3F {SITE RESPONSE ANALYSIS AND SSI ANALYSIS INPUT FOR EPGB, ESWB, CBIS, AND UHS ELECTRICAL BUILDING

This Appendix added as a Supplement to the U.S. EPR FSAR

This appendix discusses in detail the development of the seismic ground motions and the strain-compatible soil profile properties, which are used in the Soil-Structure Interaction (SSI) analysis of Seismic Category I structures. Structures analyzed in the intake area include the Common Basemat Intake Structures (CBIS), and the UHS Electrical Building. The CBIS includes two Seismic Category I structures: the Ultimate Heat Sink (UHS) Makeup Water Intake Structure and the Forebay, as well as the Seismic Category II Circulating Water Makeup Intake Structure, which all share the same basemat. Structures analyzed in the vicinity of the Nuclear Island (NI) include the Emergency Power Generating Buildings (EPGB) and the Essential Service Water Buildings (ESWB). Seismic ground motions and the strain-compatible soil profile properties for the structures associated with the NI common basemat are not discussed in this appendix.

Section 3F.1 describes the development of the Foundation Input Response Spectra (FIRS). The FIRS are developed in accordance with Regulatory Guide 1.208 (NRC, 2007), through seismic site response analysis using the rock motion spectra, presented in Section 2.5.2.5.1.4, and the soil profile properties, presented in Section 2.5.4.2. The FIRS are modified according to the requirements for checking the adequacy of the SSI input motion (NRC, 2009 and NEI, 2009). FIRS for EPGB and ESWB are amplified to account for the structure-soil-structure Interaction (SSSI) effects due to NI Common Basemat Structures.

The Site Safe Shutdown Earthquake (Site SSE), presented in Section 3.7.1.1.1.1, is shown to envelop the Adjusted FIRS, and therefore its adequacy for use in SSI analysis is confirmed. The Site SSE strain-compatible soil properties are discussed in Section 3F.2. The acceleration time histories that are to be applied at the foundation of the structures in the SSI analysis are presented in Section 3F.3. Section 3F.4 describes the computer codes used in the analyses, while Section 3F.5 includes a list of the references.

3F.1 FOUNDATION INPUT REPONSE SPECTRA (FIRS)

The EPGB and ESWB are situated at the CCNPP Unit 3 site in the NI area. The bottom of the ESWB basemat is situated approximately 22 ft (6.7 m) below grade, while the bottom of the EPGB basemat is situated approximately 5 ft (1.5 m) below grade. The confirmatory SSI analysis, the EPGB is treated as a surface structure, the FIRS for the EPGB are calculated at the ground surface.

The site-specific Seismic Category I CBIS and UHS Electrical Building are situated at the CCNPP Unit 3 intake area, along the west bank of the Chesapeake Bay. The bottom of the CBIS common basemat is situated approximately 37.5 ft (11.4 m) below grade, while the bottom of the UHS Electrical Building mat foundation is situated approximately 20.5 ft (6.2 m) below grade. Table 3F-1 summarizes the bottom of foundation depths and elevations.

The generation of low-strain site-specific simulated soil property profiles is described in Section 3F1.1, the site response analysis is discussed in Section 3F.1.2, and the calculation of FIRS is presented in Section 3F.1.3. The adjustment of FIRS is described in Section 3F.1.4 and 3F.1.5, where the Adjusted FIRS are compared to Site SSE. The Site SSE is found to envelop the Adjusted FIRS, and is therefore adequate for use in the SSI analysis.

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3F.1.1 DYNAMIC SOIL PROFILE AND STOCHASTIC SIMULATION

The computer program SPS, described in Section 3F.4, is used to generate site-specific simulated (randomized) soil profiles to represent the dynamic properties of the site while considering the uncertainty associated with each of these properties. The generation of the low-strain simulated soil profiles requires the input Best Estimate (BE) properties and their associated uncertainty. The uncertainty is expressed in terms of statistical distribution, standard deviation (SD), and correlation among engineering parameters.

The static and dynamic soil properties, required to generate the simulated profiles for the NI and Intake areas, are provided in Section 2.5.4.2. These properties include shear wave velocity, thicknesses, unit weight, and the strain-dependent property curves (shear modulus reduction and damping ratio) for the different soil layers (including the structural backfill). Figures 3F-1 and 3F-2 present the BE low-strain shear wave velocity profile for the NI area and Intake area, respectively (also see Figures 2.5-167 and 2.5-169). The total BE soil column thickness is about 2,500 ft (762 m) in both areas. At that depth, bedrock is defined with a shear-wave velocity of 9,200 ft/sec (2,804 m/sec). Figures 3F-3 and 3F-4 present the associated log-standard deviation for the shear wave velocity profile at the NI area and Intake area, respectively. While the two areas share similar properties for the deep soil strata, they are different with respect to finished grade elevation, ground water level elevation, thickness of backfill, and the upper soil strata.

Two sets of 60 simulated profiles, representing the NI and Intake area site conditions, are generated. Figure 3F-5 presents the set of 60 simulated low-strain shear wave velocity profiles for the NI area, which includes the thickness variation of the soil layers. The figure also presents the BE profile used as input for simulation and the simulated median profile, calculated as the log-mean of the 60 simulated profiles, and shows a close match between these two profiles. Figure 3F-6 presents the corresponding low-strain shear wave velocity profiles for the Intake area, also having a close match between the BE and simulated median.

As an example, the simulated shear strength reduction and damping ratio curves for the uppermost fill layer (referred to as Fill 1) at the NI area are presented in Figures 3F-7a and 3F-7b, respectively. In these figures, the BE and simulated median are compared as well as the input log-standard deviation (Input SD) and simulated log-standard deviation (Simulated SD). Maximum and minimum bounds of twice the SD around the BE are imposed on the strain-dependent property curves. Note that damping curves, in Figure 3F-7b, are truncated at a maximum of 15% as described by NUREG/CR-1161, which explains the discrepancy between input and simulated properties once that upper limit is reached. The damping truncation at 15% is a conservative measure with respect to their subsequent use in site response analysis.

3F.1.2 SITE RESPONSE ANALYSIS

The low-frequency (LF) and high frequency (HF) input rock spectra at the 1E-4 and 1E-5 hazard levels (or annual probability of exceedance) are presented in Section 2.5.2.5.1.4, Figures 2.5-70 and 2.5-71. The rock spectra are applied at bedrock having a shear wave velocity of 9,200 ft/sec (2,804 m/sec), and are propagated from bedrock to the ground surface, through the two sets of 60 simulated profiles, for the NI and Intake areas, using the computer program P-SHAKE (described in Section 3F.4).

As an input for site response analysis, the duration of the input motion is specified as a parameter in P-SHAKE. The strong motion durations are determined using the magnitudes (M) of the four input rock motions (see Table 3F-2), and Table 2.3-1 in ASCE 4-98 (ASCE, 2000). The magnitudes and corresponding durations are reported in Table 3F-2. An additional parameter required for P-SHAKE is the effective strain ratio, which is calculated as a function of earthquake

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magnitude, as shown in Equation 3F-1 (Idriss and Sun, 1992). Kramer (1996) recommends the range for the effective strain ratio to be between 0.5 and 0.7. This range is imposed on the ratios calculated using Equation 3F-1. The resulting effective strain ratios used in site response analysis are reported in Table 3F-2.

Effective Strain Ratio = (M-1)/10 Equation (3F-1)

The free field 5% damping Acceleration Response Spectra (ARS) at the ground surface and at the bottom of foundation elevations are computed as outcrop motions through analysis of the full soil column up to the ground surface. All spectra are calculated at 301 points equally spaced in log-scale in the frequency range from 0.1 to 100 Hz (a period range of 0.01 to 10 seconds). The cut-off frequency of the P-SHAKE runs is 100 Hz. Log-mean (median) ARS are calculated from the ARS results for all 60 simulated profiles, for each set of P-SHAKE analyses. ARS amplification functions are calculated at each horizon, by dividing the ARS of the given horizon by the ARS of the input rock motion. Figure 3F-8 presents the ARS amplification functions calculated at 22 ft (6.7m) depth for the NI area, while Figure 3F-9 presents the ARS amplification functions calculated at 20.5 ft (6.2 m) depth for the Intake area. The ARS amplification functions are also calculated at ground surface in the NI area, and at ground surface and at 37.5 ft (11.4 m) below grade in the Intake area, but are not presented in figures.

The P-SHAKE runs provide the strain compatible shear wave velocities and damping ratio profiles (presented in Section 3F.2) as well as the maximum strains within each soil layer. Figure 3F-10 and Figure 3F-11 present the log-mean strain profiles for the NI area and Intake area, respectively.

FIRS Calculation

The horizontal Foundation Input Response Spectra (FIRS) are calculated using the procedure described in Section 5.1 of Regulatory Guide 1.208 (NRC, 2007). At 1E-4 hazard level, the log-mean ARS are obtained by enveloping the log-mean ARS for LF and HF for the horizon of interest. The same procedure is repeated for 1E-5 hazard level. Equations 3F-2 and 3F-3 are used to determine A_R and *DF* factors for the horizon of interest.

$$A_R(f) = \frac{ARS_{1E-5}}{ARS_{1E-4}} \quad \text{Equation (3F-2)}$$

$$DF(f) = \max\left\{1.0,\ 0.6(A_R)^{0.8},\ 0.45A_R\right\} \quad \text{Equation (3F-3)}$$

The A_R and *DF* factors at the considered horizon are calculated as a function of frequency (*f*). The notation indicating the dependency on frequency is implied in Equation 3F-4. Given DF from Equation 3F-3, horizontal FIRS at the considered horizon are calculated using Equation 3F-4:

$$FIRS = DF \times ARS_{1E-4} \quad \text{Equation (3F-4)}$$

The FIRS are calculated using the 5% damping "outcrop" ARS. At ground surface, the FIRS are also designated as the performance-based surface response spectra (PBSRS).

The horizontal FIRS are scaled by an appropriate V/H scaling function to obtain the corresponding vertical FIRS. For this calculation, the V/H function is that presented in FSAR

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Section 2.5.2.6 (Table 2.5-22) and presented below as Equation 3F-5, and is applicable for both rock and soil spectra at Calvert Cliffs:

V/H = 0.75	Freq ≤ 5 Hz	
= log-linearly interpolated	5 Hz < Freq < 25 Hz	Equation (3F-5)
= 1.00	Freq ≥ 25 Hz	

Figure 3F-12 presents the horizontal and vertical FIRS calculated for the NI area, and Figure 3F-13 presents the horizontal and vertical FIRS calculated for the Intake area.

Best Estimate (BE), lower bound (LB) and upper bound (UB) soil properties are calculated consistent with the FIRS motions. The BE profile consists of the log-mean profile properties, and the LB and UB profiles are calculated maintaining a minimum variation of 0.5 on the shear modulus. Figure 3F-14 presents the shear wave velocity profiles strain-compatible with FIRS for the NI area. FIRS strain-compatible damping and P-wave velocity profiles, for the NI area, are presented in Figure 3F-15 and 3F-16, respectively. The corresponding profiles for the Intake area are presented in Figures 3F-17, and 3F-19. Note that the lower shear wave and primary wave velocity are used in conjunction with the higher damping values to form the LB profile, and vice versa for the UB profile.

3F.1.3 FIRS ADJUSTMENT

The adequacy of the horizontal and vertical FIRS, calculated at depth, as input ground motions for SSI analysis is evaluated by ensuring that the FIRS convolved from the foundation level up to the surface using the LB, BE, and UB FIRS strain-compatible soil properties envelop the PBSRS (i.e., the FIRS at ground surface). This verification is referred to as the NEI check in reference to the Nuclear Energy Institute (NEI) white paper (NEI, 2009) and Interim Staff Guidance (NRC, 2009). The check is conducted for each of the embedded FIRS, namely at the foundation elevation of the ESWB in the NI area, as well as the UHS Electrical Building and CBIS in the Intake area (refer to Table 3F-1 for foundation elevations).

For the NEI check, the horizontal and vertical FIRS are applied at the foundation level using the LB, BE, and UB FIRS strain-compatible soil properties, using P-SHAKE. The horizontal FIRS are convolved to the surface using vertically propagating shear-waves (V_S) and the vertical FIRS are convolved to the surface through vertically propagating P-waves (V_P). Shear-wave damping is used for both vertical and horizontal analyses. The analyses are carried out linearly with no further degradation of the strain-compatible shear modulus and damping profiles. The horizontal and vertical free field 5% damping ARS at surface corresponding to each FIRS are determined and the envelope ARS resulting from the LB, BE and UB soil columns is compared to the PBSRS. In the event the envelope of the LB, BE and UB ARS (at surface) does not envelop the corresponding PBSRS, the FIRS must be modified. The frequency dependent adjustment factor is either unity or the ratio of PBSRS to the envelope of LB, BE, and UB ARS, whichever is greater. This adjustment factor is applied to the computed FIRS at the foundation level to yield the horizontal and vertical Adjusted FIRS.

Figure 3F-20 presents the horizontal 5% damping ARS calculated at the ground surface using the FIRS at 37.5 ft (11.4 m) depth for the Intake area as input to P-SHAKE, and using the LB, BE and UB FIRS strain-compatible damping and shear-wave velocity profiles. The PBSRS is divided by the envelope of the response of the 3 soil cases to calculate the FIRS adjustment factor (also shown in Figure 3F-20), which is applied to the FIRS only if greater than 1. Figure 3F-21 presents the corresponding plot for the vertical 5% damping ARS. This check was also performed for the

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Intake area FIRS at 20.5 ft (6.2 m) depth and the NI area FIRS at 22 ft (6.7 m) depth, but these checks are not presented in figures. Note that only in the case of the FIRS at 37.5 ft (11.4 m) depth, does the FIRS adjustment factor exceed 1 with a maximum of less than 1.04 in the horizontal direction and a maximum of about 1.10 in the vertical direction. Hereafter FIRS that have been subjected to the NEI check are referred to as Adjusted FIRS (whether or not a FIRS adjustment was necessary).

The Adjusted FIRS for the NI area (EPGB at ground surface (GS) and ESWB at 22 ft (6.7 m) depth) are enveloped. The envelope of the Adjusted FIRS is smoothed using a simple moving average. The resulting smoothed horizontal and vertical Adjusted FIRS for the NI area (EPGB and ESWB) are presented in Figure 3F-22 and Figure 3F-23, respectively.

Similarly, the Adjusted FIRS for the Intake area (GS and at 20.5 ft (6.2 m) depth) are enveloped. The envelope of the Adjusted FIRS and the Adjusted FIRS at 37.5 ft (11.4 m) depth are smoothed. The resulting smoothed horizontal and vertical Adjusted FIRS for the Intake area are presented in Figure 3F-24 and Figure 3F-25, respectively.

3F.1.4 SSSI EFFECTS AND COMPARISON TO SSE

An amplification function is developed to account for the structure-soil-structure interaction (SSSI) that affects the seismic response of the buildings in the NI area. An analysis is conducted where the Site SSE (defined in Section 3.7.1.1.1.1) is applied as seismic input to evaluate the seismic response of the Nuclear Island (NI) and 6 nearby ancillary structures, two EPGB and four ESWB. The spectral response results at foundation level are calculated for the 6 ancillary structures with the Site SSE input at the NI foundation level. The 5% damping ARS at the 6 locations are enveloped and the amplification functions are calculated as the ratio of the envelope to the Site SSE spectrum as a function of frequency. The amplification functions for the horizontal directions (X and Y) and the vertical direction (Z) are calculated, where a minimum limit of 1 is imposed on the function. Figure 3F-26 presents the amplification functions in the vertical and horizontal directions. The developed functions are used to amplify the FIRS for the EPGB and ESWB in the NI area, thus accounting for the NI SSSI effects.

The resulting Adjusted FIRS (amplified to include NI SSSI Effects) for the EPGB and ESWB are compared to the Site SSE in Figure 3F-27, while the Adjusted FIRS for the Intake area are compared to the Site SSE in Figure 3F-28. Note that while the Intake area Adjusted FIRS are smooth, the EPGB and ESWB Adjusted FIRS are not due to the amplification accounting for the NI SSSI effects. The comparison confirms that the Site SSE envelops all the smoothed Adjusted FIRS, horizontal and vertical, at all foundation elevations, and thus the Site SSE is conservative and can be used as SSI input. The Regulatory Guide 1.60 (NRC, 1973) horizontal spectrum, scaled to 0.1 g is also plotted in these figures, and is shown to be enveloped by the Site SSE, thus confirming the Site SSE satisfies the requirements of Appendix S of 10 CFR part 50 (CFR, 2008).

3F.2 SITE SSE STRAIN-COMPATIBLE SOIL PROPERTY PROFILES

A set of LB, BE and UB profiles, strain-compatible with Site SSE, is developed for both the NI area and Intake area. The approach used here is iterative and consists of running the site response analysis, using P-SHAKE, with modified rock motions (input at bedrock) convolved through each set of 60 simulated profiles (NI area and Intake area) and computing the response at the foundation elevation horizons of interest. The analysis is repeated, modifying the input rock motion each time, until the 5% damping log-mean ARS at the FIRS horizons roughly matches the Site SSE. The set of iterated properties resulting from the set of runs yielding an

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approximate match of the log-mean response to Site SSE are considered to be the BE Site SSE strain-compatible properties.

The lower bound (LB) and upper bound (UB) values are calculated as -/+ one log-standard deviation from the log average values (i.e., BE values) using the following equations where S is the soil property considered, μ_{ln}, is the log-mean and σ_{ln} is the log-standard deviation of that property:

$$S_{LB} = \exp\left(\ln\left(\mu_{\ln}\right) - \sigma_{\ln}\right) \qquad \text{Equation (3F-6)}$$

$$S_{UB} = \exp\left(\ln\left(\mu_{\ln}\right) + \sigma_{\ln}\right) \qquad \text{Equation (3F-7)}$$

Lower bound and upper bound damping ratios corresponding to BE Site SSE are calculated using Equation 3F-6 and Equation 3F-7, respectively. Lower bound shear wave velocity profiles are calculated as the minimum resulting from Equation 3F-6 and $BE(V_s)/\sqrt{1.5}$, and upper bound shear wave velocity profiles are calculated as the maximum resulting from Equation 3F-7 and $BE(V_s)/\sqrt{1.5}$. LB, BE, and UB primary wave velocities are calculated using Equation 3F-8 where ν is the Poisson's ratio, and V_S is LB, BE, and UB shear wave velocities. In addition, below the ground water level, a minimum P-wave velocity of 4800 ft/sec (1,463 m/sec) is imposed, on the condition that ν does not exceed 0.48.

$$V_P = V_S\sqrt{\frac{2-2\nu}{1-2\nu}} \qquad \text{Equation (3F-8)}$$

The resulting Site SSE strain-compatible soil profiles are plotted in Figure 3F-29 through Figure 3F-31 for the upper 600 ft (183m) for NI area site conditions, and reported in Table 3F-3 through Table 3F-5 for the upper 300 ft. Note that the lower shear wave and primary wave velocity are used in conjunction with the higher damping values to form the LB profile, and vice versa for the UB profile. The presented profiles are used in the SSI analysis for the ESWB and EPGB in the NI area. The resulting Site SSE strain-compatible soil profiles for the Intake area site conditions are presented in Figure 3F-32 through Figure 3F-34 for the upper 600 ft (183m) and reported in Table 3F-6 through Table 3F-8 for the upper 380 ft. The Intake area profiles are used in the SSI analysis for the UHS Electrical Building and CBIS.

3F.3 SITE SSE "WITHIN" ACCELERATION TIME HISTORIES

The input time history needed for SSI analysis of the three embedded structures (ESWB in the NI area and CBIS and UHS Electrical Building in the Intake area) are "within" motions at the foundation elevation corresponding to each of the LB, BE, and UB soil profiles. As such, each of the outcrop Site SSE acceleration time-histories (2 horizontal and 1 vertical) presented in Section 3.7.1.1.2, is used as input at the foundation level to a SHAKE2000 soil column model of the LB, BE, and UB profile, and their corresponding 5% damping within time histories are obtained. The horizontal acceleration time histories are applied using strain compatible shear-wave velocities (V_S) and the vertical acceleration time-history is applied using corresponding P-wave velocities (V_P). The strain compatible shear-wave damping is used for both vertical and horizontal analyses. The analyses are carried out linearly with no further degradation of the strain-compatible shear modulus and damping profiles. This analysis results in a set of 3 "within" motions: two horizontal and one vertical. Nine (9) sets are developed corresponding to the LB, BE and UB profiles for the three embedded structures (ESWB, CBIS and UHS Electrical Building), as presented in Figure 3F-35 through Figure 3F-43. The time histories are applied at the FIRS horizon as "within" motion and are used in combination with their

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corresponding Site SSE strain-compatible soil profiles, described in Section 3F.2. The EPGB structure, which is surface founded in the SSI analysis, (see Table 3F-1 foundation depth of 5 ft (1.5 m)) uses the acceleration time histories spectrally matched to Site SSE directly. The 5% damping ARS for the calculated within ground motions are presented in Figure 3F-44 through Figure 3F-52.

3F.4 COMPUTER CODES

The computer codes SPS, SHAKE2000 and P-SHAKE are used in the analyses discussed herein, and are described in this section.

3F.4.1 SOIL PROFILE SIMULATION (SPS) PROGRAM

Description

SPS (Version 1.0 / 2009) is a Bechtel proprietary program. SPS generates a set of site-specific stochastically simulated soil profiles to represent the dynamic properties of the site while considering the uncertainty associated with each of the properties. The output is intended for use in site response analysis using the Bechtel computer programs SHAKE2000 (Section 3F.4.2) or P-SHAKE (Section 3F.4.3).

Validation

SPS was developed by Bechtel. The program validation documents are located in Bechtel's Computation Service Library.

Extent of Application

SPS is used to generate sets of stochastically simulated profiles to represent the site conditions for the NI and Intake areas.

3F.4.2 SHAKE2000

Description

The original SHAKE computer program for earthquake response analysis of horizontally layered sites was developed at the University of California, Berkeley, by B. Schnabel, John Lysmer and H. B. Seed in 1972. SHAKE2000 (Version 1.1 / 2006) is a Bechtel proprietary modified version of SHAKE, and is a separate program. SHAKE2000 generates the design earthquake-induced strain-compatible soil properties and site response motions.

Validation

SHAKE2000 was developed by Bechtel. The program validation documents are located in Bechtel's Computation Service Library.

Extent of Application

SHAKE2000 is used to convert outcrop acceleration time histories at the foundation elevation for different structures to within (in-column) acceleration time histories.

3F.4.3 P-SHAKE

Description

P-SHAKE (Version 2.0 / 2009) is a Bechtel proprietary modified version of SHAKE2000, and is a separate program. P-SHAKE generates the same design earthquake-induced strain-compatible

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soil properties and site response motions as SHAKE2000 does, and the input files of the two programs for the most parts are compatible. However, P-SHAKE is built on different program logic that allows the site response analysis to be performed with an acceleration response spectrum as input, instead of an acceleration time history as used by SHAKE2000.

Validation

P-SHAKE was developed by Bechtel. The program validation documents are located in Bechtel's Computation Service Library.

Extent of Application

P-SHAKE is used to provide site-specific earthquake-induced design ground motions and the associated strain-compatible soil properties.

3F.5 REFERENCES

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Table 3F-1—{Bottom of Foundation Depths and Elevations

Building	Location (Area)	Bottom of Foundation depth	Bottom of Foundation Elevation
		[ft]	[ft]
Emergency Power Generator Building (EPGB) *	NI	0.0	85.0
Emergency Service Water Building (ESWB)	NI	22.0	63.0
Ultimate Heat Sink Electrical Building (UHS Electrical Building)	Intake	20.5	-10.5
Common Basemat Intake Structures (CBIS)	Intake	37.5	-27.5

* The bottom of foundation depth of the EPGB is at 6.0 ft (1.5 m) below finished grade. However in the SSI analysis the EPGB is surface founded and its FIRS are calculated at the ground surface.

