REVISED RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.: **253-8300**

SRP Section: **03.07.01 – Seismic Design Parameters**

Application Section: **3.7.1**

Date of RAI Issue: **10/19/2015**

Question No. 03.07.01-5

10 CFR 50 Appendix S requires that the horizontal component of the Safe Shutdown Earthquake Ground Motion in the free field at the foundation level of the structures must be an appropriate response spectrum with a peak ground acceleration of at least 0.1g. DCD Section 3.7.1.1.1, Design Ground Motion Response Spectra, and Appendix 3.7A.2.3, Strain-Compatible Free-Field Seismic Response Motions, state that Figures 3.7A-12 and 3.7A-13 in Appendix 3.7A show that the horizontal components of the CSDRS in the free-field at the foundation level ($CSDRS_{ff}$) of all APR1400 Seismic Category I structures satisfy the Appendix S 0.1g requirement. These two figures show the envelop of the $CSDRS_{ff}$ for all nine generic soil profiles for the Nuclear Island (NI) structures, the emergency diesel generator building (EDGB), and the diesel fuel oil tank (DFOT), compared to the design time history response spectra at the ground surface, and the CSDRS scaled to 0.1g PGA. For the standard design of APR1400, the nine soil profiles S1 through S9 represent a wide range of potential sites, with fundamental site frequencies in the range from 1.27 Hz to 12.01 Hz, as shown in Table 5-21 of APR1400-E-S-NR-14001-P, Rev. 0. In order for the staff to assess whether the CSDRS in the free field at the foundation level of the NI, EDGB, and DFOT structures meets the Appendix S 0.1g requirement, the applicant is requested to provide the following additional information:

a) Plots comparing the $CSDRS_{ff}$ for each soil profile

i) Since each of the nine soil profiles can potentially be a valid COL site, these generic soil profiles should be assessed separately when comparing to the Appendix S 0.1g requirement. The use of the envelope, as shown in Figures 3.7A-12 and 3.7A-23, is not sufficient to show that all soil cases satisfy Appendix S. The staff notes that individual $CSDRS_{ff}$ are available in APR1400-E-S-NR-14001-P, Rev. 0; however, this technical report is not incorporated by reference (IBR) in the DCD, and the figures in the report do not show a direct comparison to an appropriate response spectrum with a peak ground acceleration of at least 0.1g. Therefore, the applicant is requested to supplement Figures 3.7A-12 and 3.7A-13, to show that each of the 9 $CSDRS_{ff}$ for the NI, EDGB, and DFOT structures satisfies the Appendix S 0.1g requirement.

[NOTE: In supplementing Figures 3.7A-12 and 3.7A-13, figures should be provided separately for each building; otherwise the figures would be too crowded. In addition, the curves should be rendered with different line styles/weights, in addition to different colors, to accommodate black-and-white copying.]

ii) The CSDRS are defined in DCD Section 3.7.1.1.1 as linearly interpolated on a log-log scale between the control points. The CSDRS scaled to 0.1g in Figures 3.7A-12, 3.7A-13, and 3.7A-14 are not correct because they are interpolated on a log-linear scale. Therefore, the CSDRS scaled to 0.1g should be corrected in Figures 3.7A-12 through 3.7A-14 of the DCD.

iii) Some of the labels in Figures 3.7A-12 and 3.7A-13 do not appear to be in the correct order. For example, labels for EDGB and DFOT appear to be switched in Figure 3.7A-12, and the labels for NI, EDGB, and DFOT seemingly should be EDGB, DFOT, and NI, respectively, in Figure 3.7A-13 (based on comparison to Figures 5-25 through 5-31 in APR1400-E-S-NR-14001-P, Rev. 0). In this report, Figure 5-26 appears to be exactly the same as Figure 5-25. The applicant is requested to correct these incorrect labels and figures in the DCD and report.

[NOTE: Given the mistakes cited above, all other figures and tables in the DCD and technical reports referenced in the DCD should be checked for accuracy, and any required revisions should be submitted to the staff as soon as possible, to facilitate an efficient staff review.]

b) Differences in $CSDRS_{ff}$ for Soil Profiles S6 and S7

Figures 5-25 and 5-26 of APR1400-E-S-NR-14001-P, Rev. 0 show that the $CSDRS_{ff}$ in the horizontal directions for soil profiles S6 and S7 appear to be significantly different from the other soil cases for the NI structure. Figure 5-27 shows that the $CSDRS_{ff}$ in the vertical direction for these two soil cases are also different but not as significant. The variation in the strain-compatible soil profiles among the 9 layered soil profiles are gradual, as shown in Figures 5-14 through 5-22, and as shown by the approximately linear behavior of the soil fundamental frequency on a log scale in Figure 5-24. The transfer functions shown in Figure 5-23 also indicate that amplification effect occurs at various frequency points below 50 Hz for all soil cases. It is not obvious to the staff why only $CSDRS_{ff}$ for S6 and S7 show the large dips as shown in Figures 5-25 and 5-26 and why other soil profiles for the NI structure (and all soil cases for EDGB and DFOT) do not show any dips at their fundamental frequencies. The applicant is requested to explain in detail (1) the method to calculate the $CSDRS_{ff}$ and (2) why soil cases S6 and S7 for the NI behave differently from the remaining soil cases, and if the results presented in the technical report are not accurate, to include the corrected results for all soil cases, for all 3 structures.

