | Backfill |
| 10 | 4.15 | 821 | 0.119 | MENQ 20-50 feet | Backfill |
| 11 | 9.7 | 6650 | 0.150 | Linear, k layer 1 | Bass Islands |
| 12 | 10 | 6650 | 0.150 | Linear, k layer 1 | Bass Islands |
| 13 | 10 | 6650 | 0.150 | Linear, k layer 1 | Bass Islands |
| 14 | 10 | 6650 | 0.150 | Linear, k layer 1 | Bass Islands |
| 15 | 11 | 6650 | 0.150 | Linear, k layer 1 | Bass Islands |
| 16 | 12 | 6650 | 0.150 | Linear, k layer 1 | Bass Islands |
| 17 | 12 | 6650 | 0.150 | Linear, k layer 1 | Bass Islands |
| 18 | 15 | 4600 | 0.150 | Linear, k layer 2 | Bass Islands |
| 19 | 20 | 3350 | 0.150 | Linear, k layer 3 | Salina F |
| 20 | 20 | 3350 | 0.150 | Linear, k layer 3 | Salina F |
| 21 | 20 | 3350 | 0.150 | Linear, k layer 3 | Salina F |
| 22 | 21 | 3350 | 0.150 | Linear, k layer 3 | Salina F |
| 23 | 21 | 4050 | 0.150 | Linear, k layer 3 | Salina F |
| 24 | 21 | 4050 | 0.150 | Linear, k layer 3 | Salina F |
| 25 | 10 | 5600 | 0.150 | Linear, k layer 4 | Salina E |
| 26 | 20 | 9450 | 0.150 | Linear, k layer 4 | Salina E |
| 27 | 21 | 9450 | 0.150 | Linear, k layer 4 | Salina E |
| 28 | 21 | 9450 | 0.150 | Linear, k layer 4 | Salina E |
| 29 | 21 | 9450 | 0.150 | Linear, k layer 4 | Salina E |
| 30 | 45 | 9000 | 0.160 | Linear, k layer 4 | Salina C |
| 31 | 45 | 9000 | 0.160 | Linear, k layer 4 | Salina C |
| Halfspace | | 9300 | 0.169 | 0.1 % Damping | Salina B |

## Table 3.7.1-202 Full Soil Column Site Response Analysis Profile: Intermediate Range [EF3 COL 2.0-27-A, EF3 SUP 3.7-1]

| Layer Number | Thickness (ft.) | Shear wave Velocity (fps) | Unit Weight (kips/ft.$^3$) | Material Curves | Soil/Rock Type |
|---|---|---|---|---|---|
| **Finished Ground Level Grade, Top of Profile Elevation 589.3 ft.** | | | | | |
| 1 | 2.9 | 533 | 0.1325 | Intermediate 0-20 feet | Backfill |
| 2 | 2.9 | 623 | 0.1325 | Intermediate 0-20 feet | Backfill |
| 3 | 4.2 | 680 | 0.1325 | Intermediate 0-20 feet | Backfill |
| 4 | 3.2 | 739 | 0.1325 | Intermediate 0-20 feet | Backfill |
| 5 | 2.5 | 772 | 0.1325 | Intermediate 0-20 feet | Backfill |
| 6 | 4.3 | 806 | 0.1325 | Intermediate 0-20 feet | Backfill |
| 7 | 5.0 | 854 | 0.1325 | Intermediate 20-50 feet | Backfill |
| 8 | 5.0 | 901 | 0.1325 | Intermediate 20-50 feet | Backfill |
| 9 | 3.45 | 944 | 0.1325 | Intermediate 20-50 feet | Backfill |
| 10 | 4.15 | 984 | 0.1325 | Intermediate 20-50 feet | Backfill |
| 11 | 9.7 | 6650 | 0.150 | Linear, k layer 1 | Bass Islands |
| 12 | 10 | 6650 | 0.150 | Linear, k layer 1 | Bass Islands |
| 13 | 10 | 6650 | 0.150 | Linear, k layer 1 | Bass Islands |
| 14 | 10 | 6650 | 0.150 | Linear, k layer 1 | Bass Islands |
| 15 | 11 | 6650 | 0.150 | Linear, k layer 1 | Bass Islands |
| 16 | 12 | 6650 | 0.150 | Linear, k layer 1 | Bass Islands |
| 17 | 12 | 6650 | 0.150 | Linear, k layer 1 | Bass Islands |
| 18 | 15 | 4600 | 0.150 | Linear, k layer 2 | Bass Islands |
| 19 | 20 | 3350 | 0.150 | Linear, k layer 3 | Salina F |
| 20 | 20 | 3350 | 0.150 | Linear, k layer 3 | Salina F |
| 21 | 20 | 3350 | 0.150 | Linear, k layer 3 | Salina F |
| 22 | 21 | 3350 | 0.150 | Linear, k layer 3 | Salina F |
| 23 | 21 | 4050 | 0.150 | Linear, k layer 3 | Salina F |
| 24 | 21 | 4050 | 0.150 | Linear, k layer 3 | Salina F |
| 25 | 10 | 5600 | 0.150 | Linear, k layer 4 | Salina E |
| 26 | 20 | 9450 | 0.150 | Linear, k layer 4 | Salina E |
| 27 | 21 | 9450 | 0.150 | Linear, k layer 4 | Salina E |
| 28 | 21 | 9450 | 0.150 | Linear, k layer 4 | Salina E |
| 29 | 21 | 9450 | 0.150 | Linear, k layer 4 | Salina E |
| 30 | 45 | 9000 | 0.160 | Linear, k layer 4 | Salina C |
| 31 | 45 | 9000 | 0.160 | Linear, k layer 4 | Salina C |
| Halfspace | | 9300 | 0.169 | 0.1 % Damping | Salina B |

## Table 3.7.1-203 Full Soil Column Site Response Analysis Profile: Upper Range [EF3 COL 2.0-27-A, EF3 SUP 3.7-1]

| Layer Number | Thickness (ft.) | Shear wave Velocity (fps) | Unit Weight (kips/ft.$^3$) | Material Curves | Soil/Rock Type |
|---|---|---|---|---|---|
| **Finished Ground Level Grade, Top of Profile Elevation 589.3 ft.** | | | | | |
| 1 | 2.9 | 670 | 0.146 | EPRI 0-20 feet | Backfill |
| 2 | 2.9 | 722 | 0.146 | EPRI 0-20 feet | Backfill |
| 3 | 4.2 | 781 | 0.146 | EPRI 0-20 feet | Backfill |
| 4 | 3.2 | 852 | 0.146 | EPRI 0-20 feet | Backfill |
| 5 | 2.5 | 892 | 0.146 | EPRI 0-20 feet | Backfill |
| 6 | 4.3 | 932 | 0.146 | EPRI 0-20 feet | Backfill |
| 7 | 5.0 | 990 | 0.146 | EPRI 20-50 feet | Backfill |
| 8 | 5.0 | 1046 | 0.146 | EPRI 20-50 feet | Backfill |
| 9 | 3.45 | 1098 | 0.146 | EPRI 20-50 feet | Backfill |
| 10 | 4.15 | 1147 | 0.146 | EPRI 20-50 feet | Backfill |
| 11 | 9.7 | 6650 | 0.150 | Linear, k layer 1 | Bass Islands |
| 12 | 10 | 6650 | 0.150 | Linear, k layer 1 | Bass Islands |
| 13 | 10 | 6650 | 0.150 | Linear, k layer 1 | Bass Islands |
| 14 | 10 | 6650 | 0.150 | Linear, k layer 1 | Bass Islands |
| 15 | 11 | 6650 | 0.150 | Linear, k layer 1 | Bass Islands |
| 16 | 12 | 6650 | 0.150 | Linear, k layer 1 | Bass Islands |
| 17 | 12 | 6650 | 0.150 | Linear, k layer 1 | Bass Islands |
| 18 | 15 | 4600 | 0.150 | Linear, k layer 2 | Bass Islands |
| 19 | 20 | 3350 | 0.150 | Linear, k layer 3 | Salina F |
| 20 | 20 | 3350 | 0.150 | Linear, k layer 3 | Salina F |
| 21 | 20 | 3350 | 0.150 | Linear, k layer 3 | Salina F |
| 22 | 21 | 3350 | 0.150 | Linear, k layer 3 | Salina F |
| 23 | 21 | 4050 | 0.150 | Linear, k layer 3 | Salina F |
| 24 | 21 | 4050 | 0.150 | Linear, k layer 3 | Salina F |
| 25 | 10 | 5600 | 0.150 | Linear, k layer 4 | Salina E |
| 26 | 20 | 9450 | 0.150 | Linear, k layer 4 | Salina E |
| 27 | 21 | 9450 | 0.150 | Linear, k layer 4 | Salina E |
| 28 | 21 | 9450 | 0.150 | Linear, k layer 4 | Salina E |
| 29 | 21 | 9450 | 0.150 | Linear, k layer 4 | Salina E |
| 30 | 45 | 9000 | 0.160 | Linear, k layer 4 | Salina C |
| 31 | 45 | 9000 | 0.160 | Linear, k layer 4 | Salina C |
| Halfspace | | 9300 | 0.169 | 0.1 % Damping | Salina B |

## Table 3.7.1-204 FWSC Foundation Input Response Spectrum Site Response Analysis Profile [EF3 COL 2.0-27-A, EF3 SUP 3.7-1]

| Layer Number | Thickness (ft.) | Shear wave Velocity (fps) | Unit Weight (kips/ft.$^3$) | Material Curves | Soil/Rock Type |
|---|---|---|---|---|---|
| **FWSC FIRS Profile, Top of Profile Elevation 581.6 ft** | | | | | |
| 1 | 1.9 | 7140 | 0.145 | Fill concrete | N/A |
| 2 | 1.9 | 7140 | 0.145 | Fill concrete | N/A |
| 3 | 3.2 | 7140 | 0.145 | Fill concrete | N/A |
| 4 | 2.2 | 7140 | 0.145 | Fill concrete | N/A |
| 5 | 1.5 | 7140 | 0.145 | Fill concrete | N/A |
| 6 | 3.3 | 7140 | 0.145 | Fill concrete | N/A |
| 7 | 4.0 | 7140 | 0.145 | Fill concrete | N/A |
| 8 | 4.3 | 7140 | 0.145 | Fill concrete | N/A |
| 9 | 3.5 | 7140 | 0.145 | Fill concrete | N/A |
| 10 | 4.2 | 7140 | 0.145 | Fill concrete | N/A |
| 11 | 9.7 | 6650 | 0.150 | Linear, k layer 1 | Bass Islands |
| 12 | 10 | 6650 | 0.150 | Linear, k layer 1 | Bass Islands |
| 13 | 10 | 6650 | 0.150 | Linear, k layer 1 | Bass Islands |
| 14 | 10 | 6650 | 0.150 | Linear, k layer 1 | Bass Islands |
| 15 | 11 | 6650 | 0.150 | Linear, k layer 1 | Bass Islands |
| 16 | 12 | 6650 | 0.150 | Linear, k layer 1 | Bass Islands |
| 17 | 12 | 6650 | 0.150 | Linear, k layer 1 | Bass Islands |
| 18 | 15 | 4600 | 0.150 | Linear, k layer 2 | Bass Islands |
| 19 | 20 | 3350 | 0.150 | Linear, k layer 3 | Salina F |
| 20 | 20 | 3350 | 0.150 | Linear, k layer 3 | Salina F |
| 21 | 20 | 3350 | 0.150 | Linear, k layer 3 | Salina F |
| 22 | 21 | 3350 | 0.150 | Linear, k layer 3 | Salina F |
| 23 | 21 | 4050 | 0.150 | Linear, k layer 3 | Salina F |
| 24 | 21 | 4050 | 0.150 | Linear, k layer 3 | Salina F |
| 25 | 10 | 5600 | 0.150 | Linear, k layer 4 | Salina E |
| 26 | 20 | 9450 | 0.150 | Linear, k layer 4 | Salina E |
| 27 | 21 | 9450 | 0.150 | Linear, k layer 4 | Salina E |
| 28 | 21 | 9450 | 0.150 | Linear, k layer 4 | Salina E |
| 29 | 21 | 9450 | 0.150 | Linear, k layer 4 | Salina E |
| 30 | 45 | 9000 | 0.160 | Linear, k layer 4 | Salina C |
| 31 | 45 | 9000 | 0.160 | Linear, k layer 4 | Salina C |
| Halfspace | | 9300 | 0.169 | 0.1 % Damping | Salina B |

## Table 3.7.1-205 Horizontal and Vertical PBSRS at the Finished Ground Level Grade with Associated V/H Ratios (Sheet 1 of 2) [EF3 SUP 3.7-1]

| Period (sec) | Frequency (Hz) | Horizontal PBSRS (g) | V/H | Vertical PBSRS (g) |
|---|---|---|---|---|
| 0.010 | 100.00 | 0.2368 | 1.0000 | 0.2368 |
| 0.017 | 60.241 | 0.2575 | 1.0883 | 0.2802 |
| 0.020 | 50.000 | 0.2833 | 1.1329 | 0.3210 |
| 0.025 | 40.000 | 0.3221 | 1.1289 | 0.3636 |
| 0.030 | 33.333 | 0.3465 | 1.0971 | 0.3802 |
| 0.033 | 30.303 | 0.3616 | 1.0491 | 0.3794 |
| 0.040 | 25.000 | 0.4166 | 0.9674 | 0.4030 |
| 0.042 | 23.810 | 0.4248 | 0.9542 | 0.4054 |
| 0.044 | 22.727 | 0.4328 | 0.9400 | 0.4069 |
| 0.046 | 21.739 | 0.4406 | 0.9258 | 0.4079 |
| 0.048 | 20.833 | 0.4481 | 0.9124 | 0.4089 |
| 0.050 | 20.000 | 0.4555 | 0.8997 | 0.4098 |
| 0.055 | 18.182 | 0.4683 | 0.8725 | 0.4086 |
| 0.060 | 16.667 | 0.4803 | 0.8517 | 0.4091 |
| 0.065 | 15.385 | 0.4908 | 0.8319 | 0.4083 |
| 0.070 | 14.286 | 0.5008 | 0.8138 | 0.4075 |
| 0.075 | 13.333 | 0.5102 | 0.8022 | 0.4093 |
| 0.080 | 12.500 | 0.5192 | 0.7929 | 0.4117 |
| 0.085 | 11.765 | 0.5278 | 0.7842 | 0.4140 |
| 0.090 | 11.111 | 0.5361 | 0.7762 | 0.4161 |
| 0.095 | 10.526 | 0.5440 | 0.7686 | 0.4181 |
| 0.10 | 10.000 | 0.5516 | 0.7615 | 0.4201 |
| 0.11 | 9.0910 | 0.5661 | 0.7485 | 0.4237 |
| 0.12 | 8.3330 | 0.5796 | 0.7368 | 0.4270 |
| 0.13 | 7.6920 | 0.5923 | 0.7262 | 0.4301 |
| 0.14 | 7.1430 | 0.6043 | 0.7165 | 0.4330 |
| 0.15 | 6.6670 | 0.6157 | 0.7076 | 0.4357 |
| 0.16 | 6.2500 | 0.6266 | 0.6994 | 0.4382 |
| 0.17 | 5.8820 | 0.6370 | 0.6918 | 0.4406 |
| 0.18 | 5.5560 | 0.6469 | 0.6846 | 0.4429 |
| 0.19 | 5.2630 | 0.6565 | 0.6780 | 0.4451 |
| 0.20 | 5.0000 | 0.6657 | 0.6717 | 0.4472 |
| 0.22 | 4.5450 | 0.6817 | 0.6602 | 0.4501 |
| 0.24 | 4.1670 | 0.6849 | 0.6500 | 0.4452 |
| 0.26 | 3.8460 | 0.6813 | 0.6500 | 0.4428 |
| 0.28 | 3.5710 | 0.6639 | 0.6500 | 0.4315 |
| 0.30 | 3.3330 | 0.6372 | 0.6500 | 0.4142 |
| 0.32 | 3.1250 | 0.6039 | 0.6500 | 0.3926 |
| 0.34 | 2.9410 | 0.5663 | 0.6500 | 0.3681 |
| 0.36 | 2.7780 | 0.5289 | 0.6500 | 0.3438 |
| 0.38 | 2.6320 | 0.4990 | 0.6500 | 0.3244 |
| 0.40 | 2.5000 | 0.4660 | 0.6500 | 0.3029 |
| 0.42 | 2.3810 | 0.4409 | 0.6500 | 0.2866 |
| 0.44 | 2.2730 | 0.4160 | 0.6500 | 0.2704 |
| 0.46 | 2.1740 | 0.3915 | 0.6500 | 0.2545 |

**Table 3.7.1-205 Horizontal and Vertical PBSRS at the Finished Ground Level Grade with Associated V/H Ratios (Sheet 2 of 2) [EF3 SUP 3.7-1]**

| Period (sec) | Frequency (Hz) | Horizontal PBSRS (g) | V/H | Vertical PBSRS (g) |
|---|---|---|---|---|
| 0.48 | 2.0830 | 0.3677 | 0.6500 | 0.2390 |
| 0.50 | 2.0000 | 0.3469 | 0.6500 | 0.2255 |
| 0.55 | 1.8180 | 0.3082 | 0.6500 | 0.2004 |
| 0.60 | 1.6670 | 0.2737 | 0.6500 | 0.1779 |
| 0.65 | 1.5380 | 0.2438 | 0.6500 | 0.1584 |
| 0.70 | 1.4290 | 0.2191 | 0.6500 | 0.1424 |
| 0.75 | 1.3330 | 0.1997 | 0.6500 | 0.1298 |
| 0.80 | 1.2500 | 0.1824 | 0.6500 | 0.1186 |
| 0.85 | 1.1760 | 0.1685 | 0.6500 | 0.1095 |
| 0.90 | 1.1110 | 0.1573 | 0.6500 | 0.1023 |
| 0.95 | 1.0530 | 0.1468 | 0.6500 | 0.0954 |
| 1.0 | 1.0000 | 0.1373 | 0.6500 | 0.0892 |
| 1.1 | 0.9090 | 0.1234 | 0.6500 | 0.0802 |
| 1.2 | 0.8330 | 0.1128 | 0.6500 | 0.0733 |
| 1.3 | 0.7690 | 0.1024 | 0.6500 | 0.0666 |
| 1.4 | 0.7140 | 0.0966 | 0.6500 | 0.0628 |
| 1.5 | 0.6670 | 0.0918 | 0.6500 | 0.0597 |
| 1.6 | 0.6250 | 0.0875 | 0.6500 | 0.0569 |
| 1.7 | 0.5880 | 0.0839 | 0.6500 | 0.0546 |
| 1.8 | 0.5560 | 0.0817 | 0.6500 | 0.0531 |
| 1.9 | 0.5260 | 0.0797 | 0.6500 | 0.0518 |
| 2.0 | 0.5000 | 0.0778 | 0.6500 | 0.0506 |
| 2.2 | 0.4550 | 0.0719 | 0.6500 | 0.0467 |
| 2.4 | 0.4170 | 0.0669 | 0.6500 | 0.0435 |
| 2.6 | 0.3850 | 0.0626 | 0.6500 | 0.0407 |
| 2.8 | 0.3570 | 0.0589 | 0.6500 | 0.0383 |
| 3.0 | 0.3330 | 0.0556 | 0.6500 | 0.0361 |
| 3.2 | 0.3130 | 0.0527 | 0.6500 | 0.0342 |
| 3.4 | 0.2940 | 0.0505 | 0.6500 | 0.0328 |
| 3.6 | 0.2780 | 0.0485 | 0.6500 | 0.0315 |
| 3.8 | 0.2630 | 0.0467 | 0.6500 | 0.0304 |
| 4.0 | 0.2500 | 0.0451 | 0.6500 | 0.0293 |
| 4.2 | 0.2380 | 0.0436 | 0.6500 | 0.0283 |
| 4.4 | 0.2270 | 0.0422 | 0.6500 | 0.0274 |
| 4.6 | 0.2170 | 0.0409 | 0.6500 | 0.0266 |
| 4.8 | 0.2080 | 0.0397 | 0.6500 | 0.0258 |
| 5.0 | 0.2000 | 0.0386 | 0.6500 | 0.0251 |
| 5.5 | 0.1820 | 0.0352 | 0.6500 | 0.0229 |
| 6.0 | 0.1670 | 0.0324 | 0.6500 | 0.0211 |
| 6.5 | 0.1540 | 0.0300 | 0.6500 | 0.0195 |
| 7.0 | 0.1430 | 0.0280 | 0.6500 | 0.0182 |
| 7.5 | 0.1330 | 0.0262 | 0.6500 | 0.0170 |
| 8.0 | 0.1250 | 0.0244 | 0.6500 | 0.0158 |
| 8.5 | 0.1180 | 0.0228 | 0.6500 | 0.0148 |
| 9.0 | 0.1110 | 0.0214 | 0.6500 | 0.0139 |
| 10 | 0.1000 | 0.0190 | 0.6500 | 0.0124 |

## Table 3.7.1-206 Deterministic Profile with Engineered Granular Backfill above the Top of the Bass Islands Group Bedrock: Best Estimate [EF3 SUP 3.7-1]

| Layer | Thickness (ft) | Total Depth (ft) | Unit Weight (pcf) | Shear Wave Velocity (ft/sec) | Damping Ratio (%) | Compression Wave Velocity (ft/sec) | Elevation of Layer Base (ft NAVD 88) |
|---|---|---|---|---|---|---|---|
| **Profile with Engineered Granular Backfill, Top of Profile Elevation 589.3 ft NAVD 88** | | | | | | | |
| 1 | 2.9 | 2.9 | 132.5 | 505 | 3.52 | 944 | 586.4 |
| 2 | 2.9 | 5.8 | 132.5 | 520 | 5.88 | 973 | 583.5 |
| 3 | 4.2 | 10.0 | 132.5 | 517 | 7.58 | 968 | 579.3 |
| 4 | 3.2 | 13.2 | 132.5 | 537 | 8.53 | 1004 | 576.1 |
| 5 | 2.5 | 15.7 | 132.5 | 536 | 9.00 | 2734 | 573.6 |
| 6 | 4.3 | 20.0 | 132.5 | 571 | 9.50 | 2910 | 569.3 |
| 7 | 5.0 | 25.0 | 132.5 | 639 | 7.82 | 3257 | 564.3 |
| 8 | 5.0 | 30.0 | 132.5 | 675 | 7.52 | 3443 | 559.3 |
| 9 | 3.5 | 33.5 | 132.5 | 717 | 7.33 | 3657 | 555.8 |
| 10 | 4.1 | 37.6 | 132.5 | 761 | 7.17 | 3880 | 551.7 |
| 11 | 9.5 | 47.1 | 150 | 6510 | 0.97 | 12923 | 542.2 |
| 12 | 1.8 | 48.9 | 150 | 6697 | 0.97 | 13294 | 540.4 |
| 13 | 8.4 | 57.3 | 150 | 6712 | 0.97 | 13324 | 532.0 |
| 14 | 8.3 | 65.6 | 150 | 6740 | 0.97 | 13381 | 523.7 |
| 15 | 2.1 | 67.7 | 150 | 6687 | 0.97 | 13275 | 521.6 |
| 16 | 9.7 | 77.4 | 150 | 6658 | 0.97 | 13217 | 511.9 |
| 17 | 11.1 | 88.5 | 150 | 6593 | 0.97 | 13088 | 500.8 |
| 18 | 12.0 | 100.5 | 150 | 6560 | 0.97 | 13024 | 488.8 |
| 19 | 12.1 | 112.6 | 150 | 6600 | 0.97 | 13102 | 476.7 |
| 20 | 15.0 | 127.6 | 150 | 4573 | 1.36 | 9777 | 461.7 |
| 21 | 20.3 | 147.9 | 150 | 3403 | 1.87 | 8014 | 441.4 |
| 22 | 20.0 | 167.9 | 150 | 3455 | 1.87 | 8136 | 421.4 |
| 23 | 20.0 | 187.9 | 150 | 3390 | 1.87 | 7982 | 401.4 |
| 24 | 21.0 | 208.9 | 150 | 3328 | 1.87 | 7838 | 380.4 |
| 25 | 21.0 | 229.9 | 150 | 4091 | 1.87 | 9633 | 359.4 |
| 26 | 21.1 | 251.0 | 150 | 4166 | 1.87 | 9810 | 338.3 |
| 27 | 10.1 | 261.1 | 150 | 5551 | 0.71 | 11410 | 328.2 |
| 28 | 20.2 | 281.3 | 150 | 9462 | 0.71 | 17702 | 308.0 |
| 29 | 21.0 | 302.3 | 150 | 9432 | 0.71 | 17645 | 287.0 |
| 30 | 21.0 | 323.3 | 150 | 9507 | 0.71 | 17786 | 266.0 |
| 31 | 20.3 | 343.6 | 150 | 9325 | 0.71 | 17445 | 245.7 |
| 32 | 45.0 | 388.6 | 160 | 8956 | 0.71 | 16201 | 200.7 |
| 33 | 45.2 | 433.8 | 160 | 8978 | 0.71 | 16243 | 155.5 |
| 34 | halfspace | 433.8 | 169 | 9113 | 0.10 | 16757 | 155.5 |

## Table 3.7.1-207 Deterministic Profile with Engineered Granular Backfill above the Top of the Bass Islands Group Bedrock: Lower Bound [EF3 SUP 3.7-1]

| Layer | Thickness (ft.) | Total Depth (ft) | Unit Weight (pcf) | Shear Wave Velocity (ft/sec) | Damping Ratio (%) | Compression Wave Velocity (ft/sec) | Elevation of Layer Base (ft NAVD 88) |
|---|---|---|---|---|---|---|---|
| **Profile with Engineered Granular Backfill, Top of Profile Elevation 589.3 ft NAVD 88** | | | | | | | |
| 1 | 2.9 | 2.9 | 119 | 341 | 6.22 | 638 | 586.4 |
| 2 | 2.9 | 5.8 | 119 | 365 | 10.26 | 683 | 583.5 |
| 3 | 4.2 | 10.0 | 119 | 316 | 12.78 | 592 | 579.3 |
| 4 | 3.2 | 13.2 | 119 | 304 | 13.65 | 570 | 576.1 |
| 5 | 2.5 | 15.7 | 119 | 326 | 13.53 | 1663 | 573.6 |
| 6 | 4.3 | 20.0 | 119 | 296 | 13.94 | 1509 | 569.3 |
| 7 | 5.0 | 25.0 | 119 | 364 | 12.35 | 1854 | 564.3 |
| 8 | 5.0 | 30.0 | 119 | 388 | 12.24 | 1979 | 559.3 |
| 9 | 3.5 | 33.5 | 119 | 416 | 12.05 | 2119 | 555.8 |
| 10 | 4.1 | 37.6 | 119 | 436 | 11.73 | 2224 | 551.7 |
| 11 | 9.5 | 47.1 | 150 | 5315 | 1.77 | 10552 | 542.2 |
| 12 | 1.8 | 48.9 | 150 | 5468 | 1.77 | 10855 | 540.4 |
| 13 | 8.4 | 57.3 | 150 | 5480 | 1.77 | 10879 | 532.0 |
| 14 | 8.3 | 65.6 | 150 | 5503 | 1.77 | 10925 | 523.7 |
| 15 | 2.1 | 67.7 | 150 | 5460 | 1.77 | 10839 | 521.6 |
| 16 | 9.7 | 77.4 | 150 | 5436 | 1.77 | 10792 | 511.9 |
| 17 | 11.1 | 88.5 | 150 | 5383 | 1.77 | 10686 | 500.8 |
| 18 | 12.0 | 100.5 | 150 | 5356 | 1.77 | 10634 | 488.8 |
| 19 | 12.1 | 112.6 | 150 | 5389 | 1.77 | 10698 | 476.7 |
| 20 | 15.0 | 127.6 | 150 | 3734 | 2.43 | 7983 | 461.7 |
| 21 | 20.3 | 147.9 | 150 | 2779 | 3.03 | 6544 | 441.4 |
| 22 | 20.0 | 167.9 | 150 | 2793 | 3.03 | 6576 | 421.4 |
| 23 | 20.0 | 187.9 | 150 | 2768 | 3.03 | 6517 | 401.4 |
| 24 | 21.0 | 208.9 | 150 | 2718 | 3.03 | 6400 | 380.4 |
| 25 | 21.0 | 229.9 | 150 | 3254 | 3.03 | 7663 | 359.4 |
| 26 | 21.1 | 251.0 | 150 | 3273 | 3.03 | 7708 | 338.3 |
| 27 | 10.1 | 261.1 | 150 | 4532 | 1.28 | 9316 | 328.2 |
| 28 | 20.2 | 281.3 | 150 | 7726 | 1.28 | 14454 | 308.0 |
| 29 | 21.0 | 302.3 | 150 | 7701 | 1.28 | 14407 | 287.0 |
| 30 | 21.0 | 323.3 | 150 | 7763 | 1.28 | 14522 | 266.0 |
| 31 | 20.3 | 343.6 | 150 | 7614 | 1.28 | 14244 | 245.7 |
| 32 | 45.0 | 388.6 | 160 | 7312 | 1.28 | 13228 | 200.7 |
| 33 | 45.2 | 433.8 | 160 | 7331 | 1.28 | 13262 | 155.5 |
| 34 | halfspace | 433.8 | 169 | 7441 | 0.10 | 13682 | 155.5 |

## Table 3.7.1-208 Deterministic Profile with Engineered Granular Backfill above the Top of the Bass Islands Group Bedrock: Upper Bound [EF3 SUP 3.7-1]

| Layer | Thickness (ft.) | Total Depth (ft) | Unit Weight (pcf) | Shear Wave Velocity (ft/sec) | Damping Ratio (%) | Compression Wave Velocity (ft/sec) | Elevation of Layer Base (ft NAVD 88) |
|---|---|---|---|---|---|---|---|
| **Profile with Engineered Granular Backfill, Top of Profile Elevation 589.3 ft NAVD 88** | | | | | | | |
| 1 | 2.9 | 2.9 | 146 | 750 | 2.26 | 1403 | 586.4 |
| 2 | 2.9 | 5.8 | 146 | 750 | 3.63 | 1403 | 583.5 |
| 3 | 4.2 | 10.0 | 146 | 750 | 4.73 | 1403 | 579.3 |
| 4 | 3.2 | 13.2 | 146 | 776 | 4.97 | 1451 | 576.1 |
| 5 | 2.5 | 15.7 | 146 | 831 | 5.30 | 4237 | 573.6 |
| 6 | 4.3 | 20.0 | 146 | 853 | 5.58 | 4350 | 569.3 |
| 7 | 5.0 | 25.0 | 146 | 946 | 3.94 | 4790 | 564.3 |
| 8 | 5.0 | 30.0 | 146 | 1024 | 3.89 | 4790 | 559.3 |
| 9 | 3.5 | 33.5 | 146 | 1033 | 4.06 | 4790 | 555.8 |
| 10 | 4.1 | 37.6 | 146 | 1127 | 3.76 | 4790 | 551.7 |
| 11 | 9.5 | 47.1 | 150 | 7972 | 0.50 | 15827 | 542.2 |
| 12 | 1.8 | 48.9 | 150 | 8202 | 0.50 | 16282 | 540.4 |
| 13 | 8.4 | 57.3 | 150 | 8220 | 0.50 | 16318 | 532.0 |
| 14 | 8.3 | 65.6 | 150 | 8255 | 0.50 | 16388 | 523.7 |
| 15 | 2.1 | 67.7 | 150 | 8189 | 0.50 | 16258 | 521.6 |
| 16 | 9.7 | 77.4 | 150 | 8154 | 0.50 | 16188 | 511.9 |
| 17 | 11.1 | 88.5 | 150 | 8074 | 0.50 | 16029 | 500.8 |
| 18 | 12.0 | 100.5 | 150 | 8035 | 0.50 | 15951 | 488.8 |
| 19 | 12.1 | 112.6 | 150 | 8083 | 0.50 | 16046 | 476.7 |
| 20 | 15.0 | 127.6 | 150 | 5601 | 0.71 | 11975 | 461.7 |
| 21 | 20.3 | 147.9 | 150 | 4187 | 0.95 | 9859 | 441.4 |
| 22 | 20.0 | 167.9 | 150 | 4231 | 0.95 | 9965 | 421.4 |
| 23 | 20.0 | 187.9 | 150 | 4151 | 0.95 | 9776 | 401.4 |
| 24 | 21.0 | 208.9 | 150 | 4370 | 0.95 | 10291 | 380.4 |
| 25 | 21.0 | 229.9 | 150 | 5190 | 0.95 | 12222 | 359.4 |
| 26 | 21.1 | 251.0 | 150 | 5260 | 0.95 | 12386 | 338.3 |
| 27 | 10.1 | 261.1 | 150 | 6798 | 0.37 | 13974 | 328.2 |
| 28 | 20.2 | 281.3 | 150 | 11589 | 0.37 | 21681 | 308.0 |
| 29 | 21.0 | 302.3 | 150 | 11552 | 0.37 | 21611 | 287.0 |
| 30 | 21.0 | 323.3 | 150 | 11644 | 0.37 | 21784 | 266.0 |
| 31 | 20.3 | 343.6 | 150 | 11421 | 0.37 | 21366 | 245.7 |
| 32 | 45.0 | 388.6 | 160 | 10968 | 0.37 | 19842 | 200.7 |
| 33 | 45.2 | 433.8 | 160 | 10996 | 0.37 | 19893 | 155.5 |
| 34 | halfspace | 433.8 | 169 | 11161 | 0.10 | 20523 | 155.5 |

## Table 3.7.1-209 Deterministic Profile without Engineered Granular Backfill above the Top of the Bass Islands Group Bedrock: Best Estimate [EF3 SUP 3.7-1]

| Layer | Thickness (ft.) | Total Depth (ft) | Unit Weight (pcf) | Shear Wave Velocity (ft/sec) | Damping Ratio (%) | Compression Wave Velocity (ft/sec) | Elevation of Layer Base (ft NAVD 88) |
|---|---|---|---|---|---|---|---|
| **Profile with Engineered Granular Backfill, Top of Profile Elevation 551.7 ft NAVD 88** | | | | | | | |
| 1 | 9.5 | 47.1 | 150 | 6510 | 0.97 | 12923 | 542.2 |
| 2 | 1.8 | 48.9 | 150 | 6697 | 0.97 | 13294 | 540.4 |
| 3 | 8.4 | 57.3 | 150 | 6712 | 0.97 | 13324 | 532.0 |
| 4 | 8.3 | 65.6 | 150 | 6740 | 0.97 | 13381 | 523.7 |
| 5 | 2.1 | 67.7 | 150 | 6687 | 0.97 | 13275 | 521.6 |
| 6 | 9.7 | 77.4 | 150 | 6658 | 0.97 | 13217 | 511.9 |
| 7 | 11.1 | 88.5 | 150 | 6593 | 0.97 | 13088 | 500.8 |
| 8 | 12.0 | 100.5 | 150 | 6560 | 0.97 | 13024 | 488.8 |
| 9 | 12.1 | 112.6 | 150 | 6600 | 0.97 | 13102 | 476.7 |
| 10 | 15.0 | 127.6 | 150 | 4573 | 1.36 | 9777 | 461.7 |
| 11 | 20.3 | 147.9 | 150 | 3403 | 1.87 | 8014 | 441.4 |
| 12 | 20.0 | 167.9 | 150 | 3455 | 1.87 | 8136 | 421.4 |
| 13 | 20.0 | 187.9 | 150 | 3390 | 1.87 | 7982 | 401.4 |
| 14 | 21.0 | 208.9 | 150 | 3328 | 1.87 | 7838 | 380.4 |
| 15 | 21.0 | 229.9 | 150 | 4091 | 1.87 | 9633 | 359.4 |
| 16 | 21.1 | 251.0 | 150 | 4166 | 1.87 | 9810 | 338.3 |
| 17 | 10.1 | 261.1 | 150 | 5551 | 0.71 | 11410 | 328.2 |
| 18 | 20.2 | 281.3 | 150 | 9462 | 0.71 | 17702 | 308.0 |
| 19 | 21.0 | 302.3 | 150 | 9432 | 0.71 | 17645 | 287.0 |
| 20 | 21.0 | 323.3 | 150 | 9507 | 0.71 | 17786 | 266.0 |
| 21 | 20.3 | 343.6 | 150 | 9325 | 0.71 | 17445 | 245.7 |
| 22 | 45.0 | 388.6 | 160 | 8956 | 0.71 | 16201 | 200.7 |
| 23 | 45.2 | 433.8 | 160 | 8978 | 0.71 | 16243 | 155.5 |
| 24 | halfspace | 433.8 | 169 | 9113 | 0.10 | 16757 | 155.5 |

## Table 3.7.1-210 Deterministic Profile without Engineered Granular Backfill above the Top of the Bass Islands Group Bedrock: Lower Bound [EF3 SUP 3.7-1]

| Layer | Thickness (ft.) | Total Depth (ft) | Unit Weight (pcf) | Shear Wave Velocity (ft/sec) | Damping Ratio (%) | Compression Wave Velocity (ft/sec) | Elevation of Layer Base (ft NAVD 88) |
|---|---|---|---|---|---|---|---|
| Profile with Engineered Granular Backfill, Top of Profile Elevation 551.7 ft NAVD 88 | | | | | | | |
| 1 | 9.5 | 47.1 | 150 | 5315 | 1.77 | 10552 | 542.2 |
| 2 | 1.8 | 48.9 | 150 | 5468 | 1.77 | 10855 | 540.4 |
| 3 | 8.4 | 57.3 | 150 | 5480 | 1.77 | 10879 | 532.0 |
| 4 | 8.3 | 65.6 | 150 | 5503 | 1.77 | 10925 | 523.7 |
| 5 | 2.1 | 67.7 | 150 | 5460 | 1.77 | 10839 | 521.6 |
| 6 | 9.7 | 77.4 | 150 | 5436 | 1.77 | 10792 | 511.9 |
| 7 | 11.1 | 88.5 | 150 | 5383 | 1.77 | 10686 | 500.8 |
| 8 | 12.0 | 100.5 | 150 | 5356 | 1.77 | 10634 | 488.8 |
| 9 | 12.1 | 112.6 | 150 | 5389 | 1.77 | 10698 | 476.7 |
| 10 | 15.0 | 127.6 | 150 | 3734 | 2.43 | 7983 | 461.7 |
| 11 | 20.3 | 147.9 | 150 | 2779 | 3.03 | 6544 | 441.4 |
| 12 | 20.0 | 167.9 | 150 | 2793 | 3.03 | 6576 | 421.4 |
| 13 | 20.0 | 187.9 | 150 | 2768 | 3.03 | 6517 | 401.4 |
| 14 | 21.0 | 208.9 | 150 | 2718 | 3.03 | 6400 | 380.4 |
| 15 | 21.0 | 229.9 | 150 | 3254 | 3.03 | 7663 | 359.4 |
| 16 | 21.1 | 251.0 | 150 | 3273 | 3.03 | 7708 | 338.3 |
| 17 | 10.1 | 261.1 | 150 | 4532 | 1.28 | 9316 | 328.2 |
| 18 | 20.2 | 281.3 | 150 | 7726 | 1.28 | 14454 | 308.0 |
| 19 | 21.0 | 302.3 | 150 | 7701 | 1.28 | 14407 | 287.0 |
| 20 | 21.0 | 323.3 | 150 | 7763 | 1.28 | 14522 | 266.0 |
| 21 | 20.3 | 343.6 | 150 | 7614 | 1.28 | 14244 | 245.7 |
| 22 | 45.0 | 388.6 | 160 | 7312 | 1.28 | 13228 | 200.7 |
| 23 | 45.2 | 433.8 | 160 | 7331 | 1.28 | 13262 | 155.5 |
| 24 | halfspace | 433.8 | 169 | 7441 | 0.10 | 13682 | 155.5 |