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Table 3F-2—{Input Rock Motions and Associated Parameters}

Rock Motion	Magnitude (M)	Duration [sec]	Effective Strain Ratio
LF 1E-4	5.5	5.5	0.50
HF 1E-4	6.8	10	0.58
LF 1E-5	5.5	5.5	0.50
HF 1E-5	6.9	10	0.59

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Table 3F-3—{Best Estimate Site SSE Strain-Compatible Profiles for the NI Area}

Layer No.	Thickness [ft]	Top Depth [ft]	Unit Weight [kcf]	S-Wave Vel. [ft/sec]	P-Wave Vel. [ft/sec]	Damping [%]
1	3.0	0.0	0.145	730.9	1521.6	1.88
2	3.0	3.0	0.145	705.7	1469.1	2.72
3	3.5	6.0	0.145	681.2	1418.0	3.55
4	4.0	9.5	0.145	670.0	1394.7	4.32
5	4.0	13.5	0.145	665.8	1386.0	4.94
6	4.5	17.5	0.145	677.0	1409.3	5.36
7	4.0	22.0	0.145	647.2	1347.3	6.17
8	4.0	26.0	0.145	677.0	1409.3	6.24
9	4.0	30.0	0.145	672.4	3428.6	6.46
10	4.0	34.0	0.145	657.7	3353.6	6.82
11	3.5	38.0	0.145	656.9	3349.6	7.00
12	2.0	41.5	0.145	646.8	3297.8	7.14
13	3.5	43.5	0.120	1380.3	4800.0	1.99
14	4.0	47.0	0.120	1378.3	4800.0	2.01
15	4.0	51.0	0.120	1376.2	4800.0	2.03
16	5.0	55.0	0.120	1590.6	5275.3	1.88
17	5.0	60.0	0.120	1587.9	5266.4	1.91
18	5.0	65.0	0.120	1585.3	5257.9	1.94
19	5.0	70.0	0.120	1044.9	5327.7	2.66
20	5.0	75.0	0.120	1040.9	5307.5	2.69
21	5.0	80.0	0.120	1074.5	5479.1	2.64
22	5.0	85.0	0.120	1482.1	4915.7	2.10
23	5.0	90.0	0.120	1537.2	5098.3	2.05
24	5.0	95.0	0.119	1525.0	5057.8	2.02
25	5.0	100.0	0.107	1253.3	5267.9	1.38
26	5.0	105.0	0.105	1229.5	5167.9	1.30
27	7.0	110.0	0.105	1228.9	5165.3	1.31
28	8.0	117.0	0.105	1228.2	5162.5	1.31
29	10.0	125.0	0.105	1227.5	5159.4	1.32
30	10.0	135.0	0.105	1230.0	5170.0	1.34
31	10.0	145.0	0.105	1230.5	5171.9	1.33
32	10.0	155.0	0.105	1225.1	5149.2	1.34
33	10.0	165.0	0.105	1224.7	5147.7	1.34
34	10.0	175.0	0.105	1224.0	5144.9	1.35
35	10.0	185.0	0.105	1218.3	5120.9	1.34
36	10.0	195.0	0.105	1203.4	5058.3	1.36
37	10.0	205.0	0.105	1199.1	5040.1	1.36
38	10.0	215.0	0.105	1197.8	5034.4	1.38
39	10.0	225.0	0.105	1197.1	5031.6	1.38
40	10.0	235.0	0.105	1193.1	5014.9	1.39
41	8.0	245.0	0.105	1189.1	4998.0	1.42
42	7.0	253.0	0.105	1198.4	5037.3	1.41
43	5.0	260.0	0.105	1201.3	5049.1	1.41
44	5.0	265.0	0.105	1211.4	5091.7	1.42
45	5.0	270.0	0.106	1222.9	5140.1	1.43
46	5.0	275.0	0.108	1259.4	5293.6	1.52
47	5.0	280.0	0.112	1317.4	5537.1	1.67
48	5.0	285.0	0.116	1397.8	4800.0	1.89
49	5.0	290.0	0.119	1477.8	4901.4	2.01
50	5.0	295.0	0.123	1626.3	5393.9	2.10

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Table 3F-4—{Lower Bound Site SSE Strain-Compatible Profiles for the NI Area}

Layer No.	Thickness [ft]	Top Depth [ft]	Unit Weight [kcf]	S-Wave Vel. [ft/sec]	P-Wave Vel. [ft/sec]	Damping [%]
1	3.0	0.0	0.145	582.4	1212.4	2.82
2	3.0	3.0	0.145	535.3	1114.3	4.59
3	3.5	6.0	0.145	501.8	1044.6	6.15
4	4.0	9.5	0.145	474.5	987.8	7.63
5	4.0	13.5	0.145	448.8	934.2	8.93
6	4.5	17.5	0.145	438.9	913.7	9.70
7	4.0	22.0	0.145	408.2	849.7	11.40
8	4.0	26.0	0.145	432.8	900.9	11.37
9	4.0	30.0	0.145	409.6	2088.5	11.84
10	4.0	34.0	0.145	396.5	2022.0	12.24
11	3.5	38.0	0.145	393.8	2008.0	12.34
12	2.0	41.5	0.145	376.0	1917.4	12.61
13	3.5	43.5	0.120	988.2	4800.0	2.71
14	4.0	47.0	0.120	985.6	4800.0	2.76
15	4.0	51.0	0.120	982.9	4800.0	2.81
16	5.0	55.0	0.120	1104.5	4800.0	2.51
17	5.0	60.0	0.120	1101.3	4800.0	2.56
18	5.0	65.0	0.120	1098.2	4800.0	2.61
19	5.0	70.0	0.120	733.4	3739.7	3.93
20	5.0	75.0	0.120	730.1	3723.0	3.99
21	5.0	80.0	0.120	751.3	3830.7	3.94
22	5.0	85.0	0.120	1032.6	4800.0	2.89
23	5.0	90.0	0.120	1068.8	4800.0	2.80
24	5.0	95.0	0.119	1060.6	4800.0	2.85
25	5.0	100.0	0.107	1023.3	4800.0	1.75
26	5.0	105.0	0.105	1003.9	4800.0	1.50
27	7.0	110.0	0.105	1003.4	4800.0	1.52
28	8.0	117.0	0.105	1002.8	4800.0	1.52
29	10.0	125.0	0.105	1002.2	4800.0	1.53
30	10.0	135.0	0.105	1004.3	4800.0	1.56
31	10.0	145.0	0.105	1004.7	4800.0	1.57
32	10.0	155.0	0.105	1000.3	4800.0	1.60
33	10.0	165.0	0.105	1000.0	4800.0	1.59
34	10.0	175.0	0.105	999.4	4800.0	1.60
35	10.0	185.0	0.105	994.8	4800.0	1.59
36	10.0	195.0	0.105	982.6	4800.0	1.59
37	10.0	205.0	0.105	979.1	4800.0	1.61
38	10.0	215.0	0.105	978.0	4800.0	1.64
39	10.0	225.0	0.105	977.4	4800.0	1.64
40	10.0	235.0	0.105	974.2	4800.0	1.66
41	8.0	245.0	0.105	970.9	4800.0	1.74
42	7.0	253.0	0.105	978.5	4800.0	1.70
43	5.0	260.0	0.105	980.8	4800.0	1.70
44	5.0	265.0	0.105	989.1	4800.0	1.74
45	5.0	270.0	0.106	998.5	4800.0	1.78
46	5.0	275.0	0.108	1028.3	4800.0	2.00
47	5.0	280.0	0.112	1065.4	4800.0	2.24
48	5.0	285.0	0.116	1120.0	4800.0	2.52
49	5.0	290.0	0.119	1194.9	4800.0	2.64
50	5.0	295.0	0.123	1306.3	4800.0	2.65

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Table 3F-5—{Upper Bound Site SSE Strain-Compatible Profiles for the NI Area}

Layer No.	Thickness [ft]	Top Depth [ft]	Unit Weight [kcf]	S-Wave Vel. [ft/sec]	P-Wave Vel. [ft/sec]	Damping [%]
1	3.0	0.0	0.145	917.3	1909.5	1.25
2	3.0	3.0	0.145	930.4	1936.8	1.61
3	3.5	6.0	0.145	924.7	1925.0	2.05
4	4.0	9.5	0.145	945.9	1969.1	2.45
5	4.0	13.5	0.145	987.8	2056.2	2.73
6	4.5	17.5	0.145	1044.2	2173.7	2.96
7	4.0	22.0	0.145	1026.2	2136.2	3.34
8	4.0	26.0	0.145	1059.1	2204.7	3.42
9	4.0	30.0	0.145	1103.8	4800.0	3.52
10	4.0	34.0	0.145	1090.8	4800.0	3.80
11	3.5	38.0	0.145	1095.8	4800.0	3.97
12	2.0	41.5	0.145	1112.4	4800.0	4.04
13	3.5	43.5	0.120	1927.9	6394.2	1.46
14	4.0	47.0	0.120	1927.5	6392.7	1.47
15	4.0	51.0	0.120	1926.9	6390.7	1.47
16	5.0	55.0	0.120	2290.5	7596.8	1.41
17	5.0	60.0	0.120	2289.5	7593.4	1.43
18	5.0	65.0	0.120	2288.4	7589.9	1.44
19	5.0	70.0	0.120	1488.5	7590.0	1.80
20	5.0	75.0	0.120	1483.9	7566.5	1.81
21	5.0	80.0	0.120	1536.9	7836.9	1.77
22	5.0	85.0	0.120	2127.2	7055.3	1.52
23	5.0	90.0	0.120	2210.9	7332.6	1.50
24	5.0	95.0	0.119	2192.7	7272.4	1.43
25	5.0	100.0	0.107	1535.0	6451.9	1.09
26	5.0	105.0	0.105	1505.9	6329.4	1.13
27	7.0	110.0	0.105	1505.1	6326.2	1.13
28	8.0	117.0	0.105	1504.3	6322.7	1.13
29	10.0	125.0	0.105	1503.4	6318.9	1.14
30	10.0	135.0	0.105	1506.5	6331.9	1.15
31	10.0	145.0	0.105	1507.0	6334.3	1.12
32	10.0	155.0	0.105	1500.4	6306.5	1.12
33	10.0	165.0	0.105	1500.0	6304.6	1.13
34	10.0	175.0	0.105	1499.1	6301.2	1.14
35	10.0	185.0	0.105	1492.2	6271.8	1.13
36	10.0	195.0	0.105	1473.9	6195.1	1.16
37	10.0	205.0	0.105	1468.6	6172.9	1.15
38	10.0	215.0	0.105	1466.9	6165.8	1.16
39	10.0	225.0	0.105	1466.1	6162.5	1.16
40	10.0	235.0	0.105	1461.3	6142.0	1.16
41	8.0	245.0	0.105	1456.4	6121.3	1.16
42	7.0	253.0	0.105	1467.8	6169.4	1.17
43	5.0	260.0	0.105	1471.2	6183.9	1.17
44	5.0	265.0	0.105	1483.6	6236.0	1.16
45	5.0	270.0	0.106	1497.7	6295.3	1.15
46	5.0	275.0	0.108	1542.5	6483.3	1.15
47	5.0	280.0	0.112	1629.0	6846.8	1.25
48	5.0	285.0	0.116	1744.5	5785.7	1.42
49	5.0	290.0	0.119	1827.7	6061.9	1.53
50	5.0	295.0	0.123	2024.7	6715.1	1.66

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Table 3F-6—{Best Estimate Site SSE Strain-Compatible Profiles for the Intake Area}

Layer No.	Thickness [ft]	Top Depth [ft]	Unit Weight [kcf]	S-Wave Vel. [ft/sec]	P-Wave Vel. [ft/sec]	Damping [%]
1	3.5	0.0	0.145	666.6	1387.6	2.13
2	3.5	3.5	0.145	629.4	1310.1	3.46
3	3.0	7.0	0.145	596.9	3043.7	4.62
4	4.5	10.0	0.145	590.5	3010.8	5.49
5	3.5	14.5	0.145	587.0	2993.0	6.13
6	2.5	18.0	0.145	590.5	3011.2	6.51
7	4.0	20.5	0.145	606.9	3094.7	6.89
8	4.0	24.5	0.145	631.8	3221.5	7.03
9	4.0	28.5	0.145	634.8	3236.6	7.25
10	5.0	32.5	0.145	632.0	3222.4	7.53
11	3.5	37.5	0.115	1118.4	5125.2	2.10
12	4.0	41.0	0.115	1116.4	5116.0	2.13
13	4.0	45.0	0.115	1114.2	5106.0	2.16
14	4.0	49.0	0.115	1112.1	5096.4	2.19
15	5.0	53.0	0.105	1097.1	5027.4	2.01
16	5.0	58.0	0.105	1093.0	5008.8	2.08
17	5.0	63.0	0.105	1090.6	4997.9	2.13
18	7.0	68.0	0.105	1088.0	4985.9	2.19
19	10.0	75.0	0.105	1084.7	4970.7	2.26
20	10.0	85.0	0.105	1081.3	4955.0	2.33
21	10.0	95.0	0.105	1078.2	4941.1	2.39
22	10.0	105.0	0.106	1072.1	4913.1	2.29
23	10.0	115.0	0.113	1031.5	4800.0	1.53
24	8.0	125.0	0.115	1021.3	4800.0	1.39
25	8.0	133.0	0.113	1027.8	4800.0	1.39
26	9.0	141.0	0.107	1053.2	4826.4	1.39
27	10.0	150.0	0.105	1060.2	4858.4	1.38
28	10.0	160.0	0.105	1058.2	4849.4	1.39
29	10.0	170.0	0.105	1056.2	4840.3	1.40
30	10.0	180.0	0.105	1054.3	4831.2	1.41
31	10.0	190.0	0.105	1060.3	4858.8	1.43
32	10.0	200.0	0.108	1133.4	5194.0	1.55
33	10.0	210.0	0.119	1415.0	4800.0	1.90
34	10.0	220.0	0.125	1700.6	5640.3	2.09
35	10.0	230.0	0.125	2049.2	5517.6	1.88
36	10.0	240.0	0.125	2083.2	5944.6	1.90
37	10.0	250.0	0.125	2001.5	5711.4	1.95
38	10.0	260.0	0.125	1992.0	5684.3	1.98
39	10.0	270.0	0.125	1966.5	5611.5	2.04
40	10.0	280.0	0.125	1889.1	5771.4	2.11
41	10.0	290.0	0.125	1877.8	5736.7	2.09
42	10.0	300.0	0.125	1876.4	5732.4	2.10
43	10.0	310.0	0.125	1885.0	5758.8	2.09
44	7.0	320.0	0.123	1915.2	5851.0	2.07
45	6.0	327.0	0.118	2034.5	4983.4	2.00
46	7.0	333.0	0.116	2098.4	5140.0	1.99
47	10.0	340.0	0.115	2114.0	5178.2	2.01
48	10.0	350.0	0.115	2113.4	5176.7	2.02
49	10.0	360.0	0.115	2112.8	5175.2	2.03
50	10.0	370.0	0.115	2112.2	5173.8	2.03

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Table 3F-7—{Lower Bound Site SSE Strain-Compatible Profiles for the Intake Area}

Layer No.	Thickness [ft]	Top Depth [ft]	Unit Weight [kcf]	S-Wave Vel. [ft/sec]	P-Wave Vel. [ft/sec]	Damping [%]
1	3.5	0.0	0.145	535.8	1115.4	3.19
2	3.5	3.5	0.145	462.2	962.1	5.78
3	3.0	7.0	0.145	418.3	2132.9	7.96
4	4.5	10.0	0.145	395.2	2014.9	9.44
5	3.5	14.5	0.145	374.3	1908.5	10.57
6	2.5	18.0	0.145	373.1	1902.6	11.12
7	4.0	20.5	0.145	384.5	1960.6	11.53
8	4.0	24.5	0.145	412.0	2100.5	11.52
9	4.0	28.5	0.145	403.9	2059.7	11.88
10	5.0	32.5	0.145	405.0	2065.1	12.19
11	3.5	37.5	0.115	913.2	4656.3	2.62
12	4.0	41.0	0.115	911.5	4648.0	2.67
13	4.0	45.0	0.115	909.7	4638.8	2.72
14	4.0	49.0	0.115	908.0	4630.1	2.77
15	5.0	53.0	0.105	895.8	4567.5	2.66
16	5.0	58.0	0.105	892.4	4550.6	2.79
17	5.0	63.0	0.105	890.5	4540.6	2.85
18	7.0	68.0	0.105	888.4	4529.7	2.92
19	10.0	75.0	0.105	885.6	4515.9	3.01
20	10.0	85.0	0.105	882.9	4501.7	3.11
21	10.0	95.0	0.105	880.4	4489.1	3.19
22	10.0	105.0	0.106	875.4	4463.6	3.16
23	10.0	115.0	0.113	842.2	4294.4	2.22
24	8.0	125.0	0.115	833.9	4251.9	1.76
25	8.0	133.0	0.113	839.2	4279.2	1.75
26	9.0	141.0	0.107	859.9	4384.8	1.79
27	10.0	150.0	0.105	865.6	4414.0	1.78
28	10.0	160.0	0.105	864.0	4405.7	1.79
29	10.0	170.0	0.105	862.4	4397.5	1.80
30	10.0	180.0	0.105	860.8	4389.2	1.82
31	10.0	190.0	0.105	865.7	4414.3	1.86
32	10.0	200.0	0.108	925.4	4718.9	2.14
33	10.0	210.0	0.119	1093.3	4800.0	2.51
34	10.0	220.0	0.125	1388.5	4800.0	2.51
35	10.0	230.0	0.125	1659.2	4800.0	2.28
36	10.0	240.0	0.125	1700.9	4853.7	2.22
37	10.0	250.0	0.125	1634.2	4800.0	2.30
38	10.0	260.0	0.125	1626.5	4800.0	2.37
39	10.0	270.0	0.125	1605.6	4800.0	2.44
40	10.0	280.0	0.125	1542.5	4800.0	2.49
41	10.0	290.0	0.125	1533.2	4800.0	2.46
42	10.0	300.0	0.125	1532.0	4800.0	2.48
43	10.0	310.0	0.125	1539.1	4800.0	2.46
44	7.0	320.0	0.123	1563.7	4800.0	2.43
45	6.0	327.0	0.118	1661.1	4800.0	2.35
46	7.0	333.0	0.116	1713.3	4800.0	2.33
47	10.0	340.0	0.115	1726.1	4800.0	2.32
48	10.0	350.0	0.115	1725.6	4800.0	2.33
49	10.0	360.0	0.115	1725.1	4800.0	2.35
50	10.0	370.0	0.115	1724.6	4800.0	2.35

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Table 3F-8—{Upper Bound Site SSE Strain-Compatible Profiles for the Intake Area

Layer No.	Thickness [ft]	Top Depth [ft]	Unit Weight [kcf]	S-Wave Vel. [ft/sec]	P-Wave Vel. [ft/sec]	Damping [%]
1	3.5	0.0	0.145	829.2	1726.1	1.42
2	3.5	3.5	0.145	857.0	1784.0	2.07
3	3.0	7.0	0.145	851.8	4343.4	2.68
4	4.5	10.0	0.145	882.3	4498.9	3.19
5	3.5	14.5	0.145	920.5	4693.8	3.56
6	2.5	18.0	0.145	934.6	4765.8	3.81
7	4.0	20.5	0.145	958.0	4800.0	4.12
8	4.0	24.5	0.145	968.9	4800.0	4.29
9	4.0	28.5	0.145	997.5	4800.0	4.43
10	5.0	32.5	0.145	986.1	4800.0	4.65
11	3.5	37.5	0.115	1369.8	6277.0	1.68
12	4.0	41.0	0.115	1367.3	6265.8	1.70
13	4.0	45.0	0.115	1364.6	6253.5	1.72
14	4.0	49.0	0.115	1362.1	6241.8	1.73
15	5.0	53.0	0.105	1343.6	6157.3	1.52
16	5.0	58.0	0.105	1338.7	6134.5	1.55
17	5.0	63.0	0.105	1335.7	6121.1	1.59
18	7.0	68.0	0.105	1332.5	6106.4	1.64
19	10.0	75.0	0.105	1328.5	6087.8	1.70
20	10.0	85.0	0.105	1324.3	6068.6	1.75
21	10.0	95.0	0.105	1320.6	6051.6	1.79
22	10.0	105.0	0.106	1313.1	6017.3	1.66
23	10.0	115.0	0.113	1263.3	5789.2	1.05
24	8.0	125.0	0.115	1250.8	5731.8	1.10
25	8.0	133.0	0.113	1258.8	5768.7	1.11
26	9.0	141.0	0.107	1289.9	5911.1	1.08
27	10.0	150.0	0.105	1298.5	5950.3	1.07
28	10.0	160.0	0.105	1296.1	5939.3	1.08
29	10.0	170.0	0.105	1293.6	5928.2	1.09
30	10.0	180.0	0.105	1291.2	5917.0	1.09
31	10.0	190.0	0.105	1298.6	5950.8	1.10
32	10.0	200.0	0.108	1388.2	6361.4	1.12
33	10.0	210.0	0.119	1831.2	6073.3	1.44
34	10.0	220.0	0.125	2082.8	6907.9	1.74
35	10.0	230.0	0.125	2530.8	6814.4	1.55
36	10.0	240.0	0.125	2551.4	7280.6	1.63
37	10.0	250.0	0.125	2451.3	6995.0	1.65
38	10.0	260.0	0.125	2439.7	6961.8	1.66
39	10.0	270.0	0.125	2408.4	6872.7	1.71
40	10.0	280.0	0.125	2313.7	7068.5	1.79
41	10.0	290.0	0.125	2299.8	7026.0	1.77
42	10.0	300.0	0.125	2298.1	7020.7	1.78
43	10.0	310.0	0.125	2308.7	7053.1	1.78
44	7.0	320.0	0.123	2345.6	7165.9	1.76
45	6.0	327.0	0.118	2491.7	6103.4	1.70
46	7.0	333.0	0.116	2570.0	6295.2	1.70
47	10.0	340.0	0.115	2589.1	6342.0	1.74
48	10.0	350.0	0.115	2588.4	6340.1	1.75
49	10.0	360.0	0.115	2587.6	6338.3	1.75
50	10.0	370.0	0.115	2586.9	6336.5	1.75

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Figure 3F-1—{Low-Strain Shear Wave Velocity Profile at the NI Area}

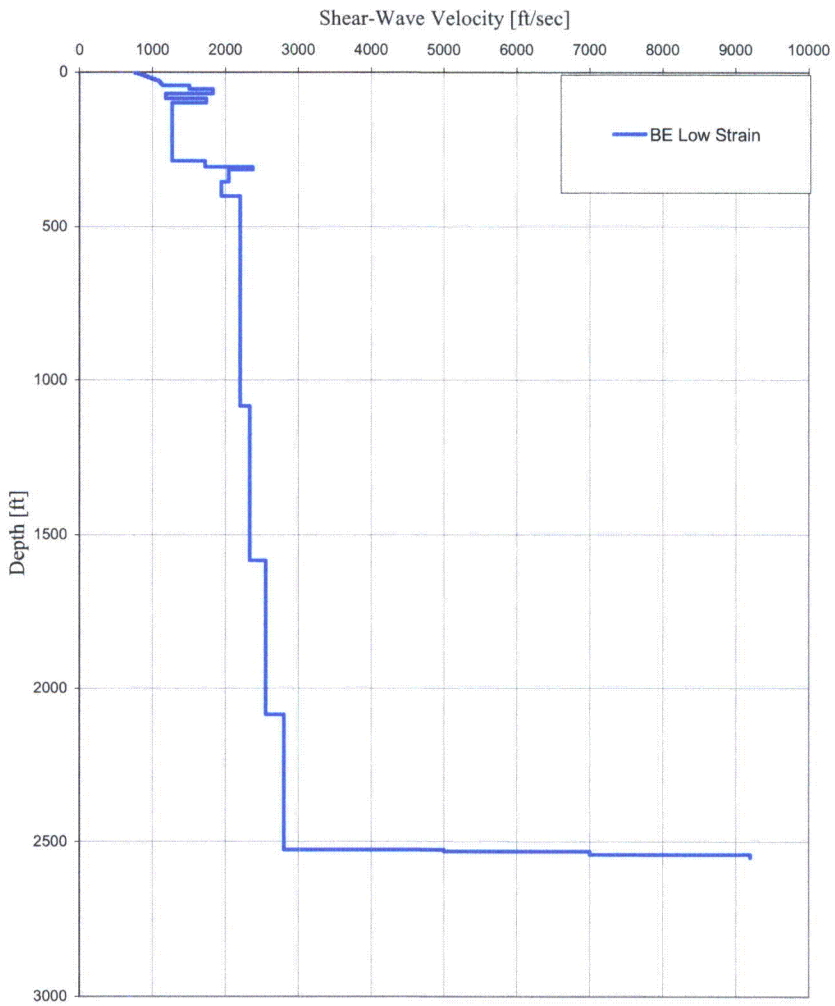

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Figure 3F-2—{Low-Strain Shear Wave Velocity Profile at the Intake Area}

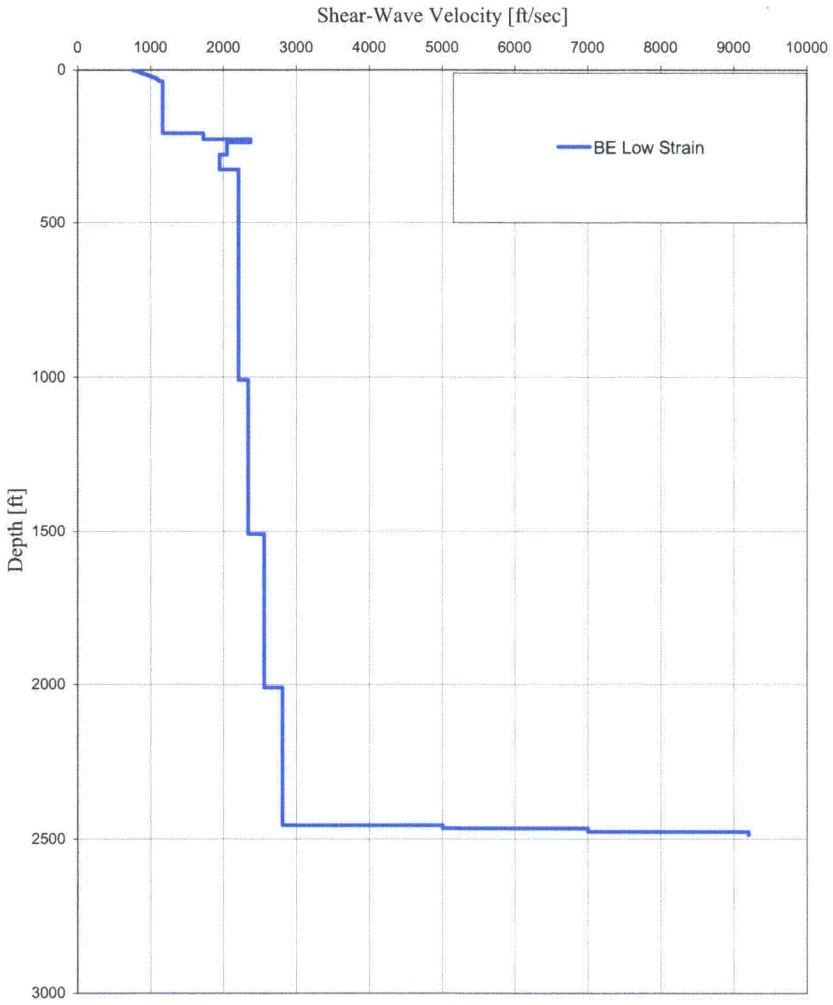

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Figure 3F-3—{Log-Standard Deviation for Low-Strain Shear Wave Velocity Profile at the NI Area}

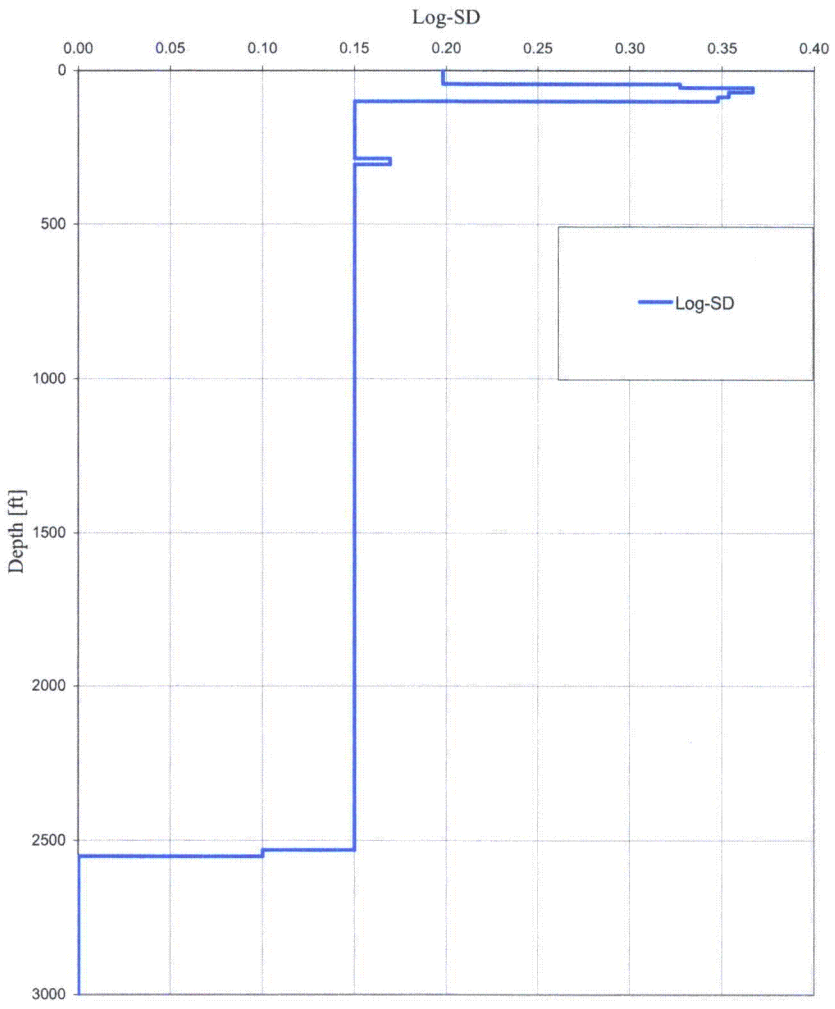

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Figure 3F-4—{Log-Standard Deviation for Low-Strain Shear Wave Velocity Profile at the Intake Area}