## Table 3.7.1-211 Deterministic Profile without Engineered Granular Backfill above the Top of the Bass Islands Group Bedrock: Upper Bound [EF3 SUP 3.7-1]

| Layer | Thickness (ft.) | Total Depth (ft) | Unit Weight (pcf) | Shear Wave Velocity (ft/sec) | Damping Ratio (%) | Compression Wave Velocity (ft/sec) | Elevation of Layer Base (ft NAVD 88) |
|---|---|---|---|---|---|---|---|
| **Profile with Engineered Granular Backfill, Top of Profile Elevation 551.7 ft NAVD 88** | | | | | | | |
| 1 | 9.5 | 47.1 | 150 | 7972 | 0.50 | 15827 | 542.2 |
| 2 | 1.8 | 48.9 | 150 | 8202 | 0.50 | 16282 | 540.4 |
| 3 | 8.4 | 57.3 | 150 | 8220 | 0.50 | 16318 | 532.0 |
| 4 | 8.3 | 65.6 | 150 | 8255 | 0.50 | 16388 | 523.7 |
| 5 | 2.1 | 67.7 | 150 | 8189 | 0.50 | 16258 | 521.6 |
| 6 | 9.7 | 77.4 | 150 | 8154 | 0.50 | 16188 | 511.9 |
| 7 | 11.1 | 88.5 | 150 | 8074 | 0.50 | 16029 | 500.8 |
| 8 | 12.0 | 100.5 | 150 | 8035 | 0.50 | 15951 | 488.8 |
| 9 | 12.1 | 112.6 | 150 | 8083 | 0.50 | 16046 | 476.7 |
| 10 | 15.0 | 127.6 | 150 | 5601 | 0.71 | 11975 | 461.7 |
| 11 | 20.3 | 147.9 | 150 | 4187 | 0.95 | 9859 | 441.4 |
| 12 | 20.0 | 167.9 | 150 | 4231 | 0.95 | 9965 | 421.4 |
| 13 | 20.0 | 187.9 | 150 | 4151 | 0.95 | 9776 | 401.4 |
| 14 | 21.0 | 208.9 | 150 | 4370 | 0.95 | 10291 | 380.4 |
| 15 | 21.0 | 229.9 | 150 | 5190 | 0.95 | 12222 | 359.4 |
| 16 | 21.1 | 251.0 | 150 | 5260 | 0.95 | 12386 | 338.3 |
| 17 | 10.1 | 261.1 | 150 | 6798 | 0.37 | 13974 | 328.2 |
| 18 | 20.2 | 281.3 | 150 | 11589 | 0.37 | 21681 | 308.0 |
| 19 | 21.0 | 302.3 | 150 | 11552 | 0.37 | 21611 | 287.0 |
| 20 | 21.0 | 323.3 | 150 | 11644 | 0.37 | 21784 | 266.0 |
| 21 | 20.3 | 343.6 | 150 | 11421 | 0.37 | 21366 | 245.7 |
| 22 | 45.0 | 388.6 | 160 | 10968 | 0.37 | 19842 | 200.7 |
| 23 | 45.2 | 433.8 | 160 | 10996 | 0.37 | 19893 | 155.5 |
| 24 | halfspace | 433.8 | 169 | 11161 | 0.10 | 20523 | 155.5 |

**Table 3.7.1-212 Horizontal and Vertical RB/FB SCOR FIRS at Elevation 523.7 (ft) NAVD 88 with Associated V/H Ratios (Sheet 1 of 3)**
**[EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**

| Period (sec) | Frequency (Hz) | Horizontal SCOR FIRS (g) | V/H Ratio | Vertical SCOR FIRS (g) |
|---|---|---|---|---|
| 0.010 | 100.00 | 0.2092 | 1.0000 | 0.2092 |
| 0.017 | 60.241 | 0.3830 | 1.1374 | 0.4356 |
| 0.020 | 50.000 | 0.4543 | 1.1244 | 0.5108 |
| 0.025 | 40.000 | 0.5075 | 1.0426 | 0.5291 |
| 0.030 | 33.333 | 0.5302 | 0.9675 | 0.5129 |
| 0.033 | 30.303 | 0.5362 | 0.9400 | 0.5041 |
| 0.040 | 25.000 | 0.5487 | 0.8800 | 0.4829 |
| 0.042 | 23.810 | 0.5435 | 0.8681 | 0.4718 |
| 0.044 | 22.727 | 0.5386 | 0.8569 | 0.4615 |
| 0.046 | 21.739 | 0.5339 | 0.8461 | 0.4518 |
| 0.048 | 20.833 | 0.5295 | 0.8355 | 0.4424 |
| 0.050 | 20.000 | 0.5253 | 0.8255 | 0.4336 |
| 0.055 | 18.182 | 0.5111 | 0.8069 | 0.4124 |
| 0.060 | 16.667 | 0.4984 | 0.7984 | 0.3979 |
| 0.065 | 15.385 | 0.4834 | 0.7906 | 0.3822 |
| 0.070 | 14.286 | 0.4763 | 0.7834 | 0.3732 |
| 0.075 | 13.333 | 0.4698 | 0.7769 | 0.3650 |
| 0.080 | 12.500 | 0.4638 | 0.7708 | 0.3575 |
| 0.085 | 11.765 | 0.4583 | 0.7651 | 0.3506 |
| 0.090 | 11.111 | 0.4531 | 0.7597 | 0.3442 |
| 0.095 | 10.526 | 0.4482 | 0.7547 | 0.3383 |
| 0.10 | 10.000 | 0.4437 | 0.7500 | 0.3327 |
| 0.11 | 9.0910 | 0.4353 | 0.7500 | 0.3265 |
| 0.12 | 8.3330 | 0.4278 | 0.7500 | 0.3209 |
| 0.13 | 7.6920 | 0.4211 | 0.7500 | 0.3158 |
| 0.14 | 7.1430 | 0.4149 | 0.7500 | 0.3112 |
| 0.15 | 6.6670 | 0.4092 | 0.7500 | 0.3069 |
| 0.16 | 6.2500 | 0.4040 | 0.7500 | 0.3030 |
| 0.17 | 5.8820 | 0.3991 | 0.7500 | 0.2994 |
| 0.18 | 5.5560 | 0.3946 | 0.7500 | 0.2960 |
| 0.19 | 5.2630 | 0.3904 | 0.7500 | 0.2928 |
| 0.20 | 5.0000 | 0.3864 | 0.7500 | 0.2898 |
| 0.22 | 4.5450 | 0.3791 | 0.7500 | 0.2844 |
| 0.24 | 4.1670 | 0.3711 | 0.7500 | 0.2783 |
| 0.26 | 3.8460 | 0.3614 | 0.7500 | 0.2710 |
| 0.28 | 3.5710 | 0.3451 | 0.7500 | 0.2588 |
| 0.30 | 3.3330 | 0.3240 | 0.7500 | 0.2430 |

**Table 3.7.1-212 Horizontal and Vertical RB/FB SCOR FIRS at Elevation 523.7 (ft) NAVD 88 with Associated V/H Ratios (Sheet 2 of 3) [EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**

| Period (sec) | Frequency (Hz) | Horizontal SCOR FIRS (g) | V/H Ratio | Vertical SCOR FIRS (g) |
|---|---|---|---|---|
| 0.32 | 3.1250 | 0.3041 | 0.7500 | 0.2281 |
| 0.34 | 2.9410 | 0.2836 | 0.7500 | 0.2127 |
| 0.36 | 2.7780 | 0.2652 | 0.7500 | 0.1989 |
| 0.38 | 2.6320 | 0.2490 | 0.7500 | 0.1868 |
| 0.40 | 2.5000 | 0.2323 | 0.7500 | 0.1742 |
| 0.42 | 2.3810 | 0.2201 | 0.7500 | 0.1650 |
| 0.44 | 2.2730 | 0.2081 | 0.7500 | 0.1561 |
| 0.46 | 2.1740 | 0.1963 | 0.7500 | 0.1472 |
| 0.48 | 2.0830 | 0.1860 | 0.7500 | 0.1395 |
| 0.50 | 2.0000 | 0.1766 | 0.7500 | 0.1325 |
| 0.55 | 1.8180 | 0.1600 | 0.7500 | 0.1200 |
| 0.60 | 1.6670 | 0.1466 | 0.7500 | 0.1099 |
| 0.65 | 1.5380 | 0.1358 | 0.7500 | 0.1018 |
| 0.70 | 1.4290 | 0.1265 | 0.7500 | 0.0949 |
| 0.75 | 1.3330 | 0.1186 | 0.7500 | 0.0889 |
| 0.80 | 1.2500 | 0.1113 | 0.7500 | 0.0835 |
| 0.85 | 1.1760 | 0.1054 | 0.7500 | 0.0790 |
| 0.90 | 1.1110 | 0.1000 | 0.7500 | 0.0750 |
| 0.95 | 1.0530 | 0.0947 | 0.7500 | 0.0710 |
| 1.0 | 1.0000 | 0.0907 | 0.7500 | 0.0680 |
| 1.1 | 0.9090 | 0.0850 | 0.7500 | 0.0638 |
| 1.2 | 0.8330 | 0.0799 | 0.7500 | 0.0599 |
| 1.3 | 0.7690 | 0.0755 | 0.7500 | 0.0567 |
| 1.4 | 0.7140 | 0.0728 | 0.7500 | 0.0546 |
| 1.5 | 0.6670 | 0.0710 | 0.7500 | 0.0533 |
| 1.6 | 0.6250 | 0.0691 | 0.7500 | 0.0518 |
| 1.7 | 0.5880 | 0.0673 | 0.7500 | 0.0505 |
| 1.8 | 0.5560 | 0.0658 | 0.7500 | 0.0494 |
| 1.9 | 0.5260 | 0.0644 | 0.7500 | 0.0483 |
| 2.0 | 0.5000 | 0.0632 | 0.7500 | 0.0474 |
| 2.2 | 0.4550 | 0.0591 | 0.7500 | 0.0443 |
| 2.4 | 0.4170 | 0.0553 | 0.7500 | 0.0415 |
| 2.6 | 0.3850 | 0.0525 | 0.7500 | 0.0394 |
| 2.8 | 0.3570 | 0.0499 | 0.7500 | 0.0374 |
| 3.0 | 0.3330 | 0.0476 | 0.7500 | 0.0357 |
| 3.2 | 0.3130 | 0.0454 | 0.7500 | 0.0341 |
| 3.4 | 0.2940 | 0.0436 | 0.7500 | 0.0327 |

**Table 3.7.1-212 Horizontal and Vertical RB/FB SCOR FIRS at Elevation 523.7 (ft) NAVD 88 with Associated V/H Ratios (Sheet 3 of 3)**
**[EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**

| Period (sec) | Frequency (Hz) | Horizontal SCOR FIRS (g) | V/H Ratio | Vertical SCOR FIRS (g) |
|---|---|---|---|---|
| 3.6 | 0.2780 | 0.0419 | 0.7500 | 0.0314 |
| 3.8 | 0.2630 | 0.0403 | 0.7500 | 0.0302 |
| 4.0 | 0.2500 | 0.0389 | 0.7500 | 0.0292 |
| 4.2 | 0.2380 | 0.0376 | 0.7500 | 0.0282 |
| 4.4 | 0.2270 | 0.0364 | 0.7500 | 0.0273 |
| 4.6 | 0.2170 | 0.0353 | 0.7500 | 0.0265 |
| 4.8 | 0.2080 | 0.0343 | 0.7500 | 0.0257 |
| 5.0 | 0.2000 | 0.0333 | 0.7500 | 0.0250 |
| 5.5 | 0.1820 | 0.0304 | 0.7500 | 0.0228 |
| 6.0 | 0.1670 | 0.0280 | 0.7500 | 0.0210 |
| 6.5 | 0.1540 | 0.0259 | 0.7500 | 0.0194 |
| 7.0 | 0.1430 | 0.0241 | 0.7500 | 0.0181 |
| 7.5 | 0.1330 | 0.0226 | 0.7500 | 0.0169 |
| 8.0 | 0.1250 | 0.0210 | 0.7500 | 0.0158 |
| 8.5 | 0.1180 | 0.0197 | 0.7500 | 0.0148 |
| 9.0 | 0.1110 | 0.0185 | 0.7500 | 0.0138 |
| 10 | 0.1000 | 0.0164 | 0.7500 | 0.0123 |

**Table 3.7.1-213 Horizontal and Vertical CB SCOR FIRS at Elevation 540.4 (ft) NAVD 88 with Associated V/H Ratios (Sheet 1 of 3) [EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**

| Period (sec) | Frequency (Hz) | Horizontal SCOR FIRS (g) | V/H Ratio | Vertical SCOR FIRS (g) |
|---|---|---|---|---|
| 0.010 | 100.00 | 0.2084 | 1.0000 | 0.2084 |
| 0.017 | 60.241 | 0.3818 | 1.1374 | 0.4343 |
| 0.020 | 50.000 | 0.4531 | 1.1244 | 0.5095 |
| 0.025 | 40.000 | 0.5063 | 1.0426 | 0.5279 |
| 0.030 | 33.333 | 0.5291 | 0.9675 | 0.5119 |
| 0.033 | 30.303 | 0.5358 | 0.9400 | 0.5037 |
| 0.040 | 25.000 | 0.5498 | 0.8800 | 0.4838 |
| 0.042 | 23.810 | 0.5445 | 0.8681 | 0.4727 |
| 0.044 | 22.727 | 0.5395 | 0.8569 | 0.4623 |
| 0.046 | 21.739 | 0.5348 | 0.8461 | 0.4525 |
| 0.048 | 20.833 | 0.5304 | 0.8355 | 0.4431 |
| 0.050 | 20.000 | 0.5261 | 0.8255 | 0.4343 |
| 0.055 | 18.182 | 0.5118 | 0.8069 | 0.4130 |
| 0.060 | 16.667 | 0.4991 | 0.7984 | 0.3984 |
| 0.065 | 15.385 | 0.4840 | 0.7906 | 0.3827 |
| 0.070 | 14.286 | 0.4769 | 0.7834 | 0.3736 |
| 0.075 | 13.333 | 0.4703 | 0.7769 | 0.3654 |
| 0.080 | 12.500 | 0.4643 | 0.7708 | 0.3578 |
| 0.085 | 11.765 | 0.4587 | 0.7651 | 0.3509 |
| 0.090 | 11.111 | 0.4534 | 0.7597 | 0.3445 |
| 0.095 | 10.526 | 0.4485 | 0.7547 | 0.3385 |
| 0.10 | 10.000 | 0.4440 | 0.7500 | 0.3330 |
| 0.11 | 9.0910 | 0.4355 | 0.7500 | 0.3267 |
| 0.12 | 8.3330 | 0.4280 | 0.7500 | 0.3210 |
| 0.13 | 7.6920 | 0.4212 | 0.7500 | 0.3159 |
| 0.14 | 7.1430 | 0.4150 | 0.7500 | 0.3112 |
| 0.15 | 6.6670 | 0.4093 | 0.7500 | 0.3070 |
| 0.16 | 6.2500 | 0.4040 | 0.7500 | 0.3030 |
| 0.17 | 5.8820 | 0.3991 | 0.7500 | 0.2994 |
| 0.18 | 5.5560 | 0.3946 | 0.7500 | 0.2959 |
| 0.19 | 5.2630 | 0.3903 | 0.7500 | 0.2927 |
| 0.20 | 5.0000 | 0.3863 | 0.7500 | 0.2898 |
| 0.22 | 4.5450 | 0.3790 | 0.7500 | 0.2843 |
| 0.24 | 4.1670 | 0.3710 | 0.7500 | 0.2782 |
| 0.26 | 3.8460 | 0.3614 | 0.7500 | 0.2710 |
| 0.28 | 3.5710 | 0.3452 | 0.7500 | 0.2589 |
| 0.30 | 3.3330 | 0.3241 | 0.7500 | 0.2431 |

## Table 3.7.1-213 Horizontal and Vertical CB SCOR FIRS at Elevation 540.4 (ft) NAVD 88 with Associated V/H Ratios (Sheet 2 of 3) [EF3 COL 2.0-27-A, EF3 SUP 3.7-1]

| Period (sec) | Frequency (Hz) | Horizontal SCOR FIRS (g) | V/H Ratio | Vertical SCOR FIRS (g) |
|---|---|---|---|---|
| 0.32 | 3.1250 | 0.3042 | 0.7500 | 0.2282 |
| 0.34 | 2.9410 | 0.2838 | 0.7500 | 0.2128 |
| 0.36 | 2.7780 | 0.2654 | 0.7500 | 0.1990 |
| 0.38 | 2.6320 | 0.2491 | 0.7500 | 0.1868 |
| 0.40 | 2.5000 | 0.2324 | 0.7500 | 0.1743 |
| 0.42 | 2.3810 | 0.2202 | 0.7500 | 0.1651 |
| 0.44 | 2.2730 | 0.2082 | 0.7500 | 0.1562 |
| 0.46 | 2.1740 | 0.1964 | 0.7500 | 0.1473 |
| 0.48 | 2.0830 | 0.1861 | 0.7500 | 0.1396 |
| 0.50 | 2.0000 | 0.1767 | 0.7500 | 0.1325 |
| 0.55 | 1.8180 | 0.1600 | 0.7500 | 0.1200 |
| 0.60 | 1.6670 | 0.1466 | 0.7500 | 0.1100 |
| 0.65 | 1.5380 | 0.1358 | 0.7500 | 0.1018 |
| 0.70 | 1.4290 | 0.1265 | 0.7500 | 0.0949 |
| 0.75 | 1.3330 | 0.1185 | 0.7500 | 0.0889 |
| 0.80 | 1.2500 | 0.1113 | 0.7500 | 0.0834 |
| 0.85 | 1.1760 | 0.1053 | 0.7500 | 0.0790 |
| 0.90 | 1.1110 | 0.1000 | 0.7500 | 0.0750 |
| 0.95 | 1.0530 | 0.0947 | 0.7500 | 0.0710 |
| 1.0 | 1.0000 | 0.0907 | 0.7500 | 0.0680 |
| 1.1 | 0.9090 | 0.0850 | 0.7500 | 0.0638 |
| 1.2 | 0.8330 | 0.0799 | 0.7500 | 0.0599 |
| 1.3 | 0.7690 | 0.0755 | 0.7500 | 0.0567 |
| 1.4 | 0.7140 | 0.0728 | 0.7500 | 0.0546 |
| 1.5 | 0.6670 | 0.0710 | 0.7500 | 0.0533 |
| 1.6 | 0.6250 | 0.0690 | 0.7500 | 0.0518 |
| 1.7 | 0.5880 | 0.0673 | 0.7500 | 0.0505 |
| 1.8 | 0.5560 | 0.0658 | 0.7500 | 0.0494 |
| 1.9 | 0.5260 | 0.0644 | 0.7500 | 0.0483 |
| 2.0 | 0.5000 | 0.0632 | 0.7500 | 0.0474 |
| 2.2 | 0.4550 | 0.0591 | 0.7500 | 0.0443 |
| 2.4 | 0.4170 | 0.0553 | 0.7500 | 0.0415 |
| 2.6 | 0.3850 | 0.0525 | 0.7500 | 0.0394 |
| 2.8 | 0.3570 | 0.0499 | 0.7500 | 0.0374 |
| 3.0 | 0.3330 | 0.0476 | 0.7500 | 0.0357 |
| 3.2 | 0.3130 | 0.0454 | 0.7500 | 0.0341 |
| 3.4 | 0.2940 | 0.0436 | 0.7500 | 0.0327 |

**Table 3.7.1-213 Horizontal and Vertical CB SCOR FIRS at Elevation 540.4 (ft) NAVD 88 with Associated V/H Ratios (Sheet 3 of 3)
[EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**

| Period (sec) | Frequency (Hz) | Horizontal SCOR FIRS (g) | V/H Ratio | Vertical SCOR FIRS (g) |
|---|---|---|---|---|
| 3.6 | 0.2780 | 0.0419 | 0.7500 | 0.0314 |
| 3.8 | 0.2630 | 0.0403 | 0.7500 | 0.0302 |
| 4.0 | 0.2500 | 0.0389 | 0.7500 | 0.0292 |
| 4.2 | 0.2380 | 0.0376 | 0.7500 | 0.0282 |
| 4.4 | 0.2270 | 0.0364 | 0.7500 | 0.0273 |
| 4.6 | 0.2170 | 0.0353 | 0.7500 | 0.0265 |
| 4.8 | 0.2080 | 0.0343 | 0.7500 | 0.0257 |
| 5.0 | 0.2000 | 0.0333 | 0.7500 | 0.0250 |
| 5.5 | 0.1820 | 0.0304 | 0.7500 | 0.0228 |
| 6.0 | 0.1670 | 0.0280 | 0.7500 | 0.0210 |
| 6.5 | 0.1540 | 0.0259 | 0.7500 | 0.0194 |
| 7.0 | 0.1430 | 0.0241 | 0.7500 | 0.0181 |
| 7.5 | 0.1330 | 0.0226 | 0.7500 | 0.0169 |
| 8.0 | 0.1250 | 0.0210 | 0.7500 | 0.0158 |
| 8.5 | 0.1180 | 0.0197 | 0.7500 | 0.0148 |
| 9.0 | 0.1110 | 0.0185 | 0.7500 | 0.0138 |
| 10 | 0.1000 | 0.0164 | 0.7500 | 0.0123 |

## Table 3.7.1-214 Enhanced Horizontal and Vertical RB/FB SCOR FIRS at Elevation 523.7 (ft) NAVD 88 (Sheet 1 of 3)

**[EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**

| Period (sec) | Frequency (Hz) | Horizontal Enhanced SCOR FIRS (g) | Vertical Enhanded SCOR FIRS (g) |
|---|---|---|---|
| 0.010 | 100.00 | 0.2217 | 0.2301 |
| 0.017 | 60.241 | 0.4060 | 0.4792 |
| 0.020 | 50.000 | 0.4816 | 0.5619 |
| 0.025 | 40.000 | 0.5380 | 0.5821 |
| 0.030 | 33.333 | 0.5620 | 0.5642 |
| 0.033 | 30.303 | 0.5684 | 0.5545 |
| 0.040 | 25.000 | 0.5817 | 0.5312 |
| 0.042 | 23.810 | 0.5761 | 0.5190 |
| 0.044 | 22.727 | 0.5709 | 0.5077 |
| 0.046 | 21.739 | 0.5660 | 0.4970 |
| 0.048 | 20.833 | 0.5613 | 0.4867 |
| 0.050 | 20.000 | 0.5568 | 0.4770 |
| 0.055 | 18.182 | 0.5417 | 0.4742 |
| 0.060 | 16.667 | 0.5283 | 0.4717 |
| 0.065 | 15.385 | 0.5244 | 0.4694 |
| 0.070 | 14.286 | 0.5207 | 0.4672 |
| 0.075 | 13.333 | 0.5174 | 0.4653 |
| 0.080 | 12.500 | 0.5142 | 0.4634 |
| 0.085 | 11.765 | 0.5113 | 0.4617 |
| 0.090 | 11.111 | 0.5086 | 0.4601 |
| 0.095 | 10.526 | 0.5060 | 0.4586 |
| 0.10 | 10.000 | 0.5036 | 0.4571 |
| 0.11 | 9.0909 | 0.4991 | 0.4544 |
| 0.12 | 8.3333 | 0.4950 | 0.4520 |
| 0.13 | 7.6923 | 0.4913 | 0.4498 |
| 0.14 | 7.1429 | 0.4879 | 0.4478 |
| 0.15 | 6.6667 | 0.4848 | 0.4459 |
| 0.16 | 6.2500 | 0.4818 | 0.4441 |
| 0.17 | 5.8824 | 0.4791 | 0.4425 |
| 0.18 | 5.5556 | 0.4765 | 0.4409 |
| 0.19 | 5.2632 | 0.4741 | 0.4394 |
| 0.20 | 5.0000 | 0.4718 | 0.4381 |
| 0.22 | 4.5455 | 0.4676 | 0.4355 |
| 0.24 | 4.1667 | 0.4638 | 0.4332 |
| 0.26 | 3.8462 | 0.4363 | 0.4320 |
| 0.28 | 3.5714 | 0.4124 | 0.4309 |

## Table 3.7.1-214 Enhanced Horizontal and Vertical RB/FB SCOR FIRS at Elevation 523.7 (ft) NAVD 88 (Sheet 2 of 3)

**[EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**

| Period (sec) | Frequency (Hz) | Horizontal Enhanced SCOR FIRS (g) | Vertical Enhanded SCOR FIRS (g) |
|---|---|---|---|
| 0.30 | 3.3333 | 0.3912 | 0.4145 |
| 0.32 | 3.1250 | 0.3724 | 0.3923 |
| 0.34 | 2.9412 | 0.3556 | 0.3726 |
| 0.36 | 2.7778 | 0.3404 | 0.3549 |
| 0.38 | 2.6316 | 0.3184 | 0.3389 |
| 0.40 | 2.5000 | 0.3130 | 0.3197 |
| 0.42 | 2.3810 | 0.3007 | 0.3024 |
| 0.44 | 2.2727 | 0.2894 | 0.2868 |
| 0.46 | 2.1739 | 0.2790 | 0.2726 |
| 0.48 | 2.0833 | 0.2694 | 0.2597 |
| 0.50 | 2.0000 | 0.2605 | 0.2479 |
| 0.55 | 1.8182 | 0.2409 | 0.2224 |
| 0.60 | 1.6667 | 0.2243 | 0.2014 |
| 0.65 | 1.5385 | 0.2100 | 0.1839 |
| 0.70 | 1.4286 | 0.1976 | 0.1690 |
| 0.75 | 1.3333 | 0.1867 | 0.1562 |
| 0.80 | 1.2500 | 0.1770 | 0.1451 |
| 0.85 | 1.1765 | 0.1684 | 0.1354 |
| 0.90 | 1.1111 | 0.1607 | 0.1290 |
| 0.95 | 1.0526 | 0.1537 | 0.1232 |
| 1.0 | 1.0000 | 0.1473 | 0.1179 |
| 1.1 | 0.9091 | 0.1362 | 0.1087 |
| 1.2 | 0.8333 | 0.1268 | 0.1010 |
| 1.3 | 0.7692 | 0.1187 | 0.0938 |
| 1.4 | 0.7143 | 0.1117 | 0.0875 |
| 1.5 | 0.6667 | 0.1056 | 0.0821 |
| 1.6 | 0.6250 | 0.1001 | 0.0774 |
| 1.7 | 0.5882 | 0.0952 | 0.0731 |
| 1.8 | 0.5556 | 0.0909 | 0.0694 |
| 1.9 | 0.5263 | 0.0869 | 0.0660 |
| 2.0 | 0.5000 | 0.0833 | 0.0629 |
| 2.2 | 0.4545 | 0.0770 | 0.0576 |
| 2.4 | 0.4167 | 0.0717 | 0.0531 |
| 2.6 | 0.3846 | 0.0672 | 0.0493 |
| 2.8 | 0.3571 | 0.0632 | 0.0461 |
| 3.0 | 0.3333 | 0.0597 | 0.0432 |

## Table 3.7.1-214 Enhanced Horizontal and Vertical RB/FB SCOR FIRS at Elevation 523.7 (ft) NAVD 88 (Sheet 3 of 3)

**[EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**

| Period (sec) | Frequency (Hz) | Horizontal Enhanced SCOR FIRS (g) | Vertical Enhanded SCOR FIRS (g) |
|---|---|---|---|
| 3.2 | 0.3125 | 0.0566 | 0.0407 |
| 3.4 | 0.2941 | 0.0539 | 0.0385 |
| 3.6 | 0.2778 | 0.0514 | 0.0365 |
| 3.8 | 0.2632 | 0.0492 | 0.0347 |
| 4.0 | 0.2500 | 0.0471 | 0.0331 |
| 4.2 | 0.2381 | 0.0450 | 0.0316 |
| 4.4 | 0.2273 | 0.0431 | 0.0303 |
| 4.6 | 0.2174 | 0.0414 | 0.0291 |
| 4.8 | 0.2083 | 0.0397 | 0.0280 |
| 5.0 | 0.2000 | 0.0382 | 0.0269 |
| 5.5 | 0.1818 | 0.0350 | 0.0247 |
| 6.0 | 0.1667 | 0.0323 | 0.0227 |
| 6.5 | 0.1538 | 0.0299 | 0.0211 |
| 7.0 | 0.1429 | 0.0279 | 0.0197 |
| 7.5 | 0.1333 | 0.0262 | 0.0185 |
| 8.0 | 0.1250 | 0.0246 | 0.0174 |
| 8.5 | 0.1176 | 0.0233 | 0.0165 |
| 9.0 | 0.1111 | 0.0221 | 0.0156 |
| 10 | 0.1000 | 0.0200 | 0.0142 |

**Table 3.7.1-215 Enhanced Horizontal and Vertical CB SCOR FIRS at Elevation 540.4 (ft) NAVD 88 (Sheet 1 of 3)**
**[EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**

| Period (sec) | Frequency (Hz) | Horizontal Enhanced SCOR FIRS (g) | Vertical Enhanded SCOR FIRS (g) |
|---|---|---|---|
| 0.010 | 100.00 | 0.2209 | 0.2292 |
| 0.017 | 60.241 | 0.4047 | 0.4777 |
| 0.020 | 50.000 | 0.4803 | 0.5604 |
| 0.025 | 40.000 | 0.5367 | 0.5807 |
| 0.030 | 33.333 | 0.5608 | 0.5631 |
| 0.033 | 30.303 | 0.5680 | 0.5541 |
| 0.040 | 25.000 | 0.5827 | 0.5322 |
| 0.042 | 23.810 | 0.5772 | 0.5200 |
| 0.044 | 22.727 | 0.5719 | 0.5086 |
| 0.046 | 21.739 | 0.5669 | 0.4978 |
| 0.048 | 20.833 | 0.5622 | 0.4875 |
| 0.050 | 20.000 | 0.5577 | 0.4777 |
| 0.055 | 18.182 | 0.5425 | 0.4749 |
| 0.060 | 16.667 | 0.5290 | 0.4723 |
| 0.065 | 15.385 | 0.5250 | 0.4700 |
| 0.070 | 14.286 | 0.5213 | 0.4678 |
| 0.075 | 13.333 | 0.5179 | 0.4658 |
| 0.080 | 12.500 | 0.5147 | 0.4639 |
| 0.085 | 11.765 | 0.5118 | 0.4622 |
| 0.090 | 11.111 | 0.5090 | 0.4605 |
| 0.095 | 10.526 | 0.5064 | 0.4590 |
| 0.10 | 10.000 | 0.5039 | 0.4575 |
| 0.11 | 9.0909 | 0.4994 | 0.4548 |
| 0.12 | 8.3333 | 0.4953 | 0.4523 |
| 0.13 | 7.6923 | 0.4915 | 0.4501 |
| 0.14 | 7.1429 | 0.4881 | 0.4480 |
| 0.15 | 6.6667 | 0.4849 | 0.4461 |
| 0.16 | 6.2500 | 0.4819 | 0.4443 |
| 0.17 | 5.8824 | 0.4792 | 0.4426 |
| 0.18 | 5.5556 | 0.4766 | 0.4410 |
| 0.19 | 5.2632 | 0.4741 | 0.4396 |
| 0.20 | 5.0000 | 0.4718 | 0.4382 |
| 0.22 | 4.5455 | 0.4676 | 0.4356 |
| 0.24 | 4.1667 | 0.4637 | 0.4332 |
| 0.26 | 3.8462 | 0.4363 | 0.4320 |
| 0.28 | 3.5714 | 0.4123 | 0.4309 |

## Table 3.7.1-215 Enhanced Horizontal and Vertical CB SCOR FIRS at Elevation 540.4 (ft) NAVD 88 (Sheet 2 of 3)

**[EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**

| Period (sec) | Frequency (Hz) | Horizontal Enhanced SCOR FIRS (g) | Vertical Enhanded SCOR FIRS (g) |
|---|---|---|---|
| 0.30 | 3.3333 | 0.3912 | 0.4145 |
| 0.32 | 3.1250 | 0.3724 | 0.3923 |
| 0.34 | 2.9412 | 0.3556 | 0.3726 |
| 0.36 | 2.7778 | 0.3404 | 0.3549 |
| 0.38 | 2.6316 | 0.3184 | 0.3389 |
| 0.40 | 2.5000 | 0.3130 | 0.3197 |
| 0.42 | 2.3810 | 0.3007 | 0.3024 |
| 0.44 | 2.2727 | 0.2894 | 0.2868 |
| 0.46 | 2.1739 | 0.2790 | 0.2726 |
| 0.48 | 2.0833 | 0.2694 | 0.2597 |
| 0.50 | 2.0000 | 0.2605 | 0.2479 |
| 0.55 | 1.8182 | 0.2409 | 0.2224 |
| 0.60 | 1.6667 | 0.2243 | 0.2014 |
| 0.65 | 1.5385 | 0.2100 | 0.1839 |
| 0.70 | 1.4286 | 0.1976 | 0.1690 |
| 0.75 | 1.3333 | 0.1867 | 0.1562 |
| 0.80 | 1.2500 | 0.1770 | 0.1451 |
| 0.85 | 1.1765 | 0.1684 | 0.1354 |
| 0.90 | 1.1111 | 0.1607 | 0.1290 |
| 0.95 | 1.0526 | 0.1537 | 0.1232 |
| 1.0 | 1.0000 | 0.1473 | 0.1179 |
| 1.1 | 0.9091 | 0.1362 | 0.1087 |
| 1.2 | 0.8333 | 0.1268 | 0.1010 |
| 1.3 | 0.7692 | 0.1187 | 0.0938 |
| 1.4 | 0.7143 | 0.1117 | 0.0875 |
| 1.5 | 0.6667 | 0.1056 | 0.0821 |
| 1.6 | 0.6250 | 0.1001 | 0.0774 |
| 1.7 | 0.5882 | 0.0952 | 0.0731 |
| 1.8 | 0.5556 | 0.0909 | 0.0694 |
| 1.9 | 0.5263 | 0.0869 | 0.0660 |
| 2.0 | 0.5000 | 0.0833 | 0.0629 |
| 2.2 | 0.4545 | 0.0770 | 0.0576 |
| 2.4 | 0.4167 | 0.0717 | 0.0531 |
| 2.6 | 0.3846 | 0.0672 | 0.0493 |
| 2.8 | 0.3571 | 0.0632 | 0.0461 |
| 3.0 | 0.3333 | 0.0597 | 0.0432 |

## Table 3.7.1-215 Enhanced Horizontal and Vertical CB SCOR FIRS at Elevation 540.4 (ft) NAVD 88 (Sheet 3 of 3)

**[EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**

| Period (sec) | Frequency (Hz) | Horizontal Enhanced SCOR FIRS (g) | Vertical Enhanded SCOR FIRS (g) |
|---|---|---|---|
| 3.2 | 0.3125 | 0.0566 | 0.0407 |
| 3.4 | 0.2941 | 0.0539 | 0.0385 |
| 3.6 | 0.2778 | 0.0514 | 0.0365 |
| 3.8 | 0.2632 | 0.0492 | 0.0347 |
| 4.0 | 0.2500 | 0.0471 | 0.0331 |
| 4.2 | 0.2381 | 0.0450 | 0.0316 |
| 4.4 | 0.2273 | 0.0431 | 0.0303 |
| 4.6 | 0.2174 | 0.0414 | 0.0291 |
| 4.8 | 0.2083 | 0.0397 | 0.0280 |
| 5.0 | 0.2000 | 0.0382 | 0.0269 |
| 5.5 | 0.1818 | 0.0350 | 0.0247 |
| 6.0 | 0.1667 | 0.0323 | 0.0227 |
| 6.5 | 0.1538 | 0.0299 | 0.0211 |
| 7.0 | 0.1429 | 0.0279 | 0.0197 |
| 7.5 | 0.1333 | 0.0262 | 0.0185 |
| 8.0 | 0.1250 | 0.0246 | 0.0174 |
| 8.5 | 0.1176 | 0.0233 | 0.0165 |
| 9.0 | 0.1111 | 0.0221 | 0.0156 |
| 10 | 0.1000 | 0.0200 | 0.0142 |

**Table 3.7.1-216 Horizontal and Vertical FWSC FIRS at Elevation 581.6 (ft) NAVD 88 with Associated V/H Ratios (Sheet 1 of 3)**
**[EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**

| Period (sec) | Frequency (Hz) | Horizontal FWSC FIRS (g) | V/H Ratio | Vertical FWSC FIRS (g) |
|---|---|---|---|---|
| 0.010 | 100.00 | 0.2290 | 1.0000 | 0.2290 |
| 0.017 | 60.241 | 0.4282 | 1.1374 | 0.4871 |
| 0.020 | 50.000 | 0.5789 | 1.1244 | 0.6509 |
| 0.025 | 40.000 | 0.7887 | 1.0426 | 0.8224 |
| 0.030 | 33.333 | 0.9961 | 0.9675 | 0.9638 |
| 0.033 | 30.303 | 1.0524 | 0.9400 | 0.9893 |
| 0.040 | 25.000 | 1.0316 | 0.8800 | 0.9078 |
| 0.042 | 23.810 | 0.9953 | 0.8681 | 0.8640 |
| 0.044 | 22.727 | 0.9559 | 0.8569 | 0.8191 |
| 0.046 | 21.739 | 0.9141 | 0.8461 | 0.7735 |
| 0.048 | 20.833 | 0.8687 | 0.8355 | 0.7258 |
| 0.050 | 20.000 | 0.8429 | 0.8255 | 0.6958 |
| 0.055 | 18.182 | 0.7880 | 0.8069 | 0.6358 |
| 0.060 | 16.667 | 0.7613 | 0.7984 | 0.6078 |
| 0.065 | 15.385 | 0.7395 | 0.7906 | 0.5846 |
| 0.070 | 14.286 | 0.7150 | 0.7834 | 0.5602 |
| 0.075 | 13.333 | 0.6930 | 0.7769 | 0.5383 |
| 0.080 | 12.500 | 0.6729 | 0.7708 | 0.5187 |
| 0.085 | 11.765 | 0.6547 | 0.7651 | 0.5009 |
| 0.090 | 11.111 | 0.6379 | 0.7597 | 0.4846 |
| 0.095 | 10.526 | 0.6224 | 0.7547 | 0.4698 |
| 0.10 | 10.000 | 0.6081 | 0.7500 | 0.4561 |
| 0.11 | 9.0910 | 0.5824 | 0.7500 | 0.4368 |
| 0.12 | 8.3330 | 0.5598 | 0.7500 | 0.4199 |
| 0.13 | 7.6920 | 0.5398 | 0.7500 | 0.4049 |
| 0.14 | 7.1430 | 0.5220 | 0.7500 | 0.3915 |
| 0.15 | 6.6670 | 0.5059 | 0.7500 | 0.3794 |
| 0.16 | 6.2500 | 0.4913 | 0.7500 | 0.3685 |
| 0.17 | 5.8820 | 0.4779 | 0.7500 | 0.3584 |
| 0.18 | 5.5560 | 0.4657 | 0.7500 | 0.3493 |
| 0.19 | 5.2630 | 0.4544 | 0.7500 | 0.3408 |
| 0.20 | 5.0000 | 0.4439 | 0.7500 | 0.3330 |
| 0.22 | 4.5450 | 0.4251 | 0.7500 | 0.3189 |
| 0.24 | 4.1670 | 0.4087 | 0.7500 | 0.3065 |
| 0.26 | 3.8460 | 0.3941 | 0.7500 | 0.2956 |
| 0.28 | 3.5710 | 0.3865 | 0.7500 | 0.2899 |
| 0.30 | 3.3330 | 0.3689 | 0.7500 | 0.2767 |

## Table 3.7.1-216 Horizontal and Vertical FWSC FIRS at Elevation 581.6 (ft) NAVD 88 with Associated V/H Ratios (Sheet 2 of 3) [EF3 COL 2.0-27-A, EF3 SUP 3.7-1]

| Period (sec) | Frequency (Hz) | Horizontal FWSC FIRS (g) | V/H Ratio | Vertical FWSC FIRS (g) |
|---|---|---|---|---|
| 0.32 | 3.1250 | 0.3471 | 0.7500 | 0.2603 |
| 0.34 | 2.9410 | 0.3232 | 0.7500 | 0.2424 |
| 0.36 | 2.7780 | 0.3002 | 0.7500 | 0.2251 |
| 0.38 | 2.6320 | 0.2789 | 0.7500 | 0.2092 |
| 0.40 | 2.5000 | 0.2564 | 0.7500 | 0.1923 |
| 0.42 | 2.3810 | 0.2391 | 0.7500 | 0.1793 |
| 0.44 | 2.2730 | 0.2236 | 0.7500 | 0.1677 |
| 0.46 | 2.1740 | 0.2085 | 0.7500 | 0.1564 |
| 0.48 | 2.0830 | 0.1956 | 0.7500 | 0.1467 |
| 0.50 | 2.0000 | 0.1843 | 0.7500 | 0.1383 |
| 0.55 | 1.8180 | 0.1653 | 0.7500 | 0.1240 |
| 0.60 | 1.6670 | 0.1500 | 0.7500 | 0.1125 |
| 0.65 | 1.5380 | 0.1380 | 0.7500 | 0.1035 |
| 0.70 | 1.4290 | 0.1281 | 0.7500 | 0.0961 |
| 0.75 | 1.3330 | 0.1198 | 0.7500 | 0.0899 |
| 0.80 | 1.2500 | 0.1118 | 0.7500 | 0.0838 |
| 0.85 | 1.1760 | 0.1059 | 0.7500 | 0.0794 |
| 0.90 | 1.1110 | 0.1007 | 0.7500 | 0.0755 |
| 0.95 | 1.0530 | 0.0952 | 0.7500 | 0.0714 |
| 1.0 | 1.0000 | 0.0910 | 0.7500 | 0.0682 |
| 1.1 | 0.9090 | 0.0852 | 0.7500 | 0.0639 |
| 1.2 | 0.8330 | 0.0802 | 0.7500 | 0.0602 |
| 1.3 | 0.7690 | 0.0759 | 0.7500 | 0.0569 |
| 1.4 | 0.7140 | 0.0730 | 0.7500 | 0.0548 |
| 1.5 | 0.6670 | 0.0713 | 0.7500 | 0.0535 |
| 1.6 | 0.6250 | 0.0694 | 0.7500 | 0.0520 |
| 1.7 | 0.5880 | 0.0675 | 0.7500 | 0.0506 |
| 1.8 | 0.5560 | 0.0660 | 0.7500 | 0.0495 |
| 1.9 | 0.5260 | 0.0646 | 0.7500 | 0.0485 |
| 2.0 | 0.5000 | 0.0634 | 0.7500 | 0.0475 |
| 2.2 | 0.4550 | 0.0593 | 0.7500 | 0.0445 |
| 2.4 | 0.4170 | 0.0555 | 0.7500 | 0.0416 |
| 2.6 | 0.3850 | 0.0528 | 0.7500 | 0.0396 |
| 2.8 | 0.3570 | 0.0502 | 0.7500 | 0.0376 |
| 3.0 | 0.3330 | 0.0478 | 0.7500 | 0.0359 |
| 3.2 | 0.3130 | 0.0457 | 0.7500 | 0.0343 |
| 3.4 | 0.2940 | 0.0438 | 0.7500 | 0.0328 |

## Table 3.7.1-216 Horizontal and Vertical FWSC FIRS at Elevation 581.6 (ft) NAVD 88 with Associated V/H Ratios (Sheet 3 of 3) [EF3 COL 2.0-27-A, EF3 SUP 3.7-1]

| Period (sec) | Frequency (Hz) | Horizontal FWSC FIRS (g) | V/H Ratio | Vertical FWSC FIRS (g) |
|---|---|---|---|---|
| 3.6 | 0.2780 | 0.0418 | 0.7500 | 0.0314 |
| 3.8 | 0.2630 | 0.0404 | 0.7500 | 0.0303 |
| 4.0 | 0.2500 | 0.0391 | 0.7500 | 0.0293 |
| 4.2 | 0.2380 | 0.0380 | 0.7500 | 0.0285 |
| 4.4 | 0.2270 | 0.0369 | 0.7500 | 0.0277 |
| 4.6 | 0.2170 | 0.0358 | 0.7500 | 0.0268 |
| 4.8 | 0.2080 | 0.0348 | 0.7500 | 0.0261 |
| 5.0 | 0.2000 | 0.0339 | 0.7500 | 0.0255 |
| 5.5 | 0.1820 | 0.0312 | 0.7500 | 0.0234 |
| 6.0 | 0.1670 | 0.0288 | 0.7500 | 0.0216 |
| 6.5 | 0.1540 | 0.0267 | 0.7500 | 0.0200 |
| 7.0 | 0.1430 | 0.0249 | 0.7500 | 0.0187 |
| 7.5 | 0.1330 | 0.0234 | 0.7500 | 0.0176 |
| 8.0 | 0.1250 | 0.0219 | 0.7500 | 0.0164 |
| 8.5 | 0.1180 | 0.0205 | 0.7500 | 0.0154 |
| 9.0 | 0.1110 | 0.0193 | 0.7500 | 0.0145 |
| 10 | 0.1000 | 0.0173 | 0.7500 | 0.0130 |

## Table 3.7.1-217 Seed Time History Recording Details [EF3 SUP 3.7-1]

| | | | Filter Corners | | Record Parameters | | | |
|---|---|---|---|---|---|---|---|---|
| Earthquake | Station | Component | High-Pass (Hz) | Low-Pass (Hz) | PGA (g) | PGV (cm/sec) | PGD (cm) | Duration* (sec) |
| 1999 Chi-Chi, Taiwan **M** 7.6 | TAP078 R = 131 km | TAP078-N | 0.04 | 40 | 0.088 | 13.0 | 5.6 | 25.8 |
| | | TAP078-W | 0.02 | 40 | 0.094 | 10.7 | 5.0 | 30.1 |
| | | TAP078-V | 0.03 | 33 | 0.063 | 8.6 | 8.3 | 30.5 |

Note:

Duration is defined as the time interval between the time history points at which 5 and 75 percent of the normalized Arias intensity (total energy measure) has been recorded.

## Table 3.7.1-218 Cross Correlation Coefficients for the Matched Time Histories [EF3 SUP 3.7-1]

| Building | Components | Cross Correlation Coefficient |
|---|---|---|
| RB/FB | H1 – H2 | -0.01 |
| | H1 – V | 0.02 |
| | H2 – V | 0.00 |
| CB | H1 – H2 | -0.02 |
| | H1 – V | 0.02 |
| | H2 – V | 0.00 |

## Table 3.7.1-219 Matched Time History (Outcrop Motions) Parameters [EF3 SUP 3.7-1]

| Response Spectrum | Component | Record Parameters | | | | | |
|---|---|---|---|---|---|---|---|
| | | PGA (g) | PGV (cm/sec) | PGD (cm) | Duration (sec) | PGV/PGA (cm/sec/g) | PGAxPGD/ $(PGV)^2$ |
| RB/FB Enhanced SCOR FIRS | Horizontal 1 | 0.24 | 17.80 | 12.11 | 24.65 | 74.03 | 9.01 |
| | Horizontal 2 | 0.24 | 17.28 | 12.57 | 29.21 | 73.50 | 9.71 |
| | Vertical | 0.24 | 14.06 | 9.38 | 30.89 | 58.17 | 11.25 |
| CB Enhanced SCOR FIRS | Horizontal 1 | 0.24 | 18.63 | 12.07 | 24.52 | 77.24 | 8.23 |
| | Horizontal 2 | 0.23 | 16.03 | 12.16 | 29.15 | 69.92 | 10.65 |
| | Vertical | 0.24 | 14.21 | 8.78 | 31.05 | 58.84 | 10.31 |

Note:

PGA – Peak ground acceleration (100 Hz)

PGV – Peak ground velocity

PGD – Peak ground displacement

Duration is defined as the time interval between the time history points at which 5 and 75 percent of the normalized Arias intensity (total energy measure) has been recorded.

**Table 3.7.1-220 Cumulative Power below 50 Hz for In-Column Acceleration Time Histories with and without Engineered Granular Backfill above the Top of the Bass Islands Group Bedrock [EF3 SUP 3.7-1]**

| Structure | Engineered Granular Backfill above the Top of the Bass Islands Group Bedrock | In-Column Time History Component | Cumulative Power Below 50 Hz | | |
|---|---|---|---|---|---|
| | | | Deterministic Profile | | |
| | | | BE | LB | UB |
| RB/FB | Without Backfill | Vertical | 92% | 94% | 91% |
| | | Horizontal – H1 | 100% | 99% | 99% |
| | | Horizontal – H2 | 99% | 98% | 98% |
| | With Backfill | Vertical | 93% | 95% | 91% |
| | | Horizontal – H1 | 100% | 99% | 99% |
| | | Horizontal – H2 | 99% | 98% | 98% |
| CB | Without Backfill | Vertical | 88% | 89% | 88% |
| | | Horizontal – H1 | 96% | 97% | 95% |
| | | Horizontal – H2 | 93% | 94% | 92% |
| | With Backfill | Vertical | 90% | 91% | 92% |
| | | Horizontal – H1 | 96% | 97% | 96% |
| | | Horizontal – H2 | 93% | 94% | 93% |

**Figure 3.7.1-201 Shear Wave Velocity Profiles for Site Response Analysis: Intermediate Range, Lower Range, and Upper Range Values [EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**

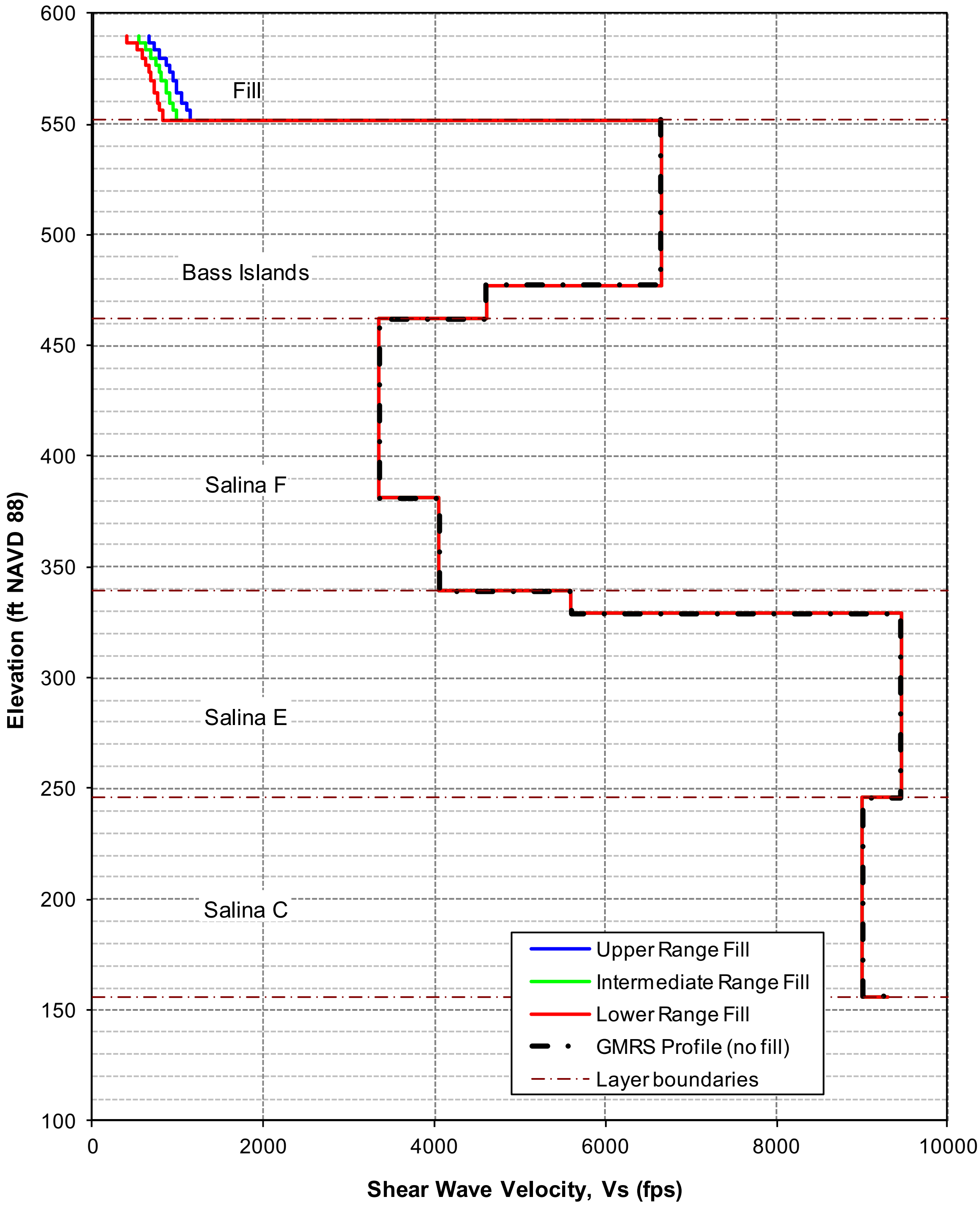


**Figure 3.7.1-202 Shear Wave Velocity Profiles for Site Response Analysis: FWSC Shear Wave Velocity Profile [EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**

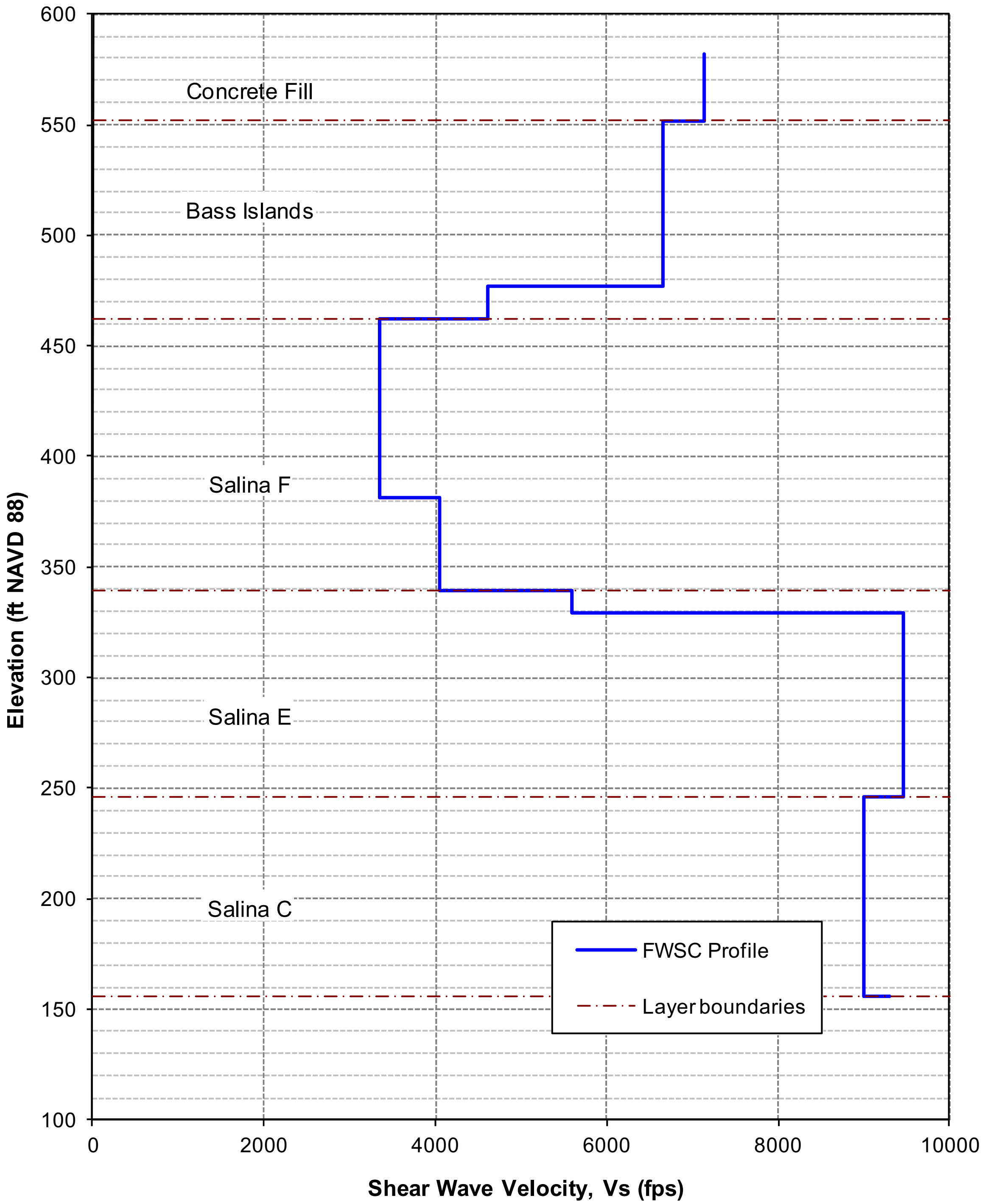


**Figure 3.7.1-203 Modulus Reduction and Damping Relationships Used for the Engineered Granular Backfill Material [EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**

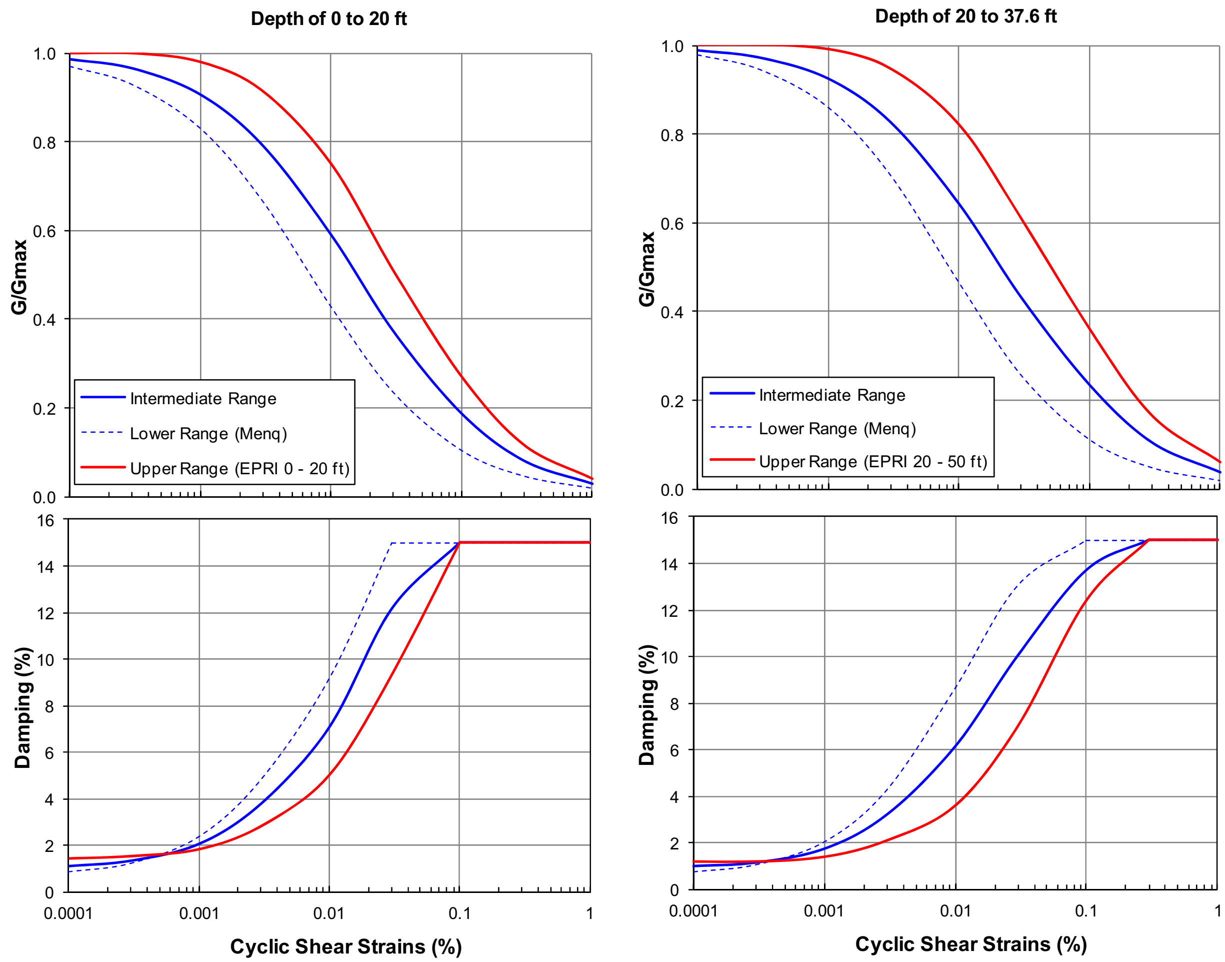


**Figure 3.7.1-204 Randomized Shear Wave Velocity Profiles 1-30 for the Intermediate Range Site Response Analysis Profile [EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**

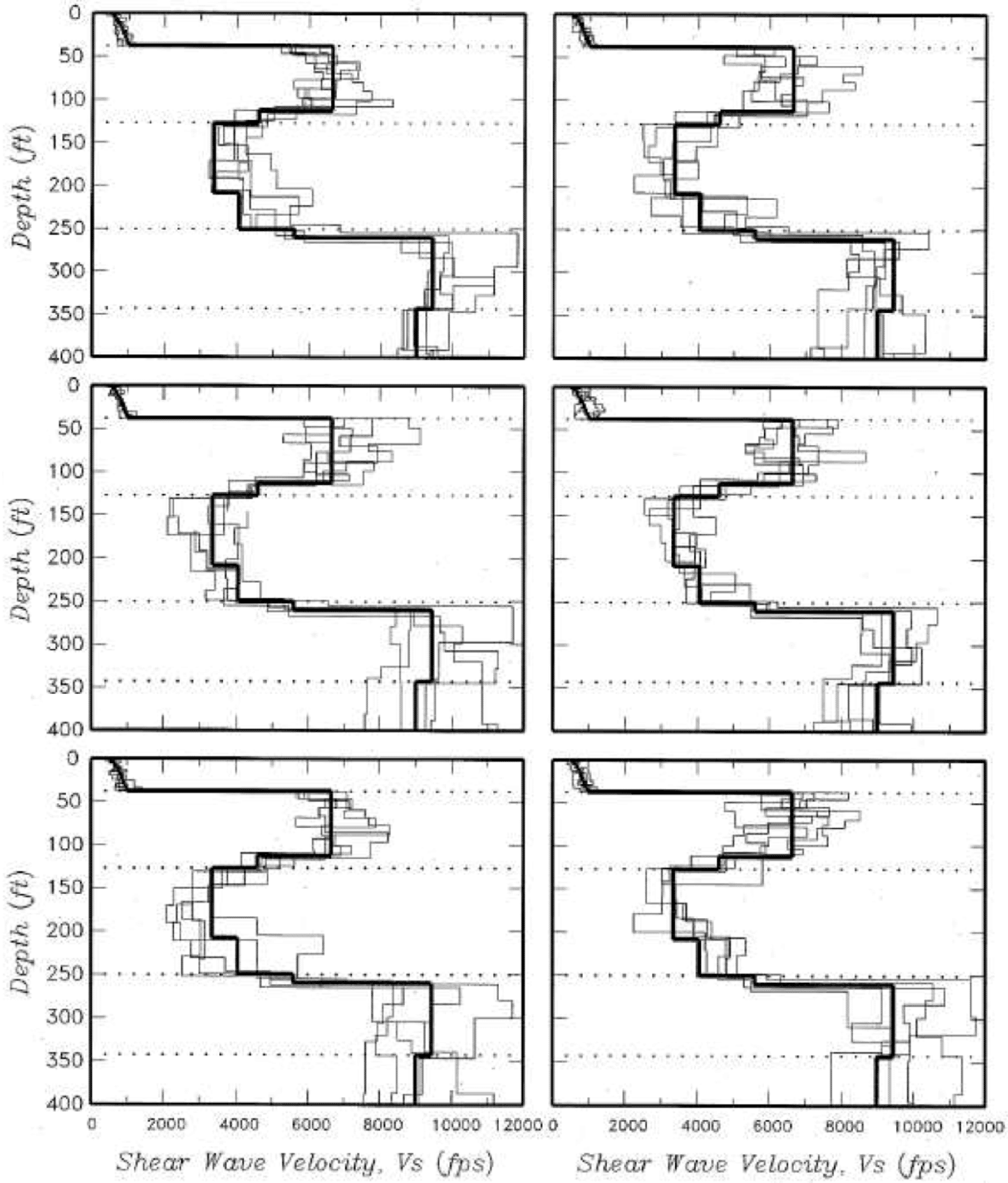


**Figure 3.7.1-205 Randomized Shear Wave Velocity Profiles 31-60 for the Intermediate Range Site Response Analysis Profile [EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**

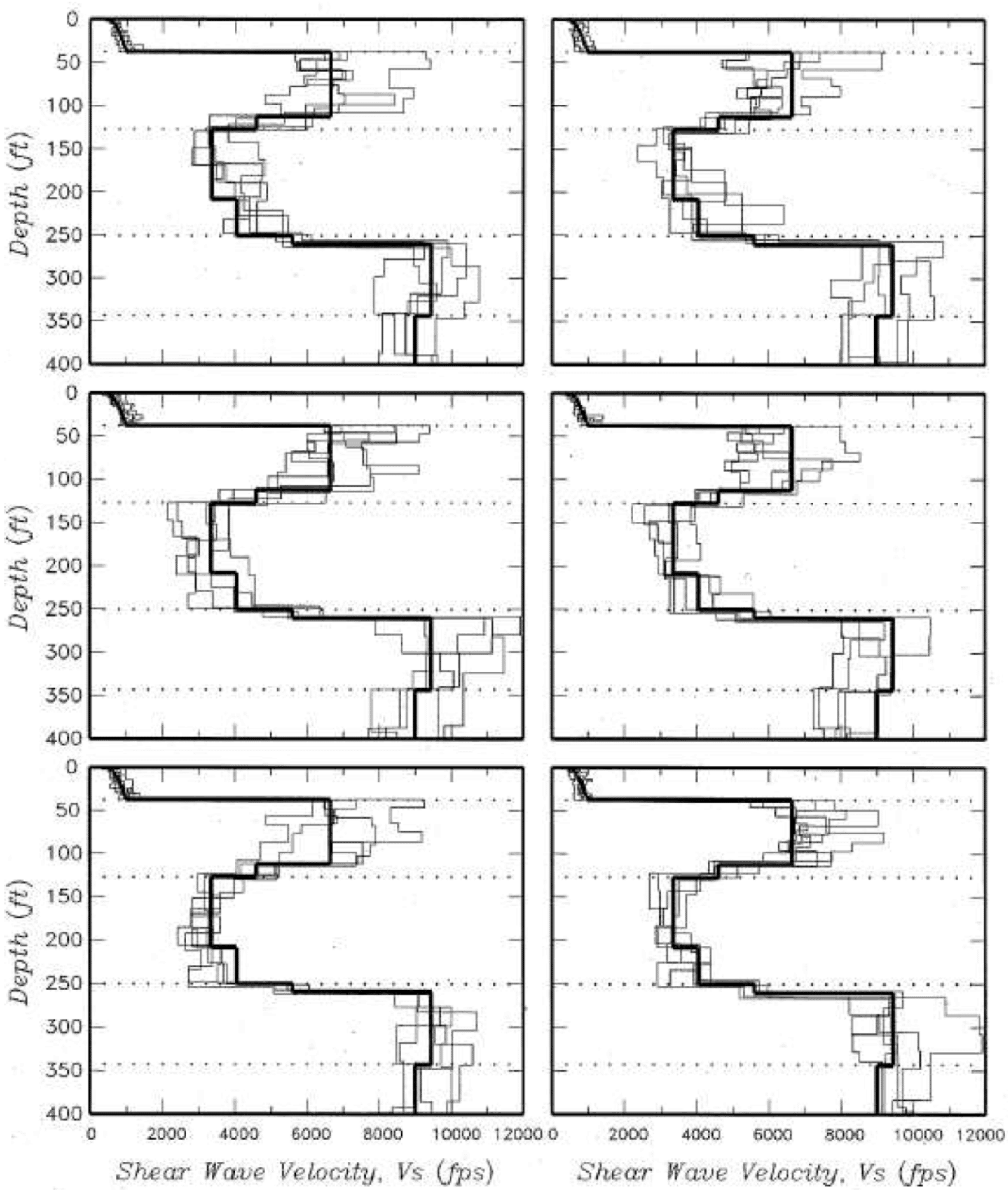


**Figure 3.7.1-206 Statistics of Randomized Shear Wave Velocity Profiles for the Intermediate Range Site Response Analysis Profile [EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**

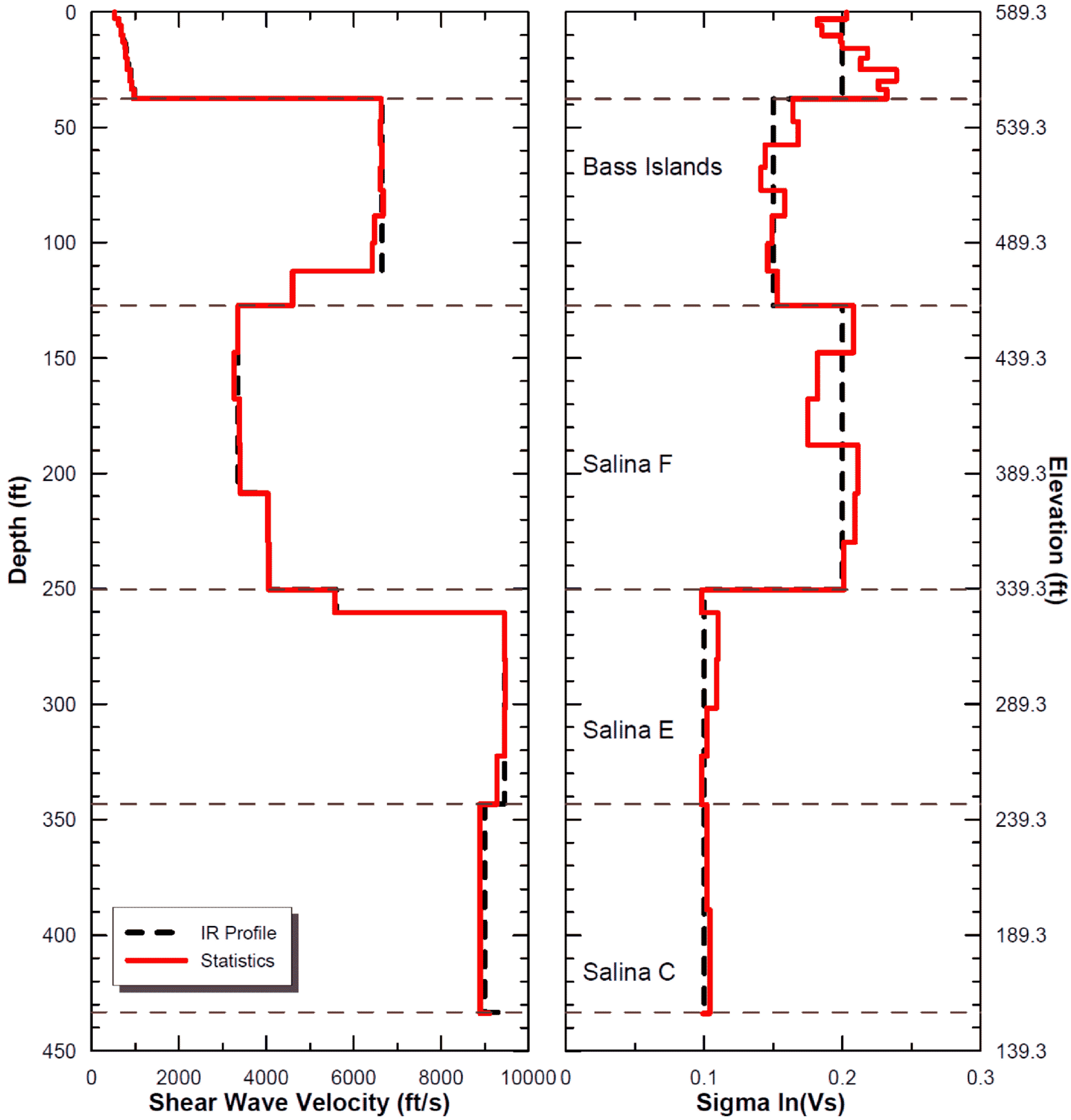
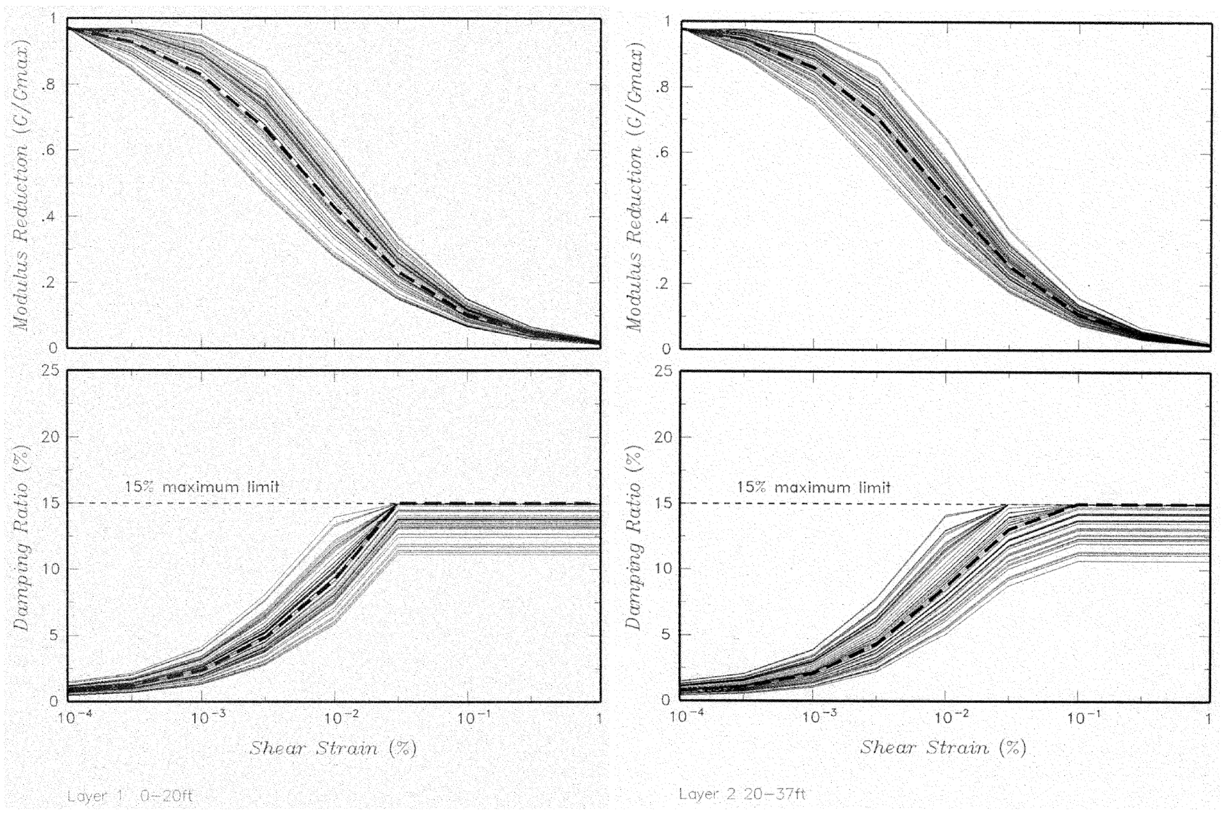


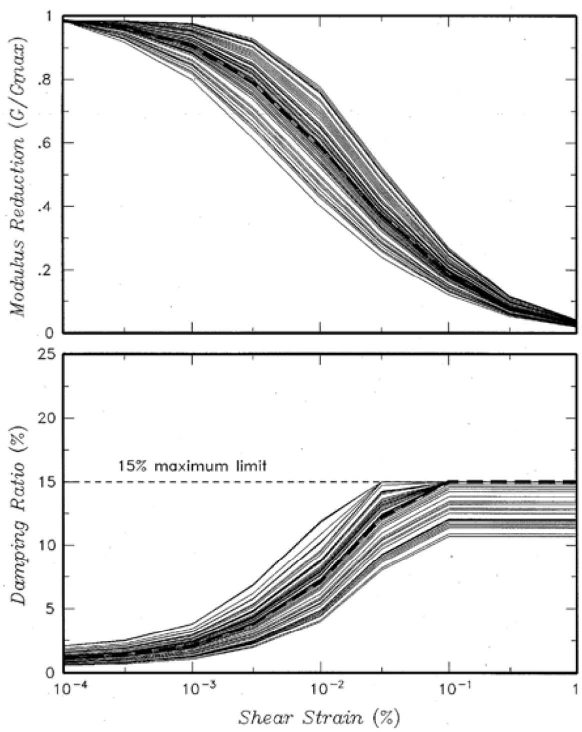
**Figure 3.7.1-207 Randomized Shear Modulus Reduction and Damping Relationships Used for LR Engineered Granular Backfill Material [EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**