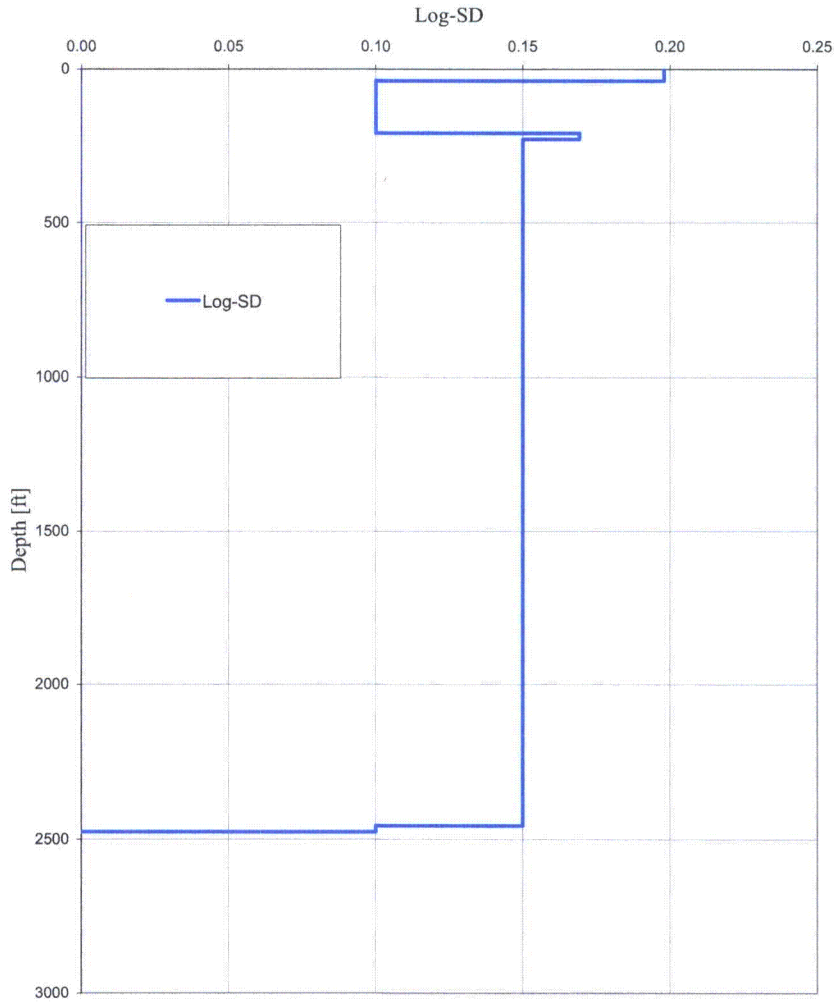

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Figure 3F-5—{Shear Wave Velocity for 60 Simulated Profiles – NI Area (Halfspace at first occurrence of Vs =9200 ft/sec)}

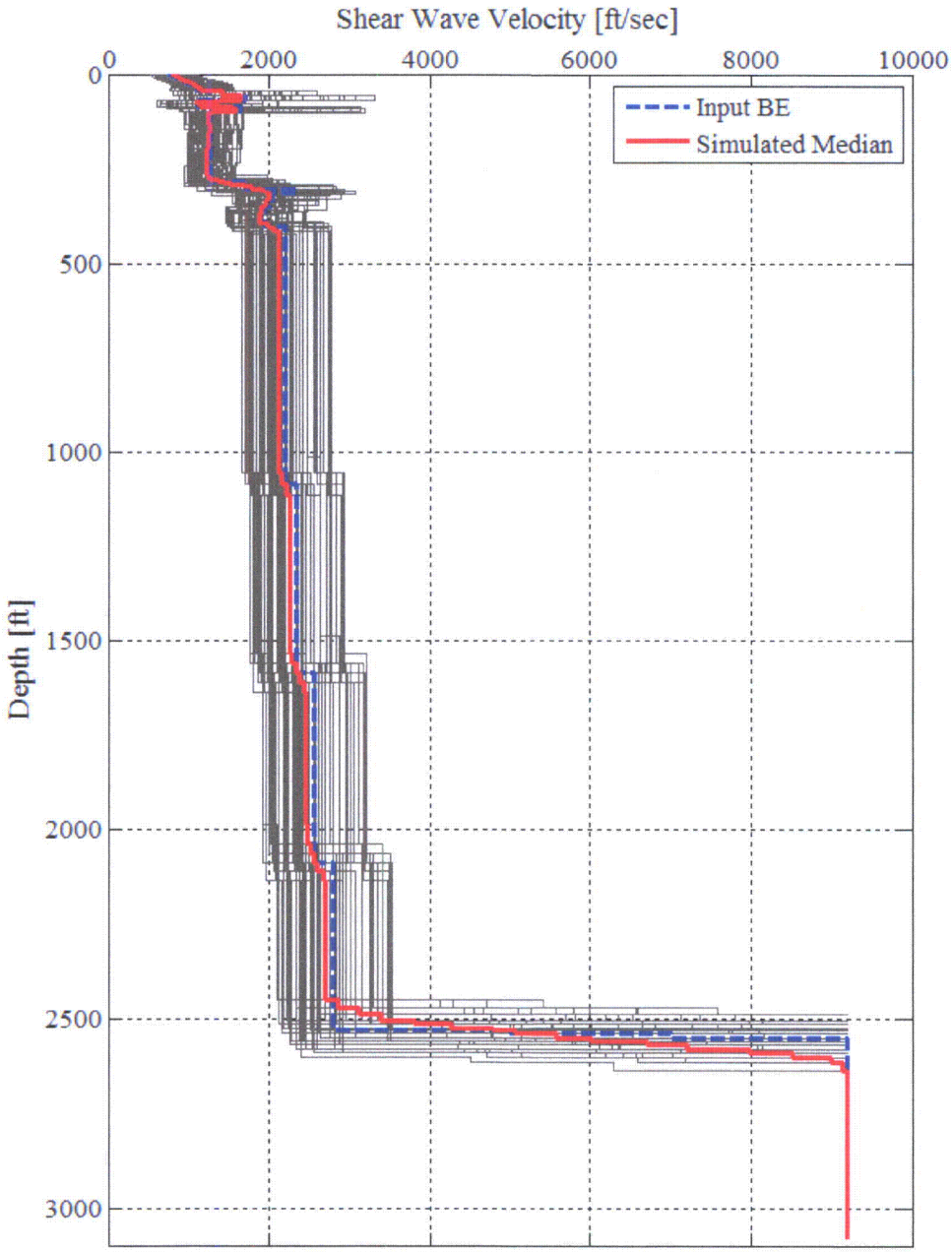

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Figure 3F-6— {Shear Wave Velocity for 60 Simulated Profiles – Intake Area (Halfspace at first occurrence of Vs =9200 ft/sec)}

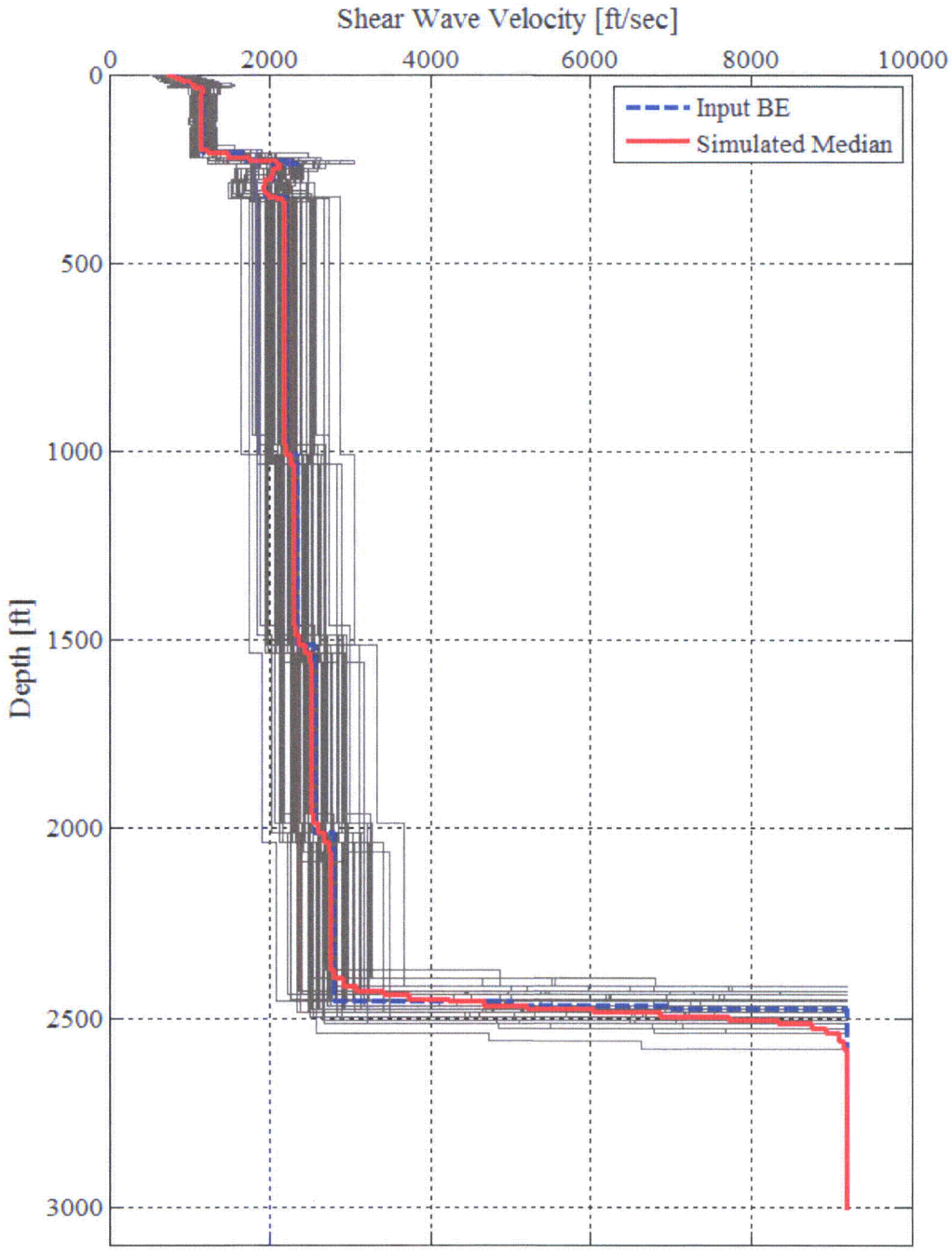

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Figure 3F-7a—{Fill 1 Shear Modulus Reduction Curves for 60 Simulated Profiles – NI Area}

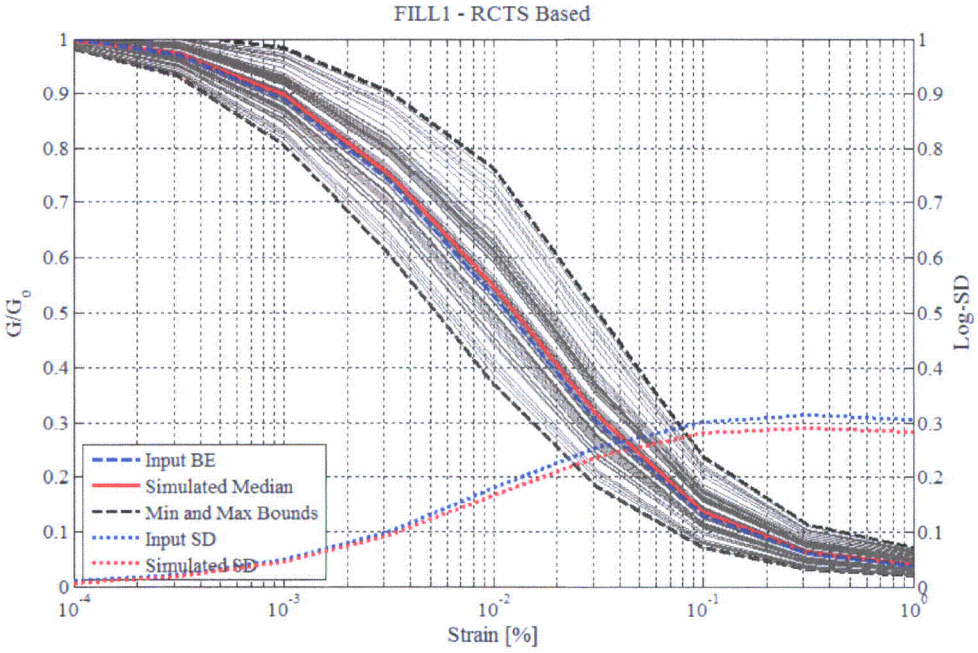
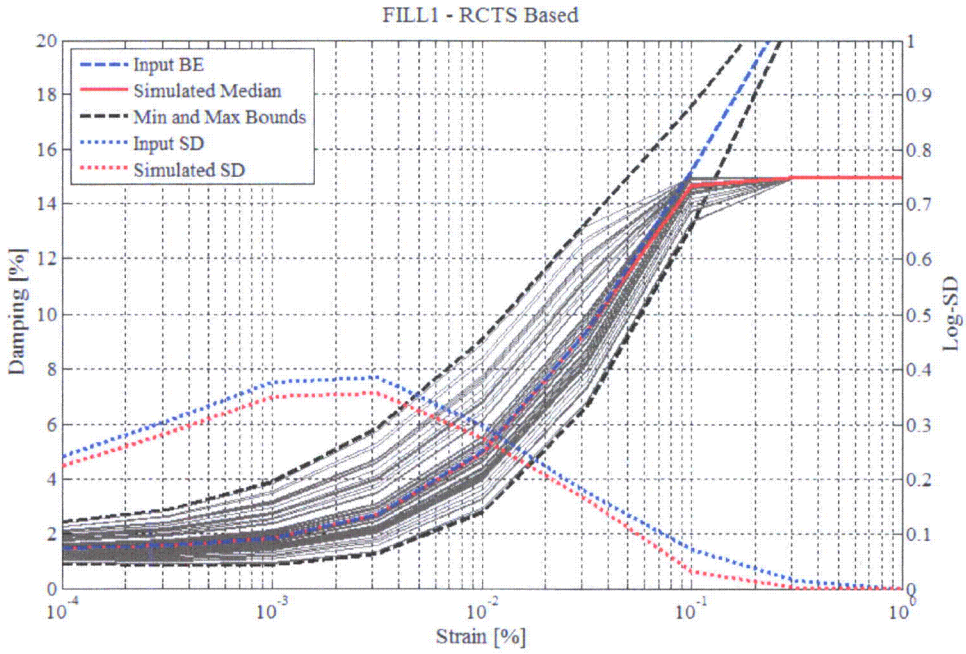


Figure 3F-7b— {Fill 1 Damping Ratio Curves for 60 Simulated Profiles – NI Area}



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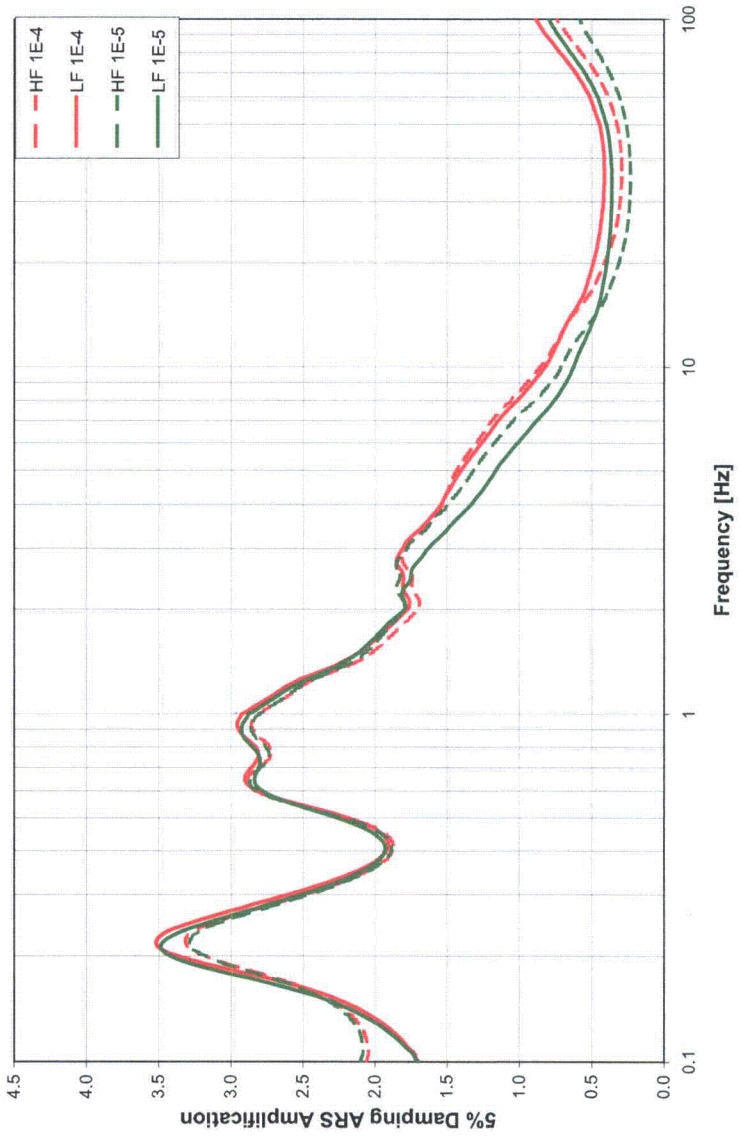

Figure 3F-8— {5% Damping ARS Amplification Functions at 22 ft Depth – NI Area}

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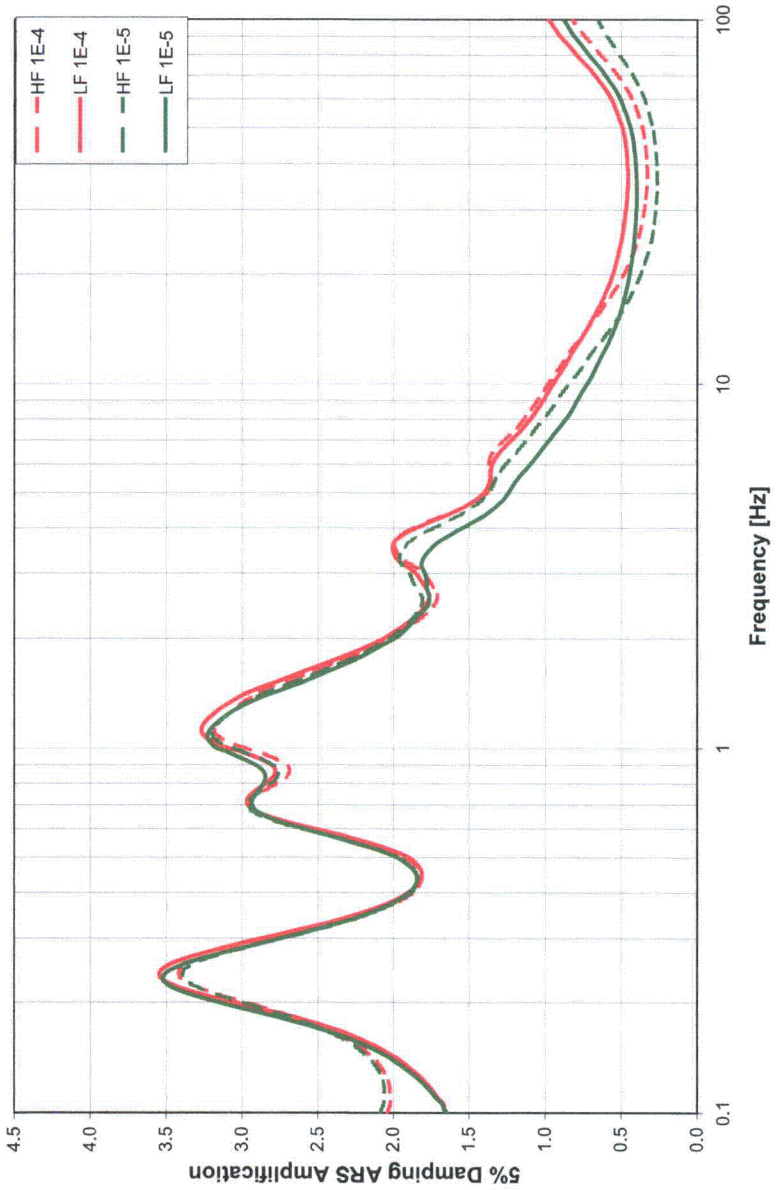

Figure 3F-9—{5% Damping ARS Amplification Function at 20.5 ft Depth – Intake Area}

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Figure 3F-10—{Log-Mean Strain Profiles - NI Area}

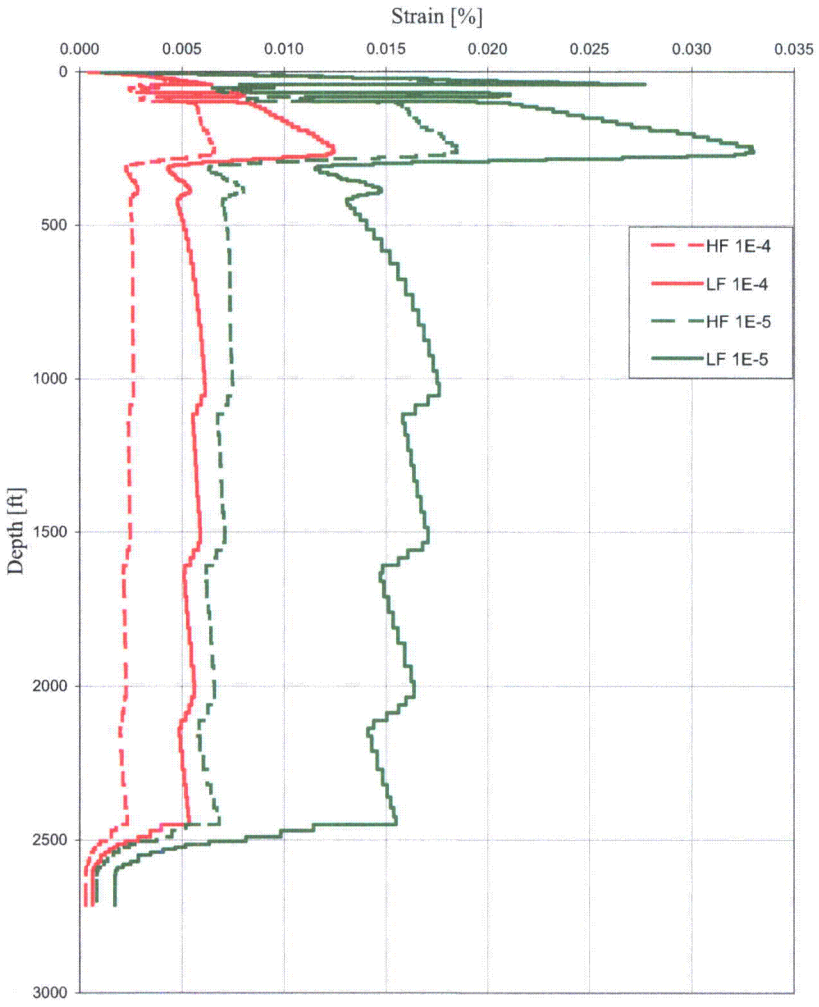

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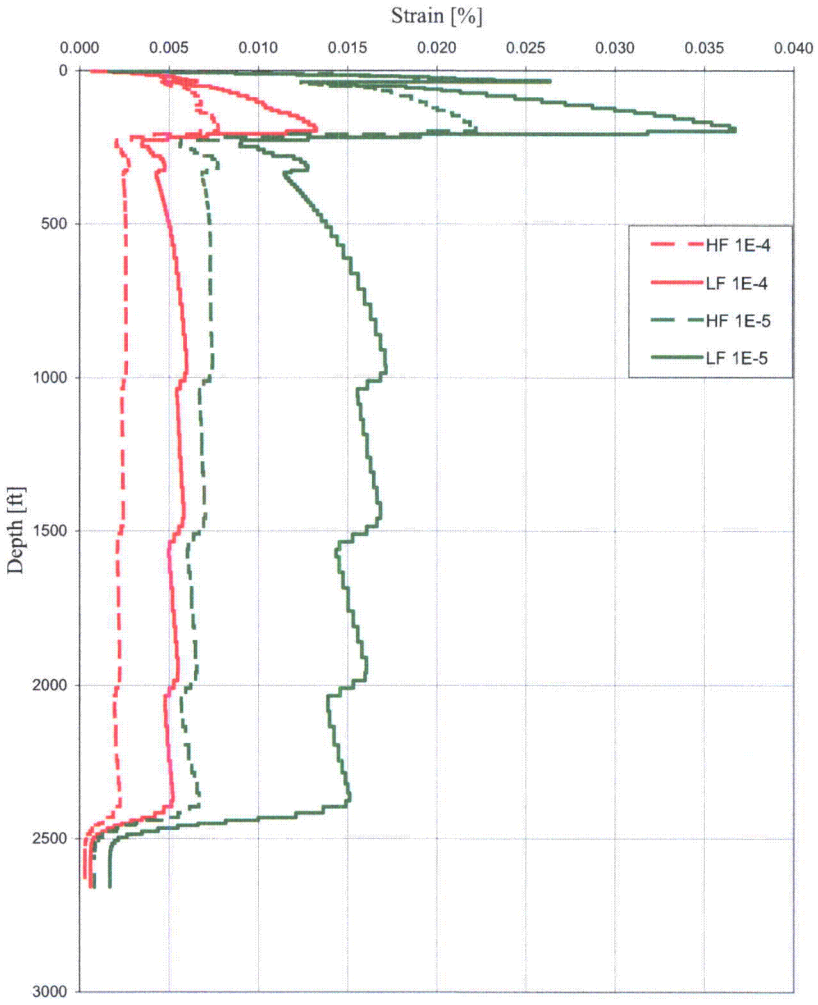
Figure 3F-11—{Log-Mean Strain Profiles - Intake Area}



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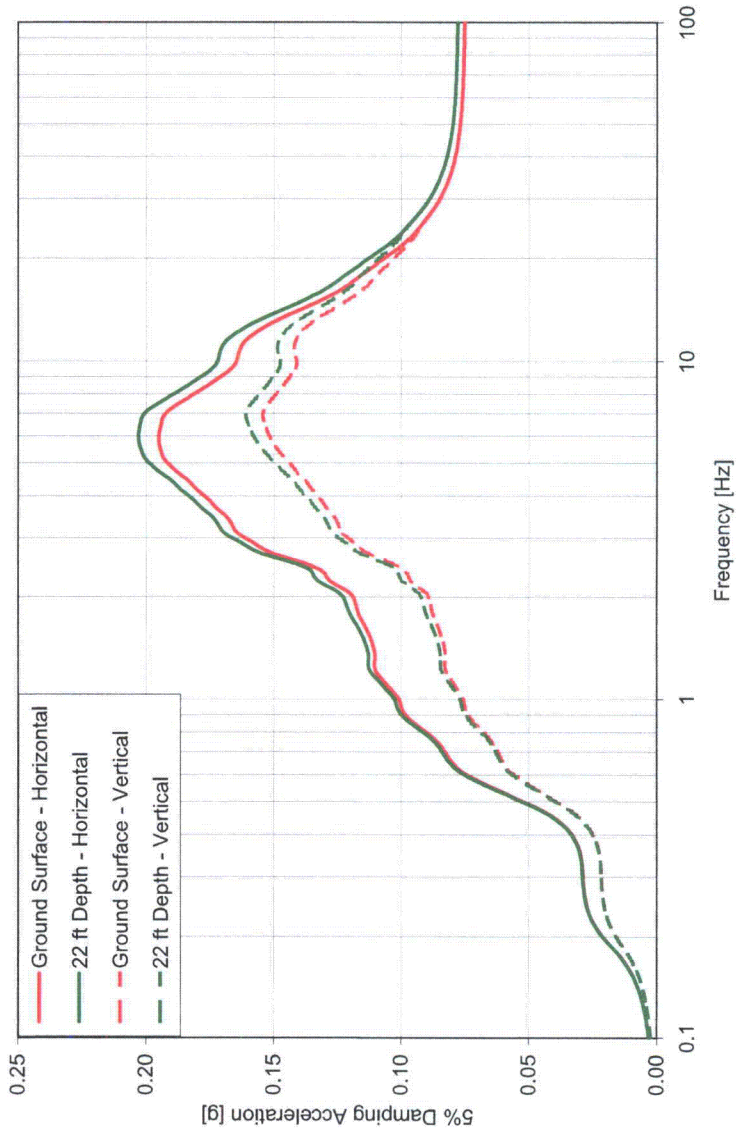