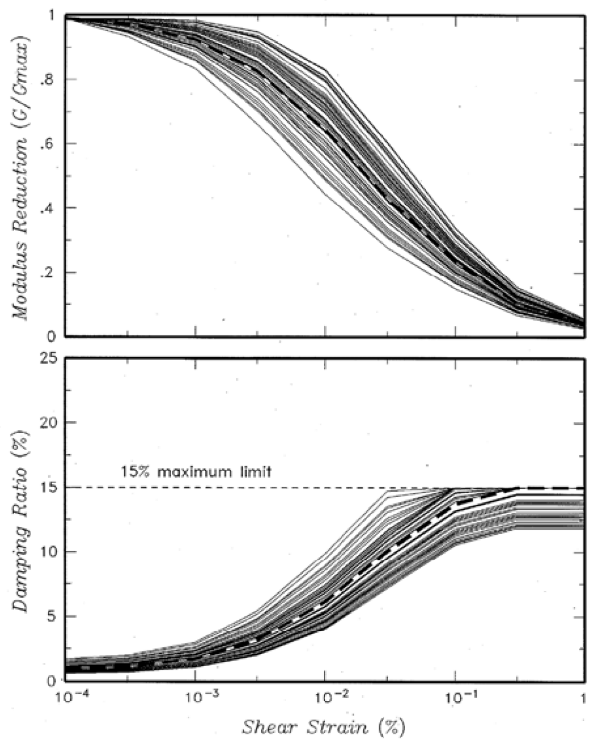

0 to 20 feet depth

20 to 37.6 feet depth

**Figure 3.7.1-208 Randomized Shear Modulus Reduction and Damping Relationships Used for IR Engineered Granular Backfill Material [EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**

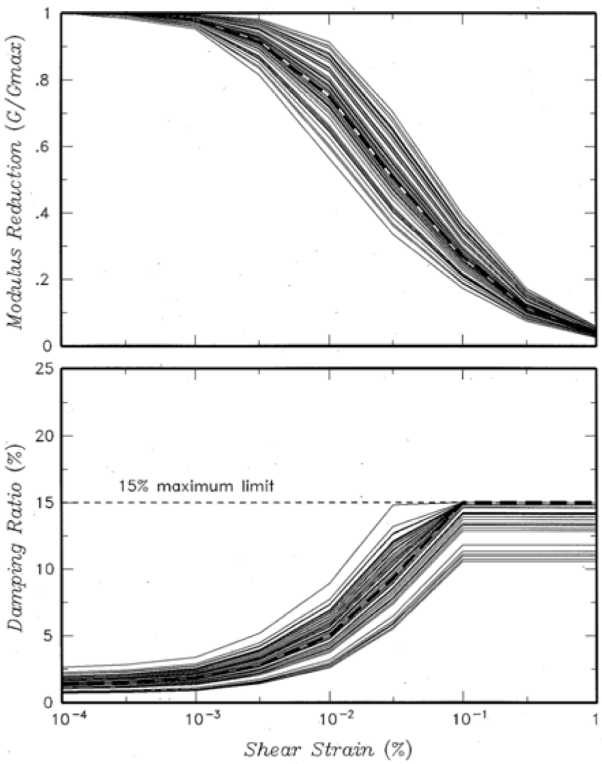



0 to 20 feet depth

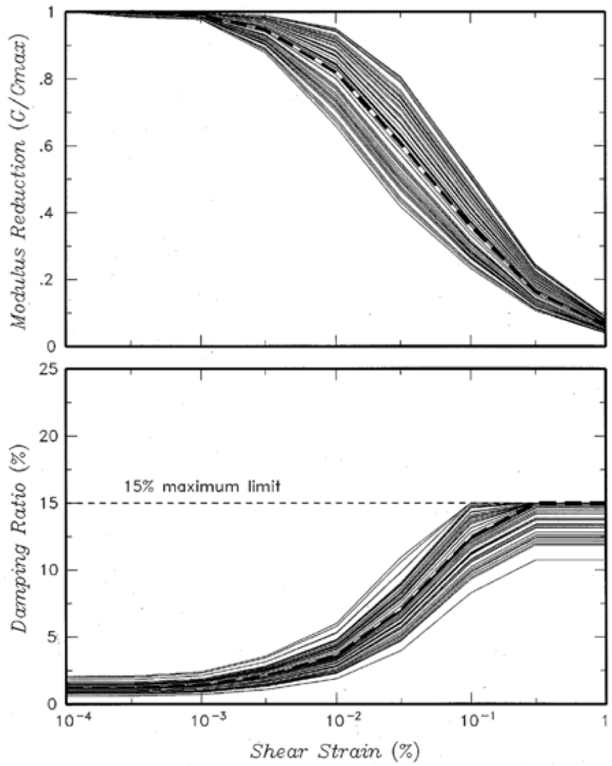



20 to 50 feet depth

**Figure 3.7.1-209 Randomized Shear Modulus Reduction and Damping Relationships Used for UR Engineered Granular Backfill Material [EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**



0 to 20 feet depth



20 to 50 feet depth

**Figure 3.7.1-210 Site Response Logic Tree for Full Soil Column Profile [EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**

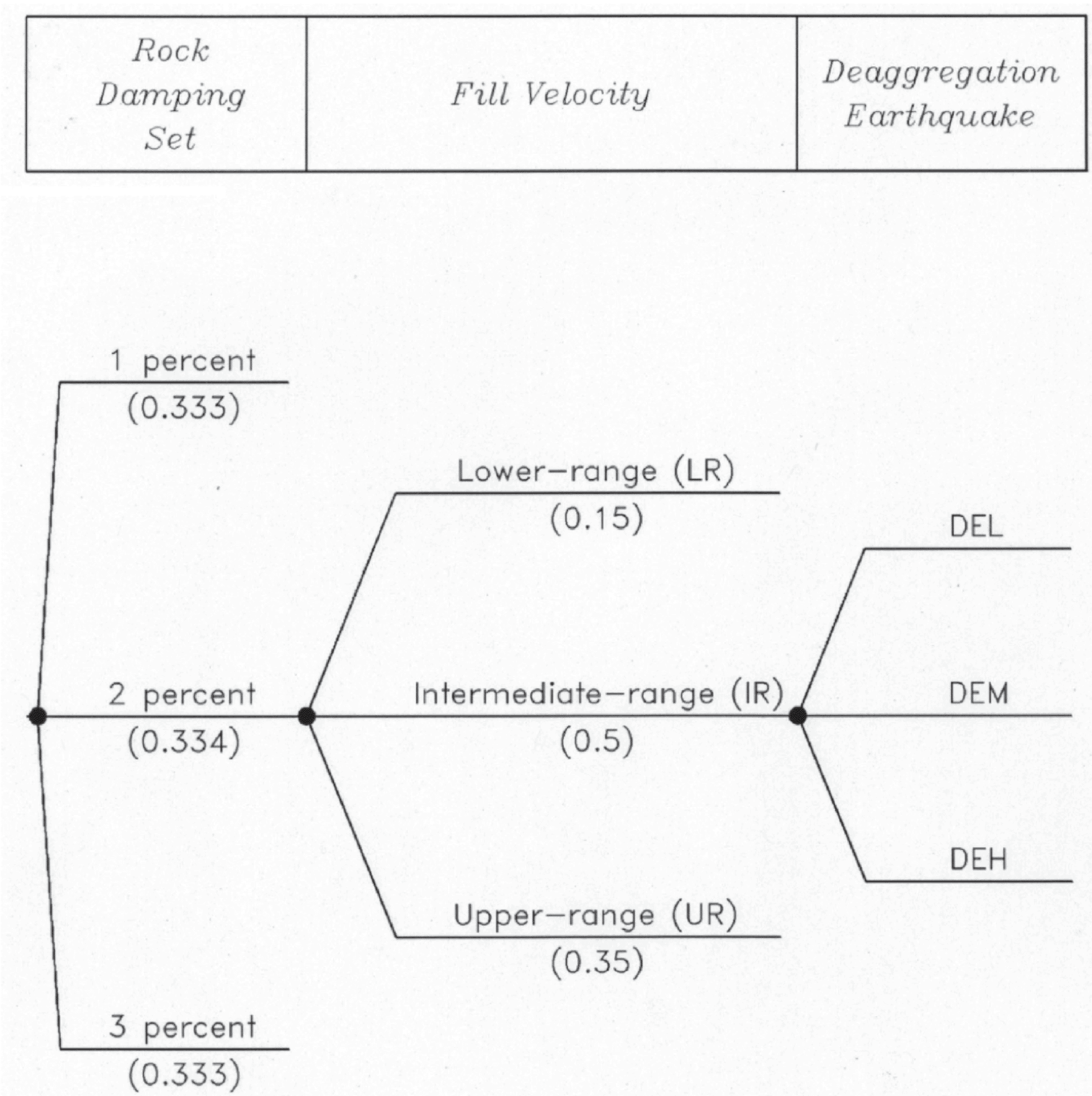


**Figure 3.7.1-211 PBSRS Amplification Functions for the Fermi 3 Site [EF3 SUP 3.7-1]**

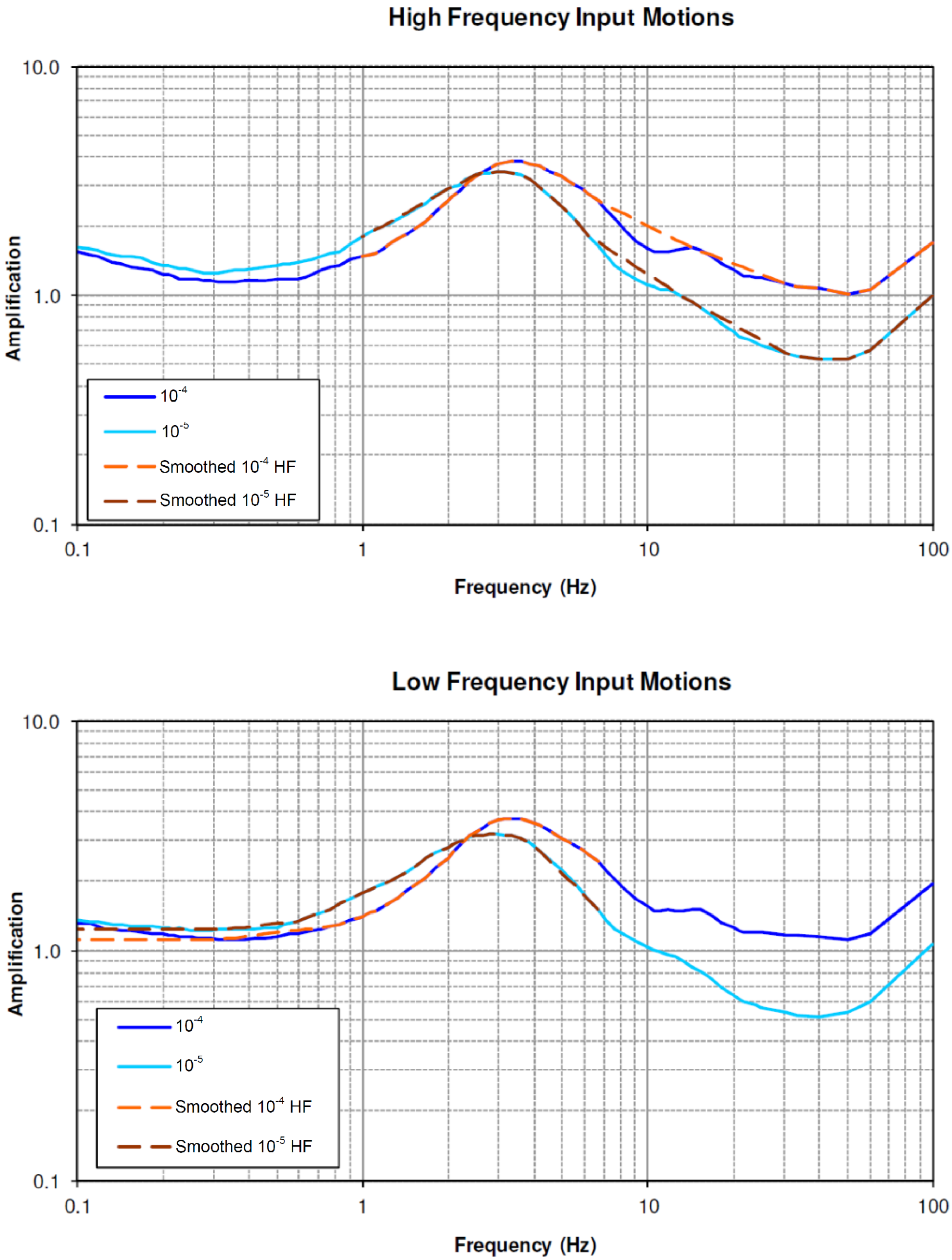
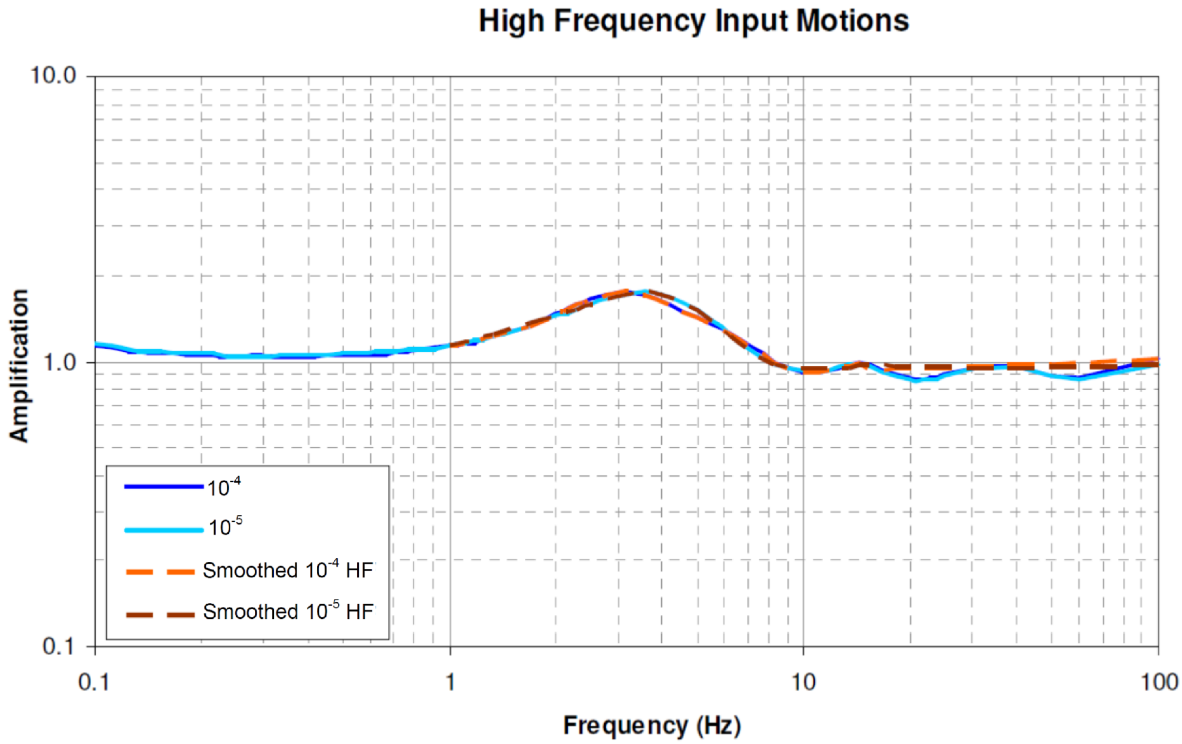


**Figure 3.7.1-212 RB/FB SCOR FIRS Amplification Functions for the Fermi 3 Site [EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**



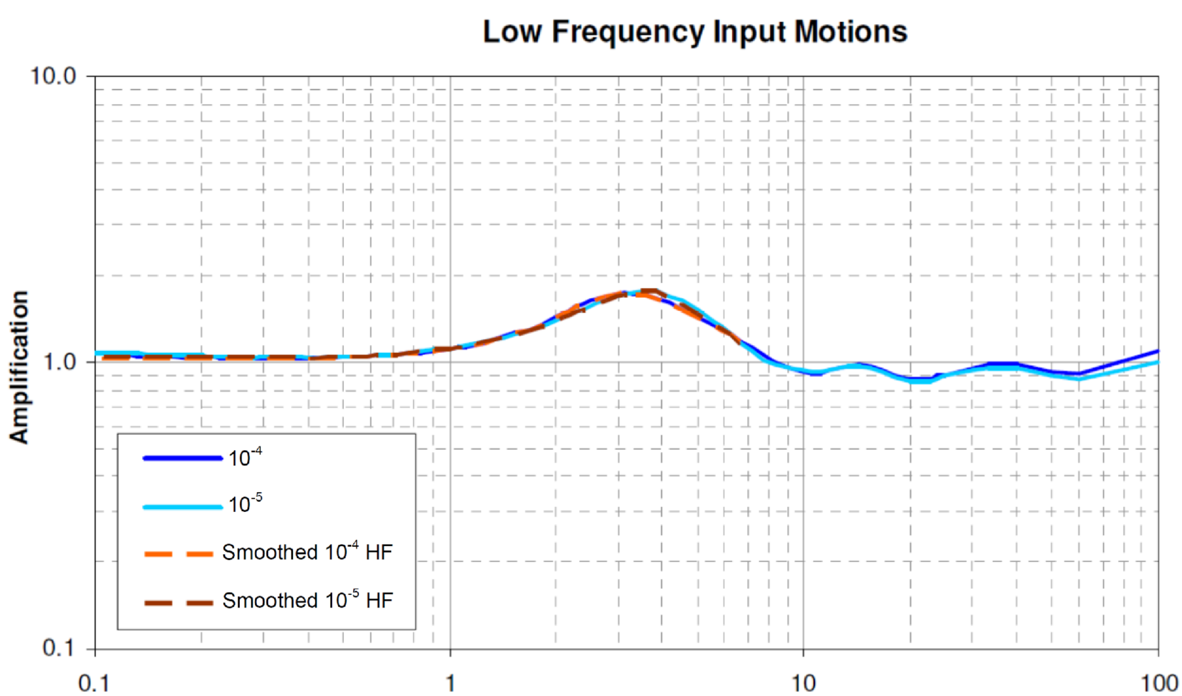
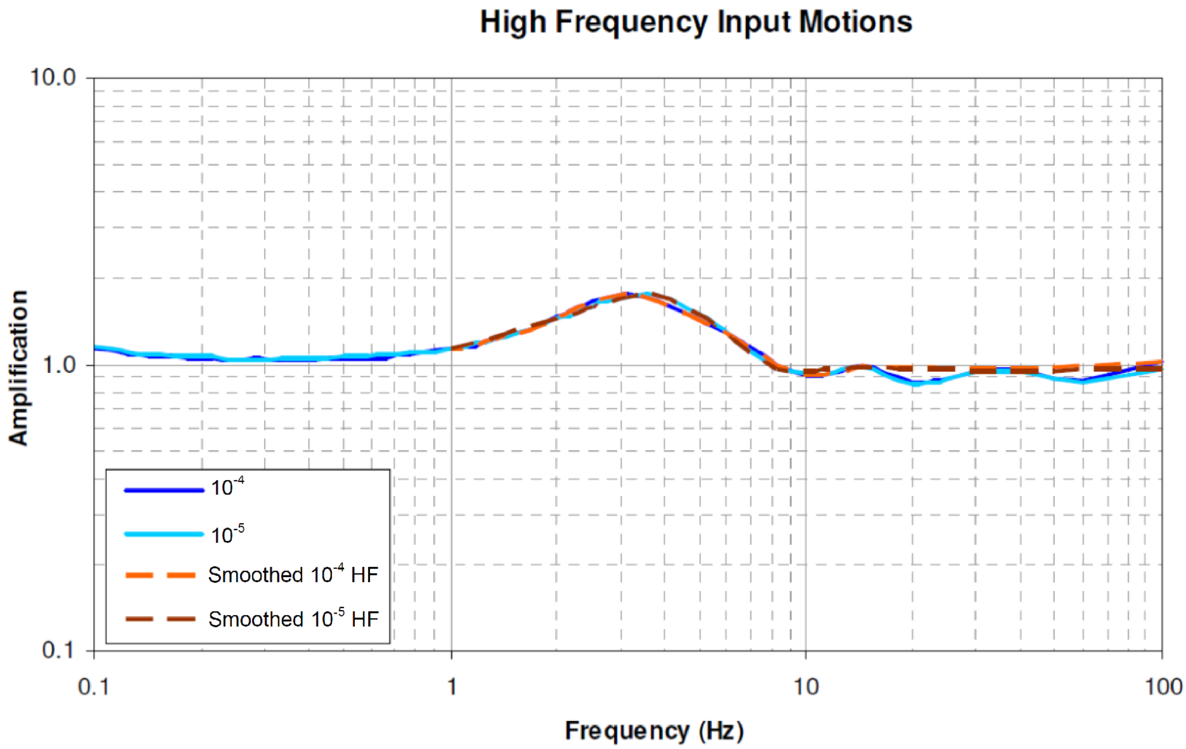



**Figure 3.7.1-213 CB SCOR FIRS Amplification Functions for the Fermi 3 Site [EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**



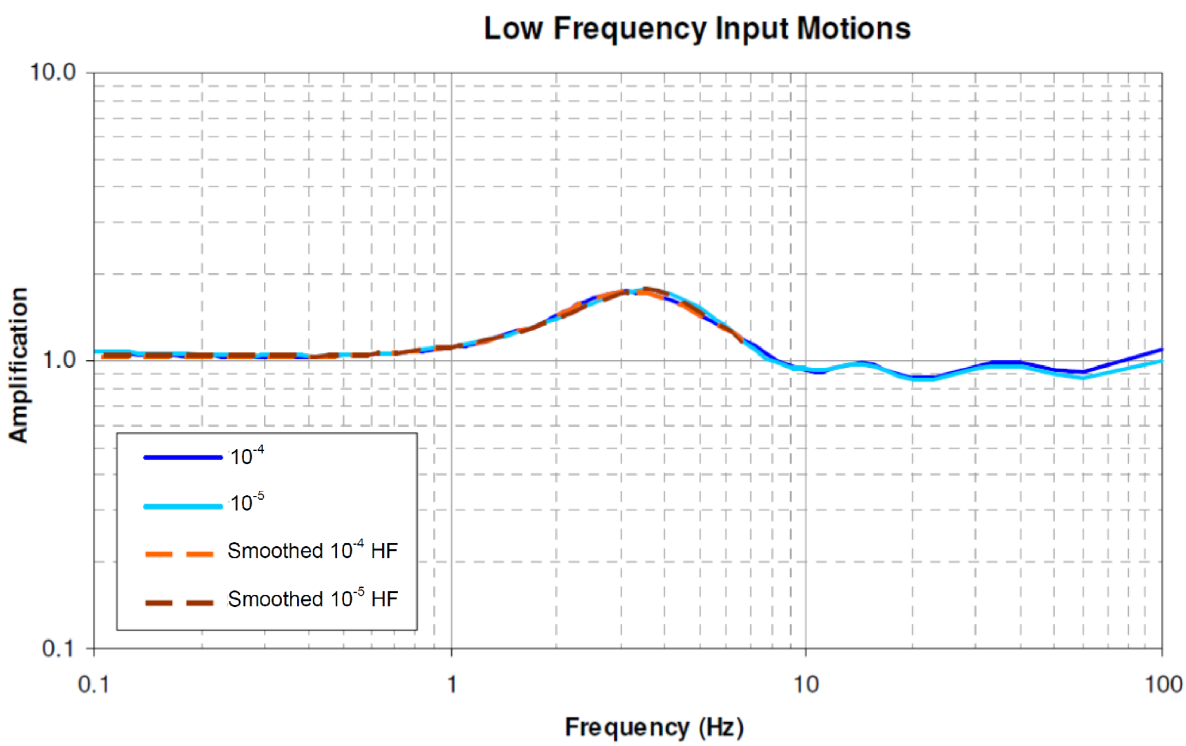



**Figure 3.7.1-214 Example of FWSC 2D/1D Response Spectral Ratios for Fill Concrete Based on the $10^{-4}$ and $10^{-5}$ Exccedance Levels of Input Ground Motion [EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**

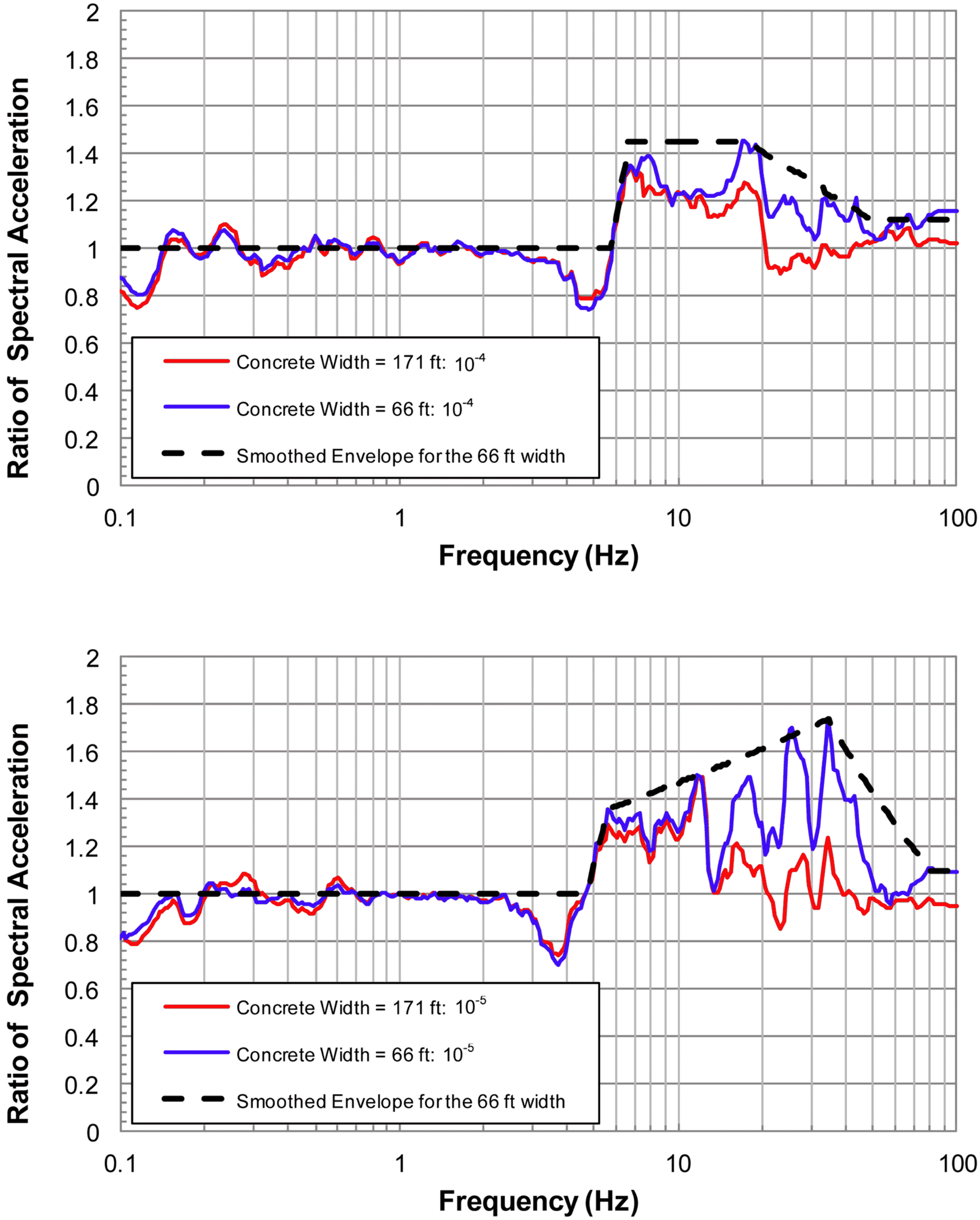


**Figure 3.7.1-215 FWSC 2D/1D Response Spectral Ratios for Fill Concrete [EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**

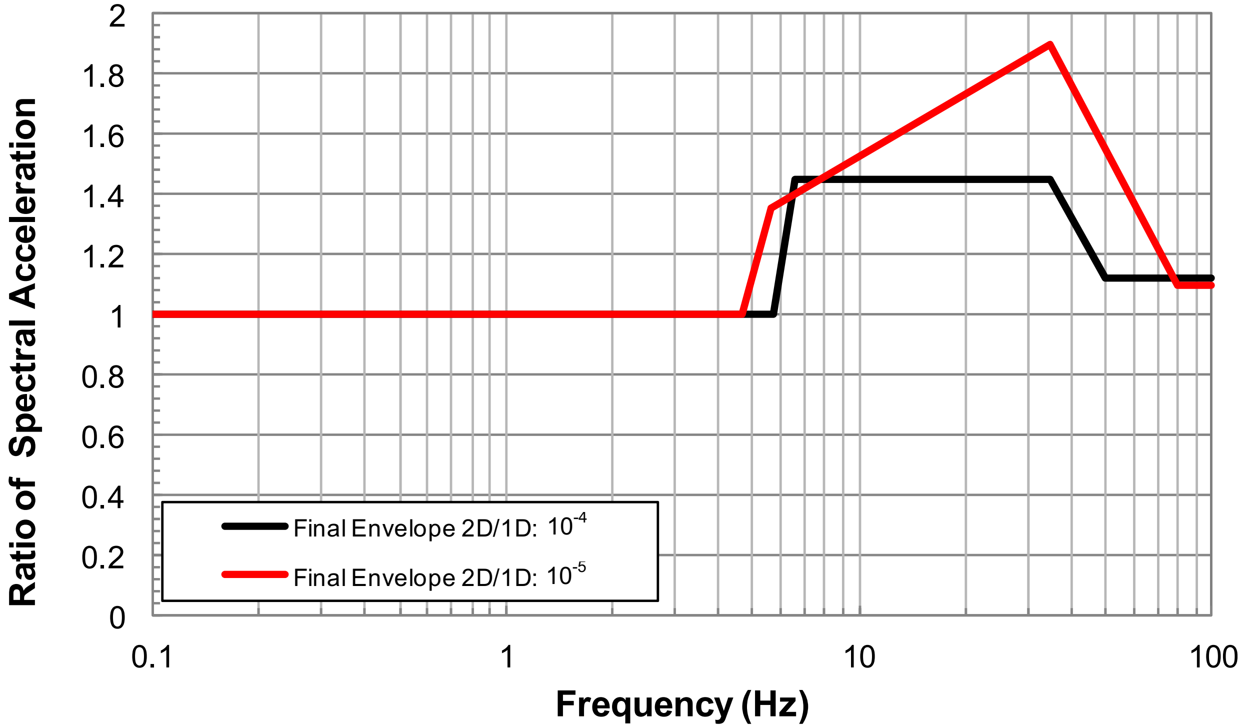


**Figure 3.7.1-216 FWSC FIRS Amplification Functions for the Fermi 3 Site [EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**

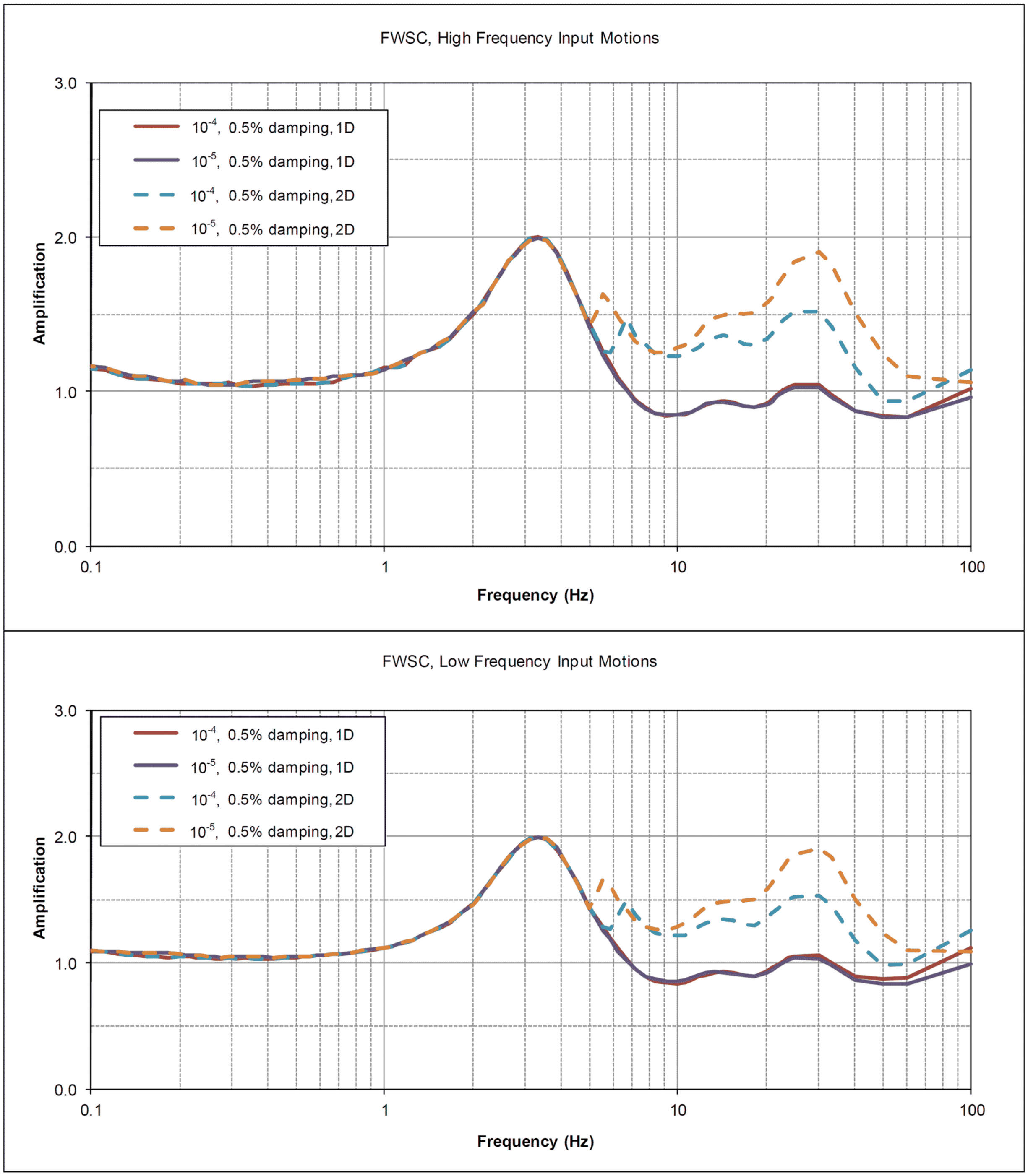


**Figure 3.7.1-217 Development of $10^{-4}$ Surface UHRS at the Finished Ground Level Grade for the Full Soil Column Profile [EF3 SUP 3.7-1]**

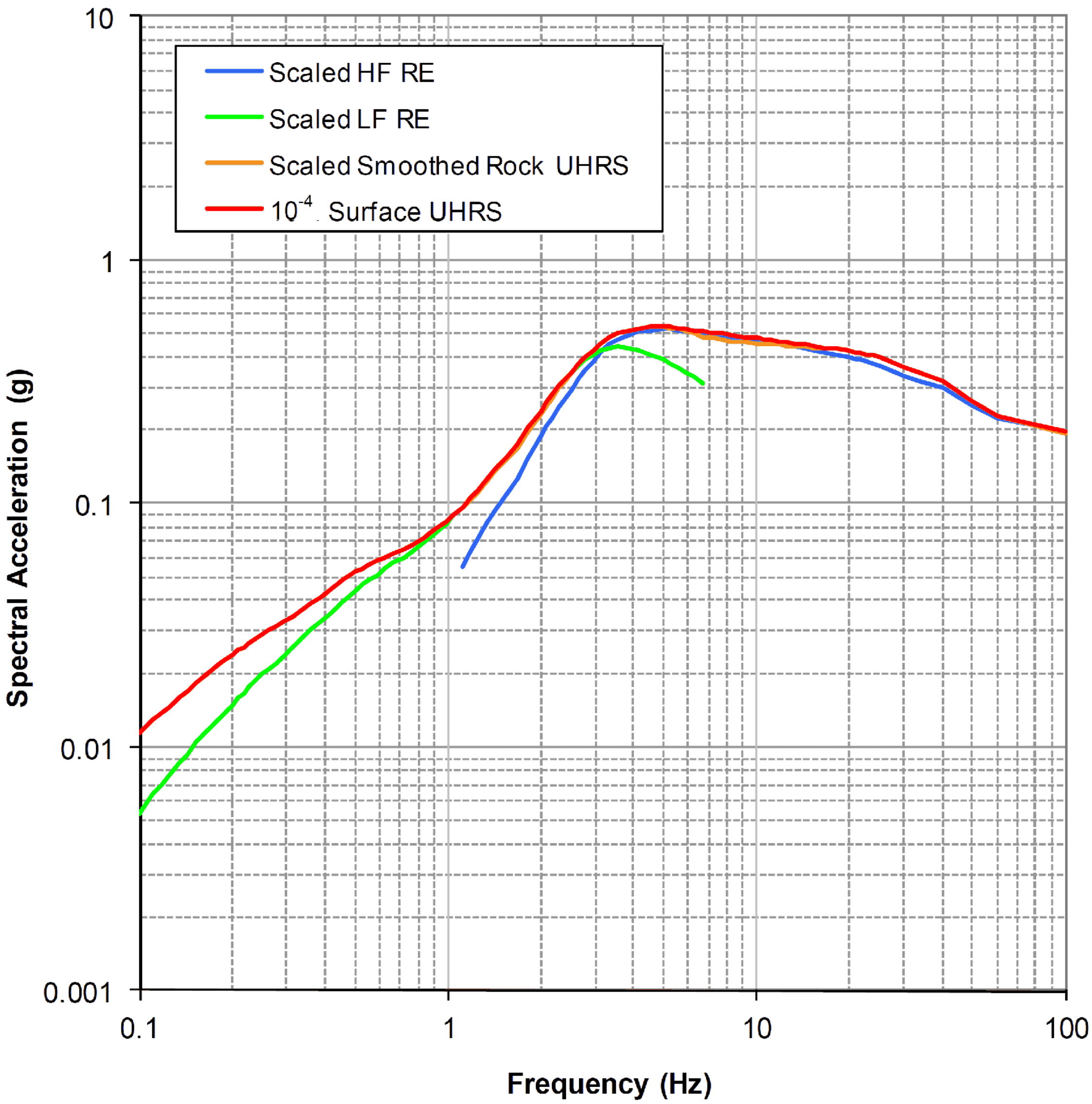


**Figure 3.7.1-218 Development of $10^{-4}$ SCOR UHRS at the RB/FB Foundation Level for the Full Soil Column Profile**
**[EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**

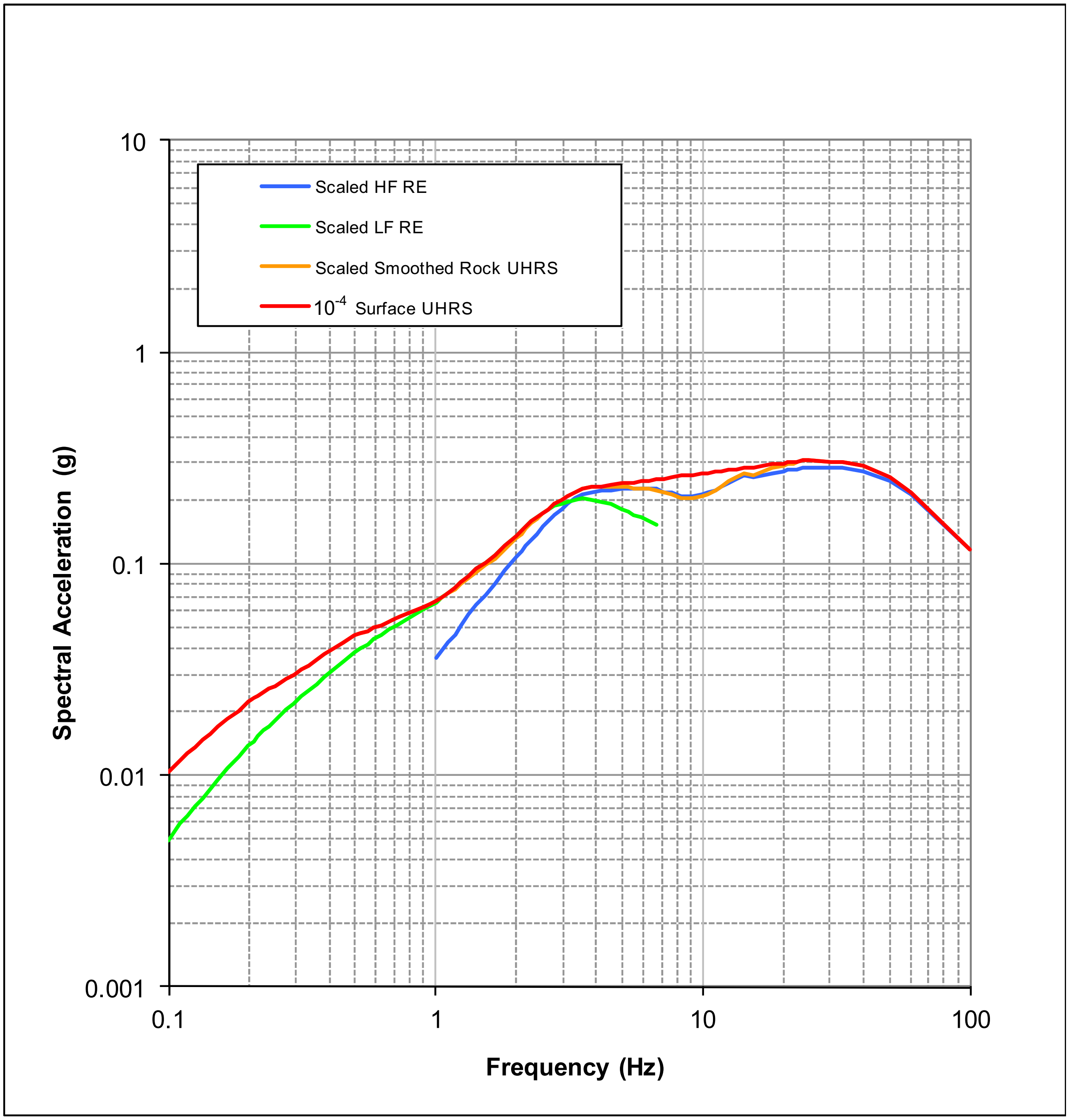


**Figure 3.7.1-219 Development of the Horizontal PBSRS for the Fermi 3 Site [EF3 SUP 3.7-1]**

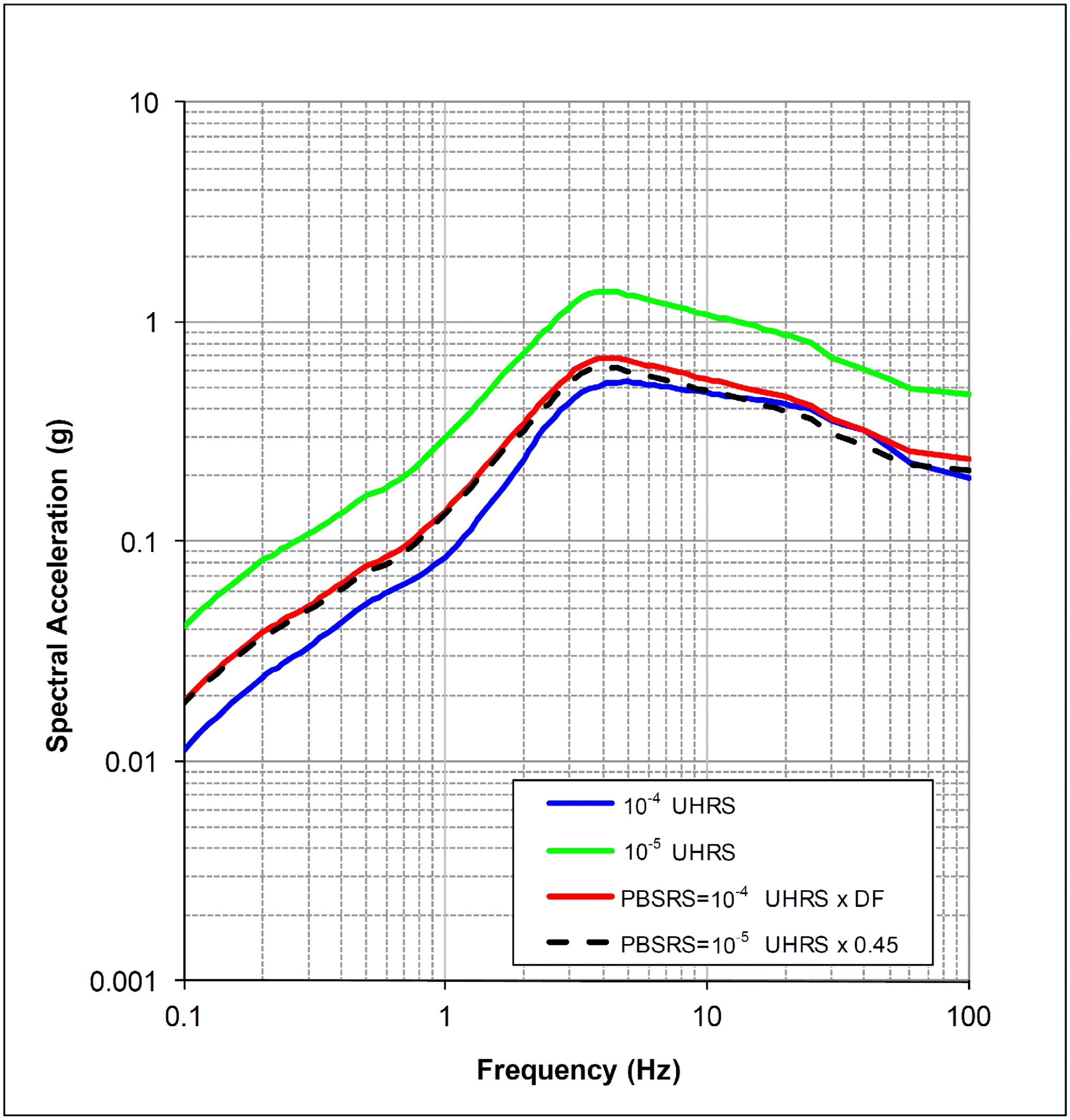


**Figure 3.7.1-220 Vertical to Horizontal Spectral ratios Developed for the Fermi 3 Site Full Soil Column Profile**
**[EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**

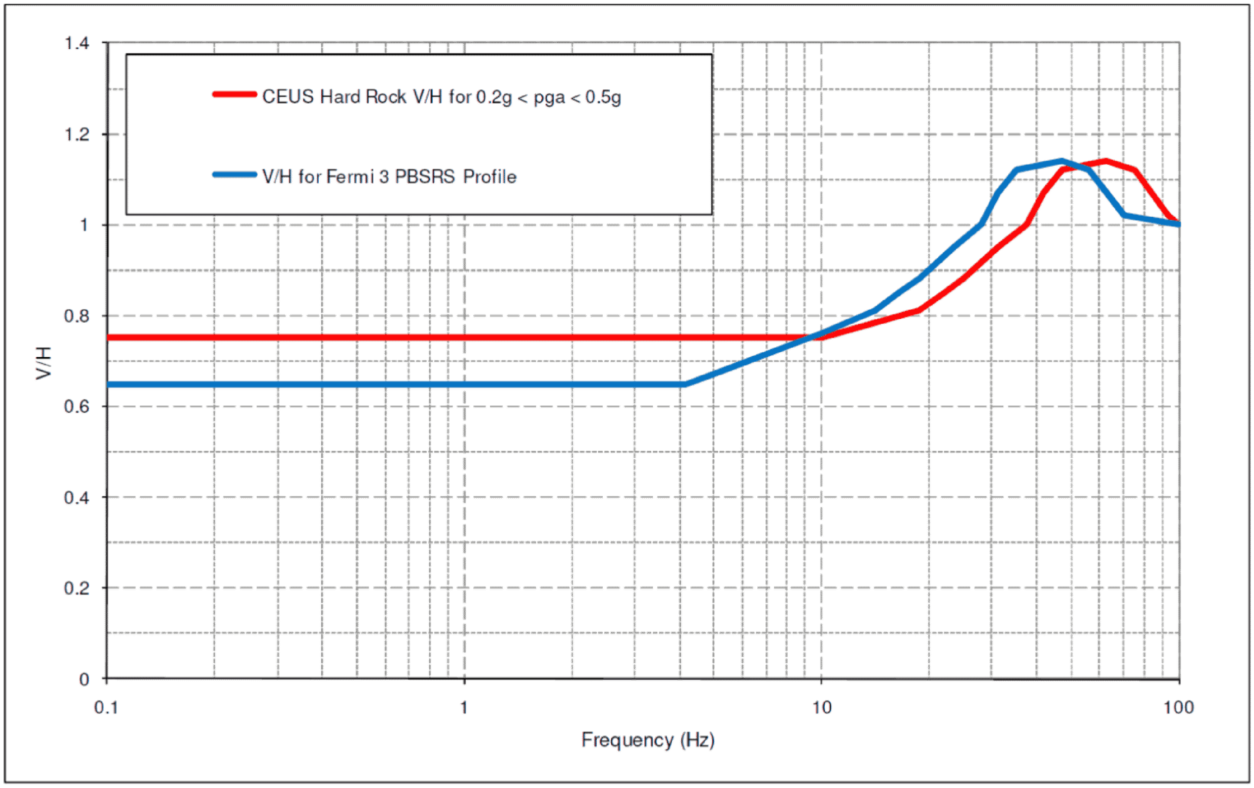


**Figure 3.7.1-221 Horizontal and Vertical Fermi 3 PBSRS at Finished Ground Level Grade (5 Percent Damping) [EF3 SUP 3.7-1]**

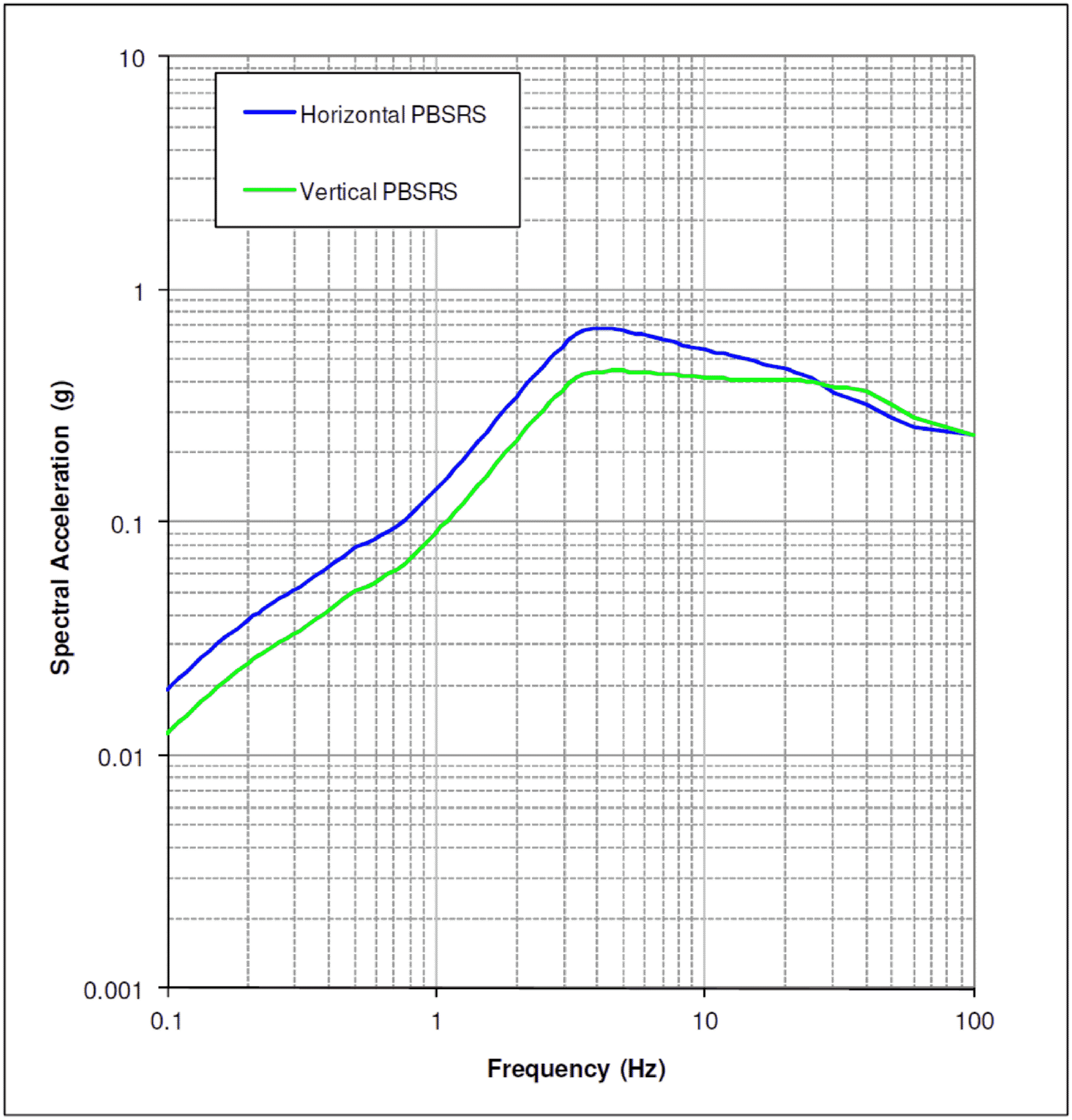


**Figure 3.7.1-222 Deterministic Shear Wave Velocity Profiles for the Full Soil Column with Engineered Granular Backfill Above the Top of the Bass Islands Group Bedrock [EF3 SUP 3.7-1]**

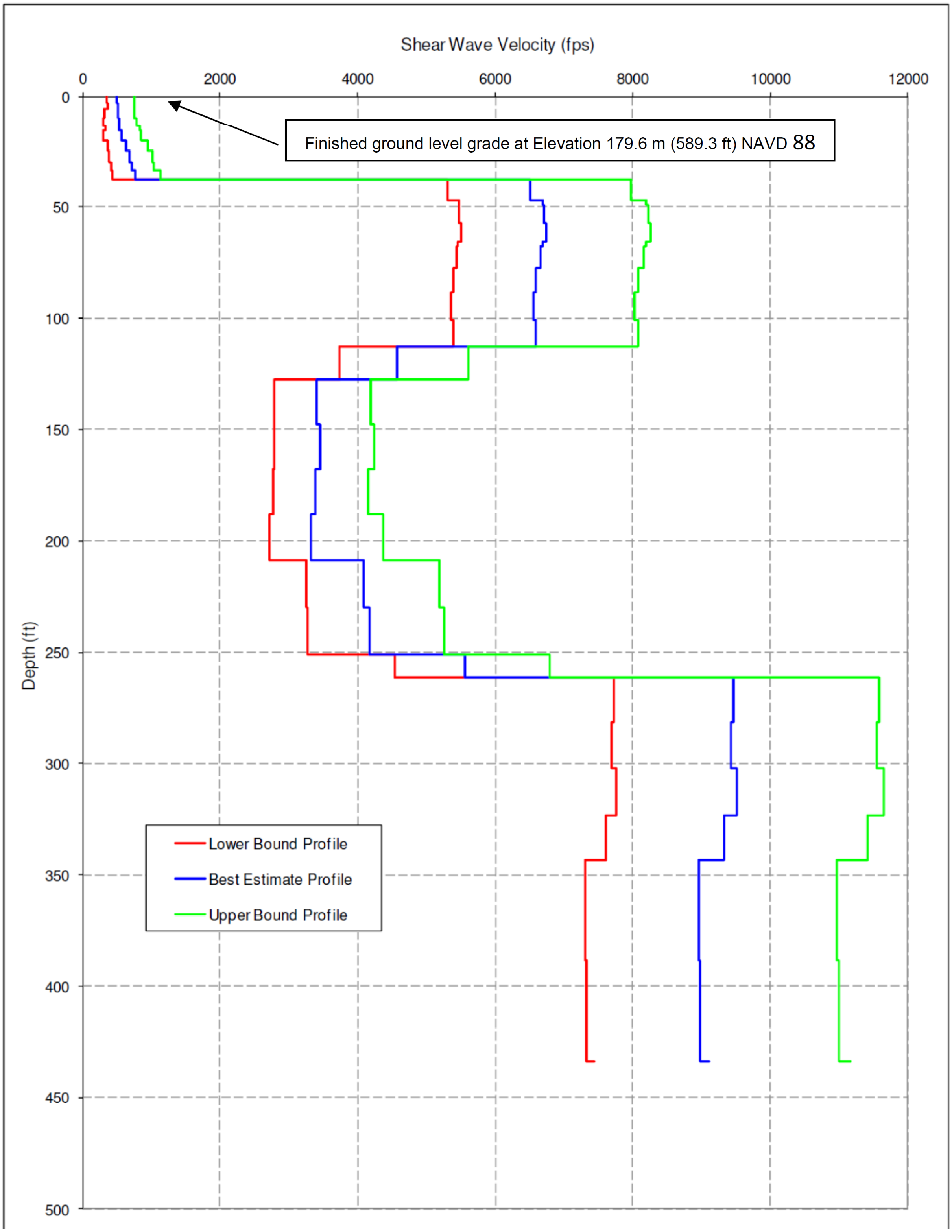


**Figure 3.7.1-223 Deterministic Shear Wave Velocity Profiles for the Soil Column without Engineered Granular Backfill Above the Top of the Bass Islands Group Bedrock [EF3 SUP 3.7-1]**

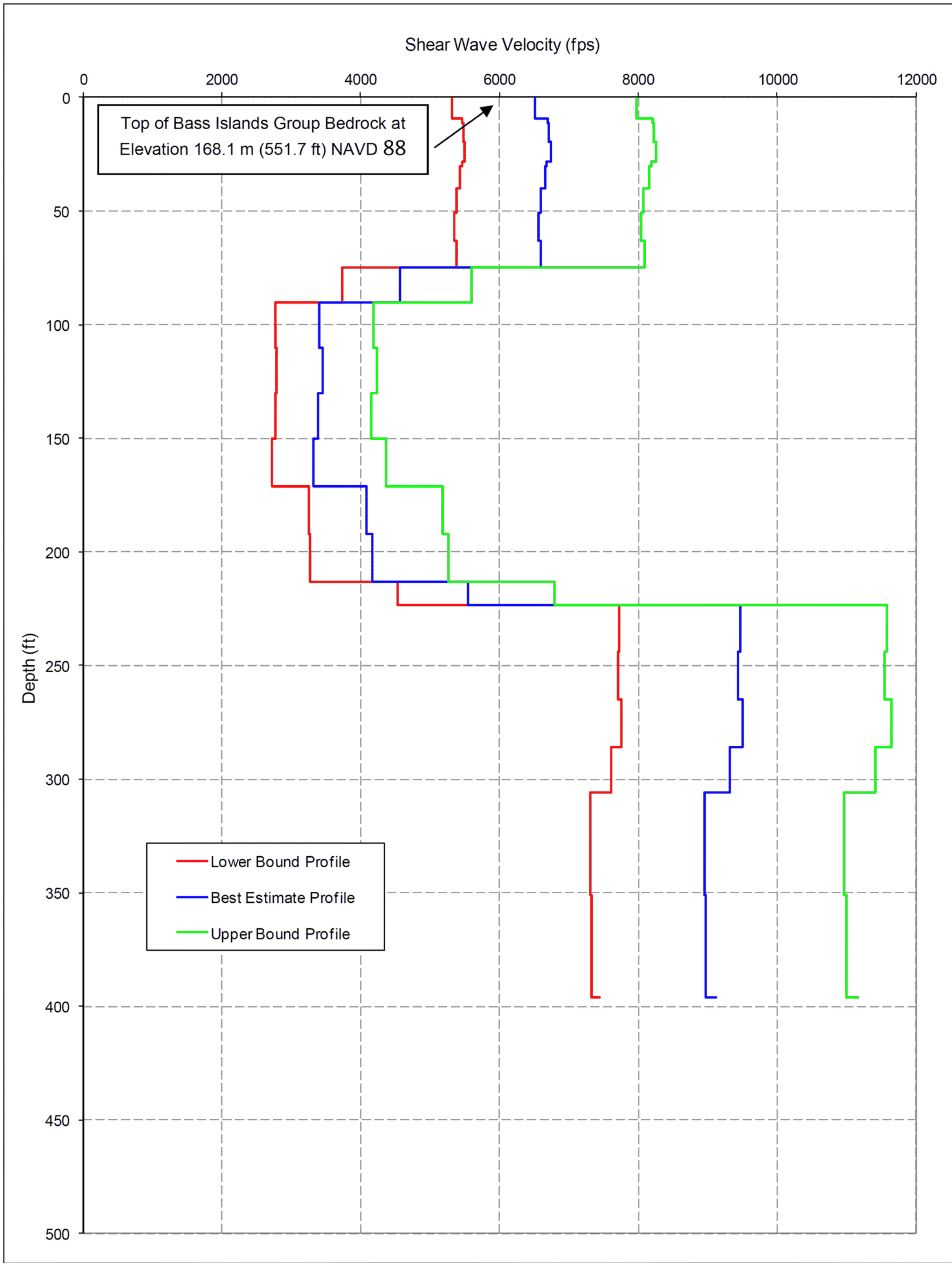
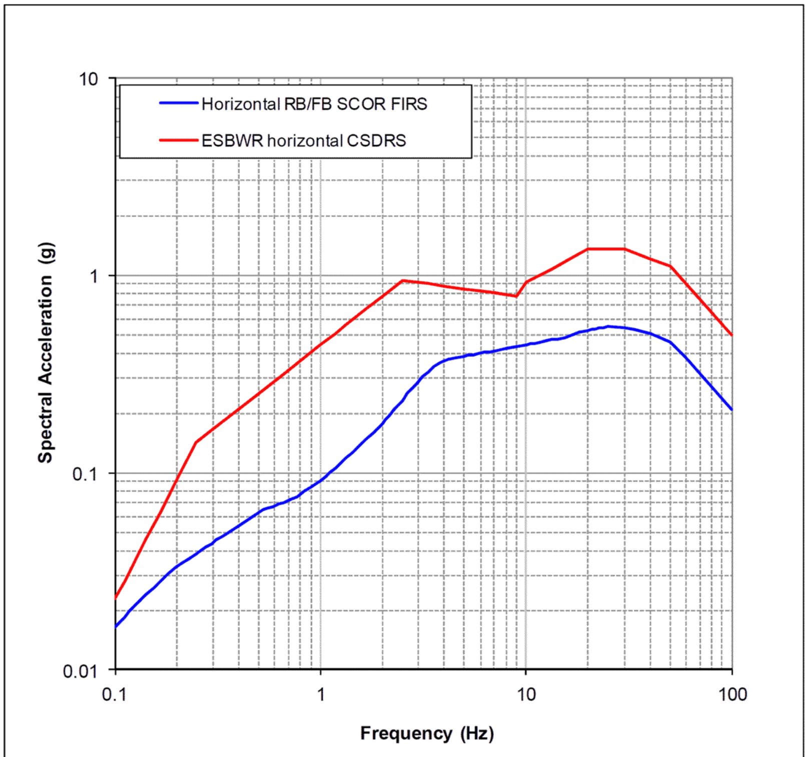


**Figure 3.7.1-224 Fermi 3 RB/FB SCOR FIRS (5 Percent Damping) [EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**



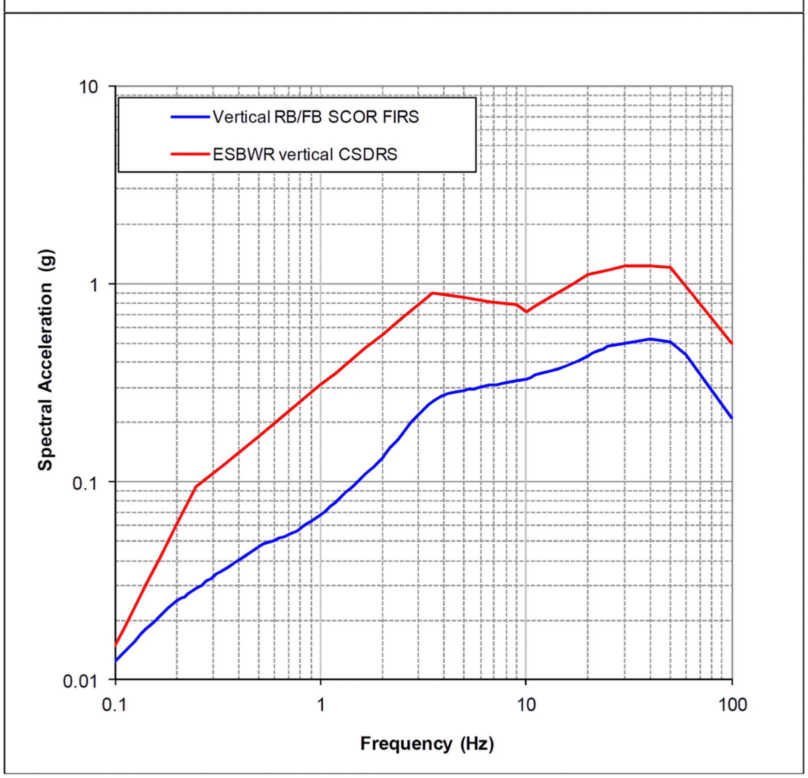



**Figure 3.7.1-225 Fermi 3 CB SCOR FIRS (5 Percent Damping) [EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**

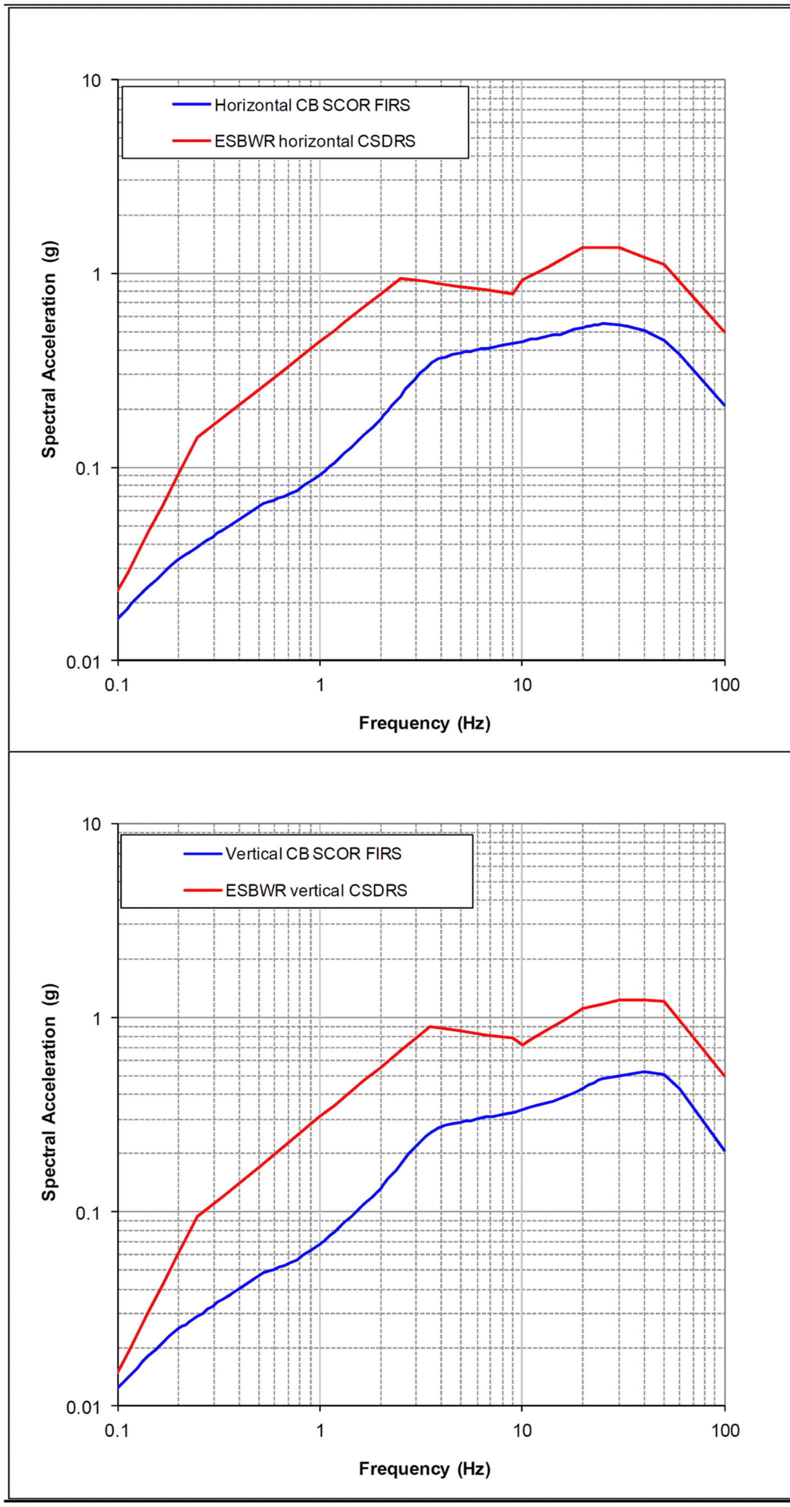


**Figure 3.7.1-226 Fermi 3 Horizontal RB/FB SCOR FIRS and Initially Enhanced SCOR FIRS with the NUREG/CR-0098 Median Rock Spectral Shape, Enveloping NUREG/CR-6728 CEUS Spectral Shape, and RG 1.60 Spectral Shape, all Scaled to a Minimum PGA of 0.1 g (5 Percent Damping)**

**[EF3 SUP 3.7-1]**

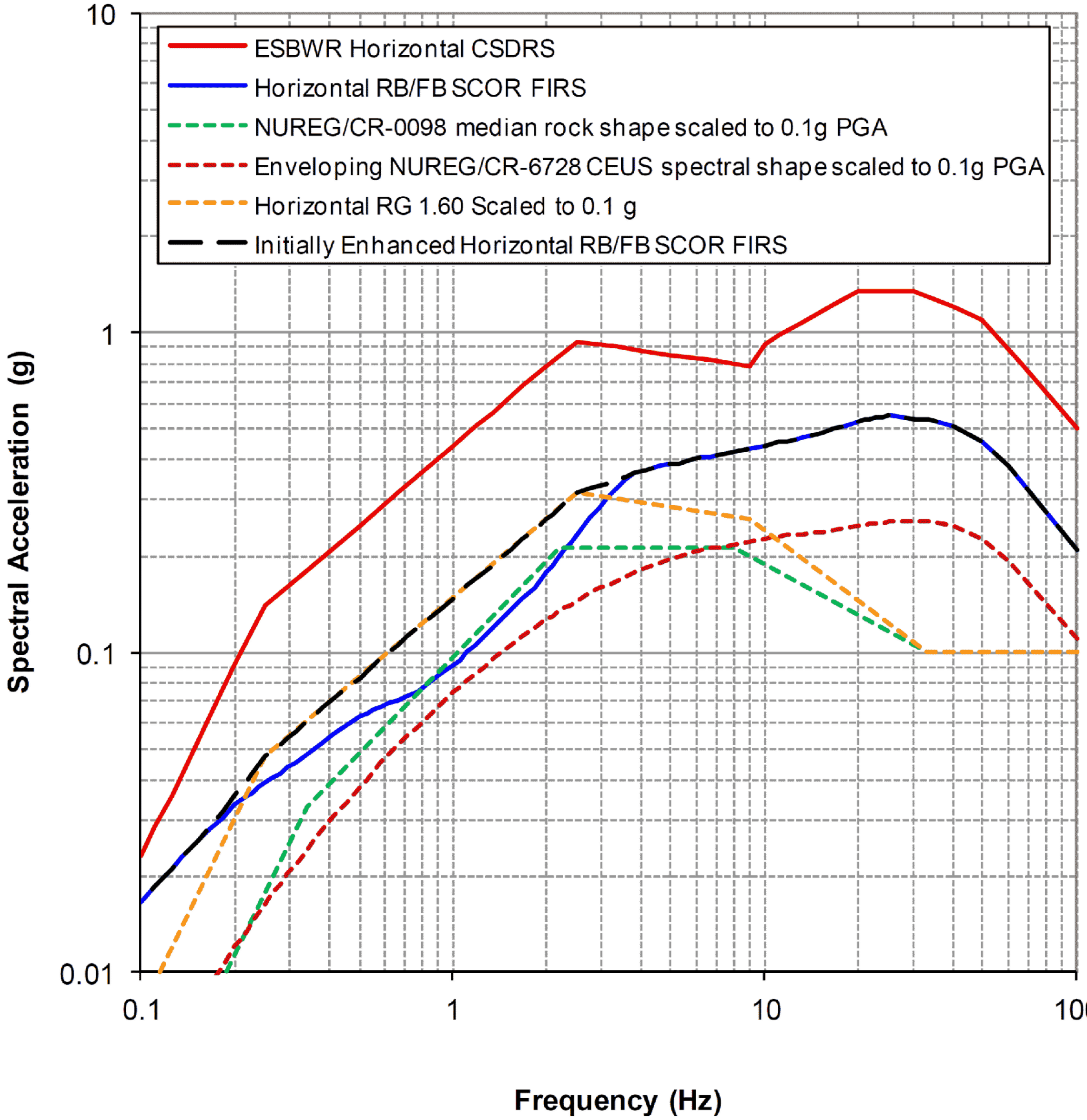


**Figure 3.7.1-227 Fermi 3 Horizontal CB SCOR FIRS and Initially Enhanced SCOR FIRS with the NUREG/CR-0098 Median Rock Spectral Shape, Enveloping NUREG/CR-6728 CEUS Spectral Shape, and RG 1.60 Spectral Shape, all Scaled to a Minimum PGA of 0.1 g (5 Percent Damping) [EF3 SUP 3.7-1]**

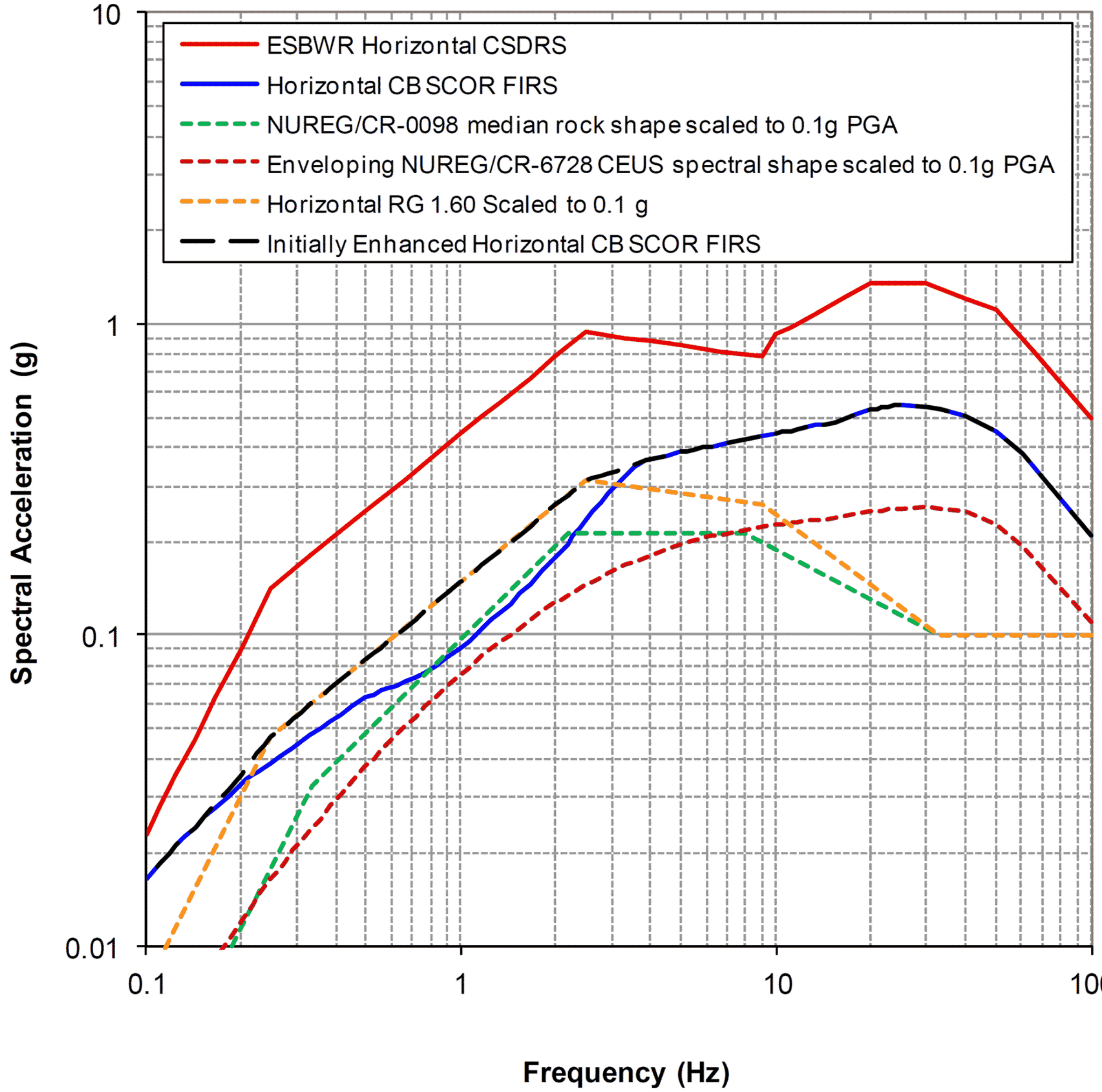
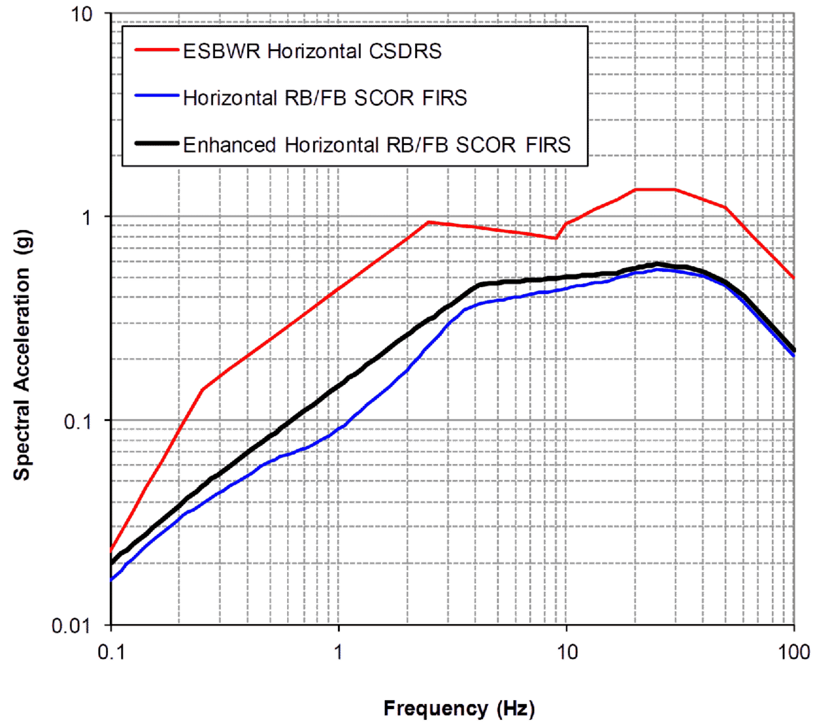