Figure 3F-12—{5% Damping Horizontal and Vertical FIRS – NI Area}

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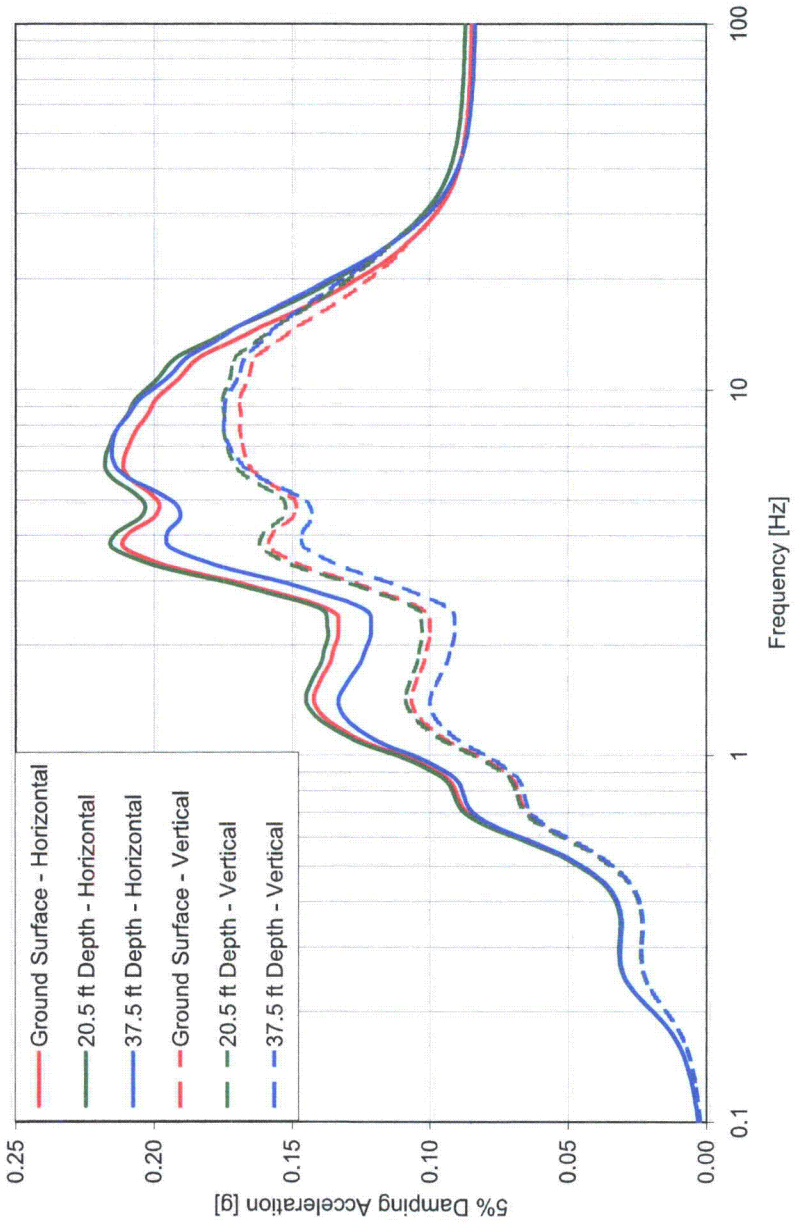

Figure 3F-13—{5% Damping Horizontal and Vertical FIRS – Intake Area}

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Figure 3F-14—{Shear-Wave Velocity Profiles Strain-Compatible with FIRS for the NI Area}

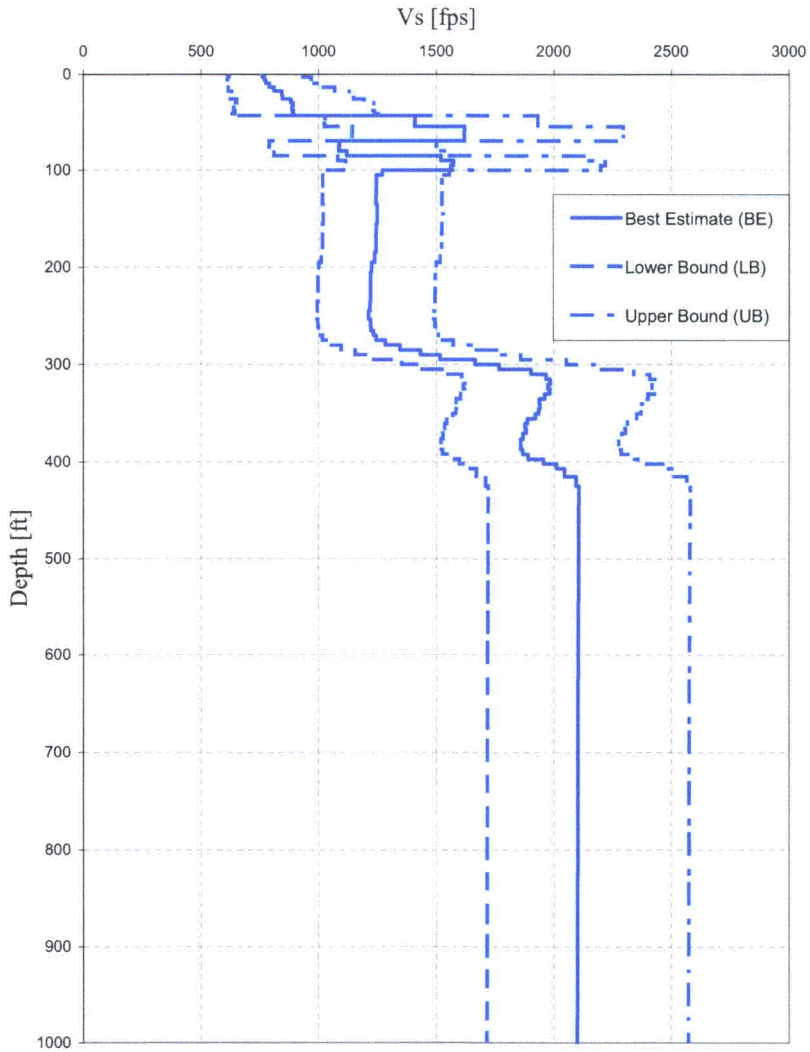

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Figure 3F-15—{Damping Profiles Strain-Compatible with FIRS for the NI Area}

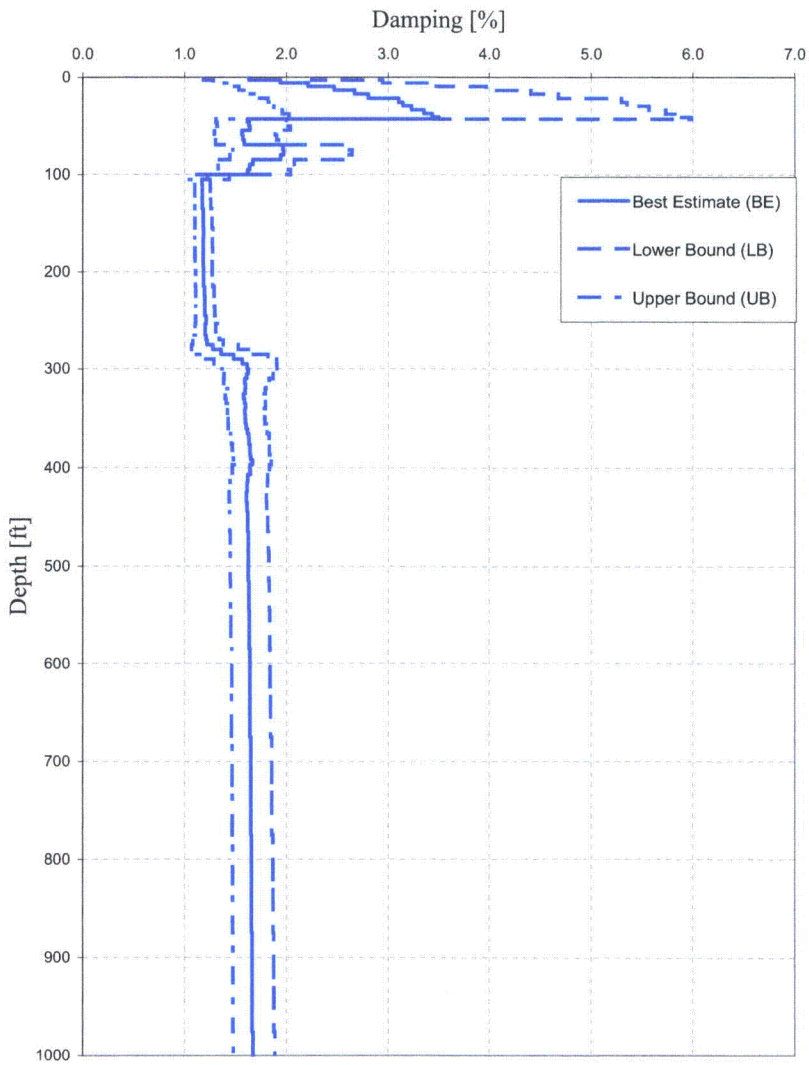

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Figure 3F-16—{FIRS P-Wave Velocity Profiles for the NI Area}

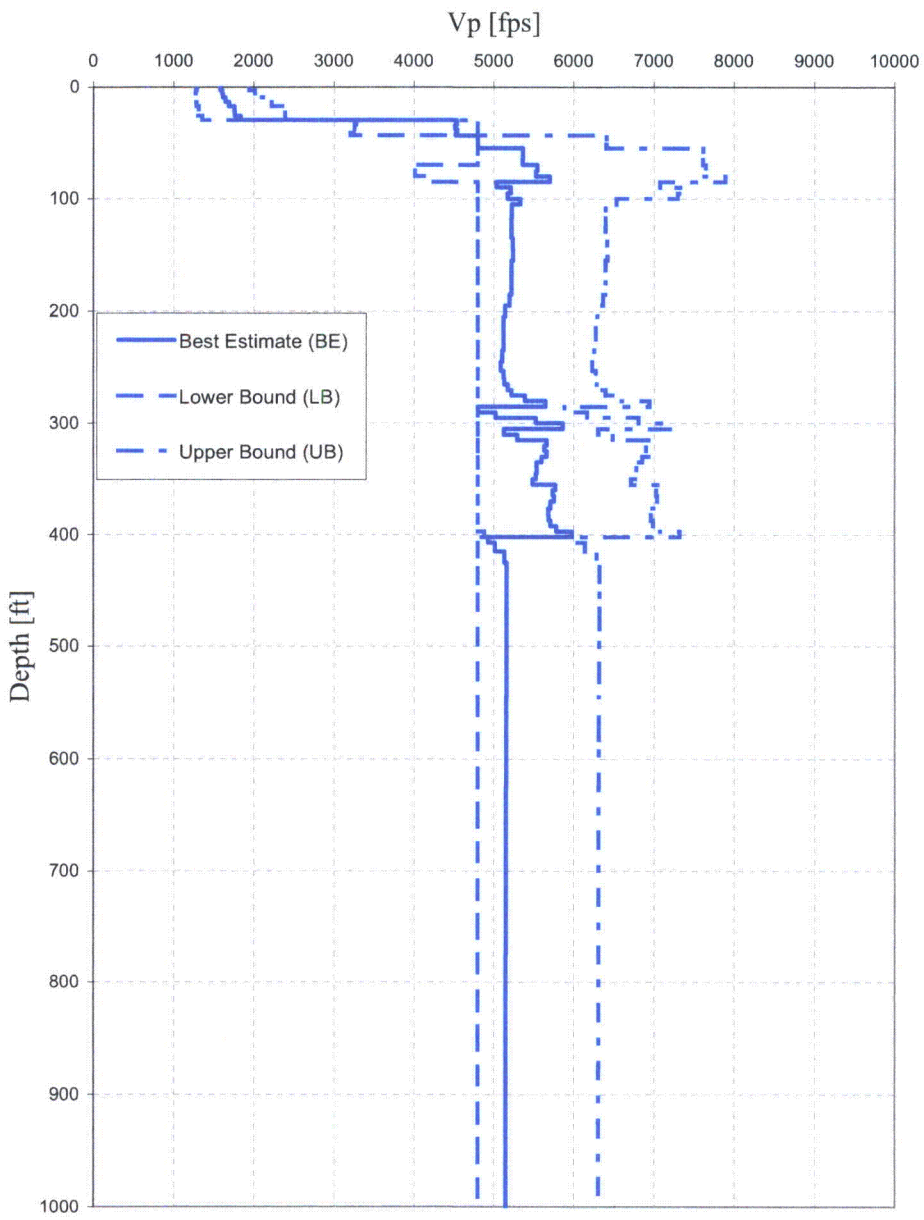

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Figure 3F-17—{Shear-Wave Velocity Profiles Strain-Compatible with FIRS for the Intake Area}

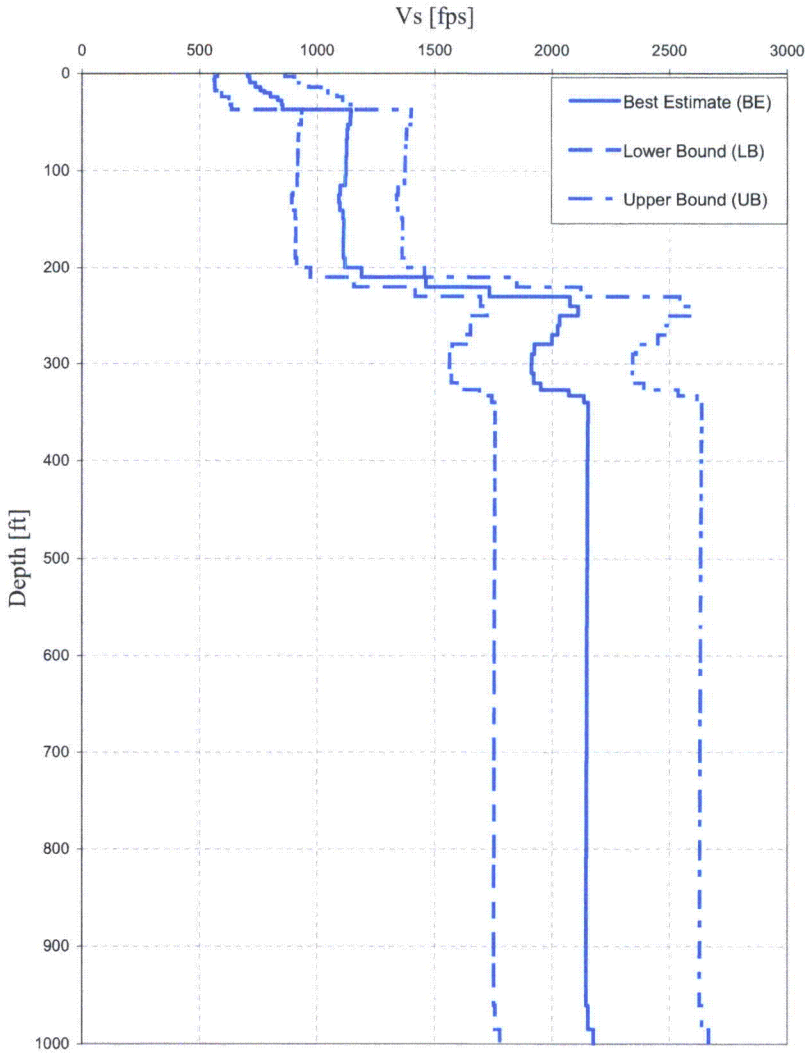

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Figure 3F-18—{Damping Profiles Strain-Compatible with FIRS for the Intake Area}

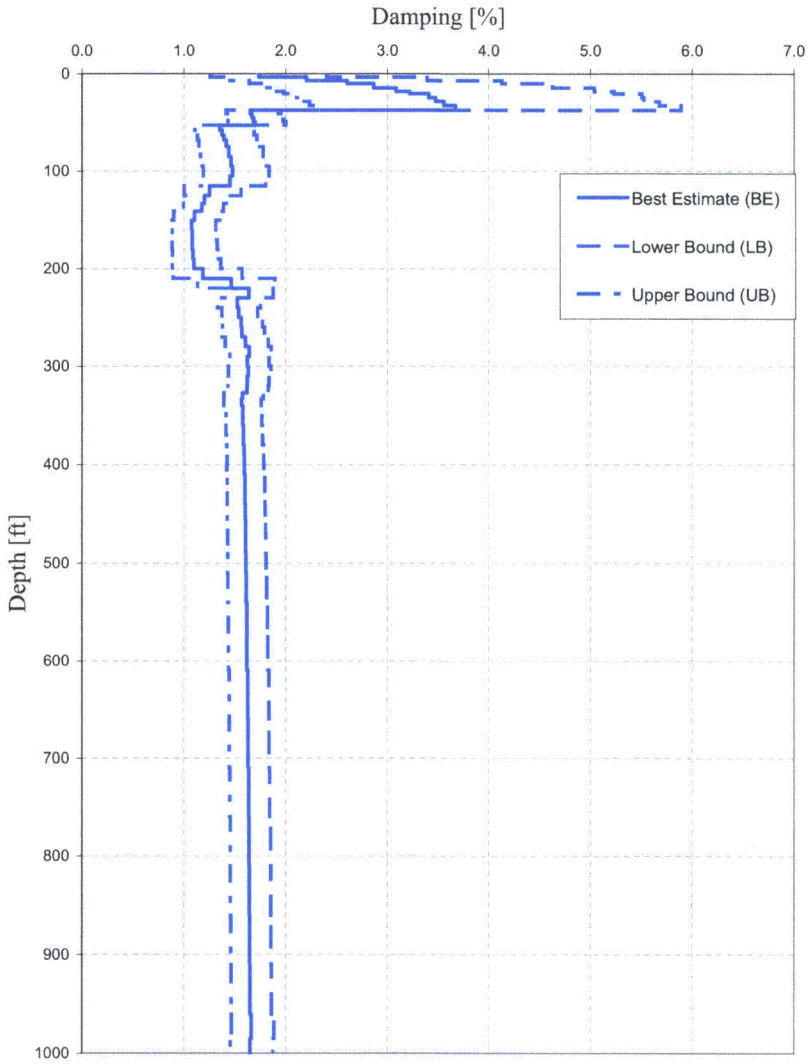

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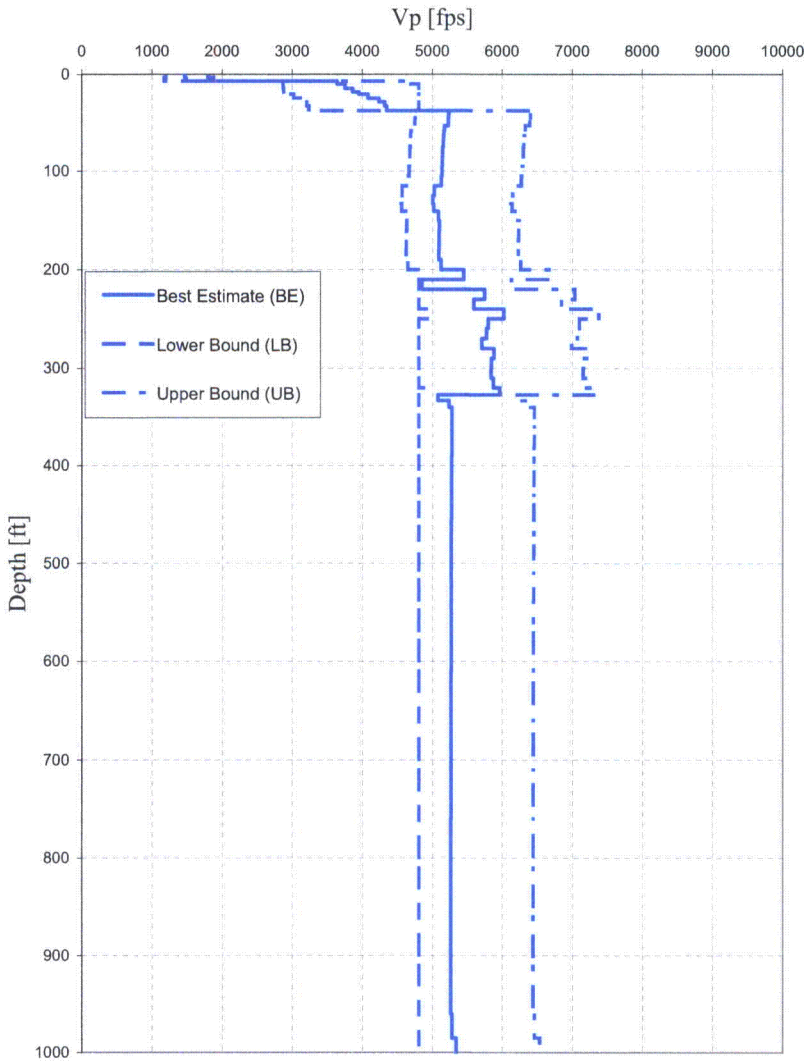
Figure 3F-19—{FIRS P-Wave Velocity Profiles for the Intake Area}



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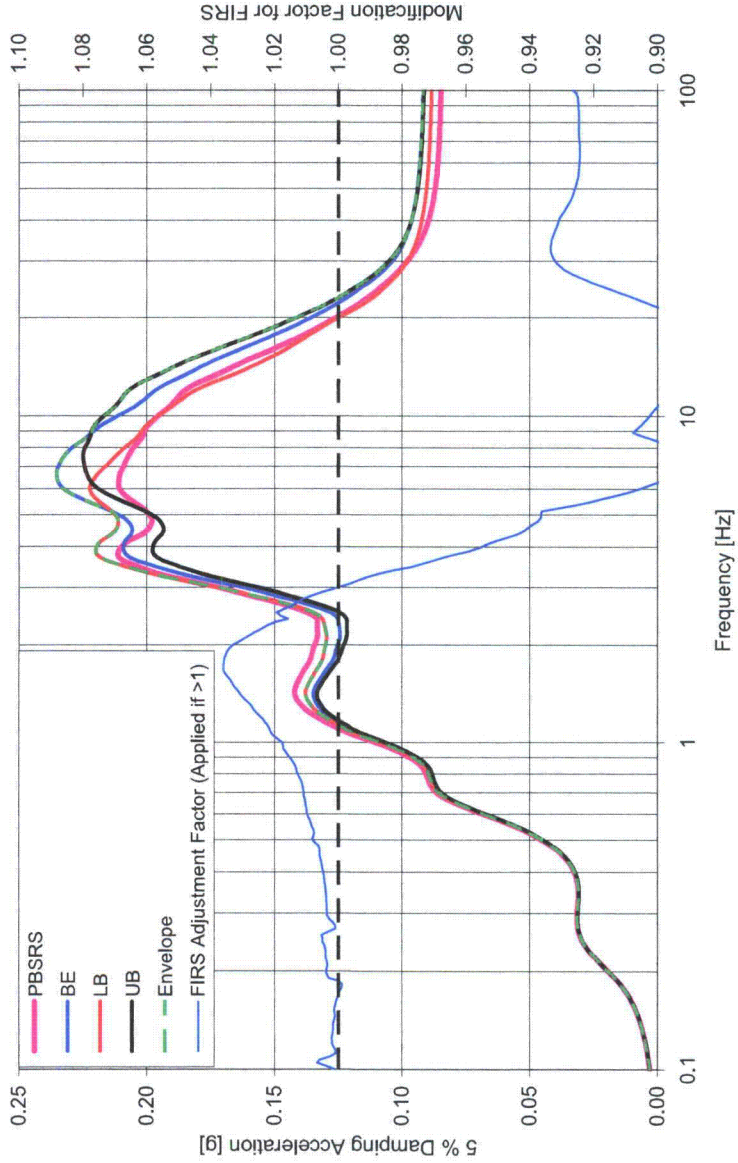

Figure 3F-20—{NEI Check for Horizontal FIRS at 37.5 ft Depth at the Intake Area}

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Figure 3F-21—{NEI Check for Vertical FIRS at 37.5 ft Depth at the Intake Area}

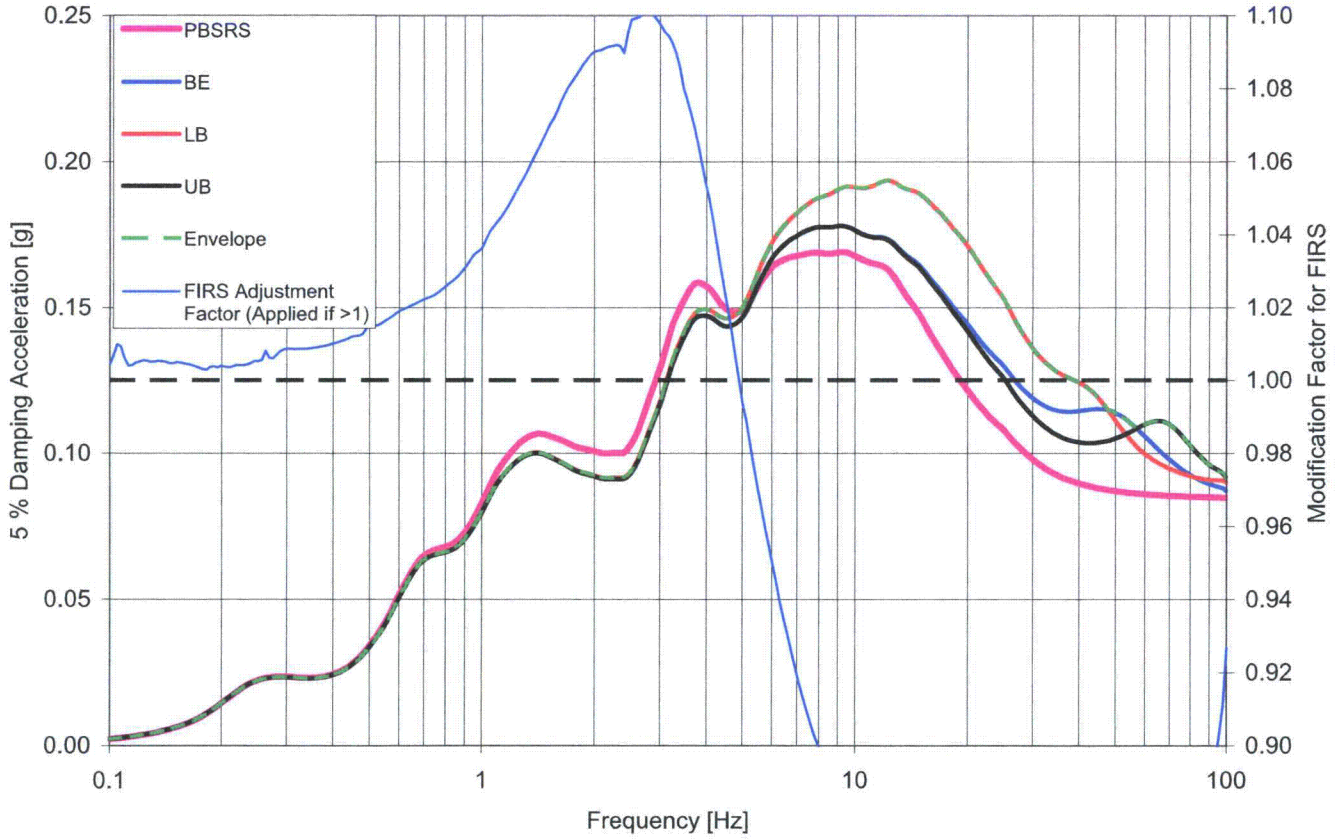

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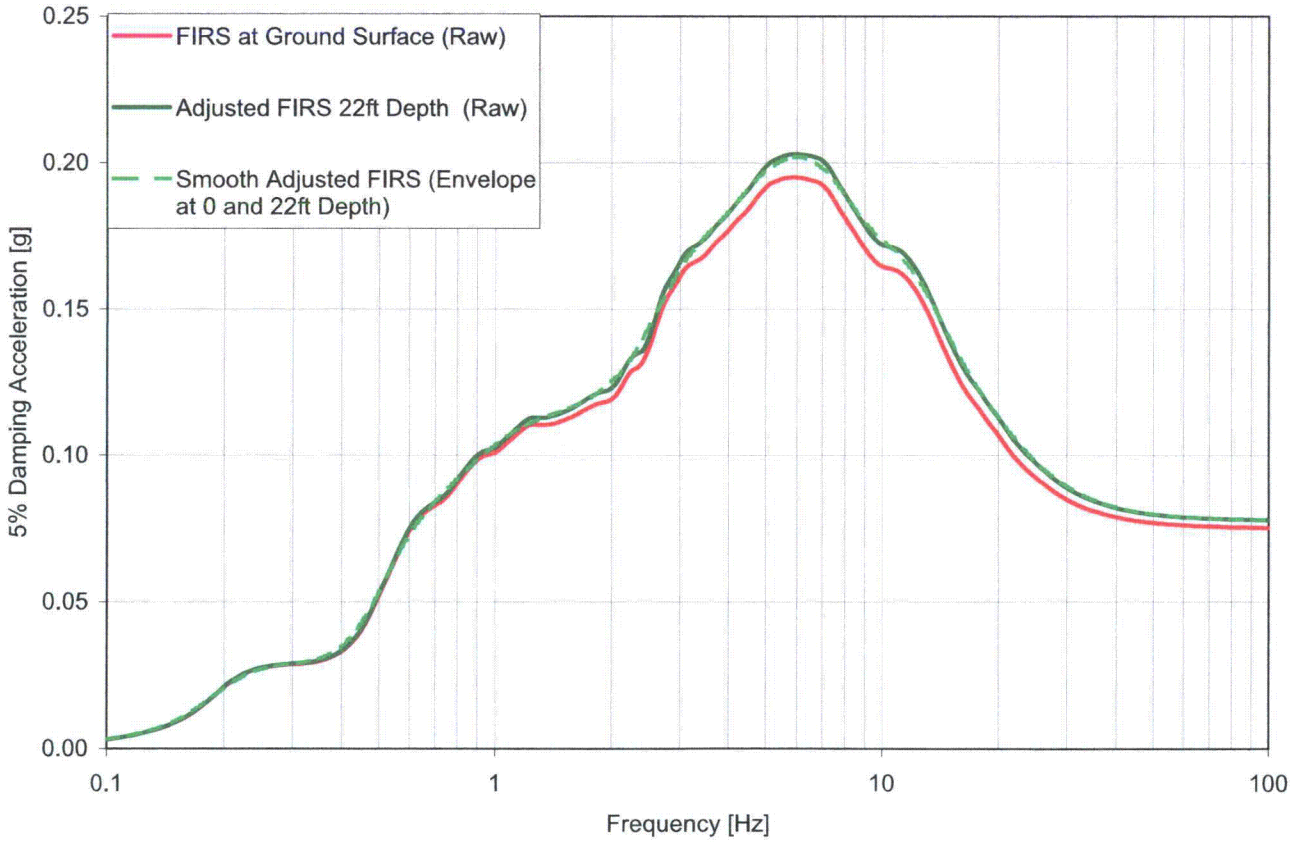
Figure 3F-22—{Envelope Horizontal Smooth Adjusted FIRS – EPGB and ESWB (No Adjustment Necessary for FIRS at 22 ft Depth)}



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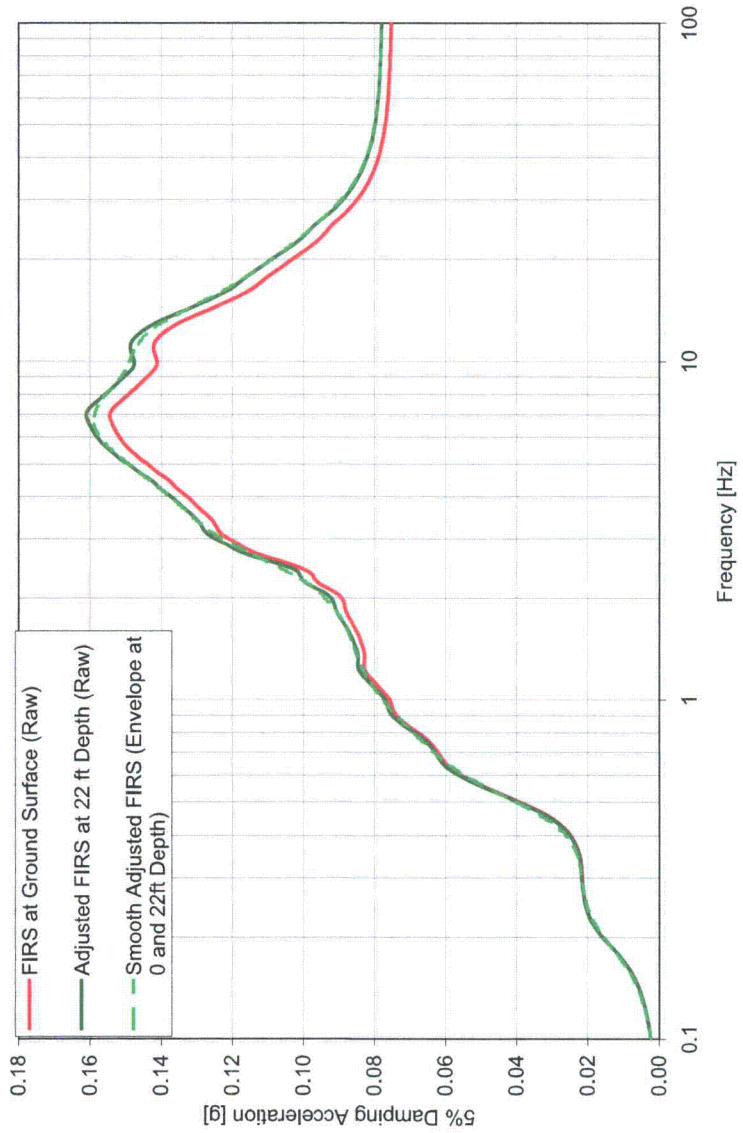

Figure 3F-23—{Envelope Vertical Smooth Adjusted FIRS – EPGB and ESWB (No Adjustment Necessary for FIRS at 22 ft Depth)}

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Figure 3F-24—{Envelope Horizontal Smooth Adjusted FIRS – Intake Area (No Adjustment Necessary for FIRS at 20.5 ft Depth)}

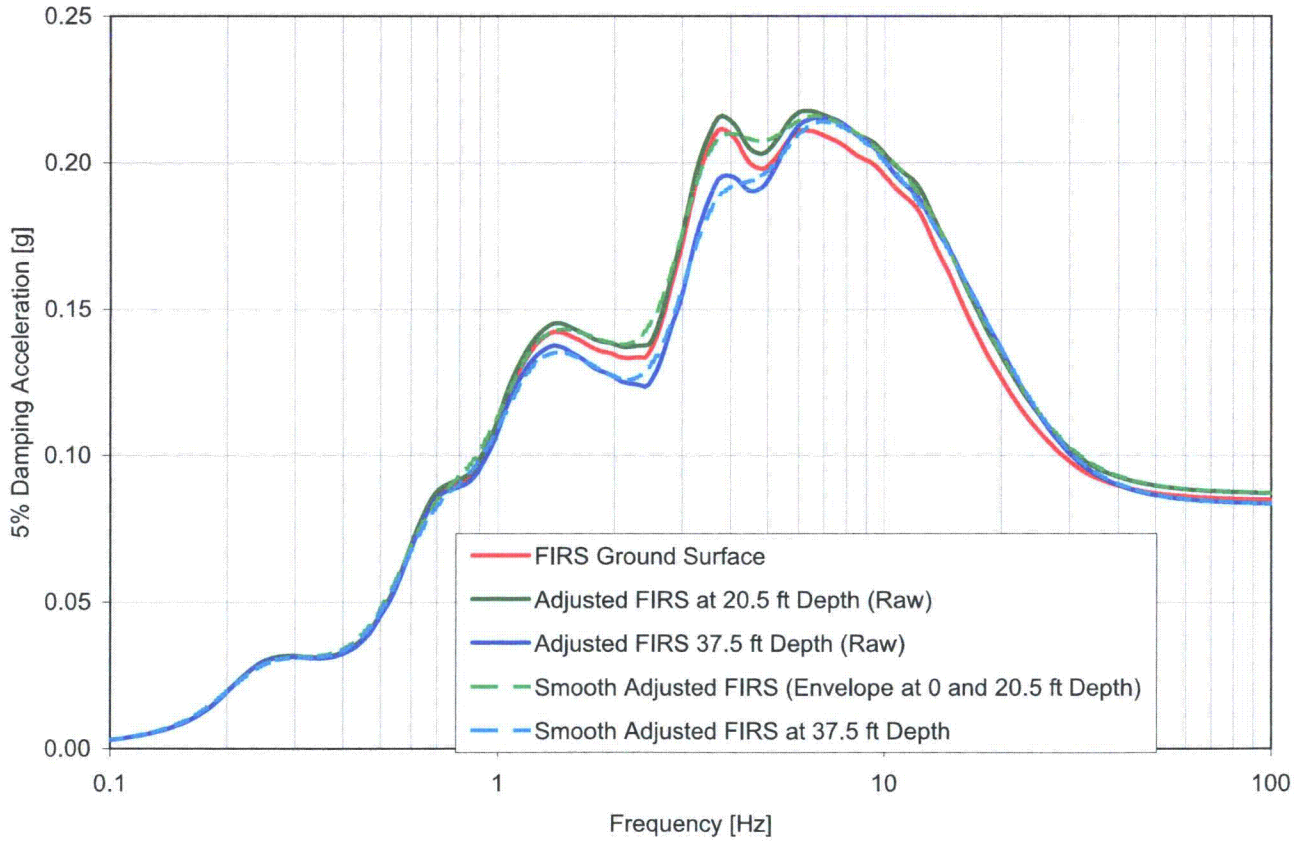

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Figure 3F-25—{Envelope Vertical Smooth Adjusted FIRS – Intake Area (No Adjustment Necessary for FIRS at 20.5 ft Depth)}

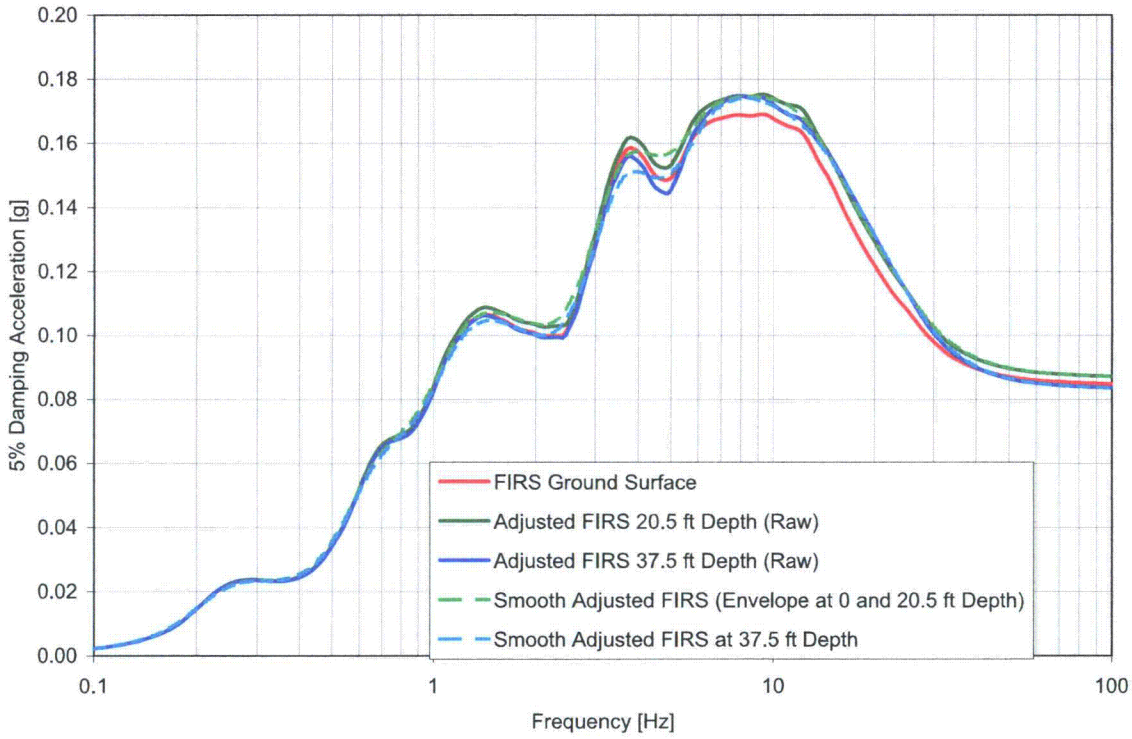

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Figure 3F-26—{SSSI Effect 5% Damping ARS Amplification Functions for EPGB and ESWB}

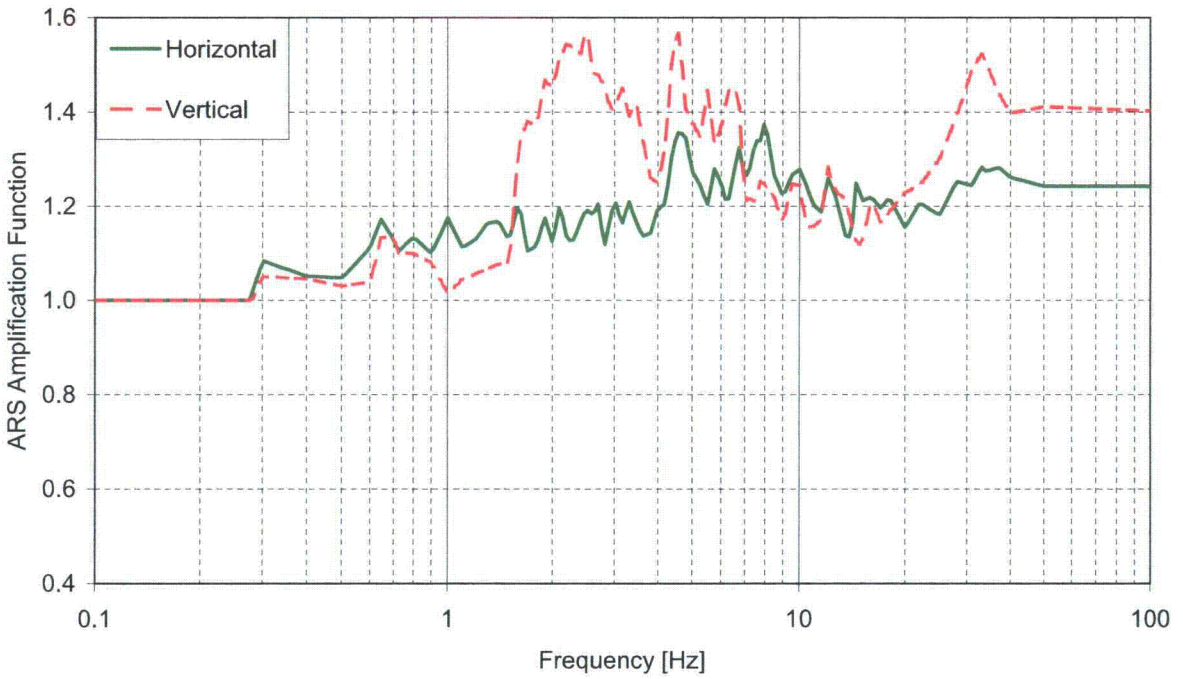

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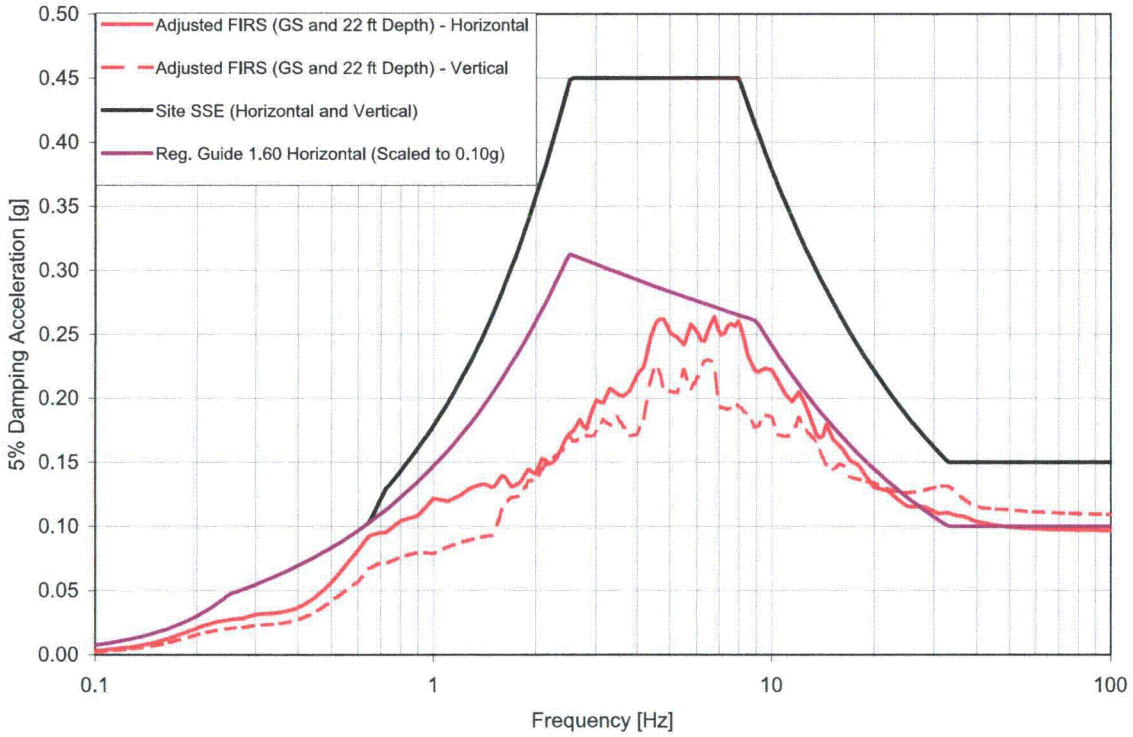
Figure 3F-27—{Site SSE Comparison with Adjusted FIRS (including NI SSSI Effects) and RG 1.60 – EPGB and ESWB}



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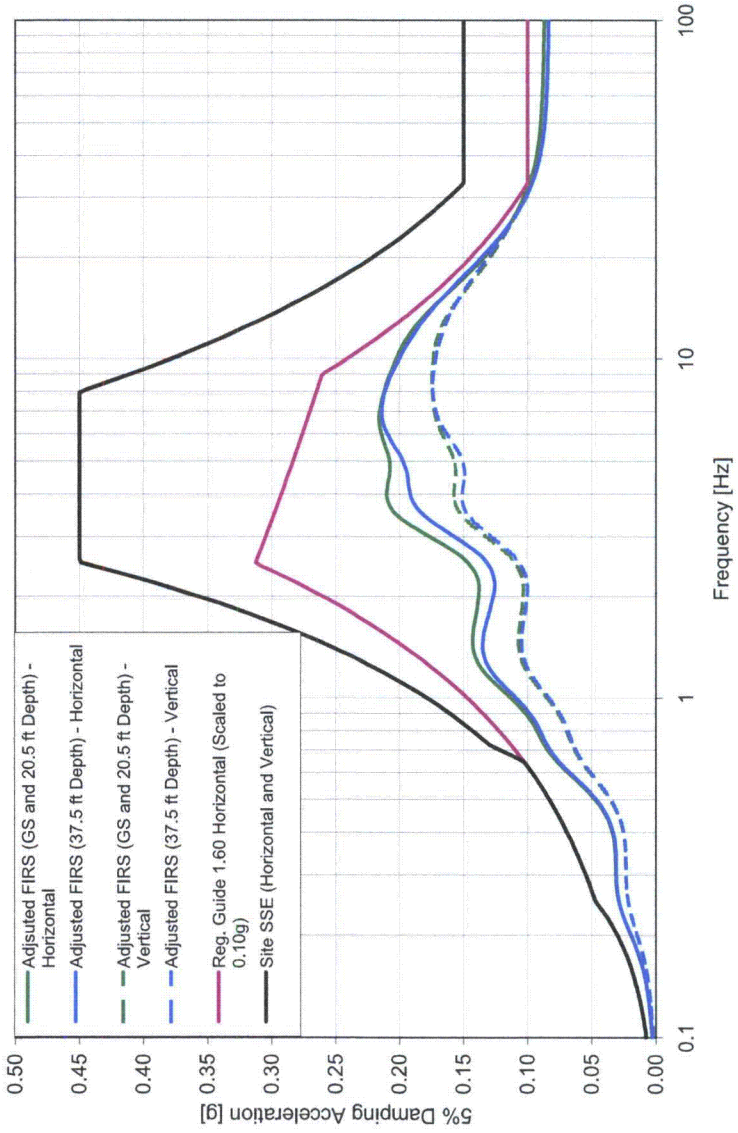

Figure 3F-28—{Site SSE Comparison with Adjusted FIRS and RG 1.60 – Intake Area}

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Figure 3F-29—{Shear Wave Velocity Profiles Strain-Compatible with Site SSE for the NI Area}

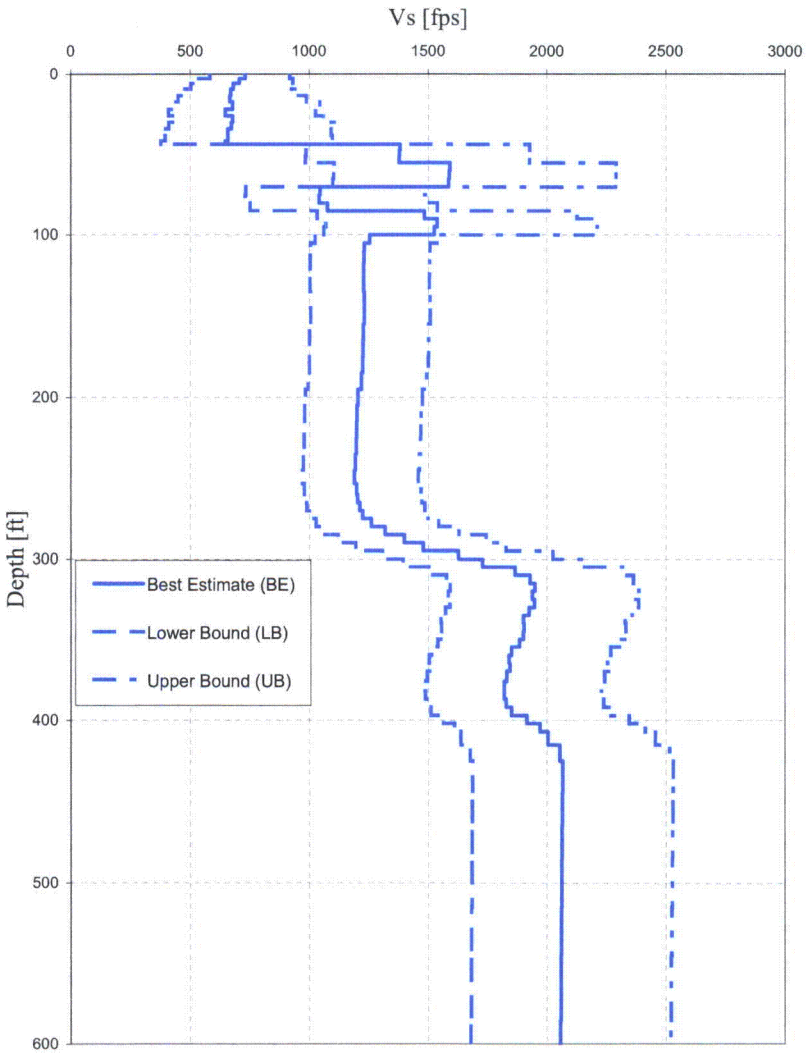

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Figure 3F-30—{Damping Profiles Strain-Compatible with Site SSE for the NI Area}

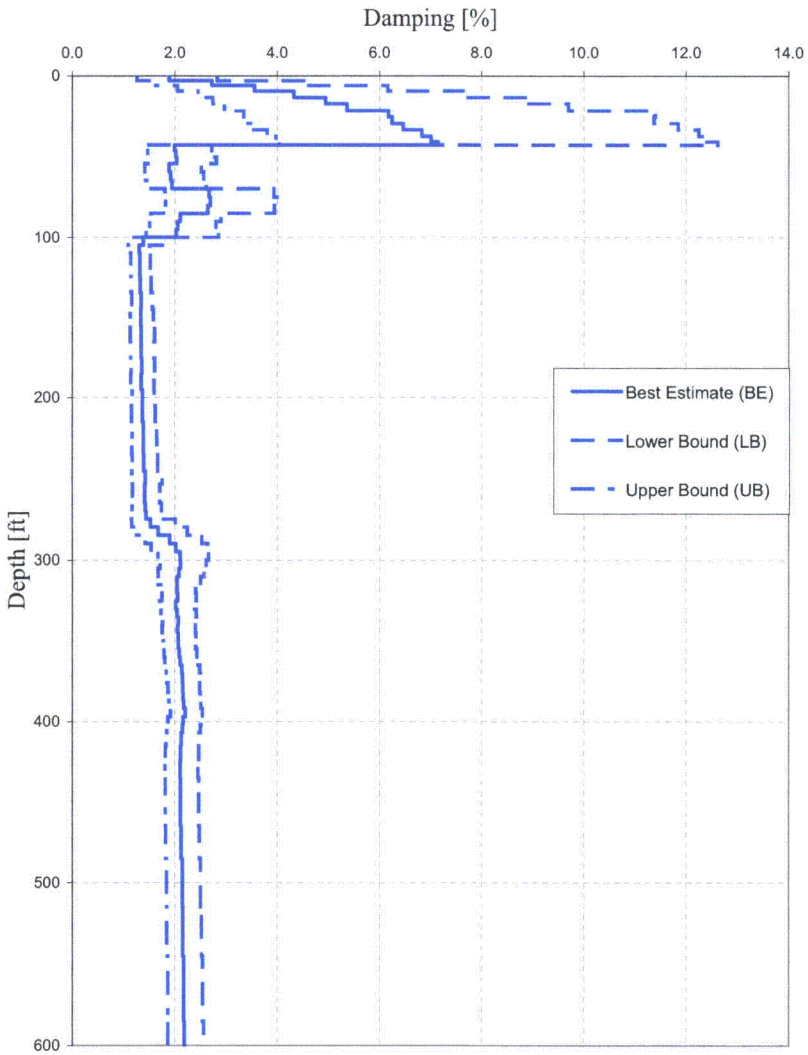

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Figure 3F-31—{Site SSE P-Wave Velocity Profiles for the NI Area}

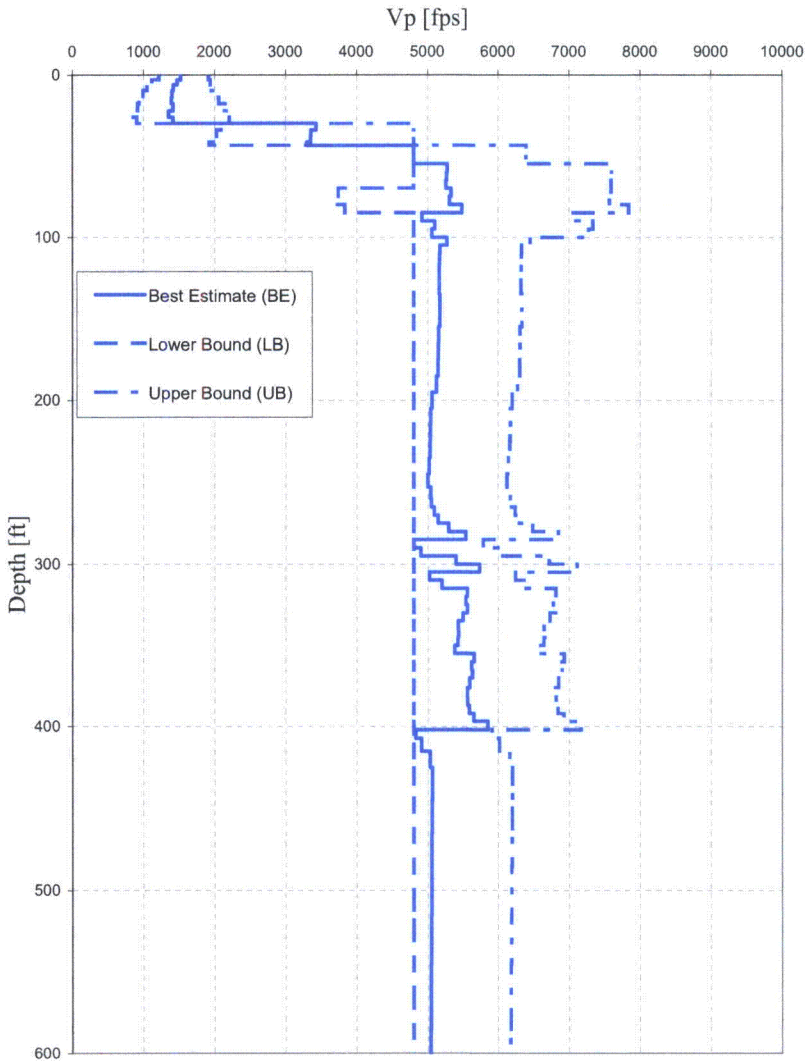

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Figure 3F-32—{Shear Wave Velocity Profiles Strain-Compatible with Site SSE for the Intake Area}