**Figure 3.7.1-228 Fermi 3 Horizontal and Vertical RB/FB SCOR FIRS and Enhanced RB/FB SCOR FIRS (5 Percent Damping)**
**[EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**



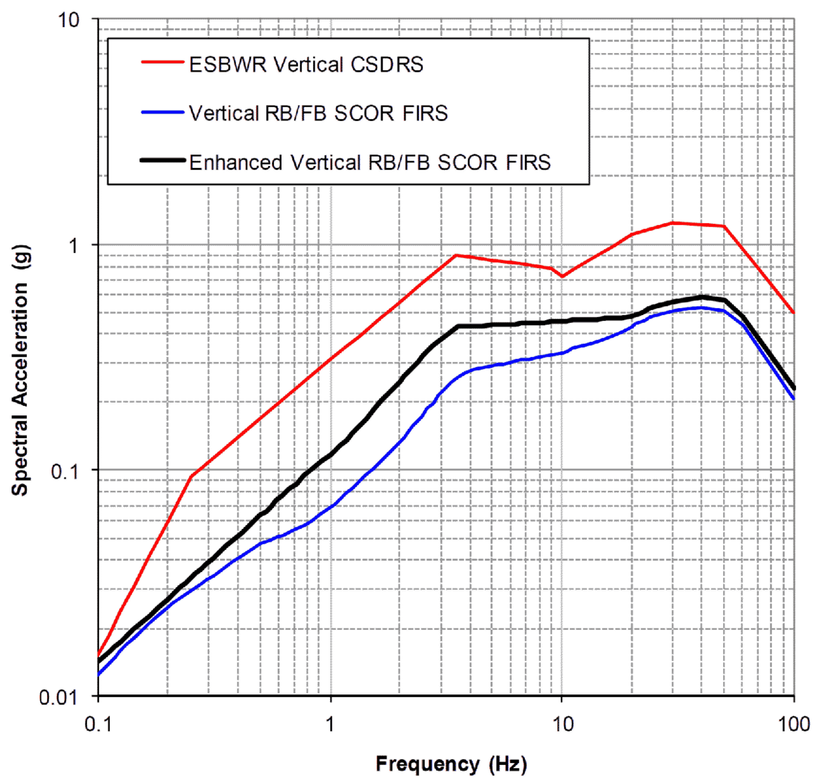
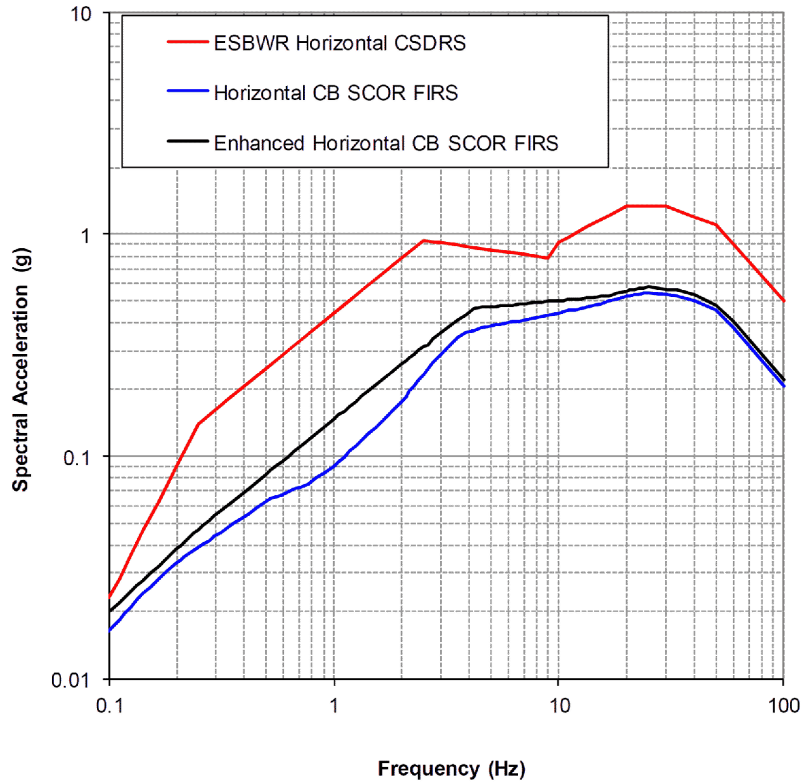



**Figure 3.7.1-229 Fermi 3 Horizontal CB SCOR FIRS and Enhanced CB SCOR FIRS (5 Percent Damping) [EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**



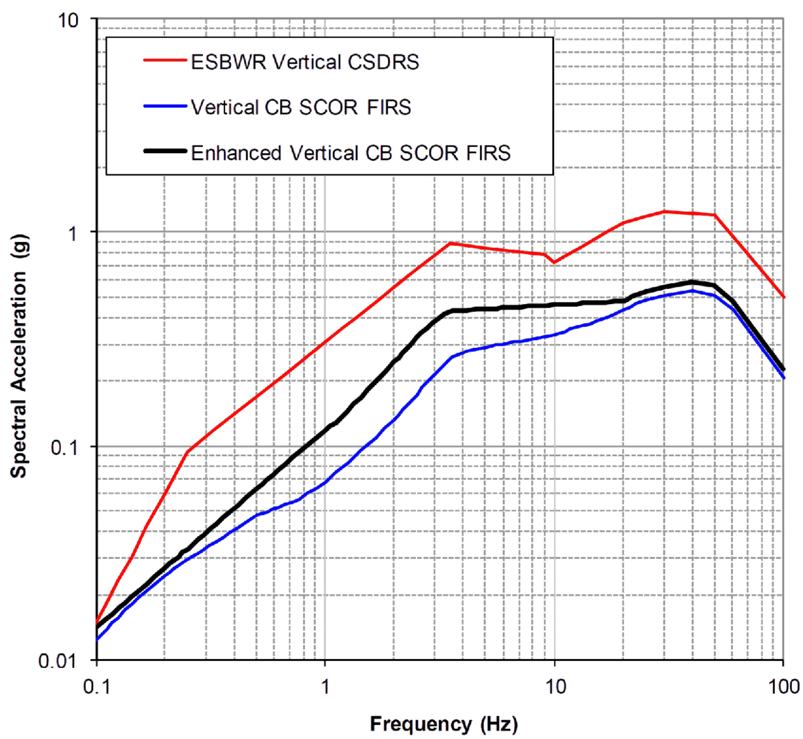



**Figure 3.7.1-230 Comparison of the Envelope of the Response Spectra of Computed Horizontal Component Surface Motions for Deterministic Profiles with Engineered Granular Backfill above the Top of the Bass Islands Group Bedrock Using the RB/FB Enhanced SCOR FIRS Input Motions with the Horizontal PBSRS [EF3 SUP 3.7-1]**

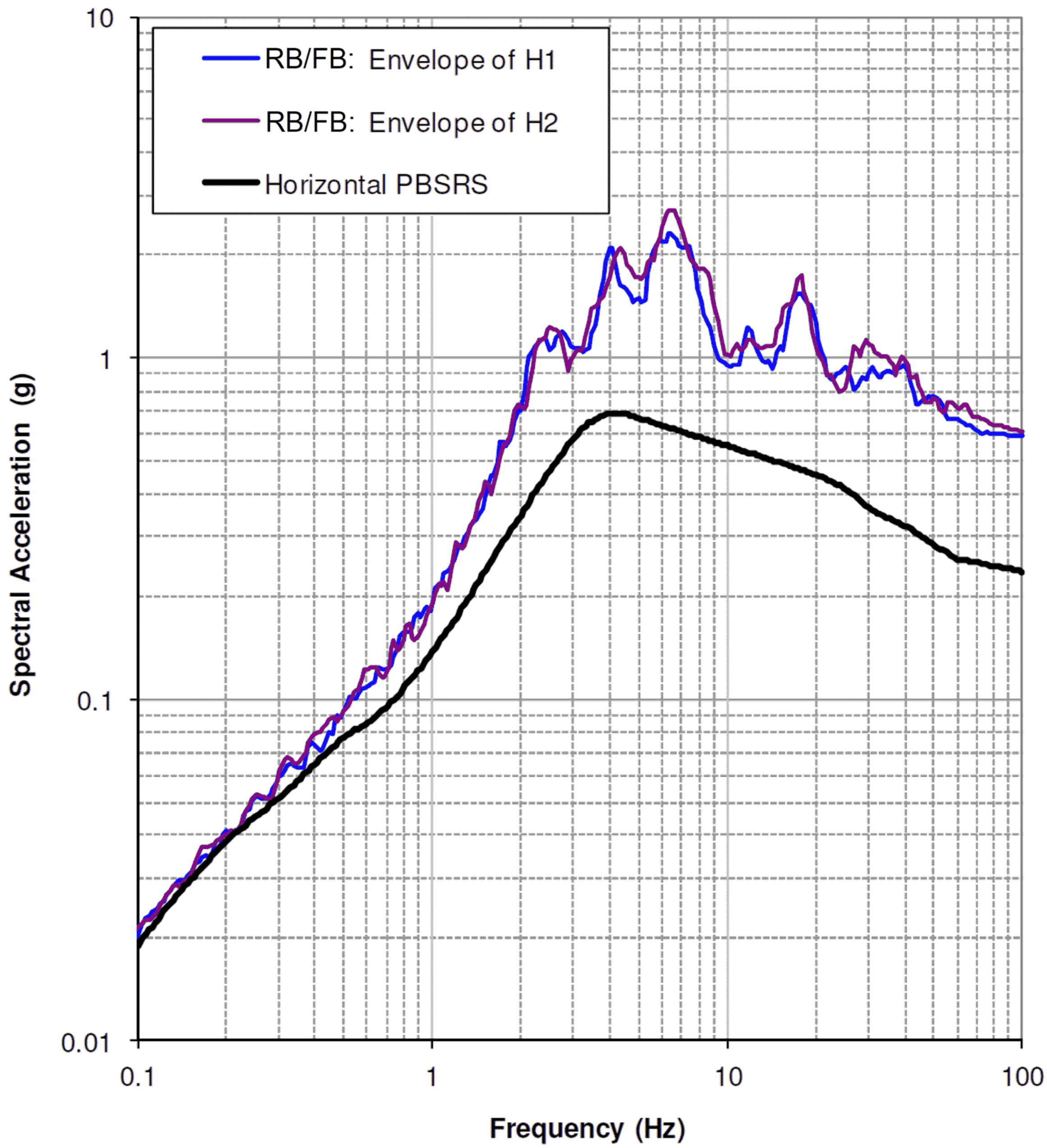


**Figure 3.7.1-231 Comparison of the Envelope of the Response Spectra of Computed Horizontal Component Surface Motions for Deterministic Profiles with Engineered Granular Backfill above the Top of the Bass Islands Group Bedrock Using the CB Enhanced SCOR FIRS Input Motions with the Horizontal PBSRS [EF3 SUP 3.7-1]**

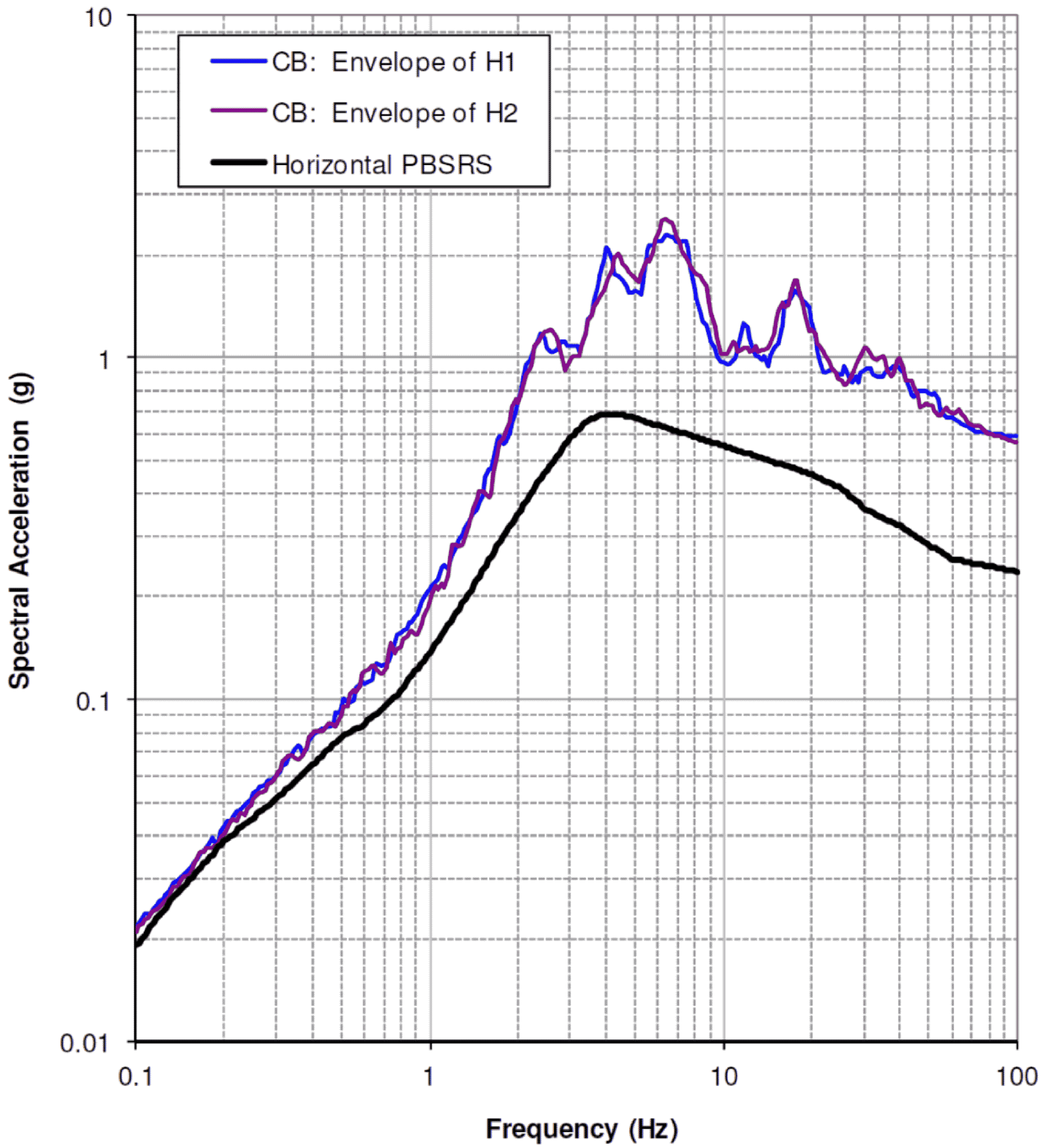


**Figure 3.7.1-232 Comparison of the Envelope of the Response Spectra of Computed Horizontal Component Surface Motions for Deterministic Profiles without Engineered Granular Backfill above the Top of the Bass Islands Group Bedrock Using the RB/FB Enhanced SCOR FIRS Input Motions with the Horizontal GMRS [EF3 SUP 3.7-1]**

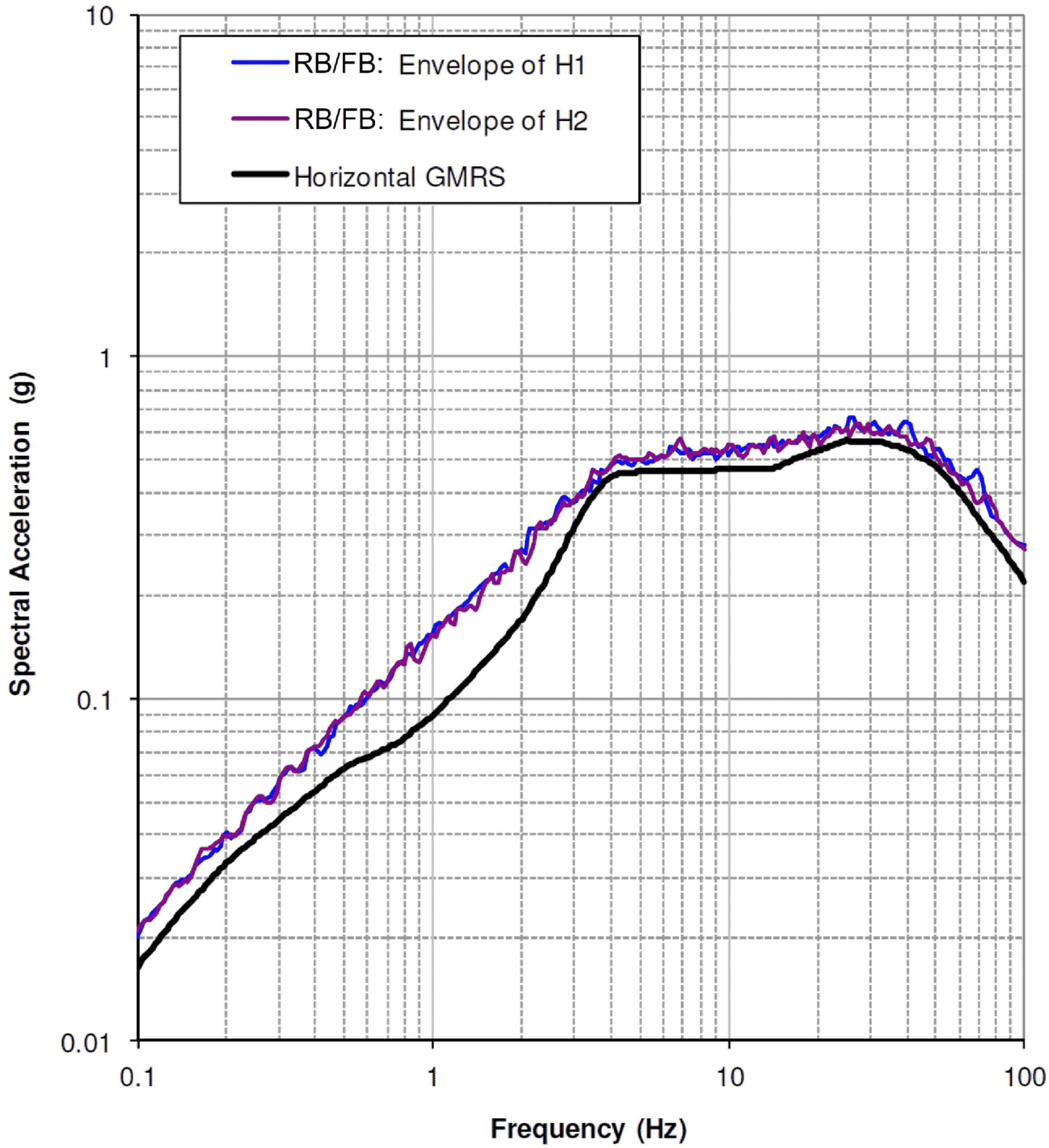


**Figure 3.7.1-233 Comparison of the Envelope of the Response Spectra of Computed Horizontal Component Surface Motions for Deterministic Profiles without Engineered Granular Backfill above the Top of the Bass Islands Group Bedrock Using the CB Enhanced SCOR FIRS Input Motions with the Horizontal GMRS [EF3 SUP 3.7-1]**

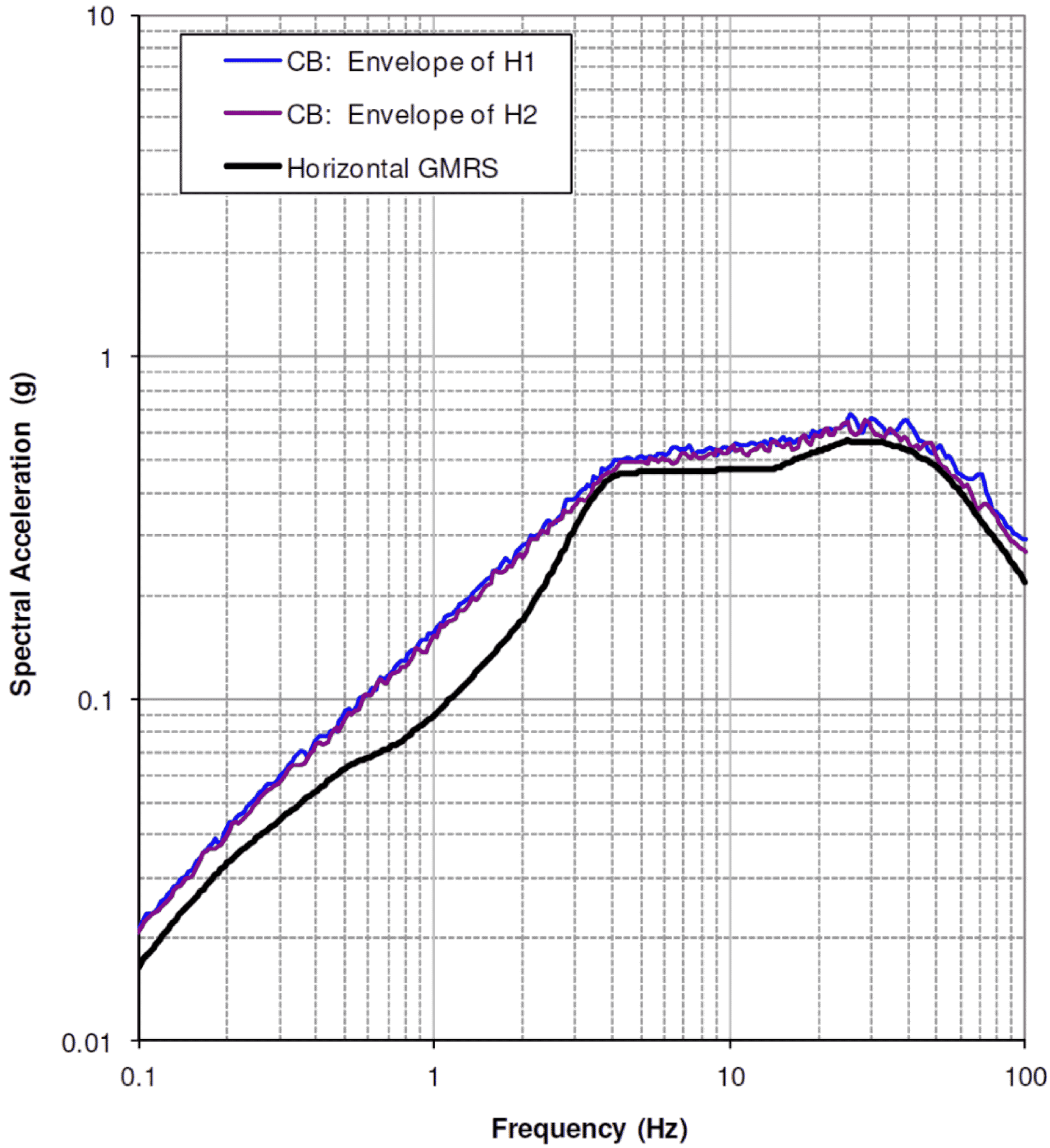


**Figure 3.7.1-234 Comparison of the Envelope of the Response Spectra of Computed Vertical Component Surface Motions for Deterministic Profiles With Engineered Granular Backfill Above the top of the Bass Islands Group Bedrock Using the RB/FB Enhanced SCOR FIRS Input Motions with the Vertical PBSRS [EF3 SUP 3.7-1]**

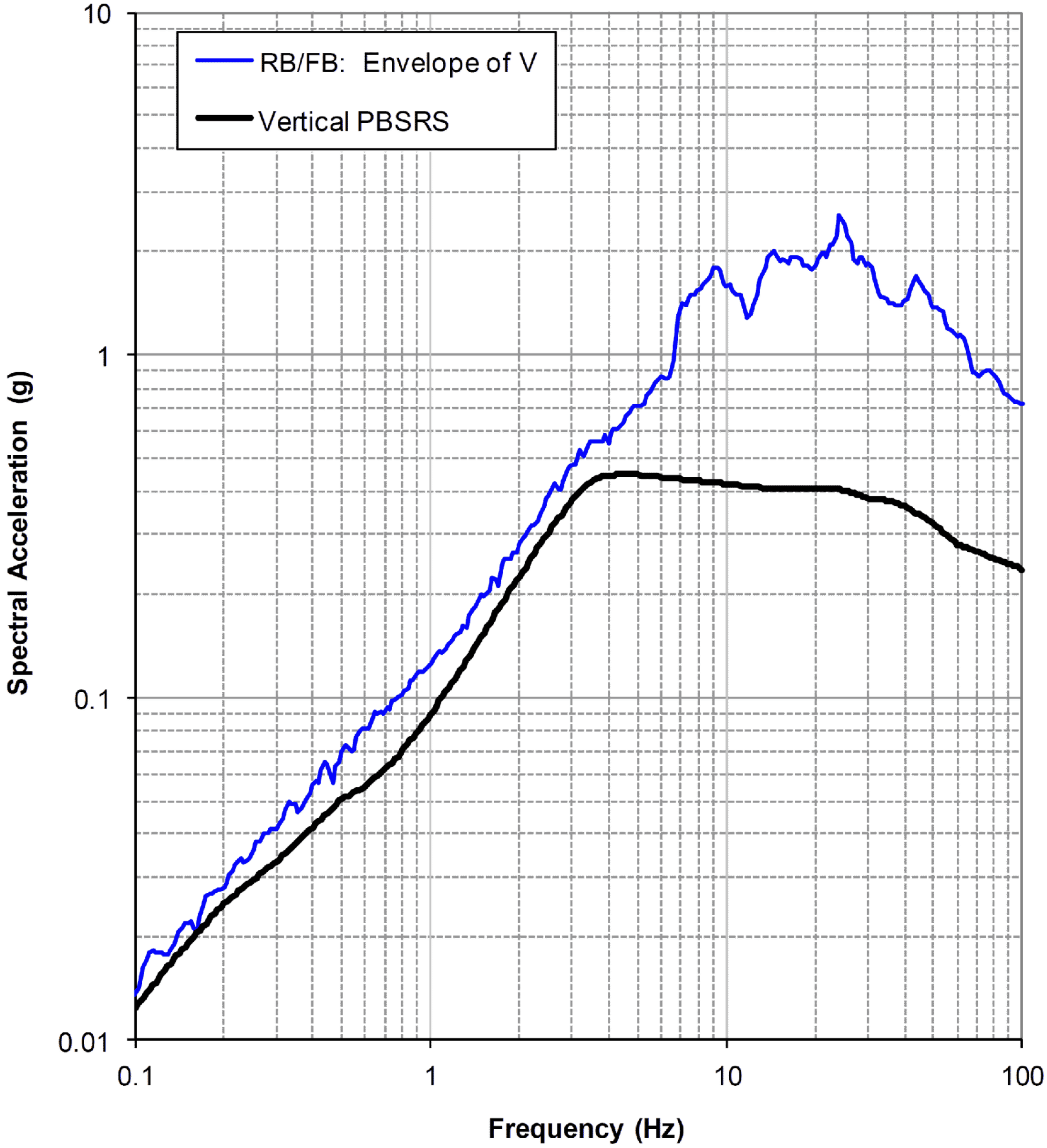


**Figure 3.7.1-235 Comparison of the Envelope of the Response Spectra of Computed Vertical Component Surface Motions for Deterministic Profiles With Engineered Granular Backfill Above the top of the Bass Islands Group Bedrock Using the CB Enhanced SCOR FIRS Input Motions with the Vertical PBSRS [EF3 SUP 3.7-1]**

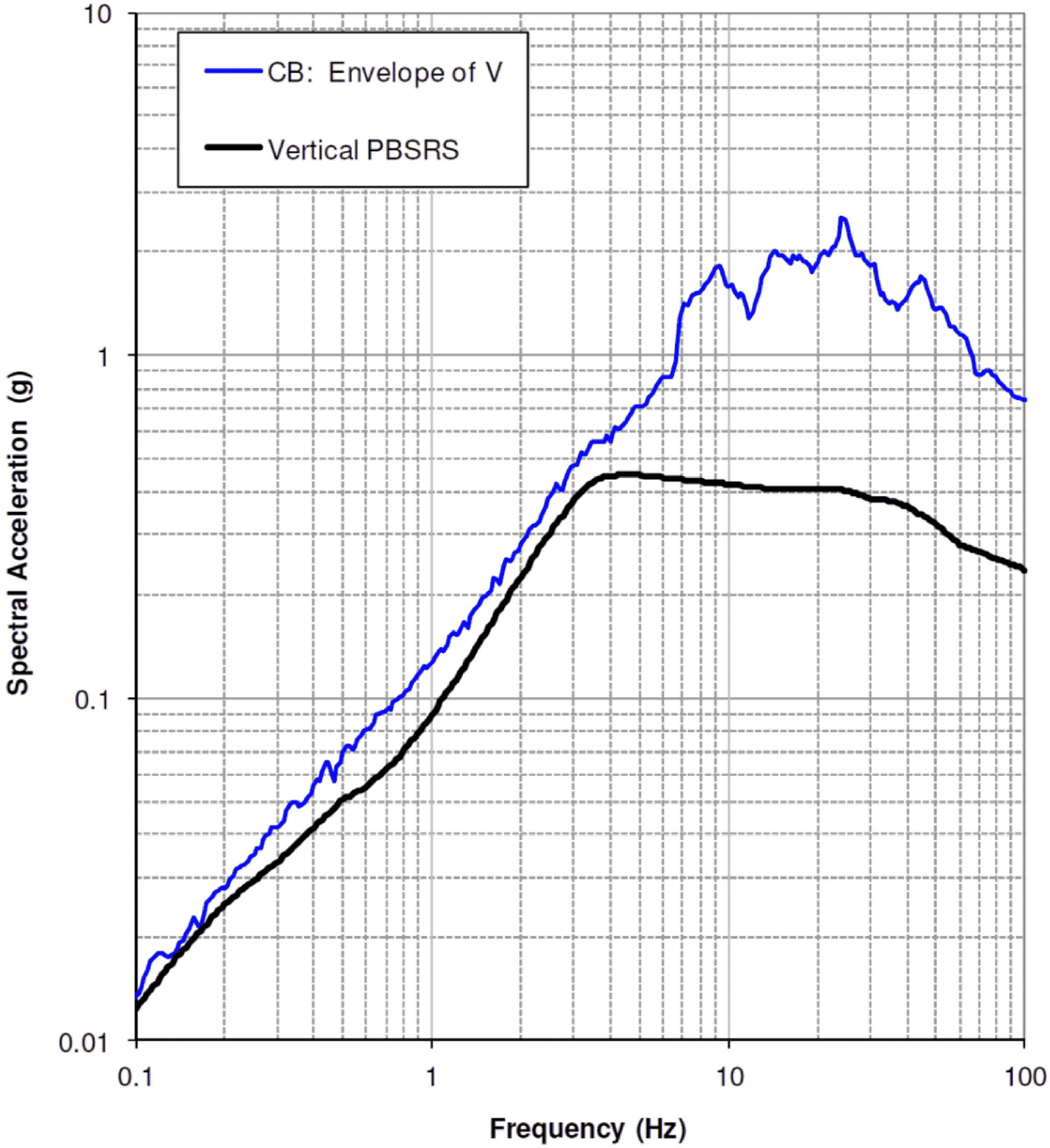


**Figure 3.7.1-236 Comparison of the Envelope of the Response Spectra of Computed Vertical Component Surface Motions for Deterministic Profiles without Engineered Granular Backfill above the Top of the Bass Islands Group Bedrock Using the RB/FB Enhanced SCOR FIRS Input Motions with the Vertical GMRS [EF3 SUP 3.7-1]**

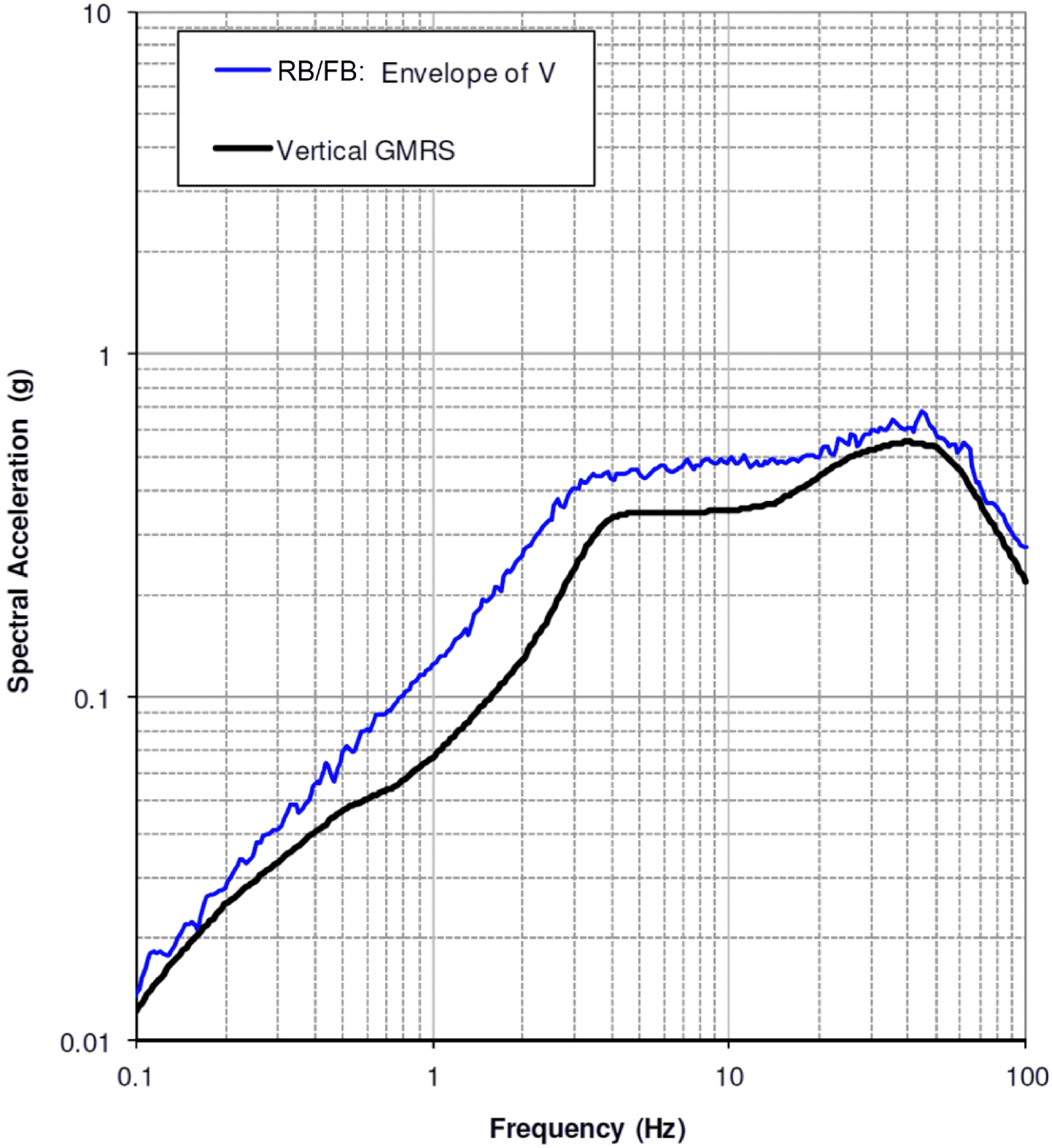


**Figure 3.7.1-237 Comparison of the Envelope of the Response Spectra of Computed Vertical Component Surface Motions for Deterministic Profiles without Engineered Granular Backfill above the Top of the Bass Islands Group Bedrock Using the CB Enhanced SCOR FIRS Input Motions with the Vertical GMRS [EF3 SUP 3.7-1]**