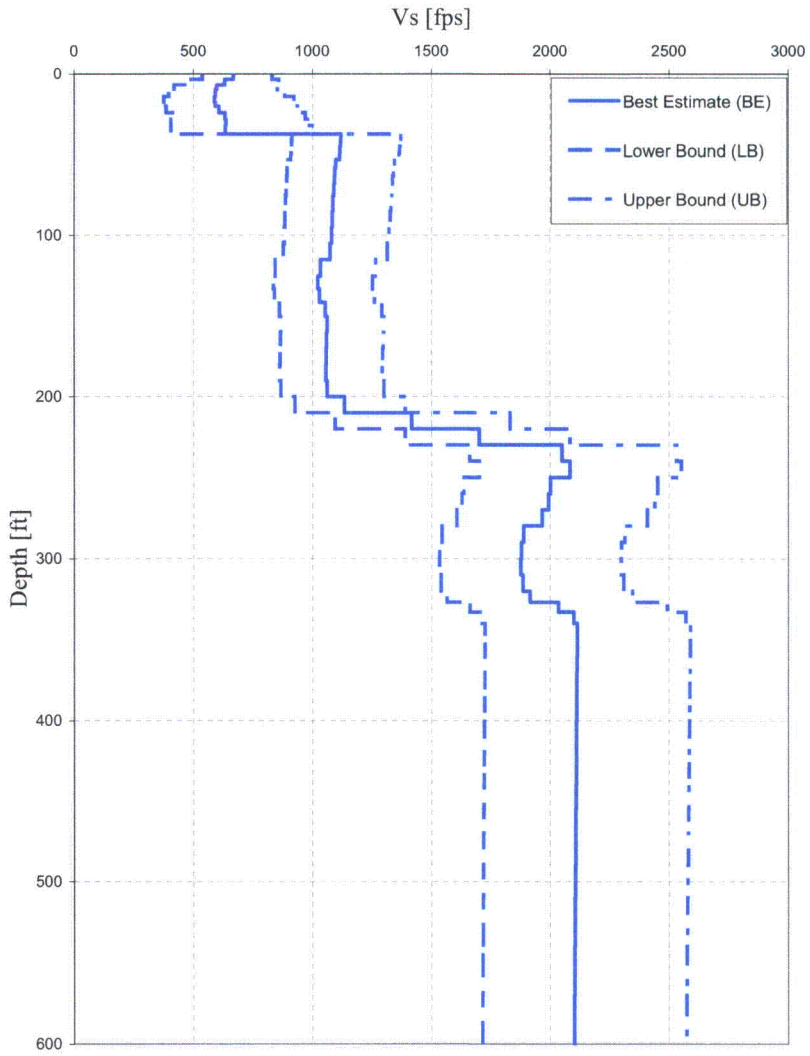

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Figure 3F-33—{Damping Profiles Strain-Compatible with Site SSE for the Intake Area}

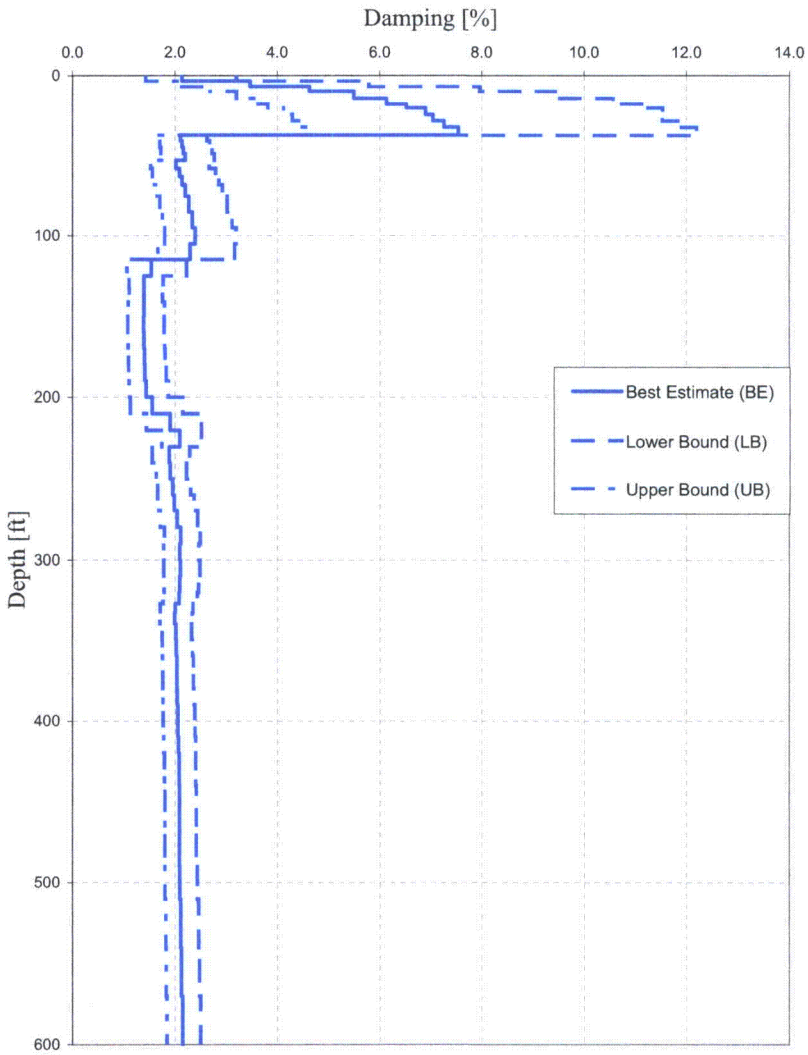

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Figure 3F-34—{Site SSE P-Wave Velocity Profiles for the Intake Area}

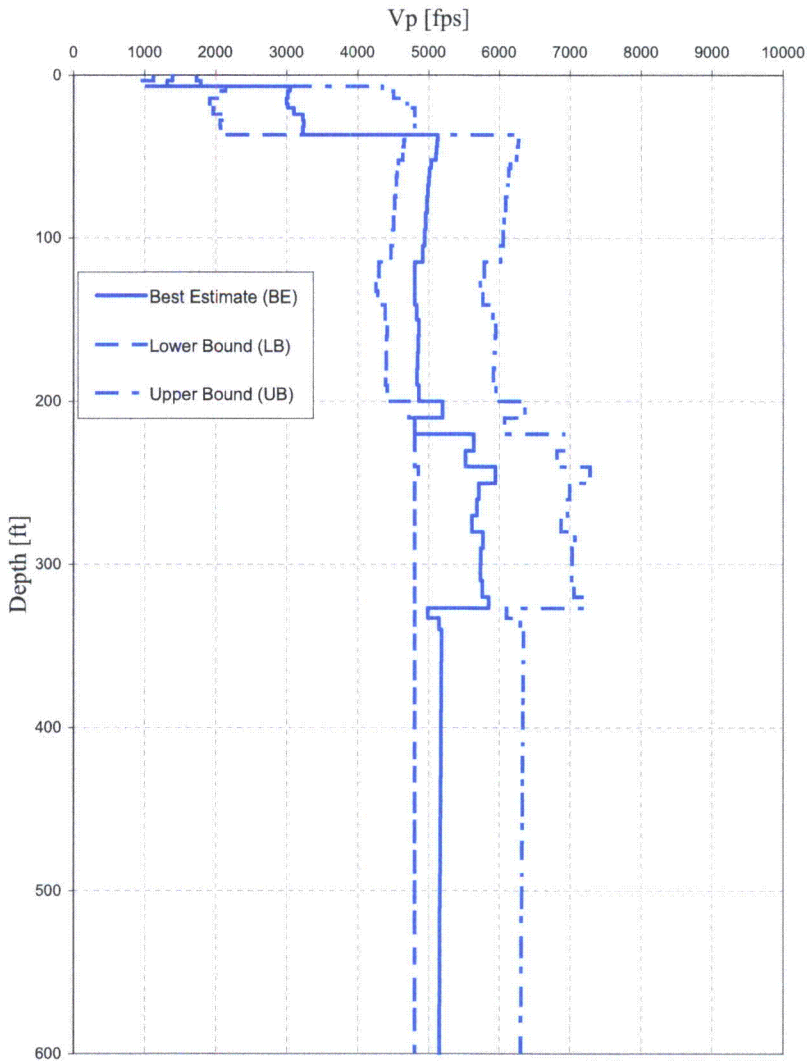

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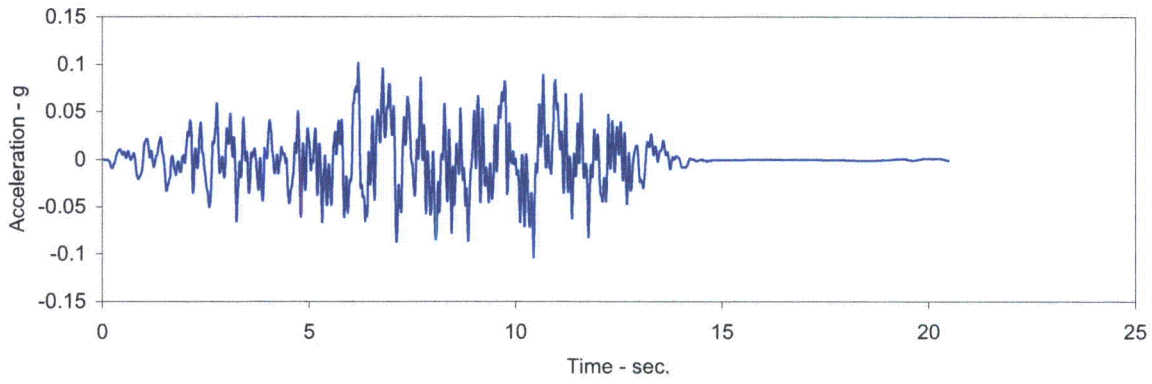
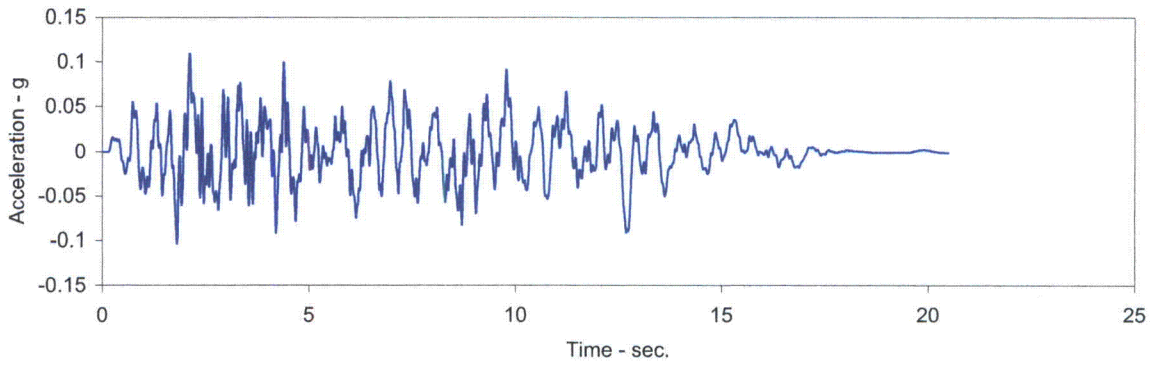
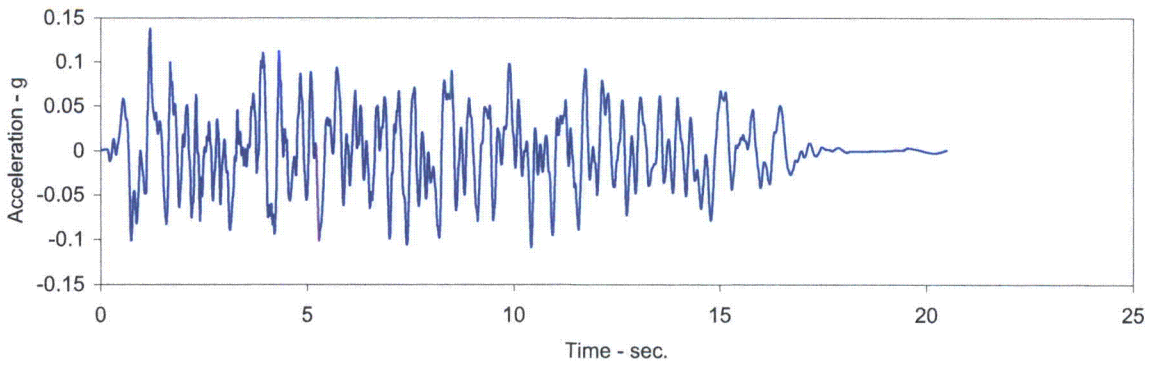
Figure 3F-35—{SSI "Within" Acceleration Time Histories for Input at ESWB Foundation (LB Soil Case)– NI Area (22 ft Depth) }



a) Horizontal Direction S1



b) Horizontal Direction S2



c) Vertical Direction S3

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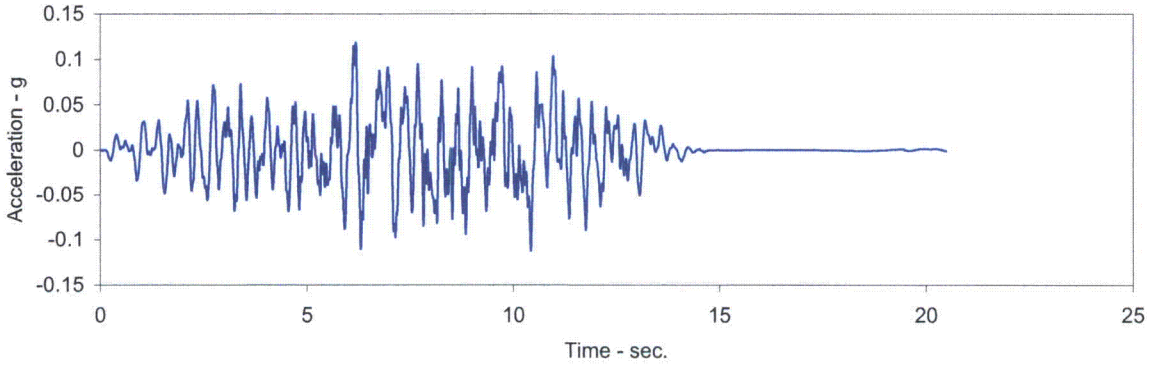
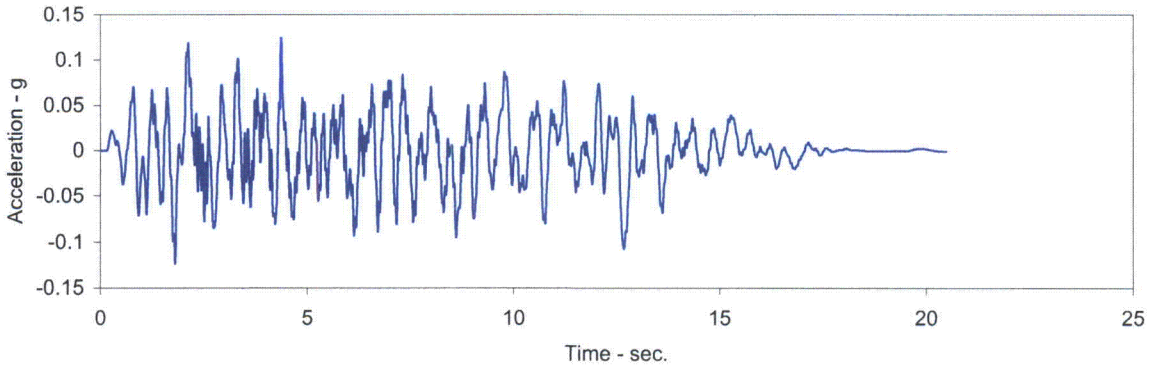
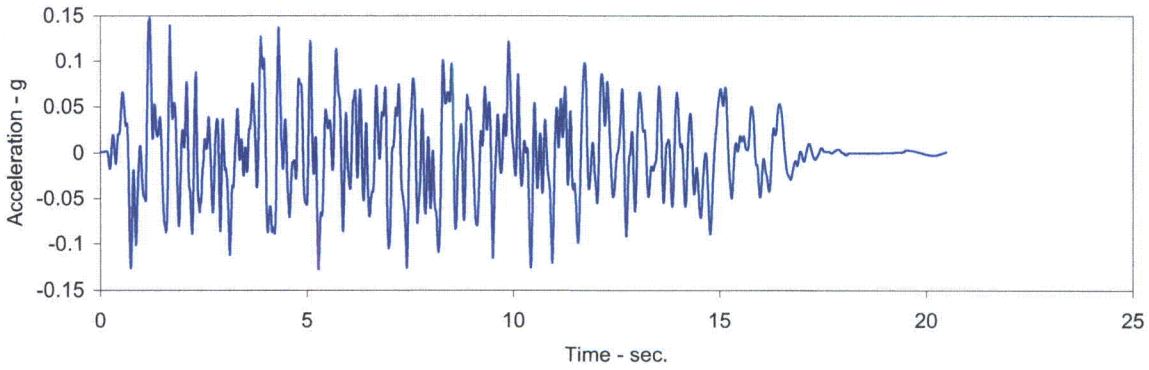
Figure 3F-36—{SSI "Within" Acceleration Time Histories for Input at ESWB Foundation (BE Soil Case)– NI Area (22 ft Depth) }



a) Horizontal Direction S1



b) Horizontal Direction S2



c) Vertical Direction S3

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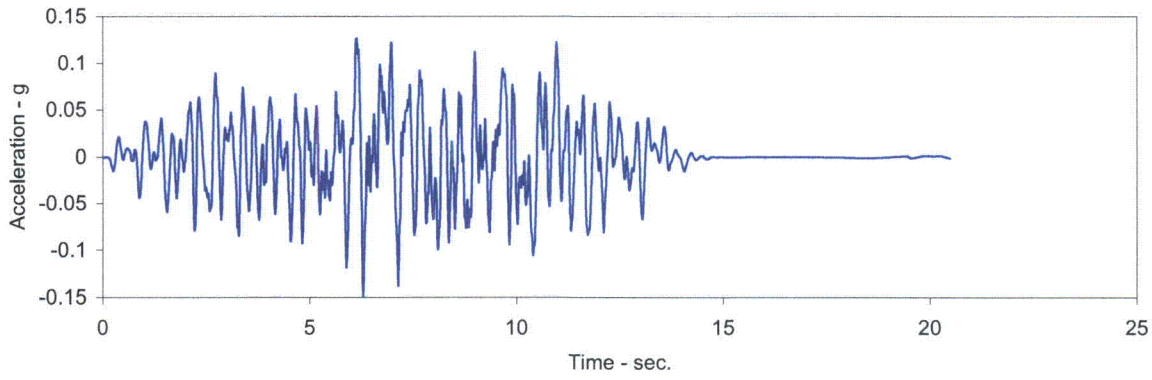
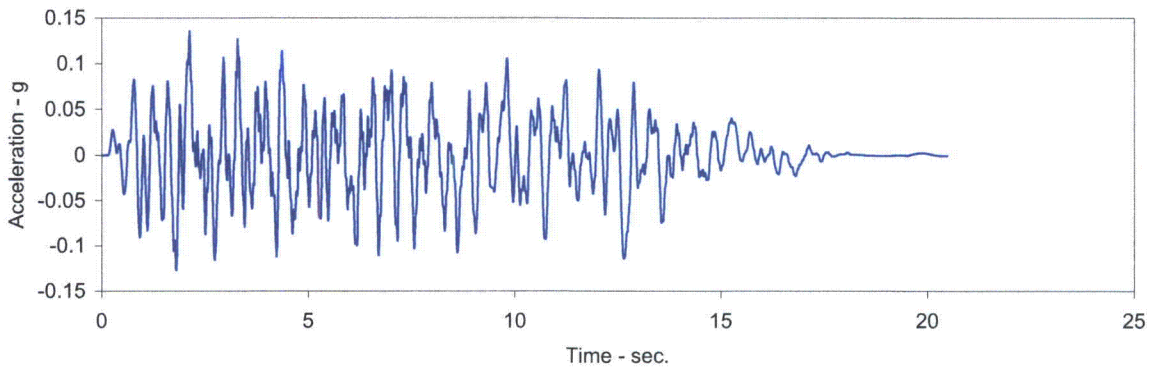
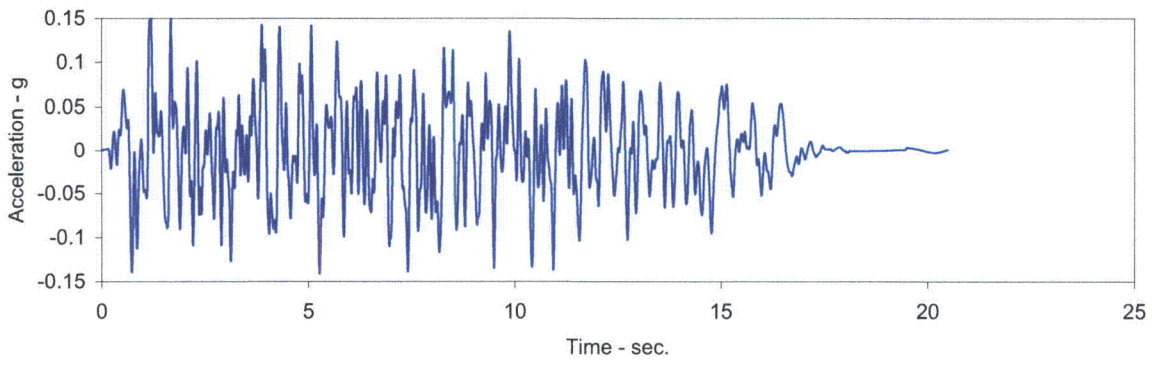
Figure 3F-37—{SSI "Within" Acceleration Time Histories for Input at ESWB Foundation (UB Soil Case)– NI Area (22 ft Depth) }



a) Horizontal Direction S1



b) Horizontal Direction S2



c) Vertical Direction S3

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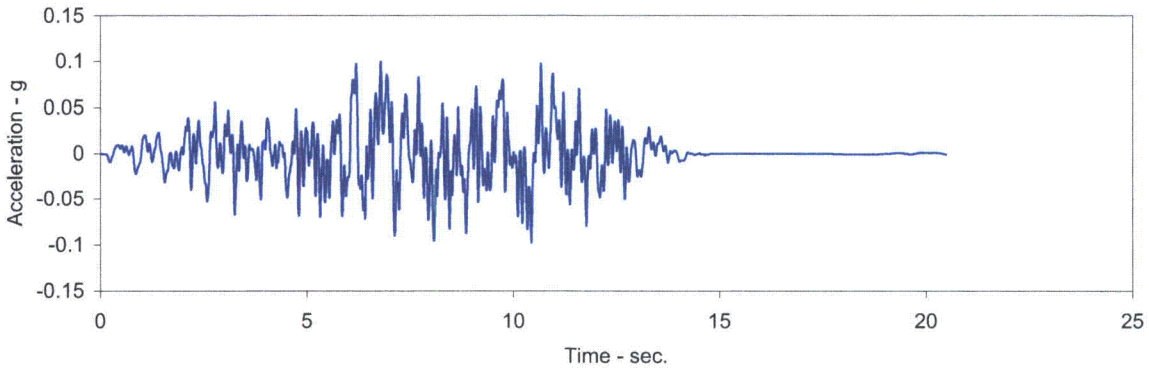
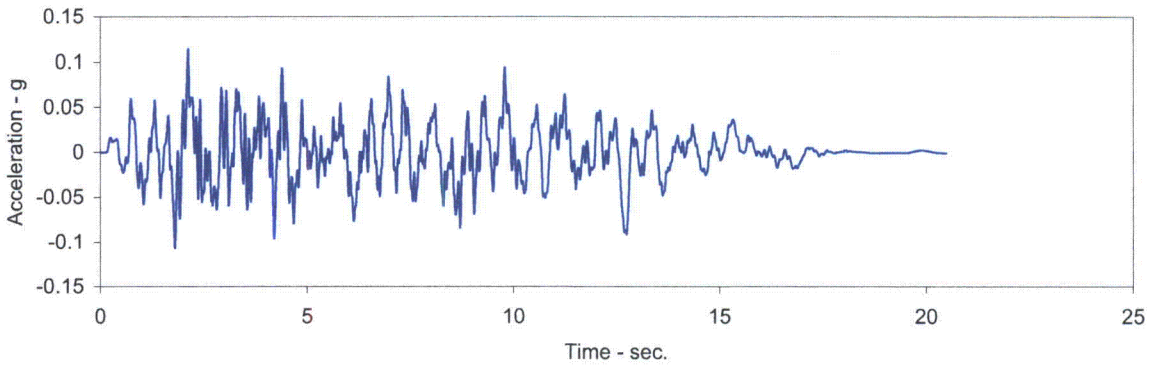
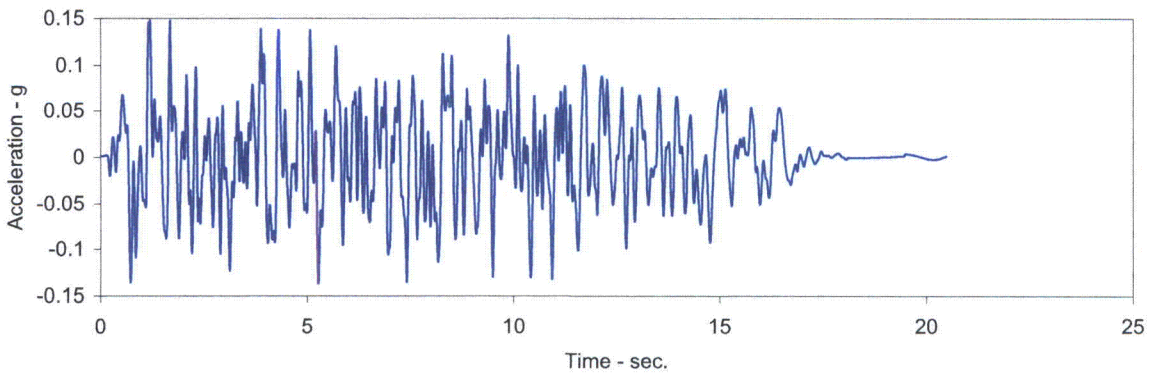
Figure 3F-38—{SSI "Within" Acceleration Time Histories for Input at UHS Electrical Building Foundation (LB Soil Case)– Intake Area (20.5 ft Depth)}