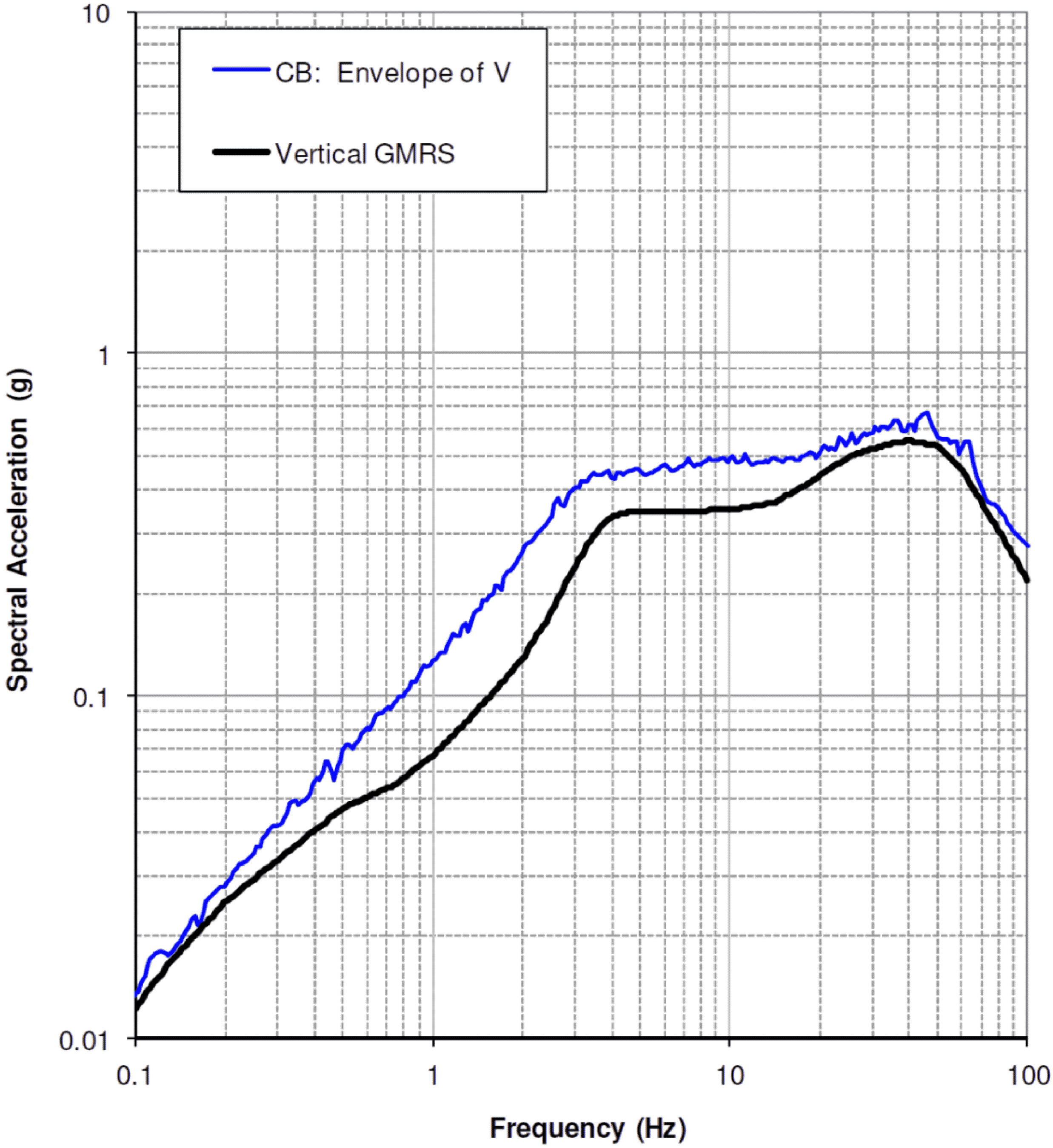


**Figure 3.7.1-238 Fermi 3 FWSC FIRS (5 Percent Damping) [EF3 COL 2.0-27-A, EF3 SUP 3.7-1]**

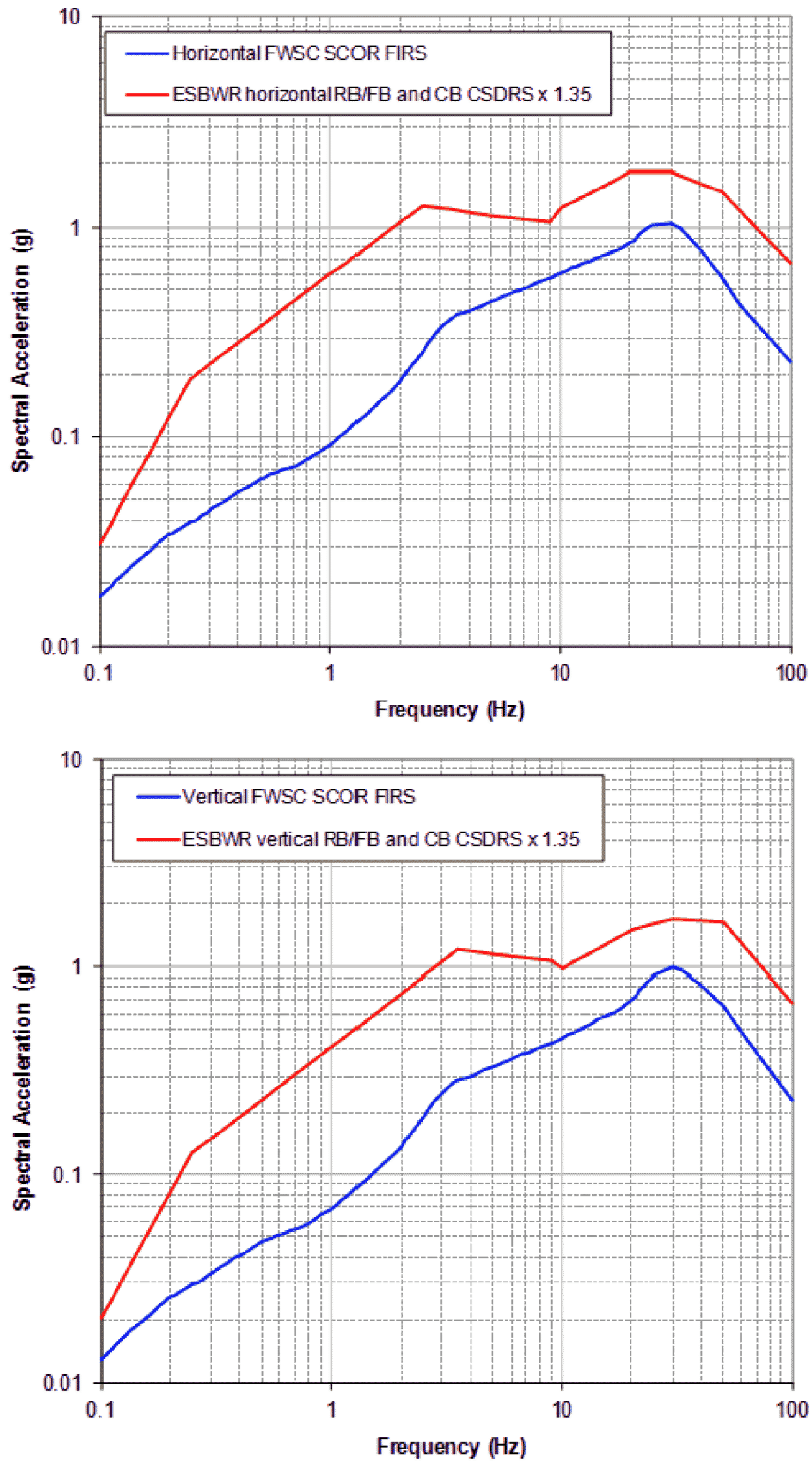


**Figure 3.7.1-239 Response Spectrum for Spectrally Matched Horizontal (H1) Component for the Fermi 3 RB/FB Enhanced SCOR FIRS [EF3 SUP 3.7-1]**

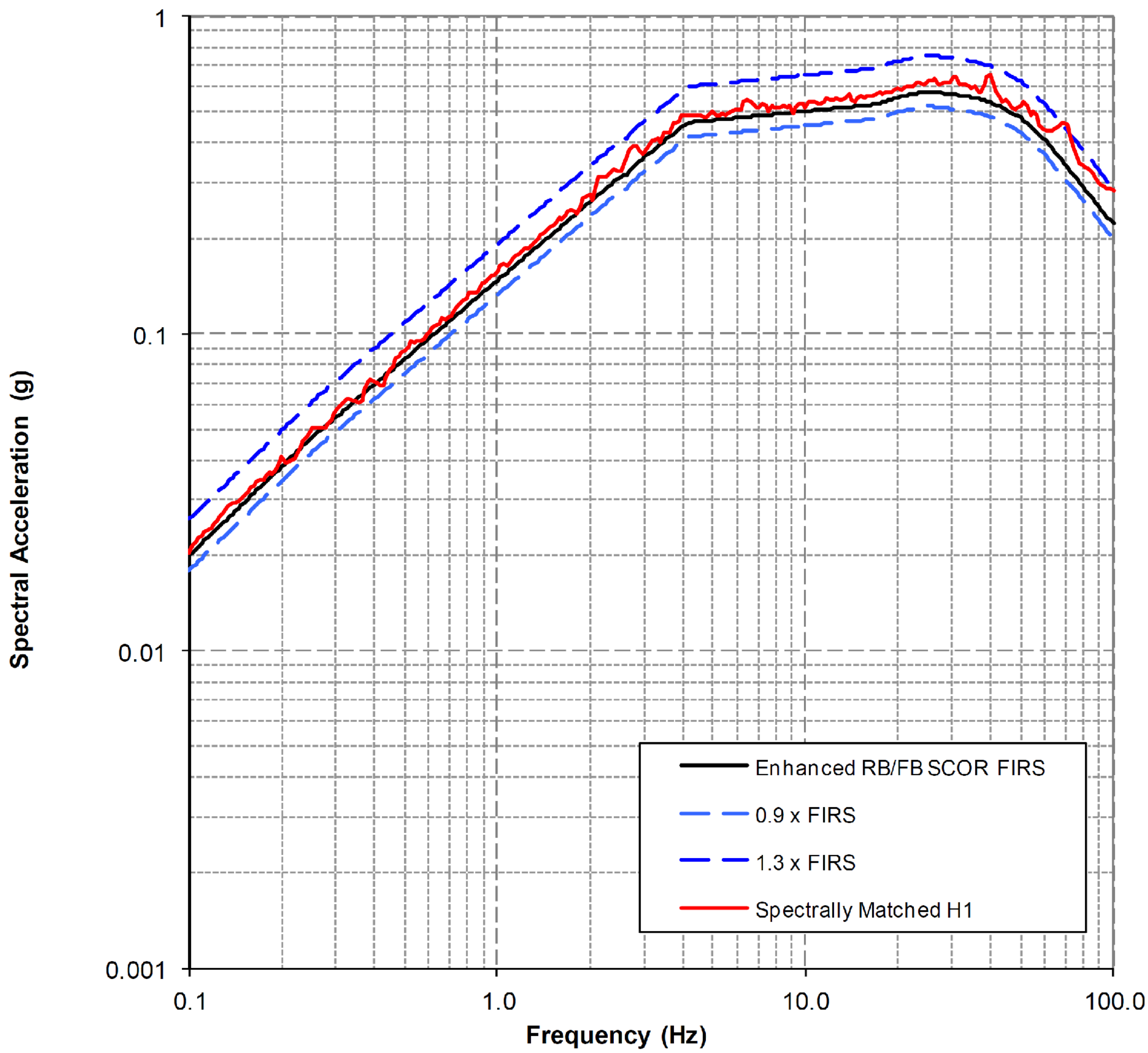


**Figure 3.7.1-240 Response Spectrum for Spectrally Matched Horizontal (H2) Component for the Fermi 3 RB/FB Enhanced SCOR FIRS [EF3 SUP 3.7-1]**

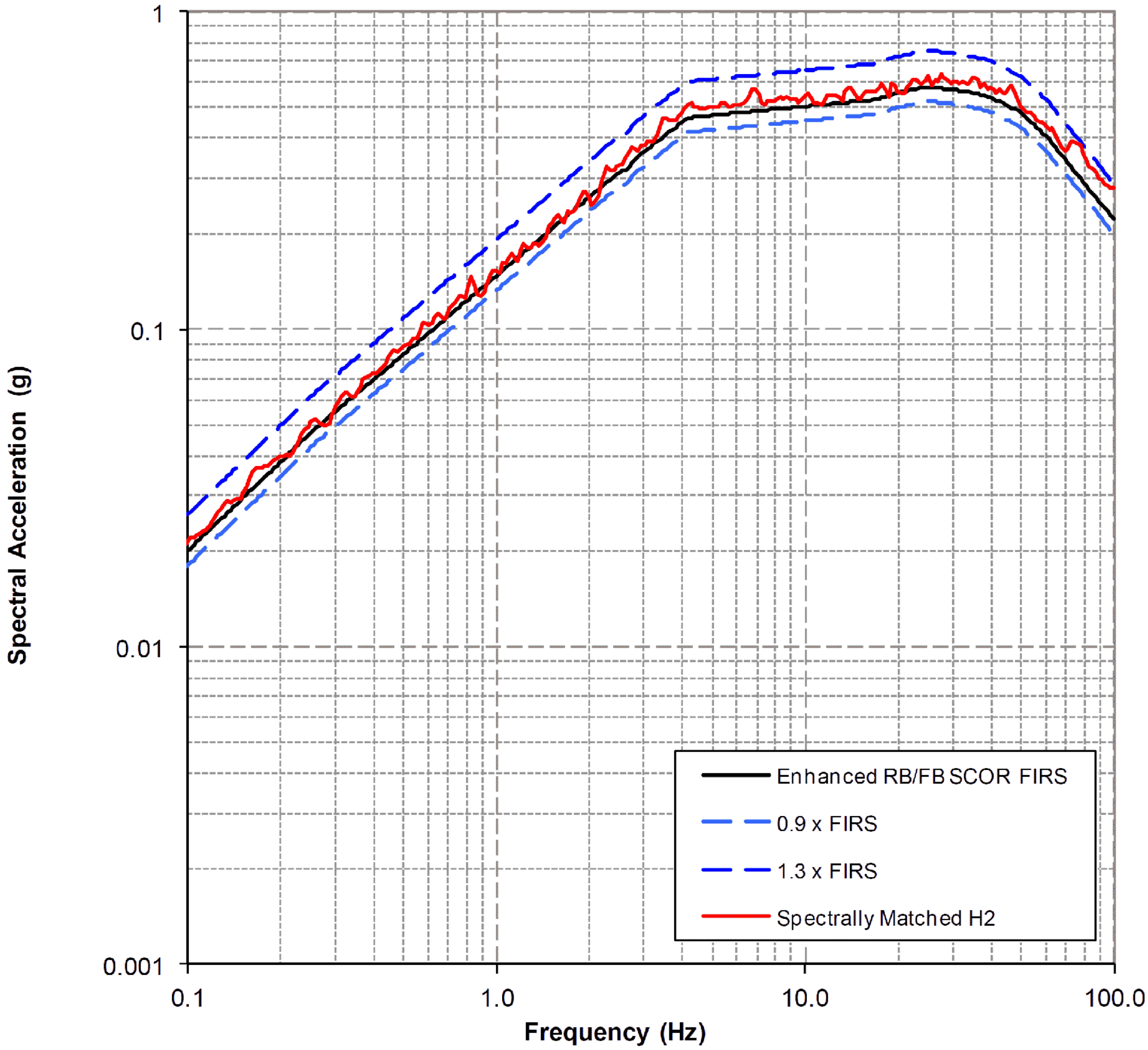


**Figure 3.7.1-241 Response Spectrum for Spectrally Matched Vertical (V) Component for the Fermi 3 RB/FB Enhanced SCOR FIRS [EF3 SUP 3.7-1]**

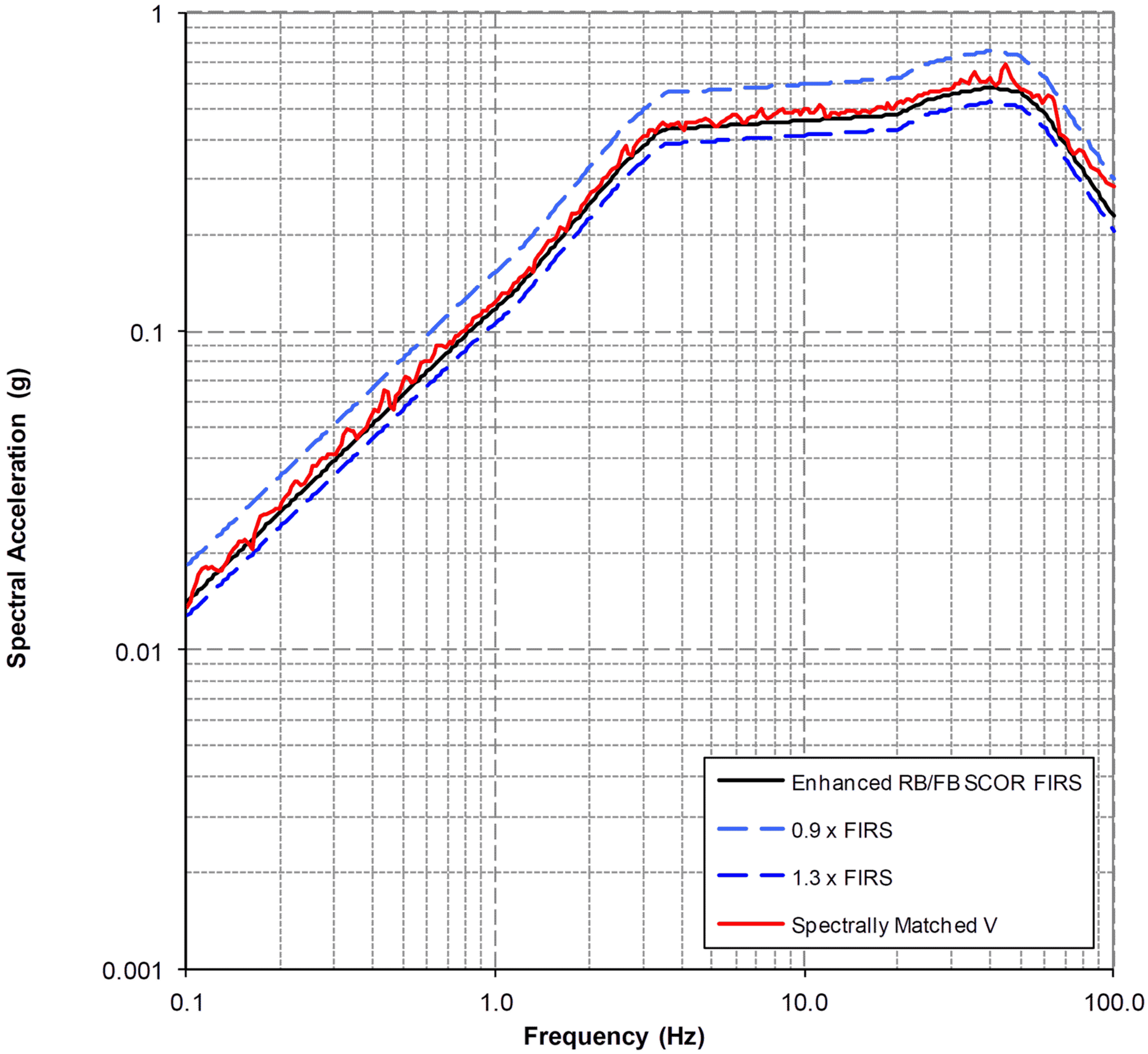


**Figure 3.7.1-242 Response Spectrum for Spectrally Matched Horizontal (H1) Component for the Fermi 3 CB Enhanced SCOR FIRS [EF3 SUP 3.7-1]**

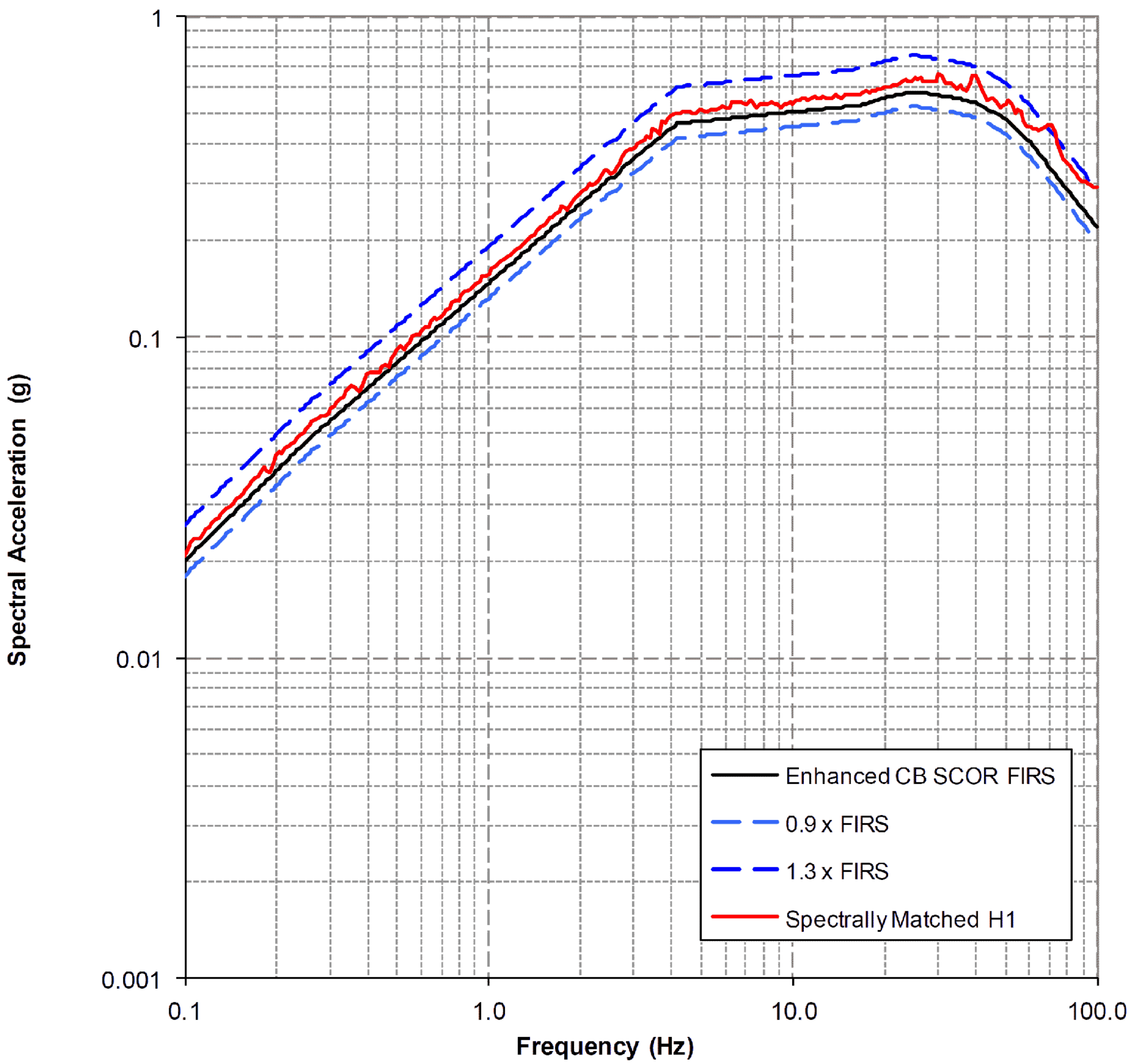


**Figure 3.7.1-243 Response Spectrum for Spectrally Matched Horizontal (H2) Component for the Fermi 3 CB Enhanced SCOR FIRS [EF3 SUP 3.7-1]**

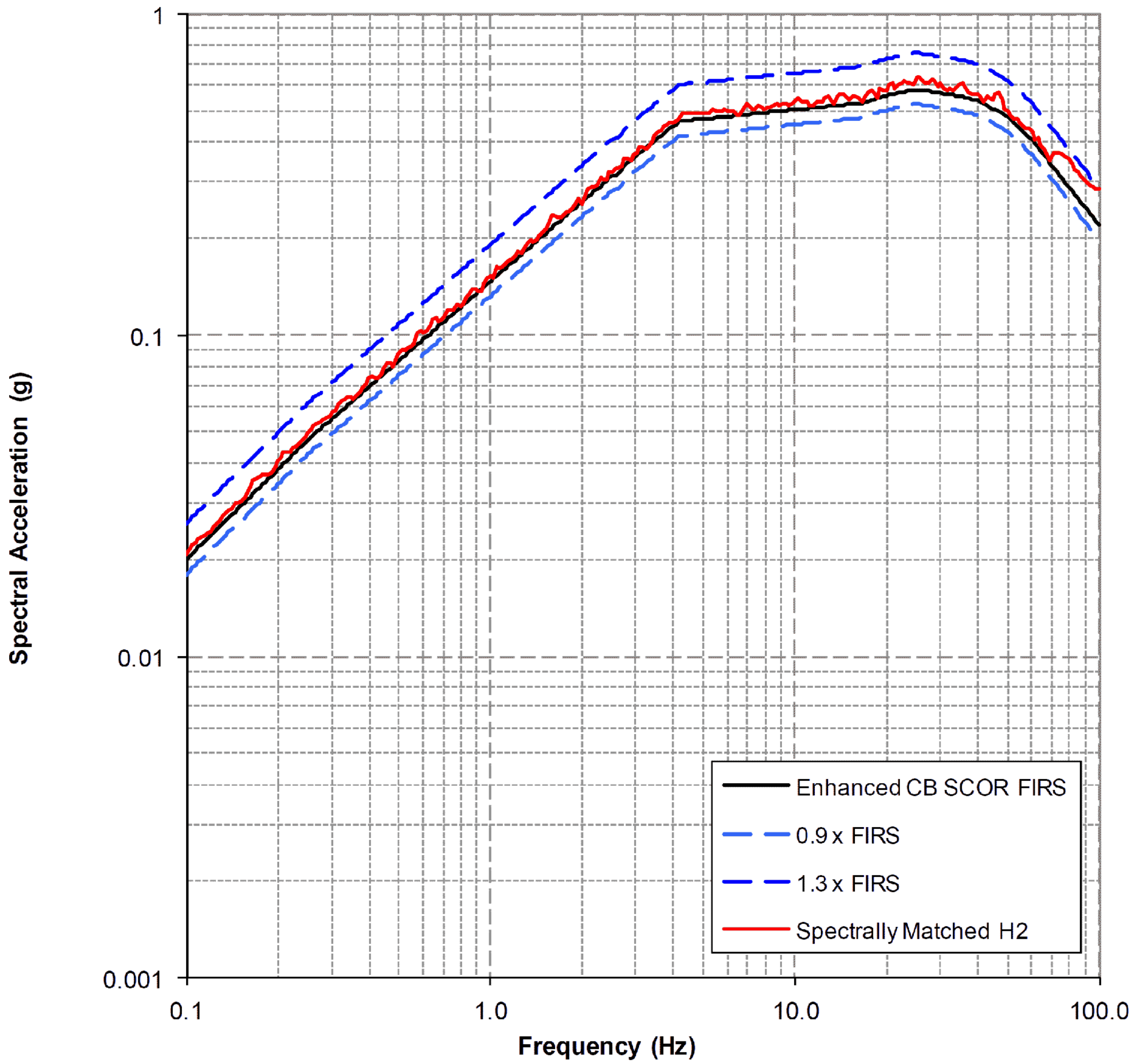


**Figure 3.7.1-244 Response Spectrum for Spectrally Matched Vertical (V) Component for the Fermi 3 CB Enhanced SCOR FIRS [EF3 SUP 3.7-1]**

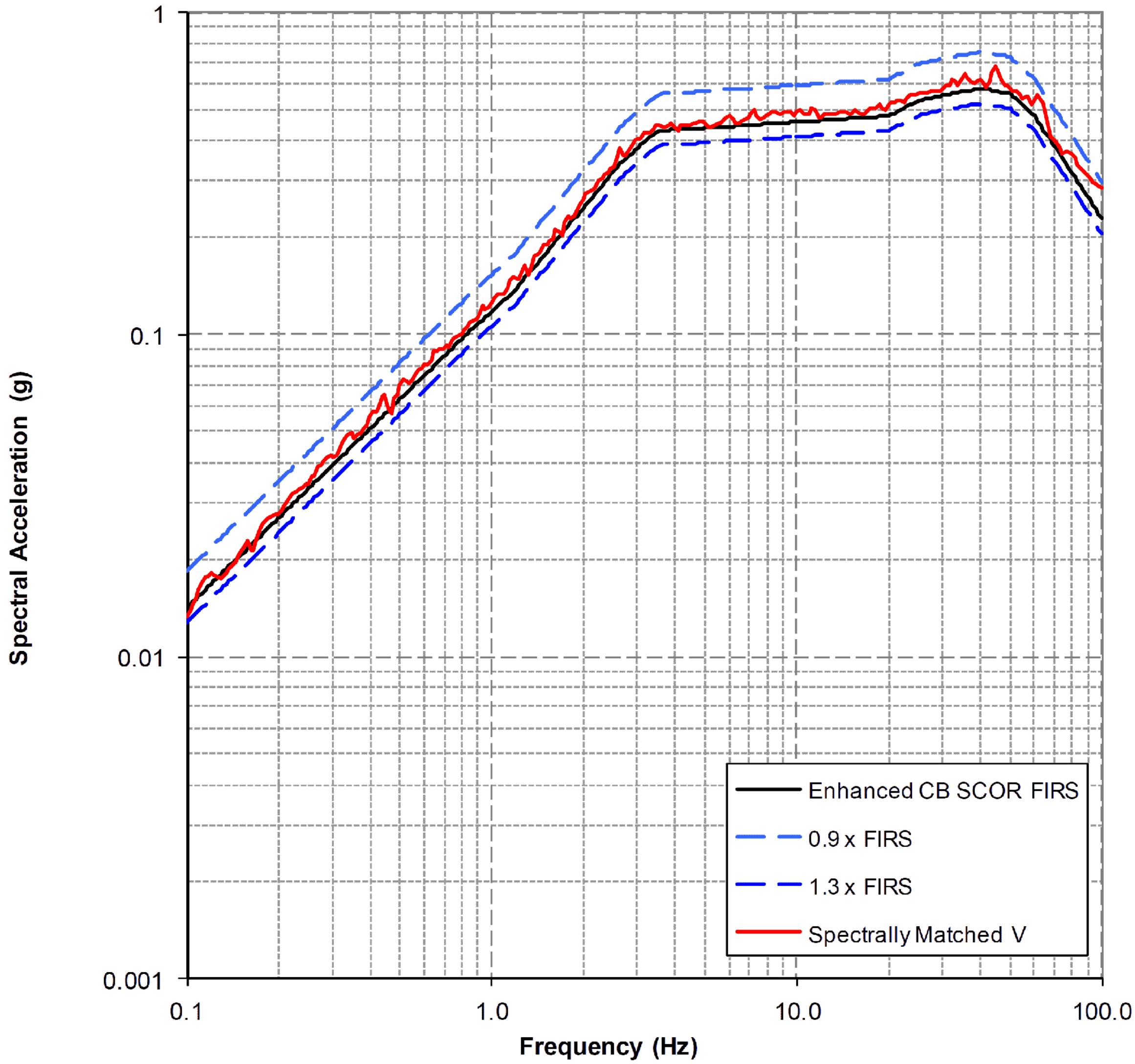
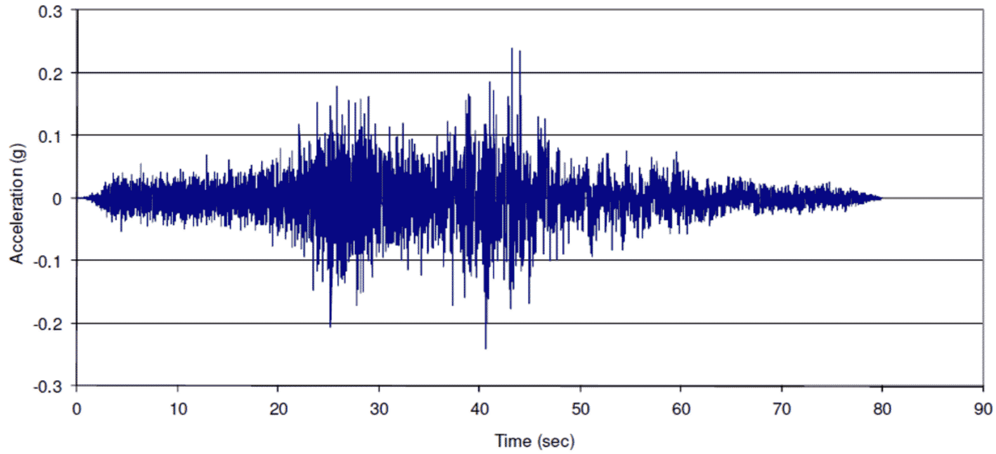
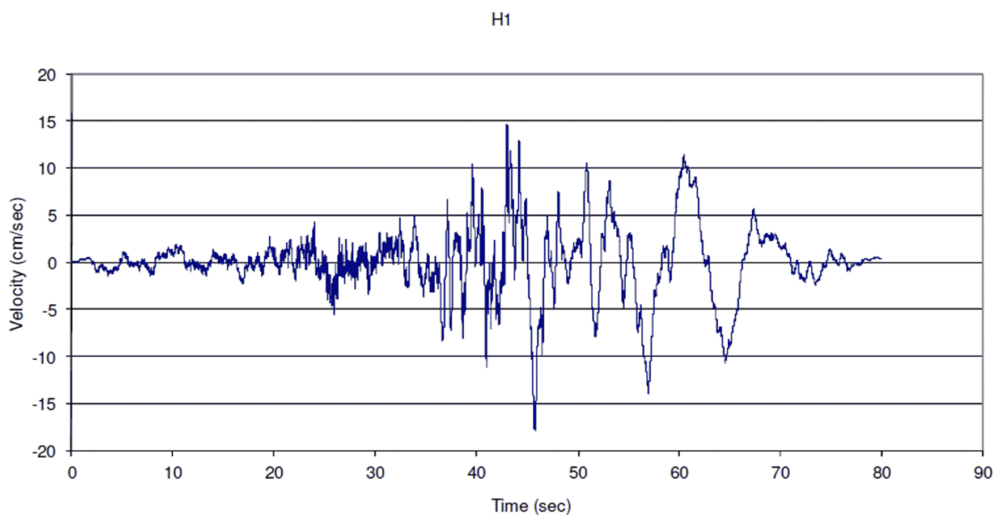


**Figure 3.7.1-245 Acceleration, Velocity, and Displacement Time Histories for the Spectrally Matched Horizontal (H1) Component Compatible with the Fermi 3 RB/FB Enhanced SCOR FIRS [EF3 SUP 3.7-1]**



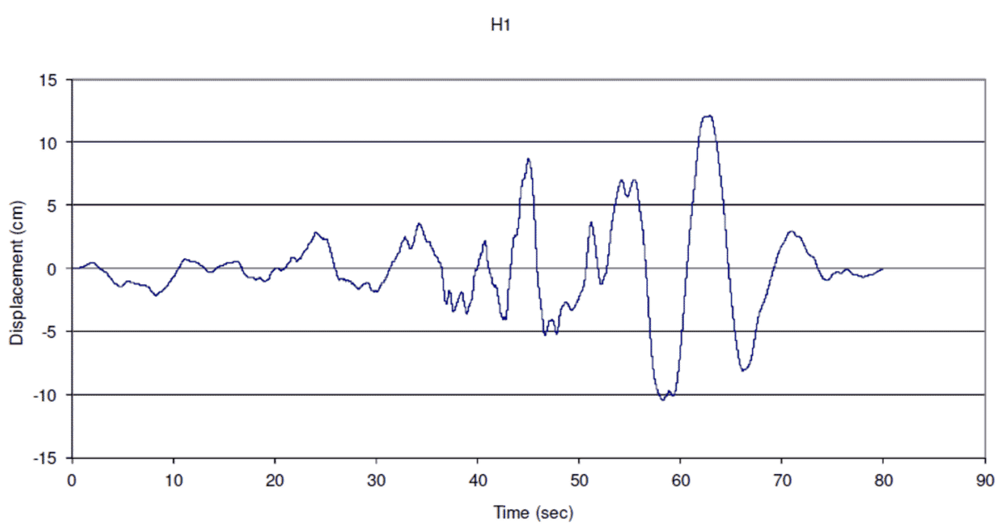



**Figure 3.7.1-246 Acceleration, Velocity, and Displacement Time Histories for the Spectrally Matched Horizontal (H2) Component Compatible with the Fermi 3 RB/FB Enhanced SCOR FIRS [EF3 SUP 3.7-1]**

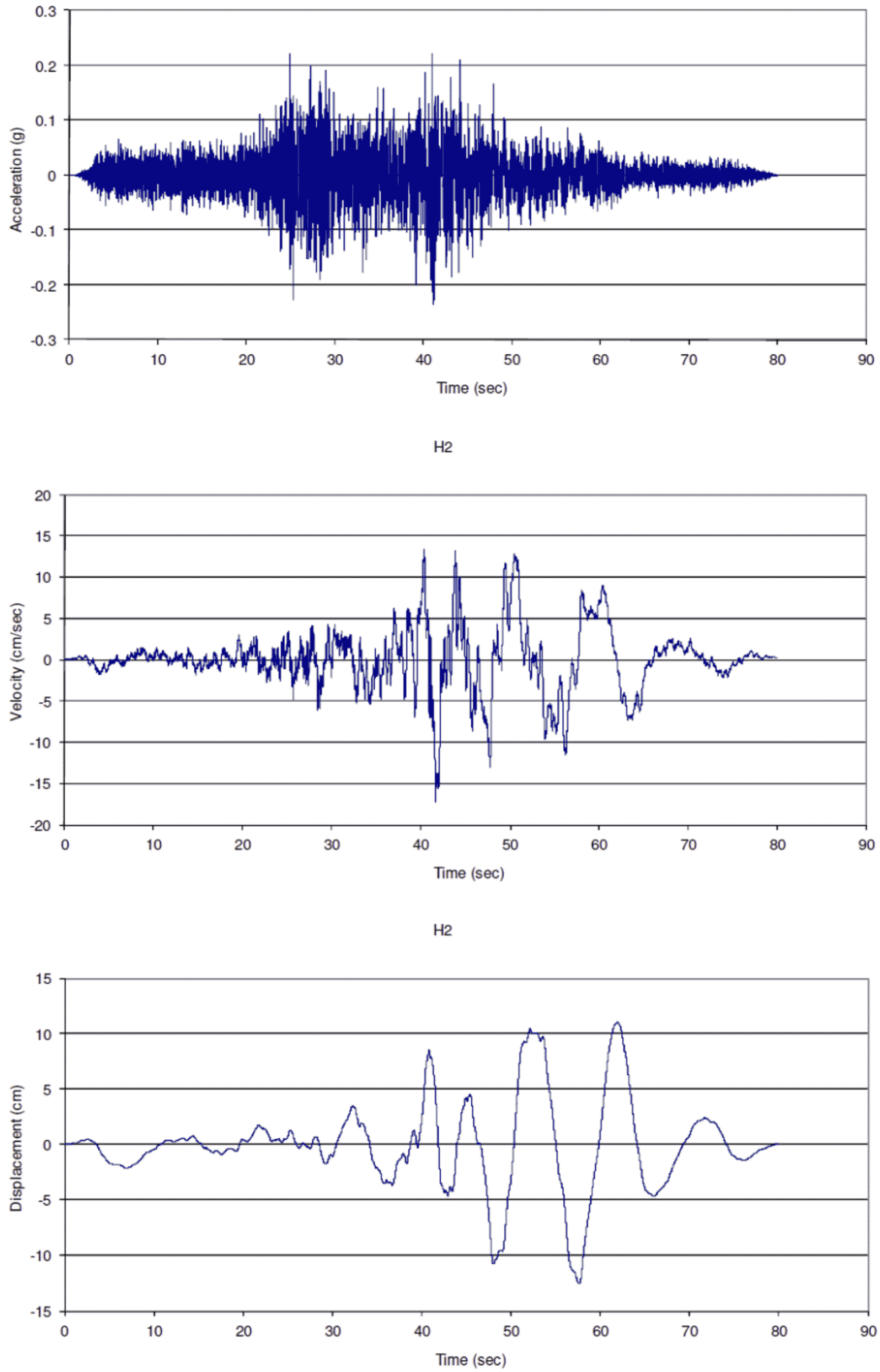


**Figure 3.7.1-247 Acceleration, Velocity, and Displacement Time Histories for the Spectrally Matched Vertical (V) Component Compatible with the Fermi 3 RB/FB Enhanced SCOR FIRS [EF3 SUP 3.7-1]**

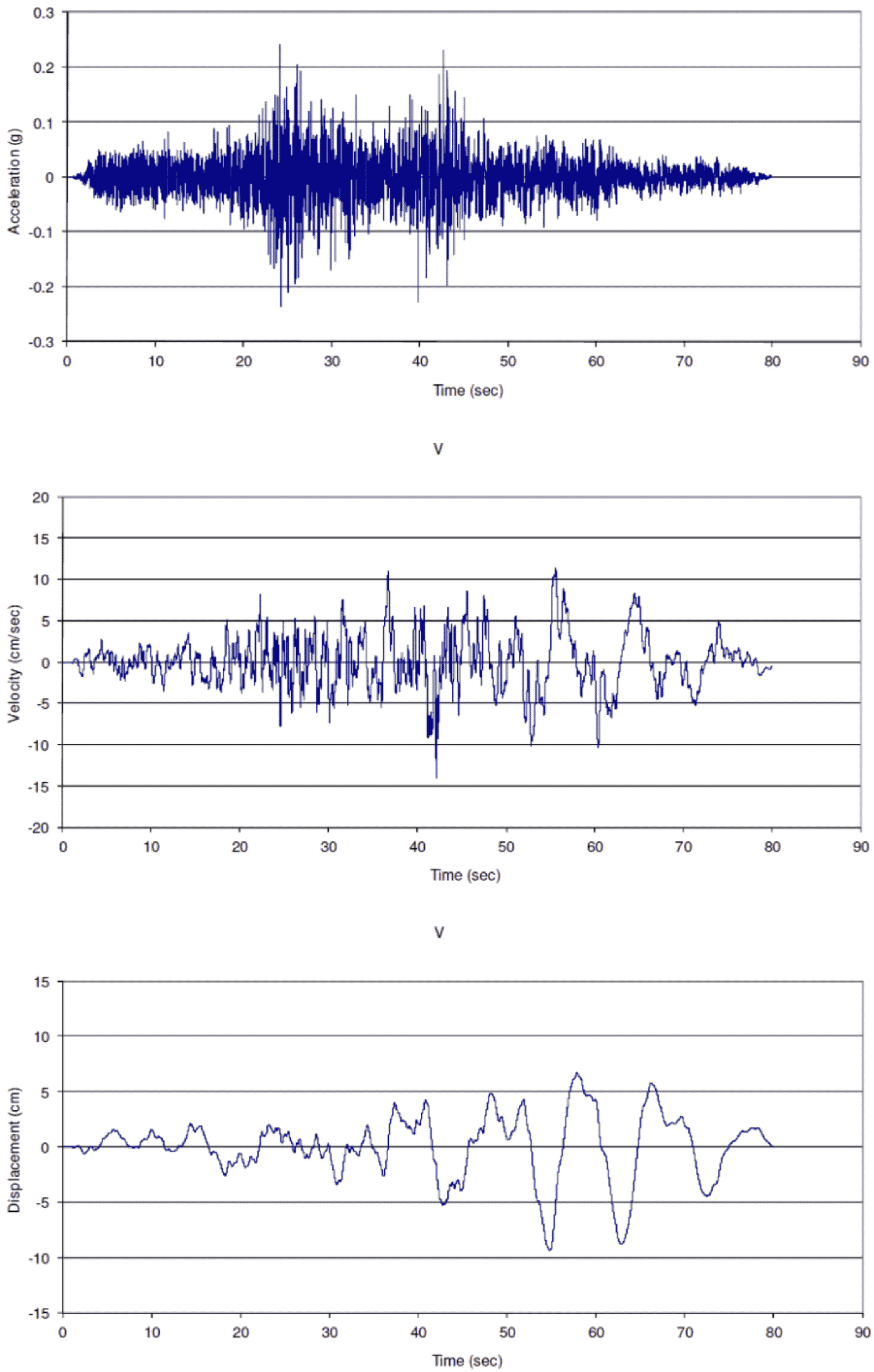


**Figure 3.7.1-248 Acceleration, Velocity, and Displacement Time Histories for the Spectrally Matched Horizontal (H1) Component Compatible with the Fermi 3 CB Enhanced SCOR FIRS [EF3 SUP 3.7-1]**

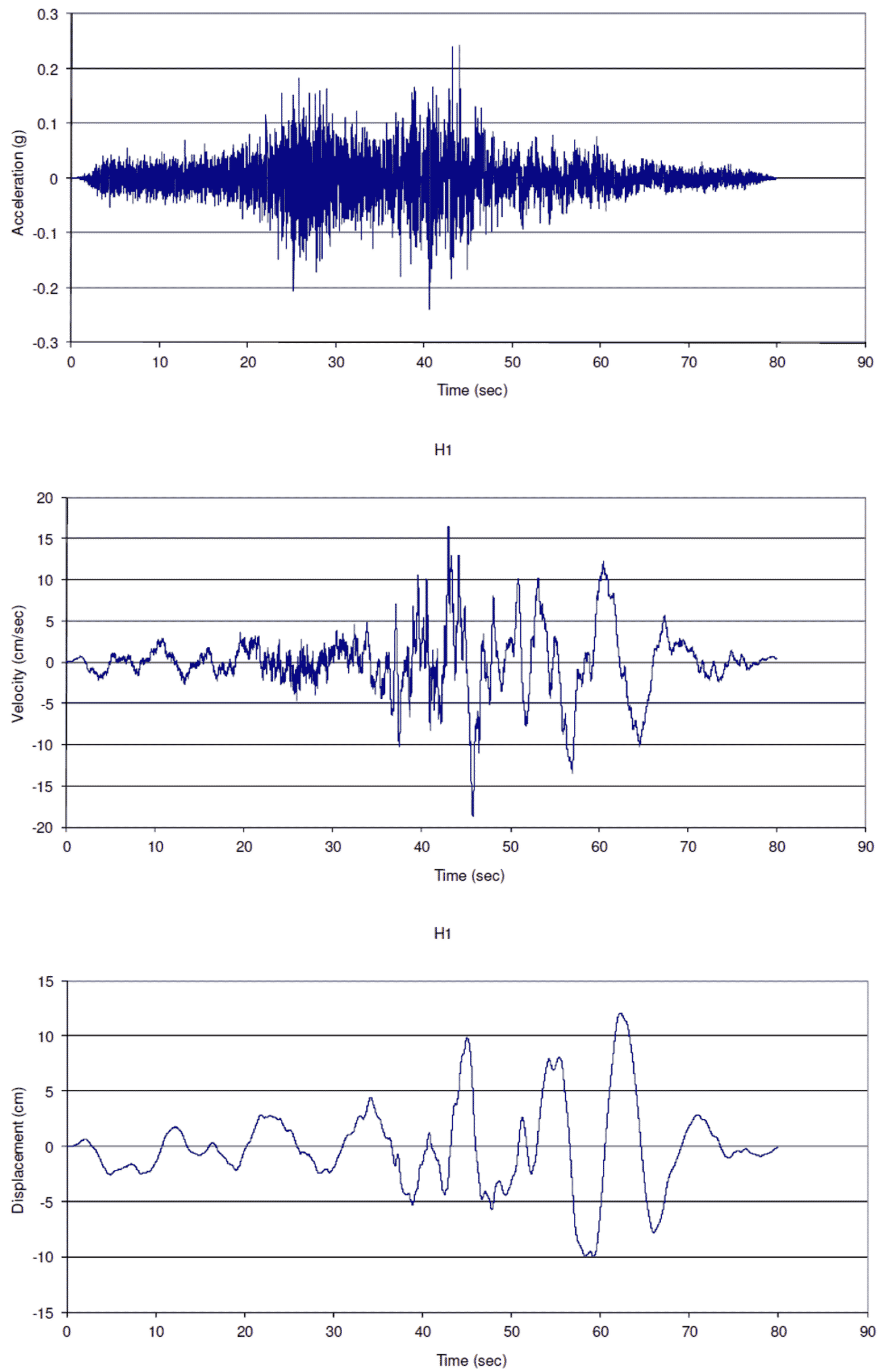


**Figure 3.7.1-249 Acceleration, Velocity, and Displacement Time Histories for the Spectrally Matched Horizontal (H2) Component Compatible with the Fermi 3 CB Enhanced SCOR FIRS [EF3 SUP 3.7-1]**

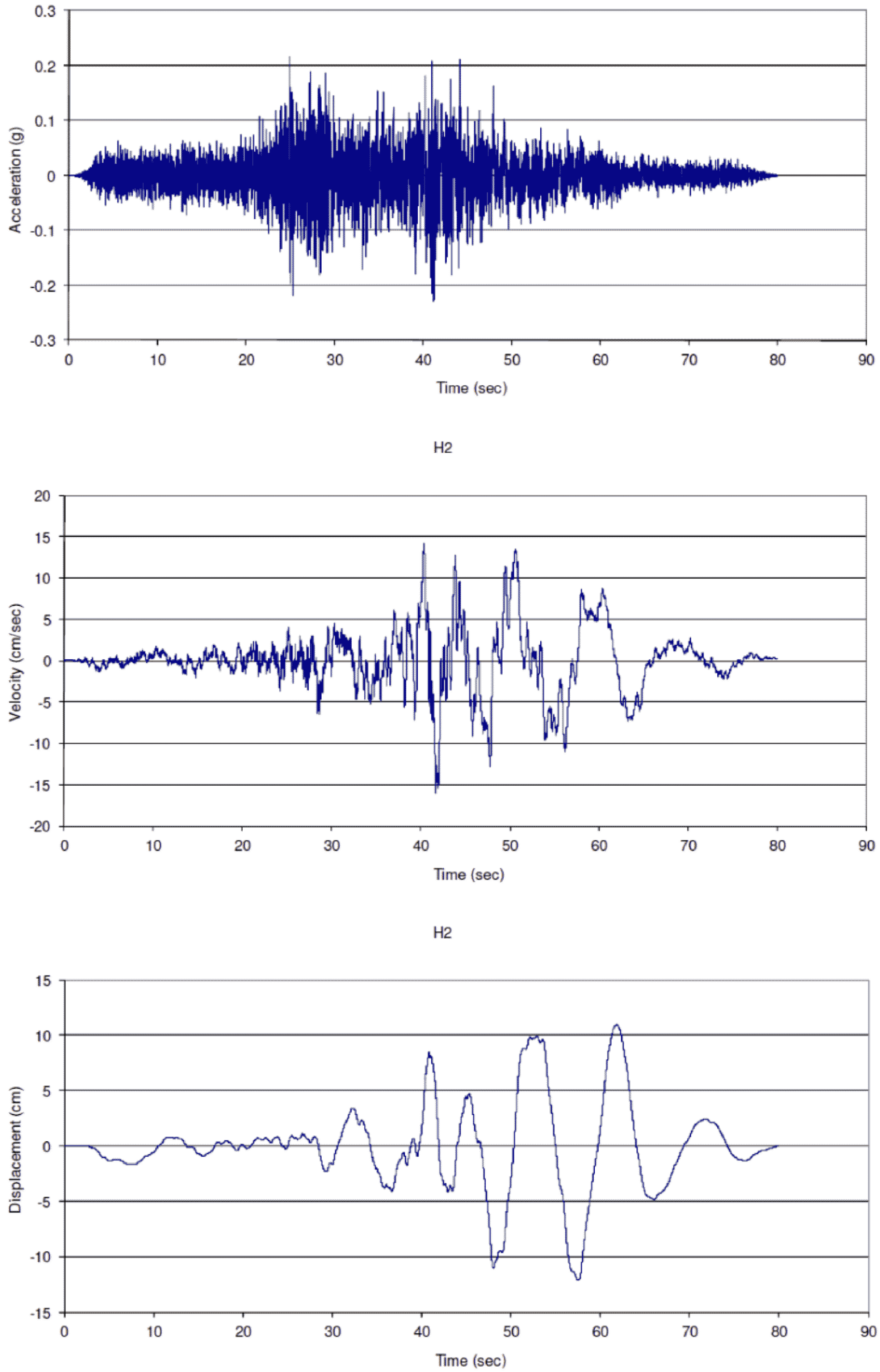


**Figure 3.7.1-250 Acceleration, Velocity, and Displacement Time Histories for the Spectrally Matched Vertical (V) Component Compatible with the Fermi 3 CB Enhanced SCOR FIRS [EF3 SUP 3.7-1]**

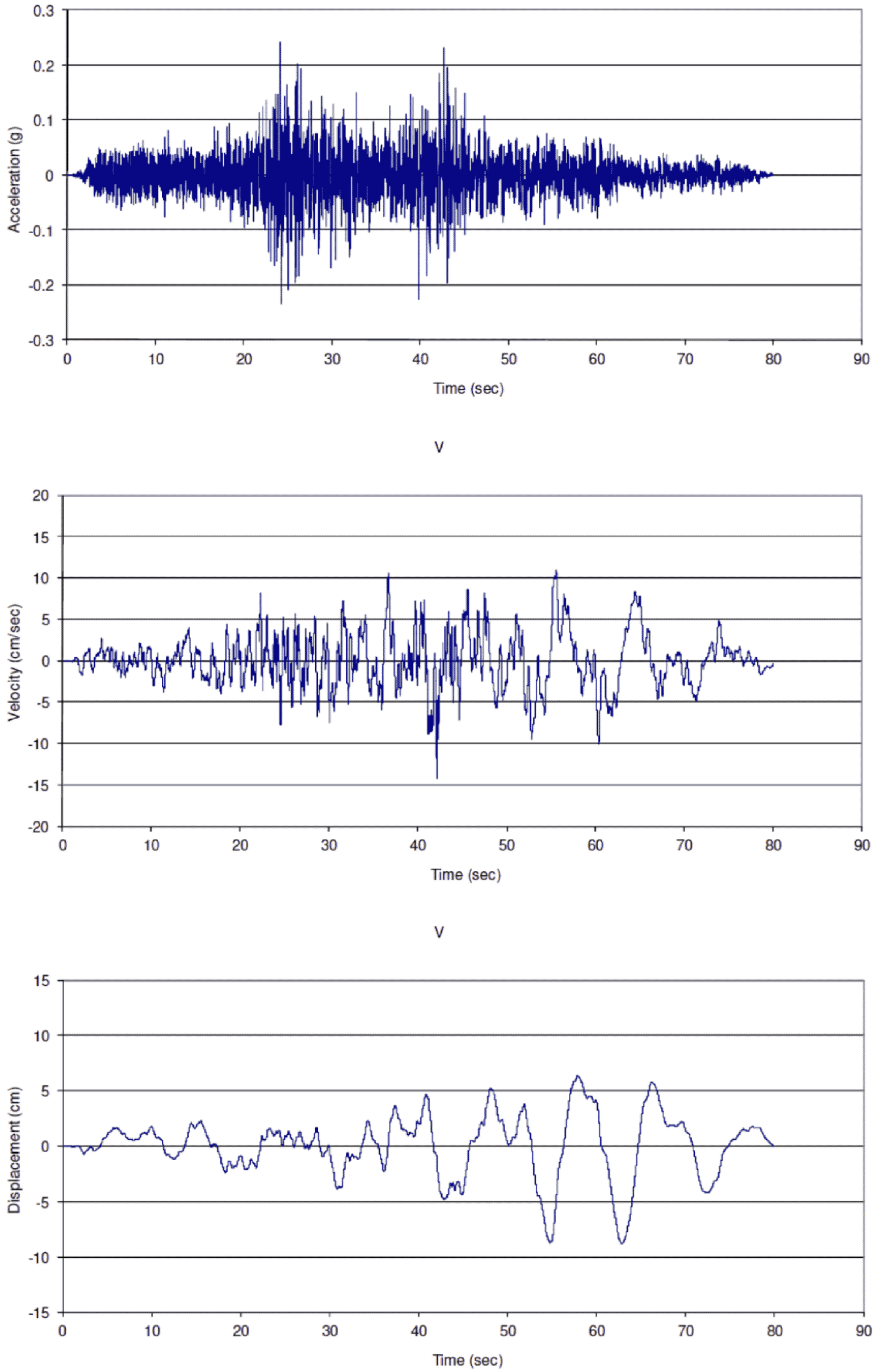
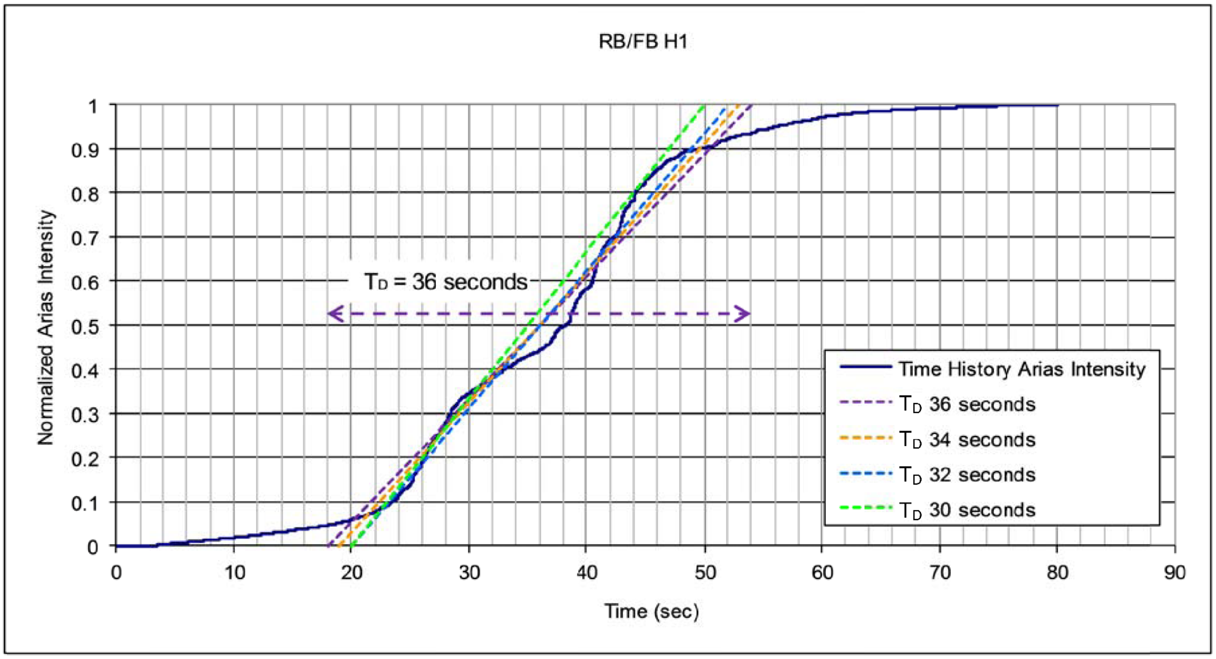


**Figure 3.7.1-251 Normalized Arias Intensity and Estimates of Equivalent Stationary Duration for Calculating the PSD for the Spectrally Matched Horizontal (H1 and H2) Components Compatible with the Fermi 3 RB/FB Enhanced SCOR FIRS [EF3 SUP 3.7-1]**



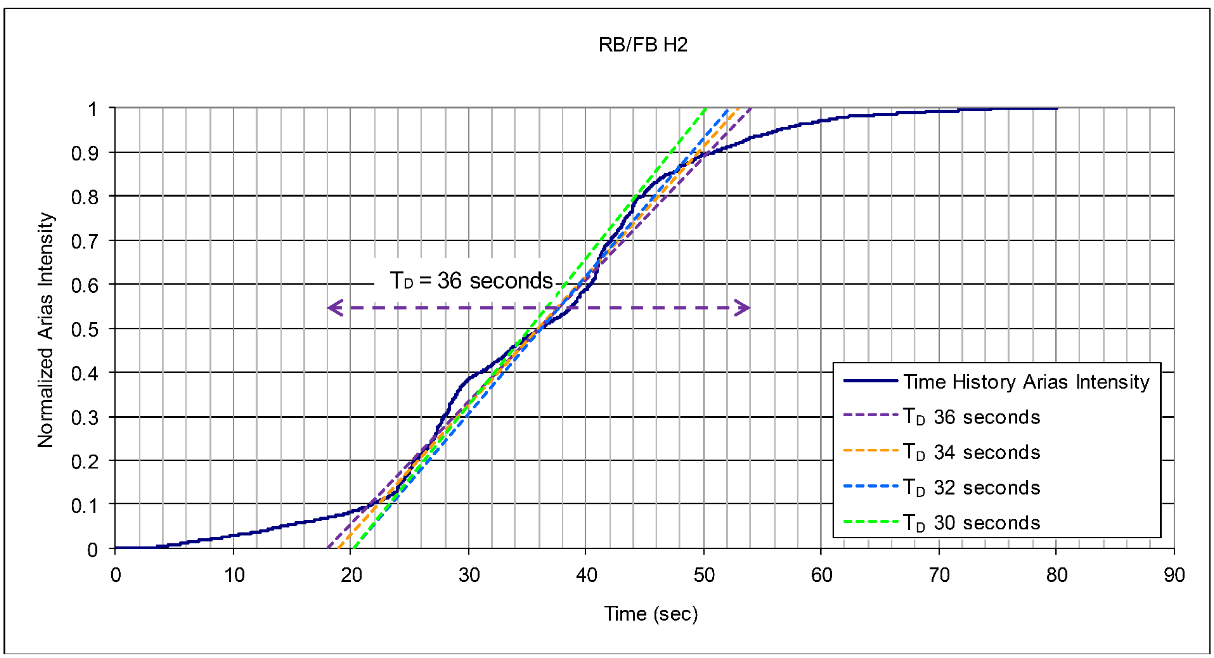



**Figure 3.7.1-252 PSD Computed for the RB/FB H1 Component Spectrally Matched Time History (Enhanced SCOR FIRS) Using Full Duration Time Histories and Time Histories Windowed to an Equivalent Stationary Duration, $T_D$ [EF3 SUP 3.7-1]**

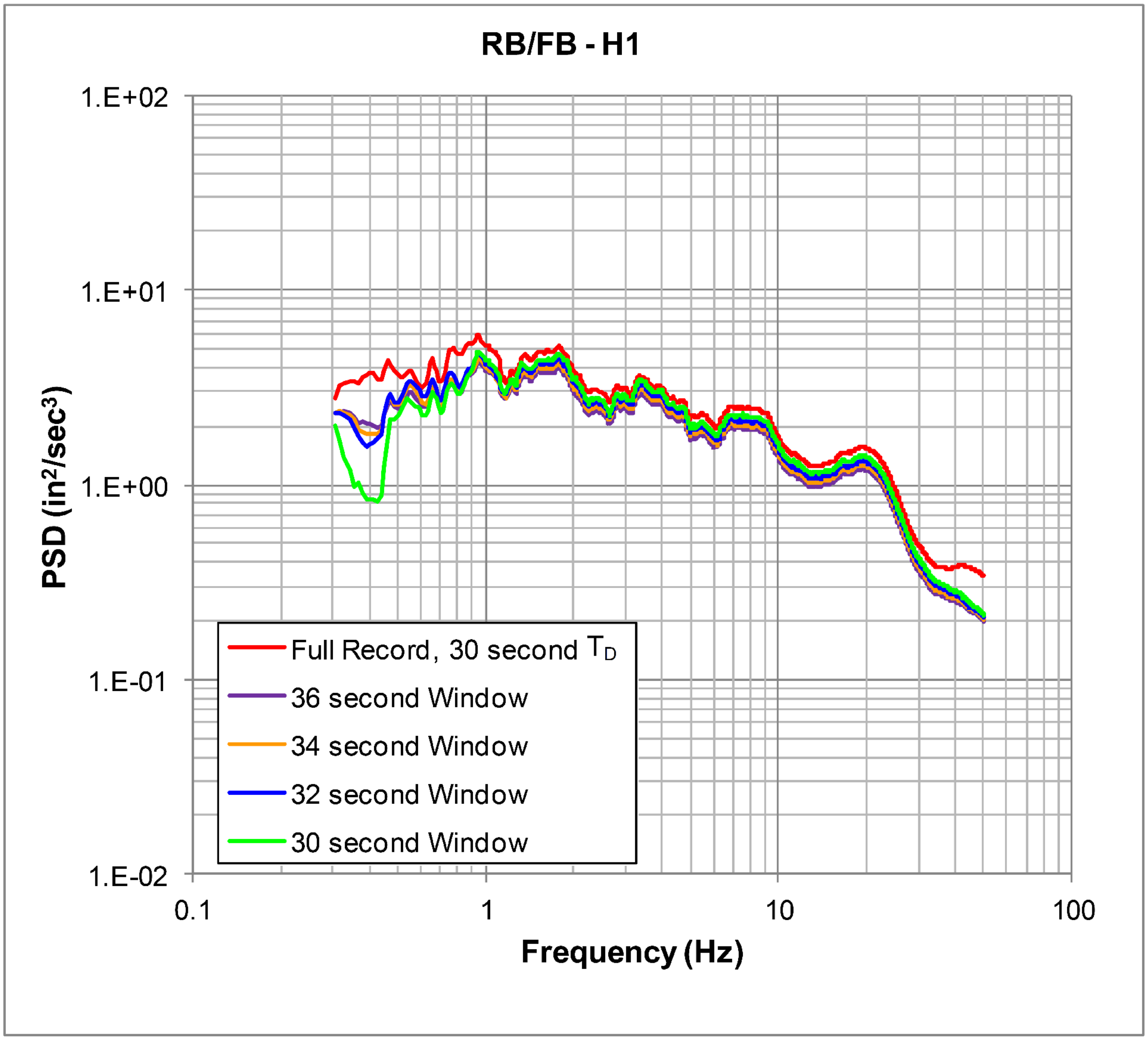


**Figure 3.7.1-253 PSD Computed for the RB/FB H2 Component Spectrally Matched Time History (Enhanced SCOR FIRS) Using Full Duration Time Histories and Time Histories Windowed to an Equivalent Stationary Duration, $T_D$ [EF3 SUP 3.7-1]**

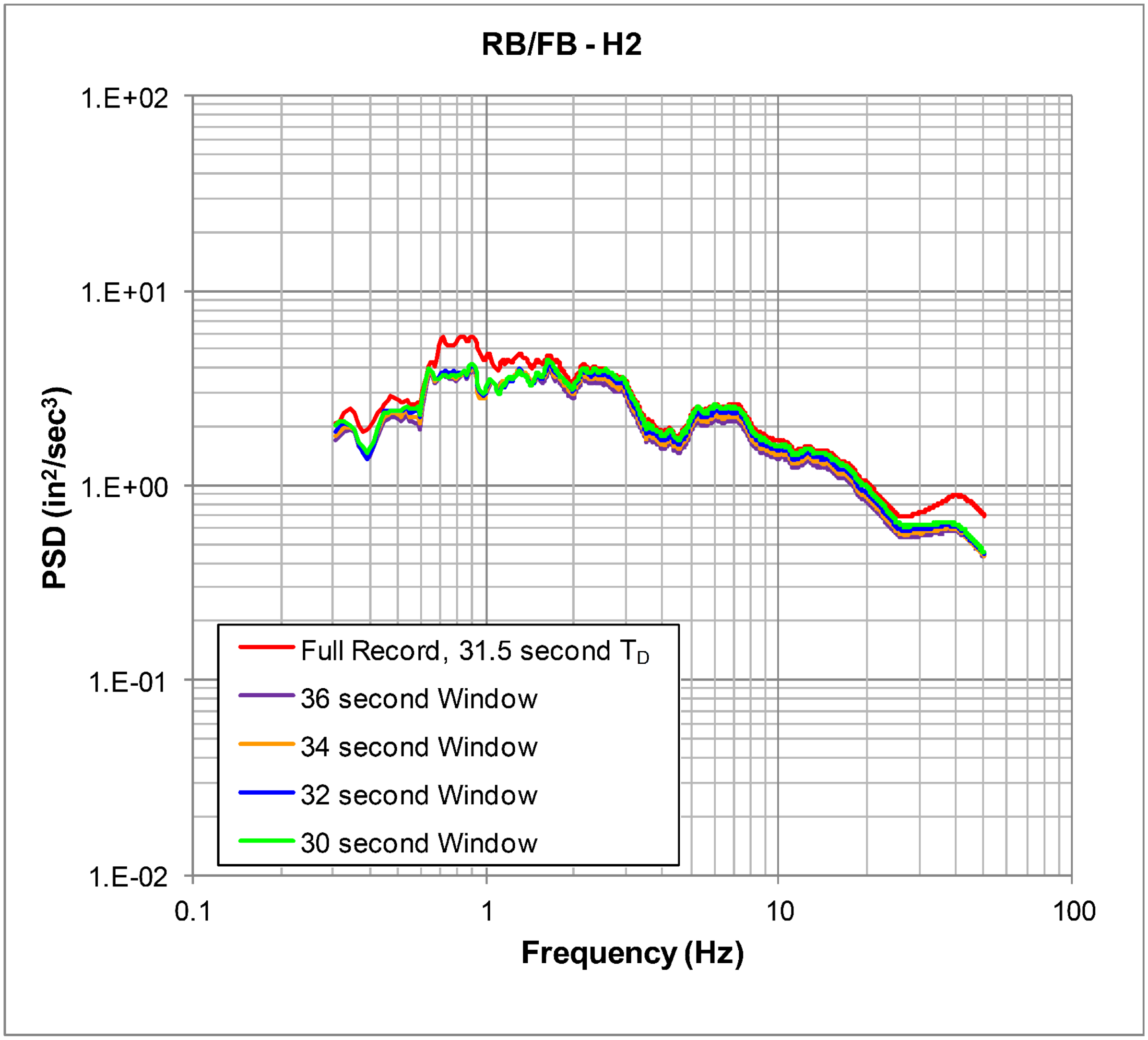


**Figure 3.7.1-254 PSD Computed for the CB H1 Component Spectrally Matched Time History (Enhanced SCOR FIRS) Using Full Duration Time Histories and Time Histories Windowed to an Equivalent Stationary Duration, $T_D$ [EF3 SUP 3.7-1]**

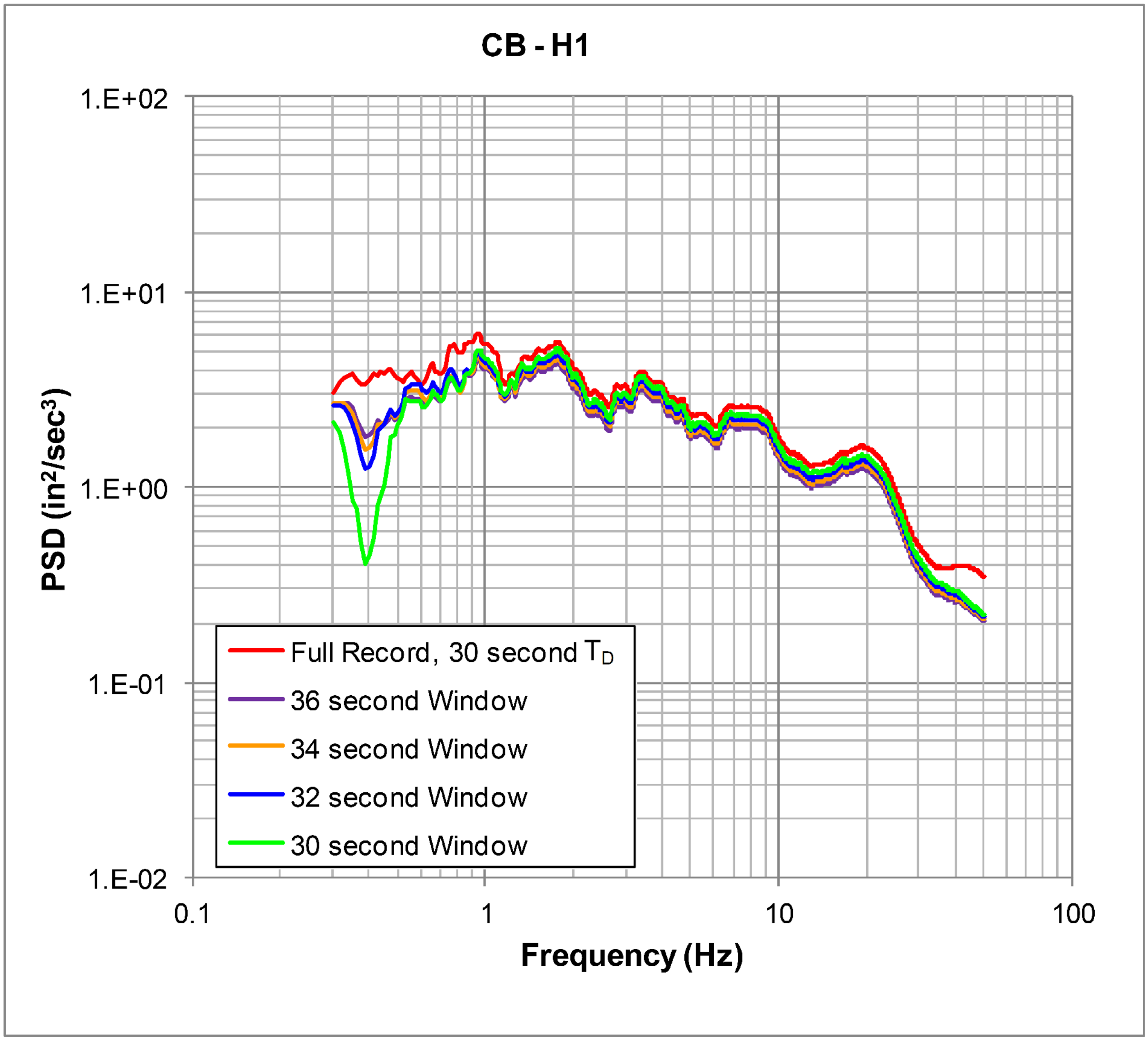


**Figure 3.7.1-255 PSD Computed for the CB H2 Component Spectrally Matched Time History (Enhanced SCOR FIRS) Using Full Duration Time Histories and Time Histories Windowed to an Equivalent Stationary Duration, $T_D$ [EF3 SUP 3.7-1]**

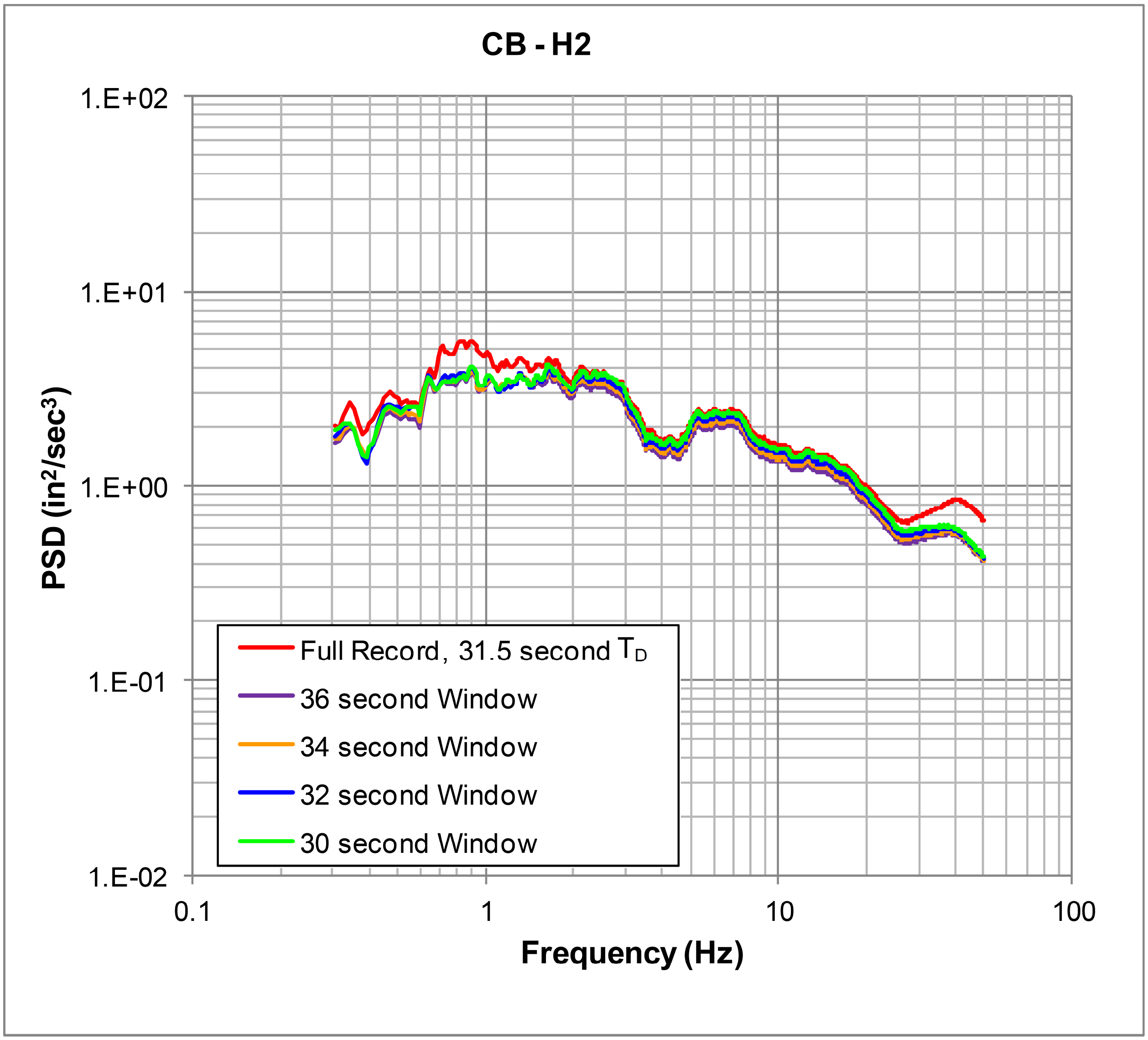


**Figure 3.7.1-256 Power Spectra and Cumulative Power Plots for the Horizontal In-Column Acceleration Time Histories (H1 and H2) Compatible with the BE Deterministic Profile without Engineered Granular Backfill above the Top of the Bass Islands Group Bedrock [EF3 SUP 3.7-1]**