a) Horizontal Direction S1



b) Horizontal Direction S2



c) Vertical Direction S3

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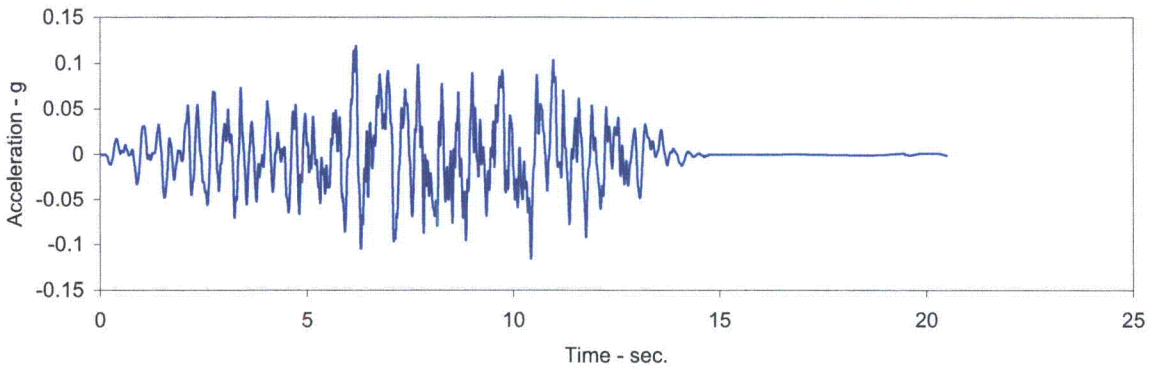
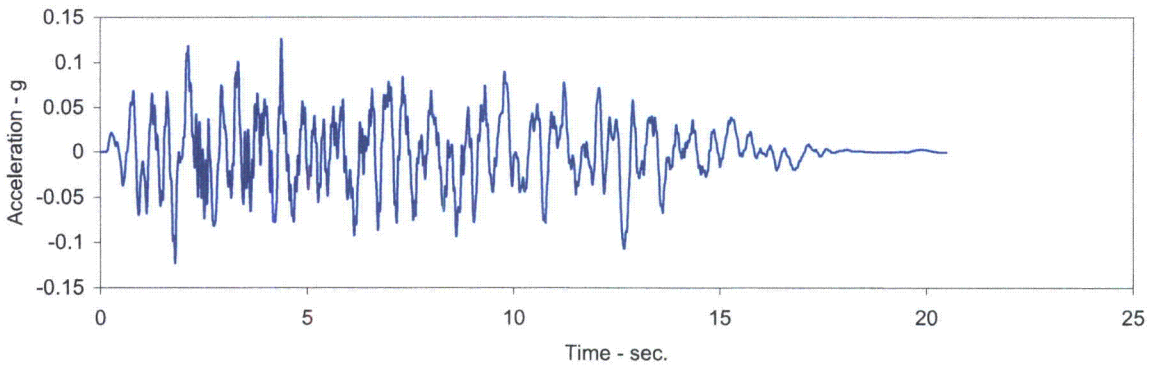
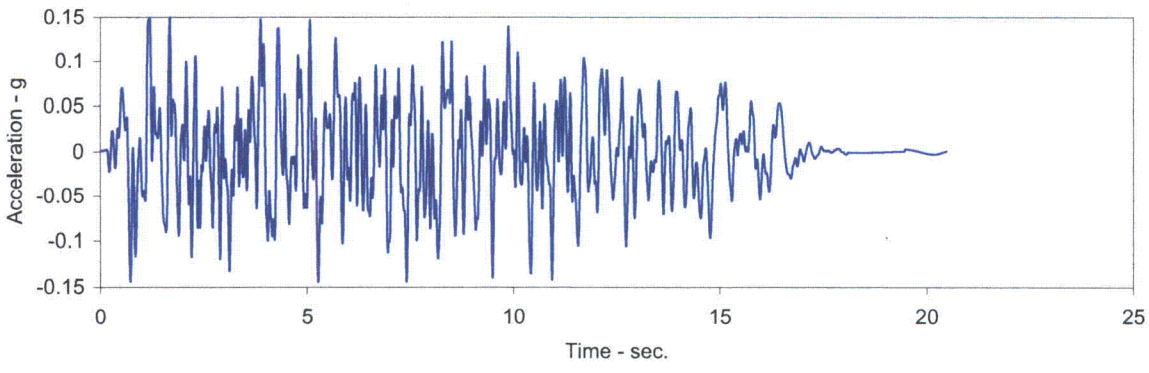
Figure 3F-39—{SSI "Within" Acceleration Time Histories for Input at UHS Electrical Building Foundation (BE Soil Case)– Intake Area (20.5 ft Depth)}



a) Horizontal Direction S1



b) Horizontal Direction S2



c) Vertical Direction S3

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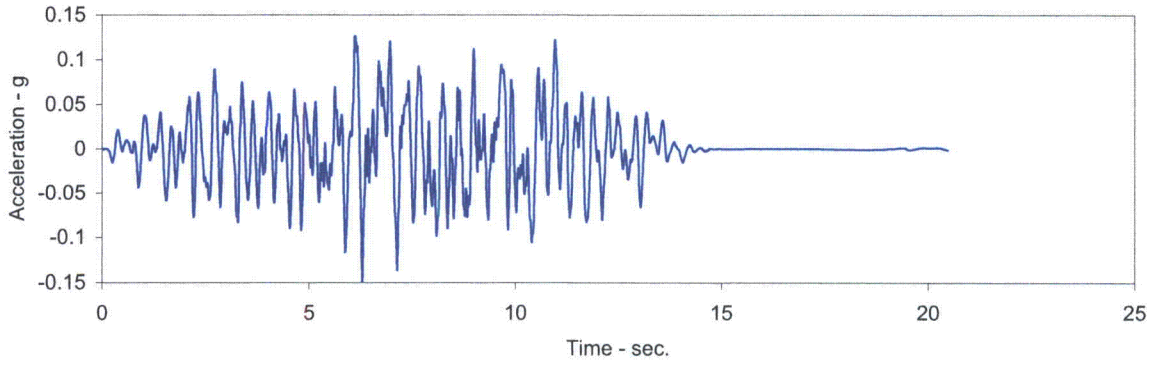
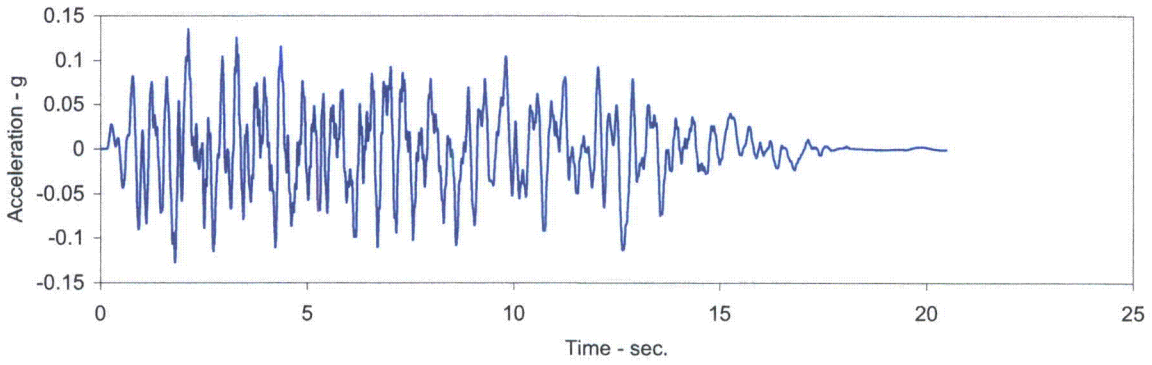
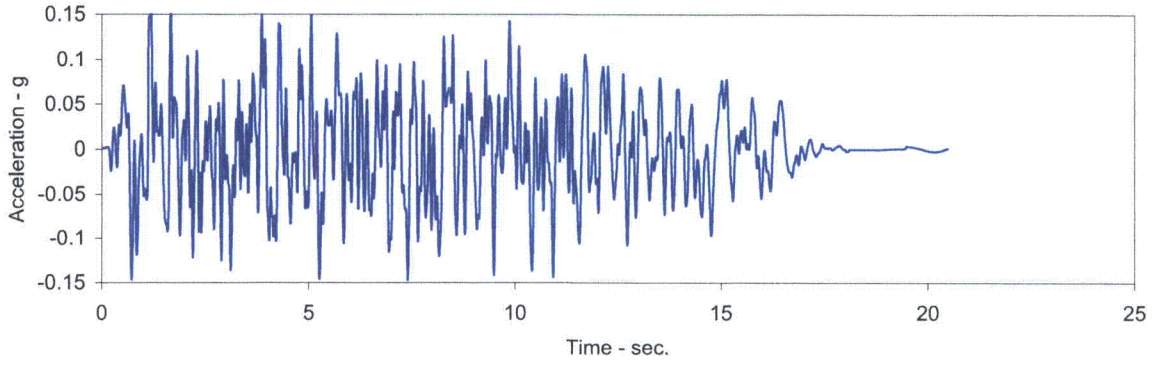
Figure 3F-40—{SSI "Within" Acceleration Time Histories for Input at UHS Electrical Building Foundation (UB Soil Case)– Intake Area (20.5 ft Depth)}



a) Horizontal Direction S1



b) Horizontal Direction S2



c) Vertical Direction S3

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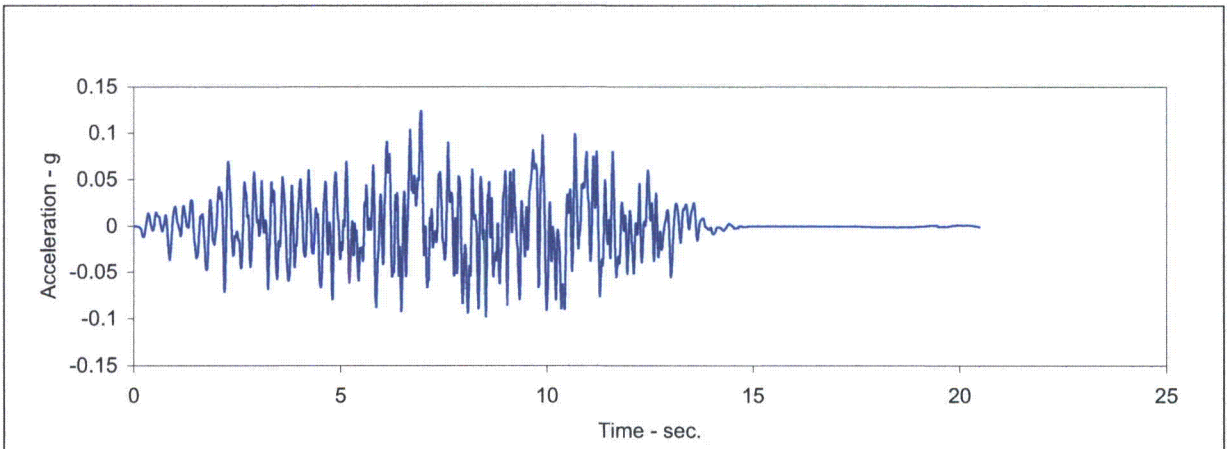
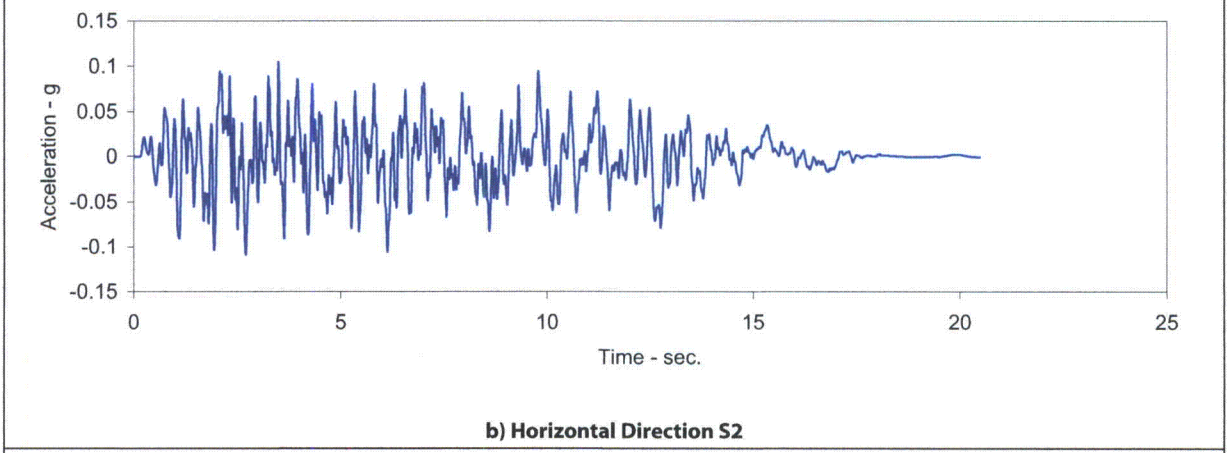
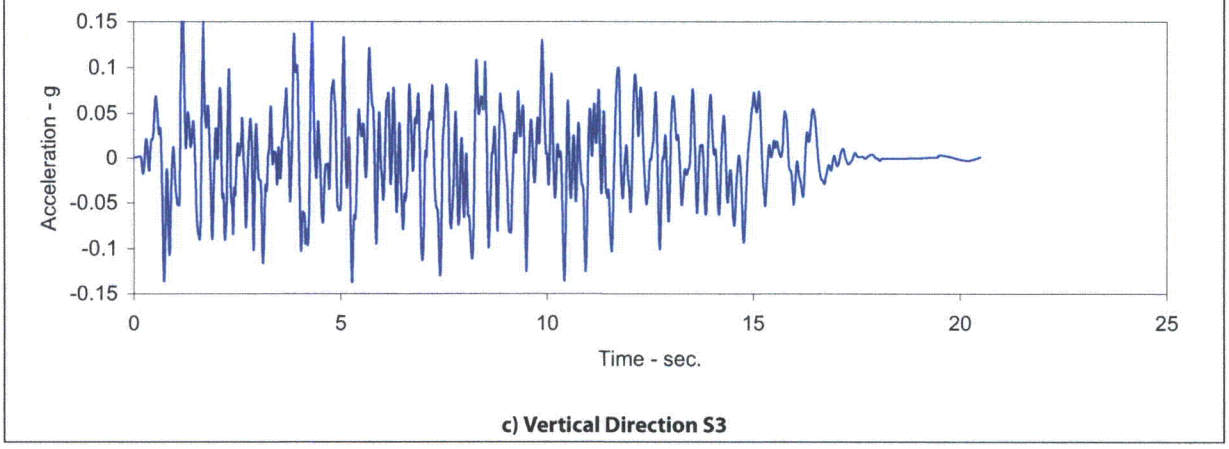
Figure 3F-41—{SSI "Within" Acceleration Time Histories for Input at CBIS Foundation (LB Soil Case)– Intake Area (37.5 ft Depth)}



a) Horizontal Direction S1



b) Horizontal Direction S2



c) Vertical Direction S3

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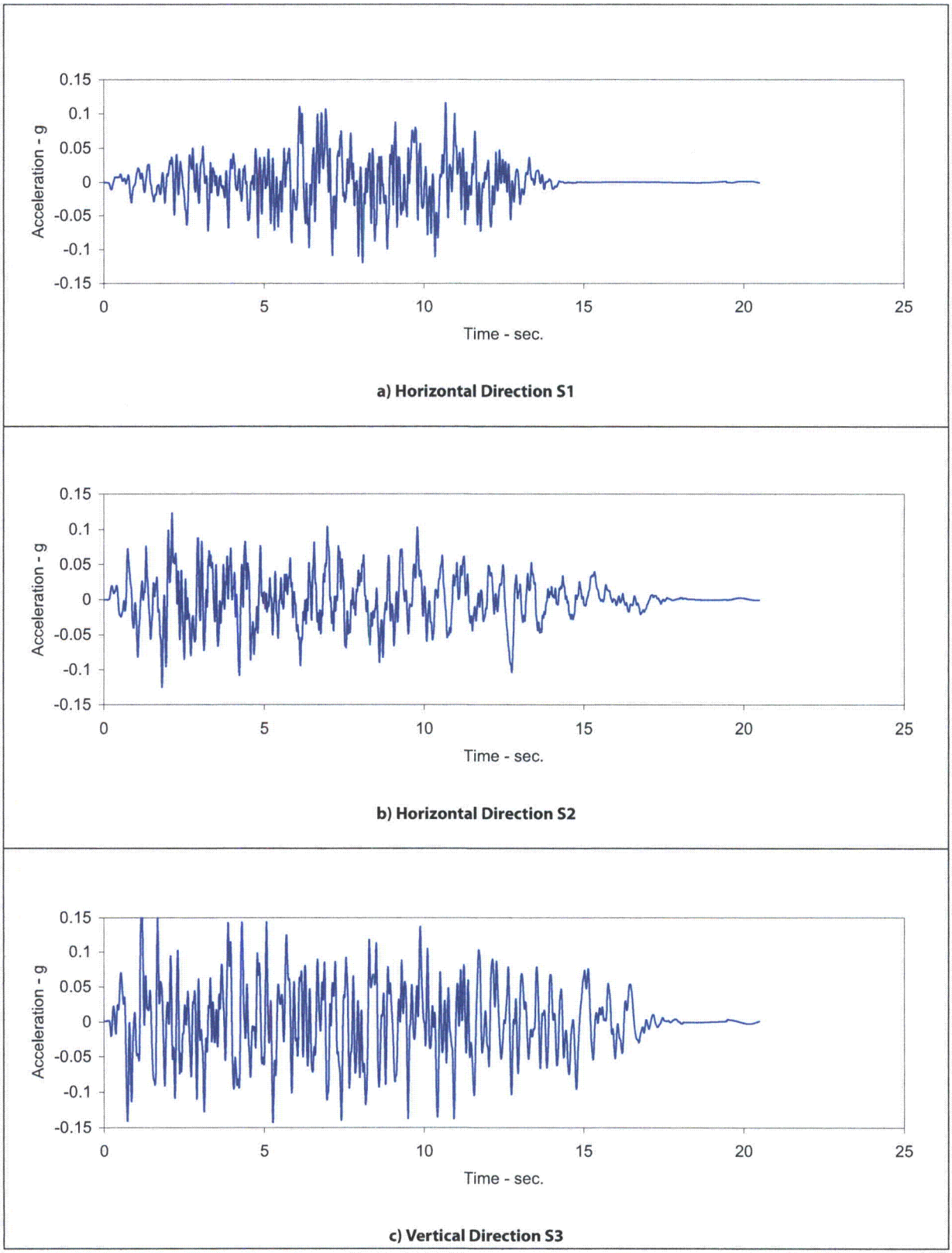
Figure 3F-42—{SSI "Within" Acceleration Time Histories for Input at CBIS Foundation (BE Soil Case)– Intake Area (37.5 ft Depth)}



a) Horizontal Direction S1

b) Horizontal Direction S2

c) Vertical Direction S3

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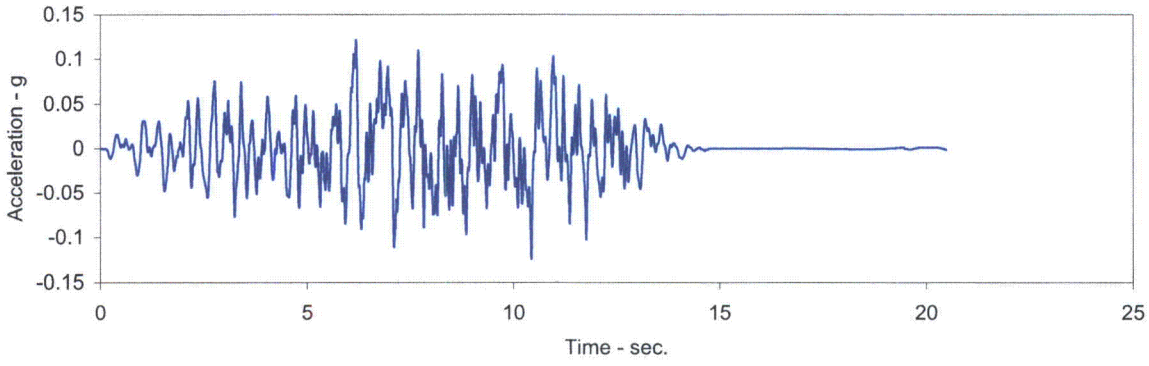
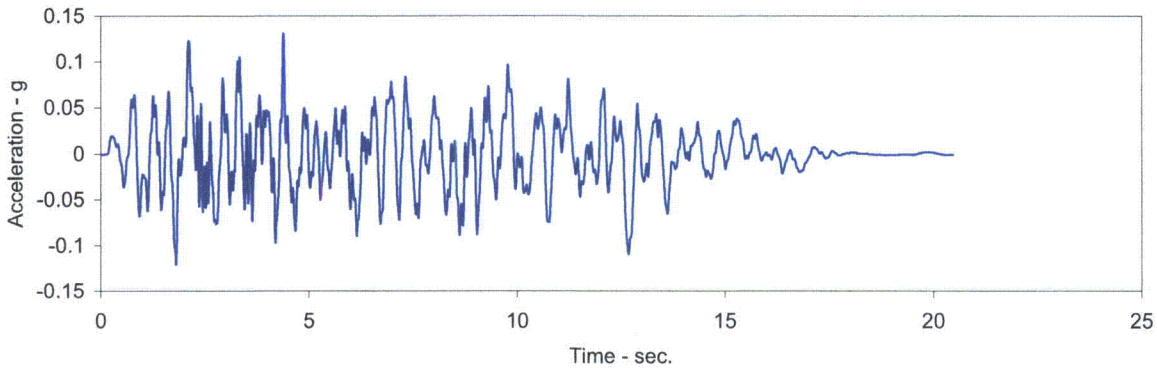
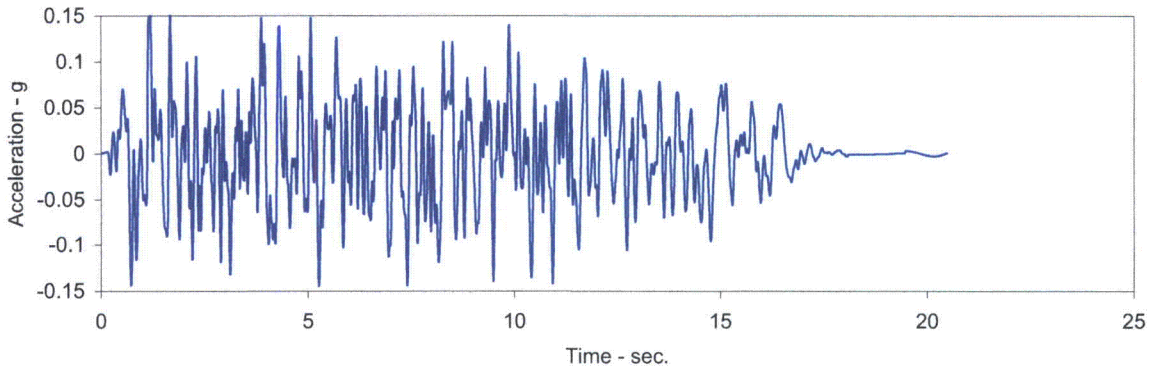
Figure 3F-43—{SSI "Within" Acceleration Time Histories for Input at CBIS Foundation (UB Soil Case)– Intake Area (37.5 ft Depth)}



a) Horizontal Direction S1



b) Horizontal Direction S2



c) Vertical Direction S3

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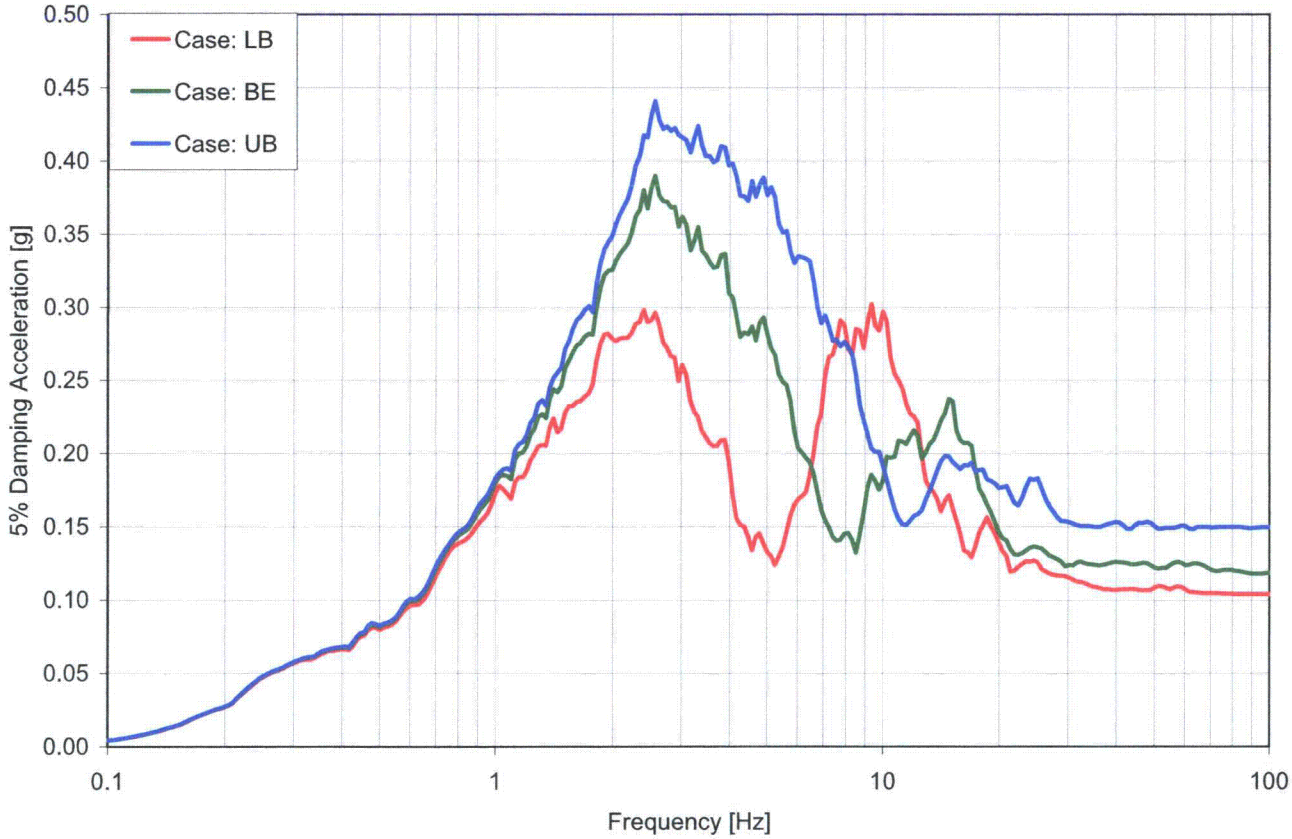
Figure 3F-44—{5% Damping within ARS at ESWB Foundation Horizontal Direction (S1) – NI Area (22 ft Depth)}



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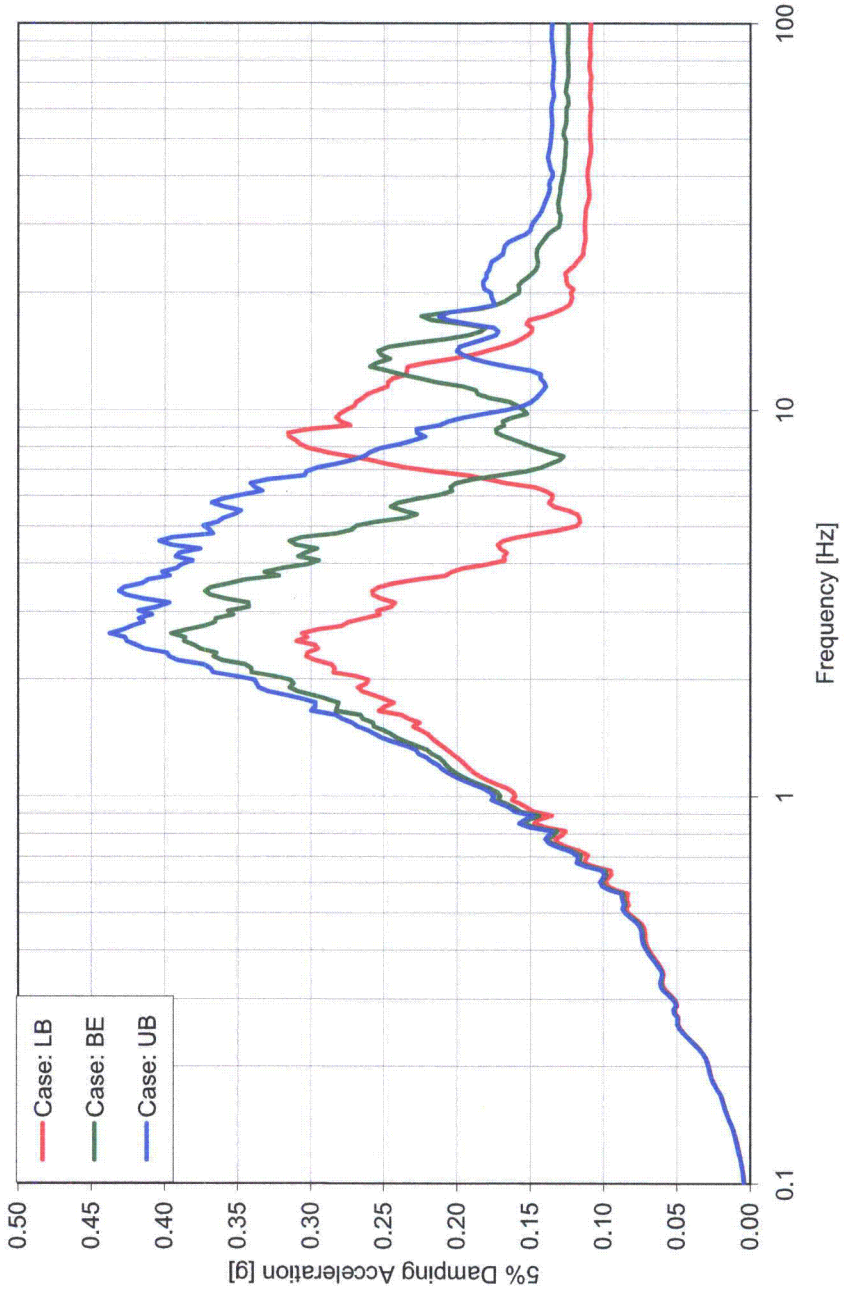

Figure 3F-45—{5% Damping within ARS at ESWB Foundation Horizontal Direction (S2) – NI Area (22 ft Depth)}

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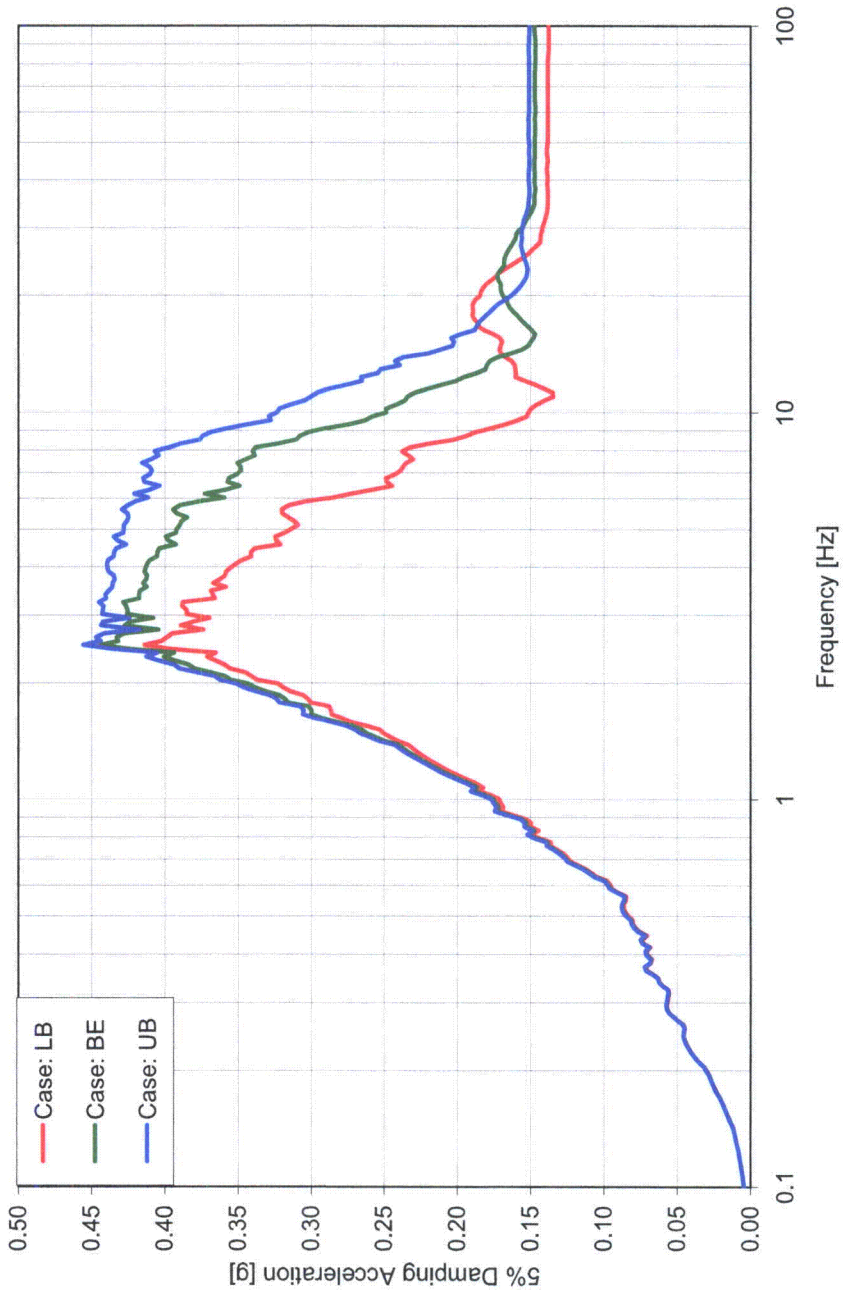

Figure 3F-46—{5% Damping within ARS at ESWB Foundation Vertical Direction (S3) – NI Area (22 ft Depth)}

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Figure 3F-47—{5% Damping within ARS at UHS Electrical Building Foundation Horizontal Direction (S1)– Intake Area (20.5 ft Depth)}

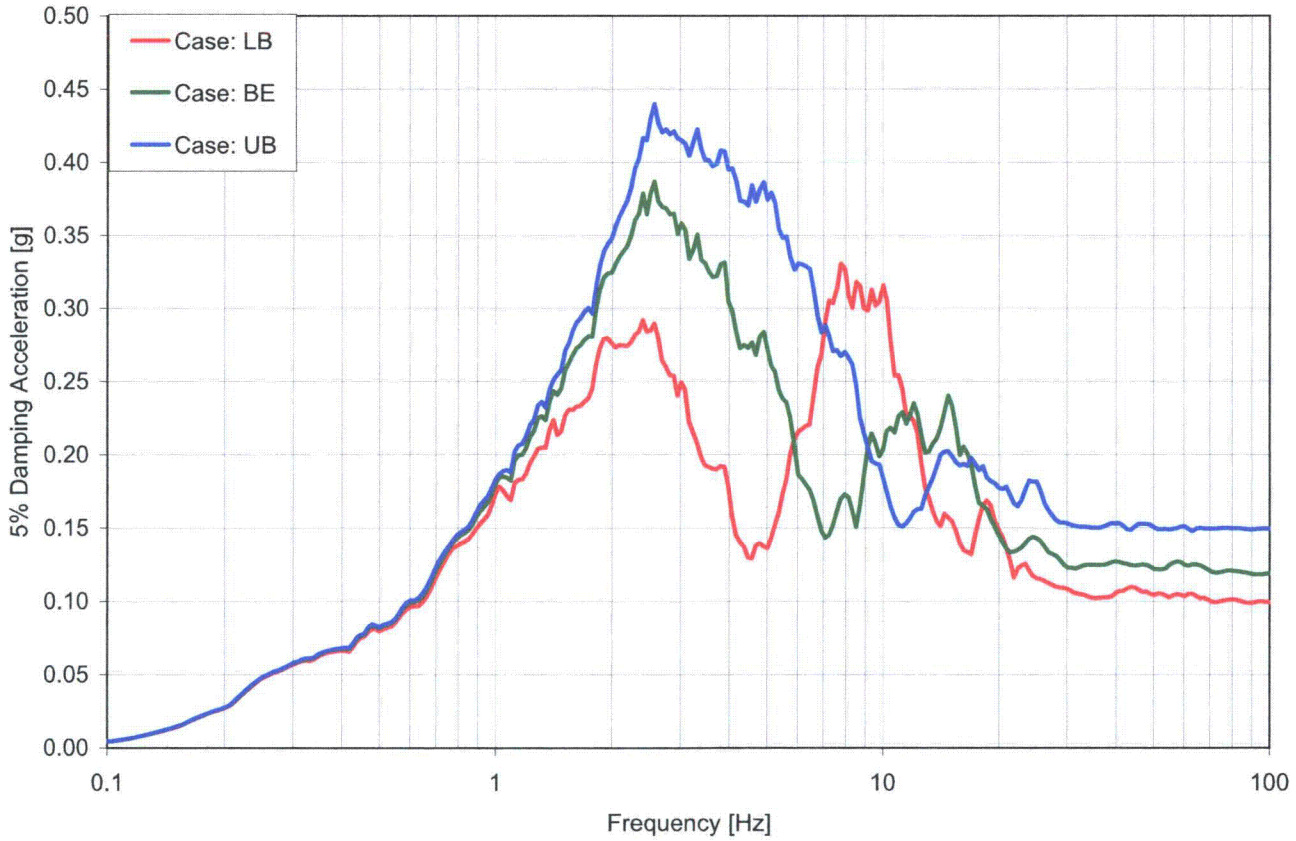

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Figure 3F-48—{5% Damping within ARS at UHS Electrical Building Foundation Horizontal Direction (S2)– Intake Area (20.5 ft Depth)}

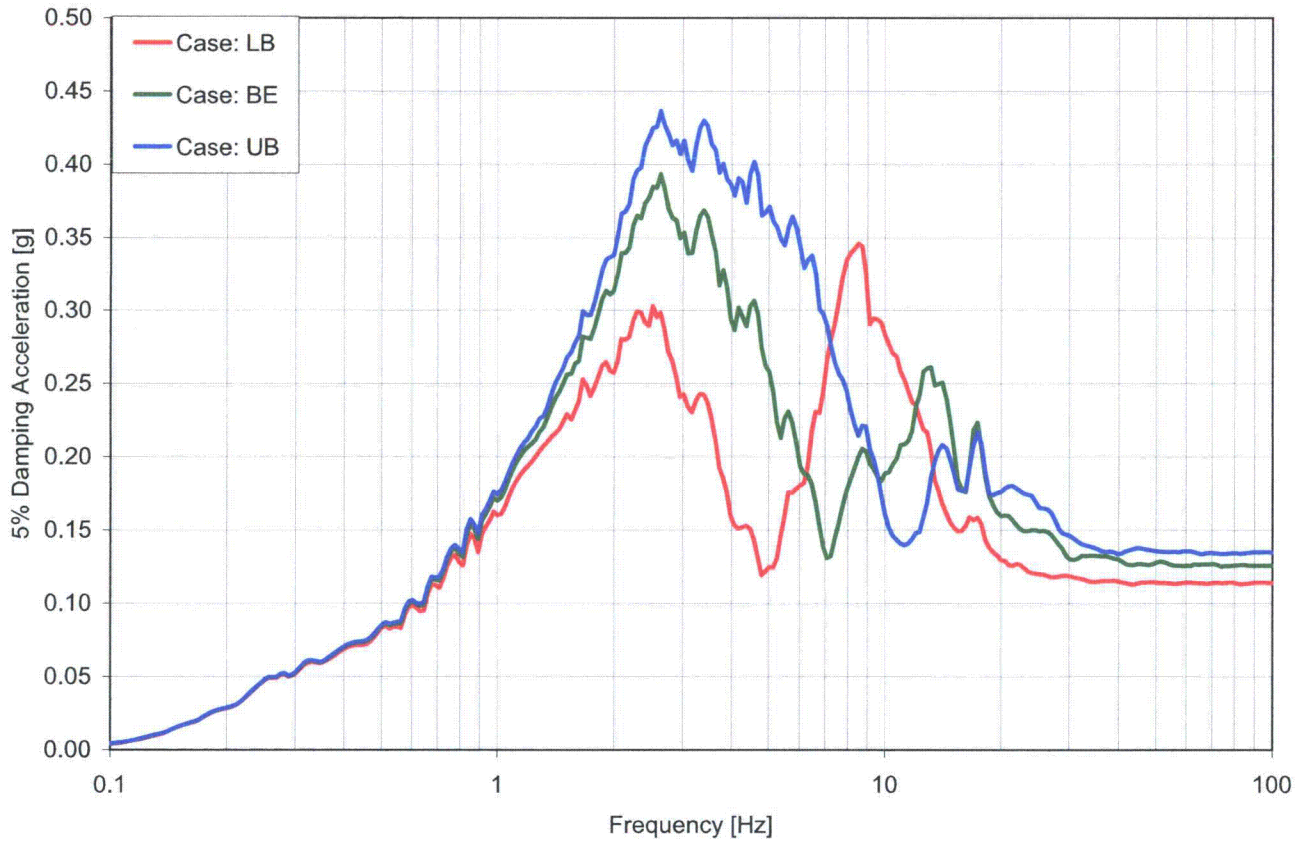

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Figure 3F-49—{5% Damping within ARS at UHS Electrical Building Foundation Vertical Direction (S3)– Intake Area (20.5 ft Depth)}

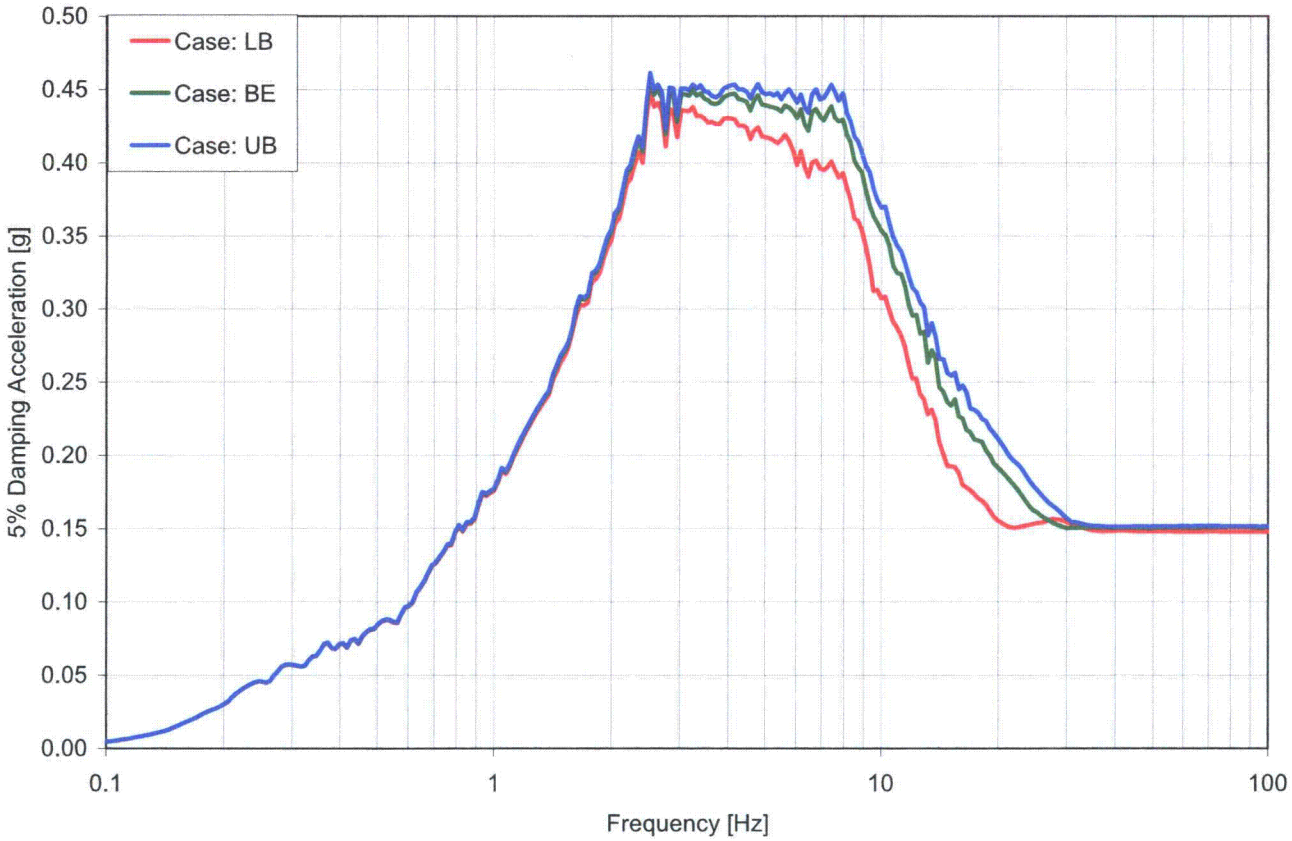

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Figure 3F-50—{5% Damping within ARS at CBIS Foundation Horizontal Direction (S1)– Intake Area (37.5 ft Depth) }

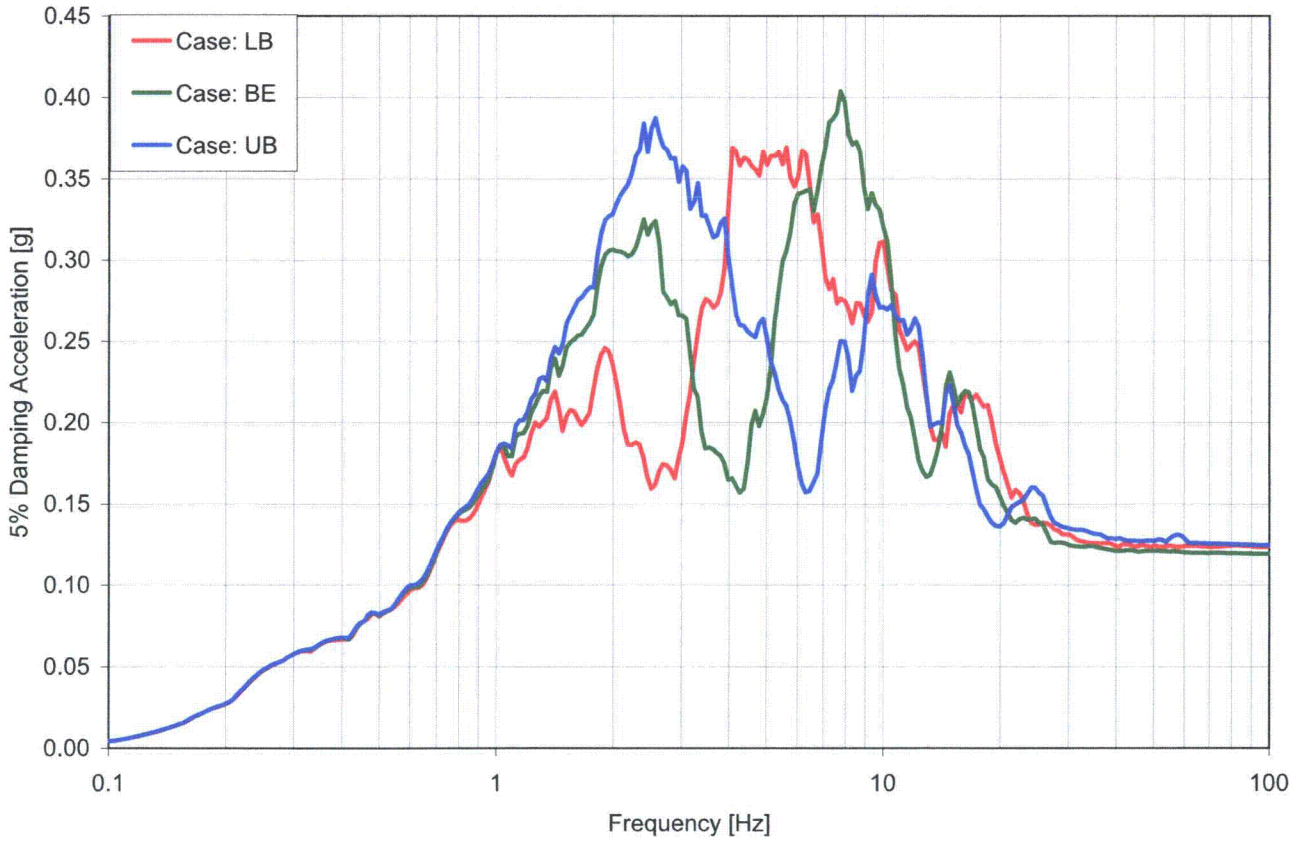

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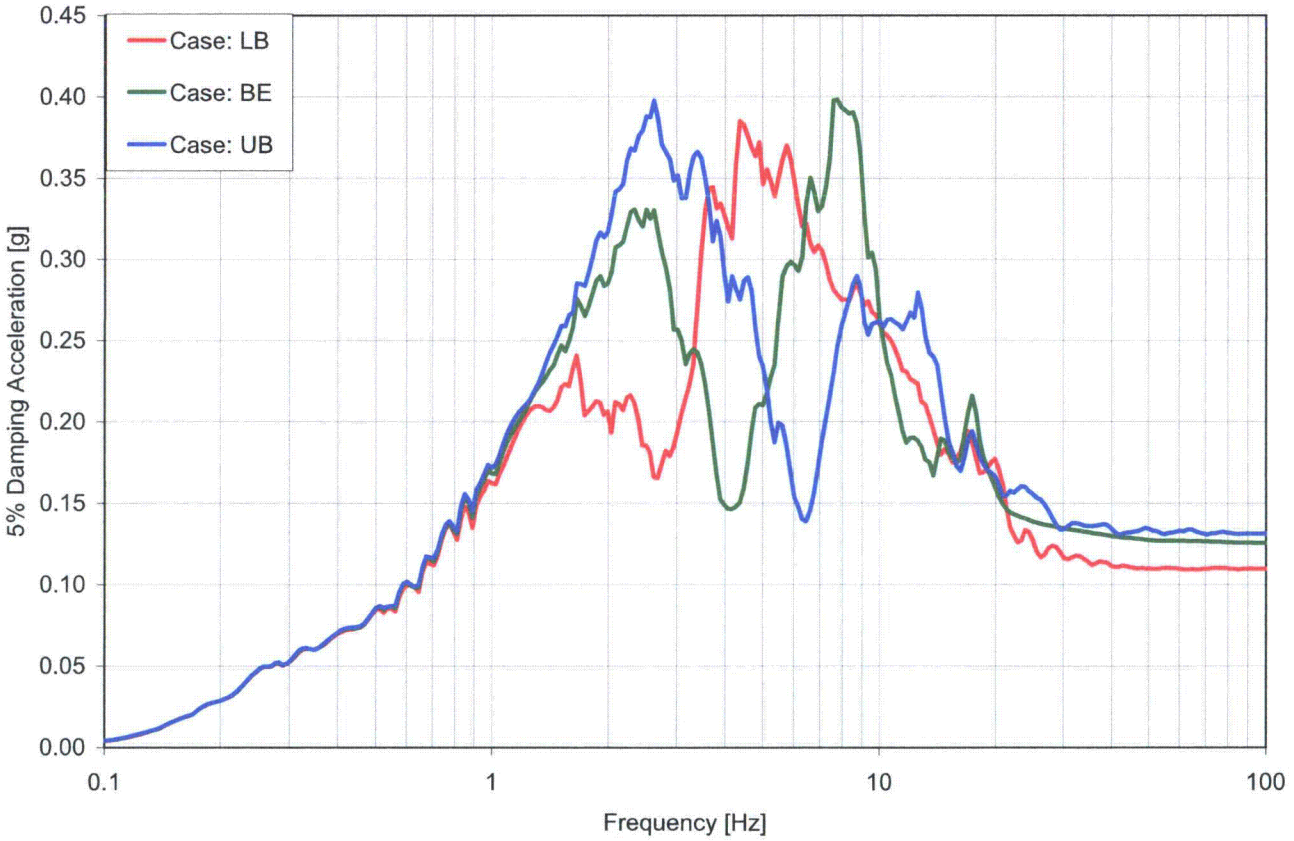
Figure 3F-51—{5% Damping within ARS at CBIS Foundation Horizontal Direction (S2)– Intake Area (37.5 ft Depth)



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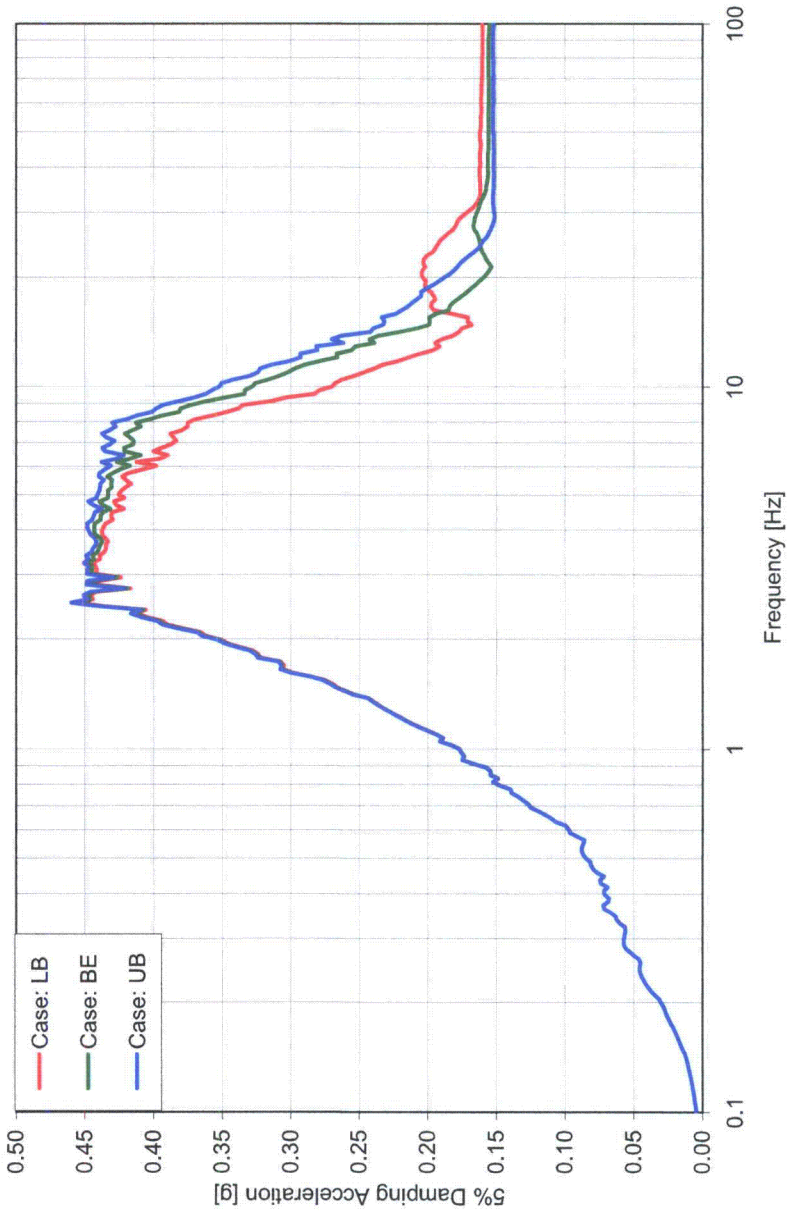

Figure 3F-52—{5% Damping within ARS at CBIS Foundation Vertical Direction (S3)– Intake Area (37.5 ft Depth)}

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