Response

a) Figures 3.7A-12, 3.7A-13, and 3.7A-14 in DCD Tier 2 and Figures 5-25 through 5-31 in APR1400-E-S-NR-14001-P/NP, Rev.0, “Seismic Design Bases” will be revised as indicated in the attachment associated with this response. The revised figures are presented on a log-log scale. Labels on the revised figures, along with those which have not been changed in the DCD and technical reports, have been reviewed and confirmed to be correct. DCD Tier 2, Section 3.7.6 cites ARP1400-E-S-NR-14001-P/NP, Rev.0, “Seismic Design Bases” as Reference 9.

b) The $CSDRS_{ff}$ is generated from outcrop motions using the SHAKE91 program. The outcrop motions are calculated at the foundation elevation of each building. The procedure described in the NEI white paper, “Consistent Site-Response/Soil-Structure Interaction Analysis and Evaluation,” (June 12, 2009) was followed to produce the results.

The large dips for the S6 and S7 soil cases for the NI are due to the specific site layering configurations and site properties of the S6 and S7 profiles. These large dips are reflected in the site response transfer functions of the motions at the FIRS elevations of the NI structures, DFOT, and EDGB relative to their corresponding free-field surface motions, as indicated in Figures 1 through 18.

The input parameters for calculating transfer functions using the SHAKE91 program are the thickness of the soil layer, damping ratio, unit weight density, and shear wave velocity. However, the discontinuity of the shear wave velocity is expected to affect the transfer functions among the various input parameters.

To demonstrate this expectation, the transfer functions and response spectra at upper and lower layers of the interfaces which have discontinuity of shear wave velocity are computed as shown in Figures 19 through 24. Figures 19 and 22 represent the transfer functions and response spectra at layers numbers 40 and 41 of the S1 profile, as presented in DCD Tier 2, Table 3.7A-1. As indicated in Figures 19 and 22, transfer functions and response spectra at layer numbers 40 and 41 are quite different from each other, even though soil layer numbers 40 and 41 have similar input parameters, for thickness, unit weight density, and damping ratio, which are representative of the sand soil type. Despite all other parameters being similar, the shear wave velocities of layer numbers 40 and 41are not similar.

Similarly, Figures 20 and 23 represent the transfer functions and response spectra at layer numbers 20 and 21 of the S2 profile, as presented in DCD Tier 2, Table 3.7A-2. Soil layer numbers 20 and 21 have similar input parameters for the sand soil type, except for the shear wave velocities. Figures 21 and 24 represent the transfer functions and response spectra at soil layer numbers 20 and 21 of the S5 profile, as presented in DCD Tier 2, Table 3.7A-5. The soil layer numbers 20 and 21 of the S5 profile are of the rock soil type, and those layers have similar input parameters, except for the shear wave velocities.

Thus, the large dips in the transfer functions and response spectra for the S6 and S7 profiles are reasonable, because the interface which has a discontinuous shear wave velocity is located between the FIRS elevations of the NI structure and the DFOT/EDGB for the S6 and S7 profiles.

The soil profiles are provided on the enclosed CD (9 text files in CD)

A. Soil Profile for S1

B. Soil Profile for S2

C. Soil Profile for S3

D. Soil Profile for S4

E. Soil Profile for S5

F. Soil Profile for S6

G. Soil Profile for S7

H. Soil Profile for S8

I. Soil Profile for S9

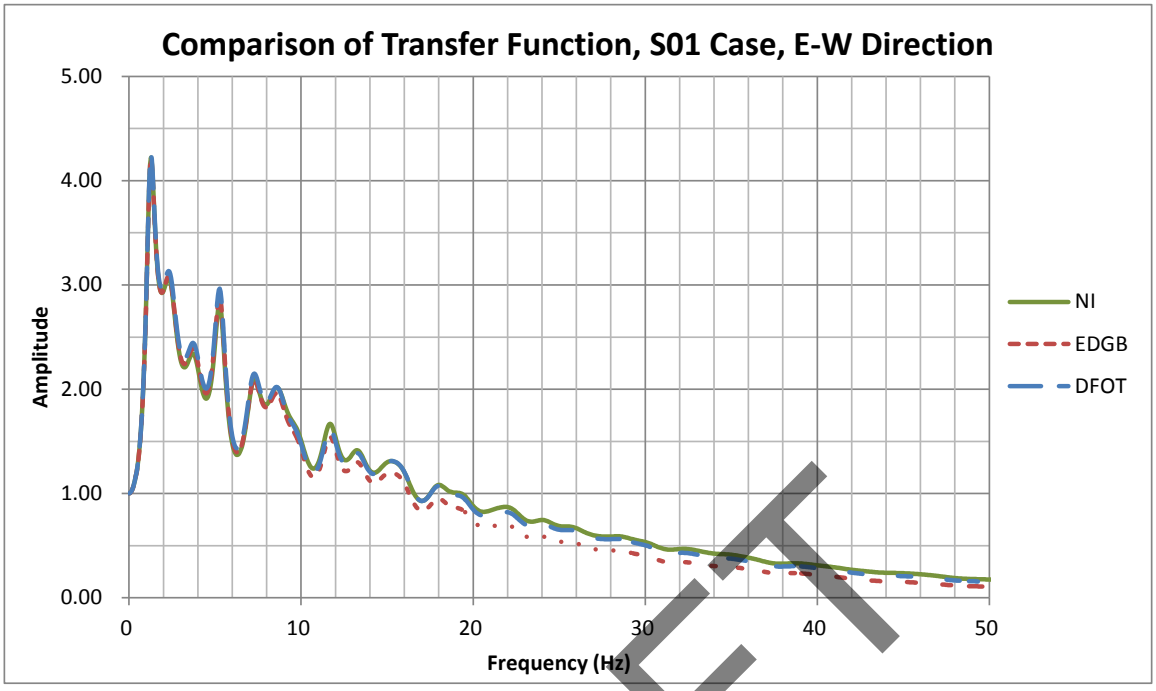

Figure 1: Comparison of Transfer Function for NI, EDGB and DFOT, S01 Case, E-W Direction

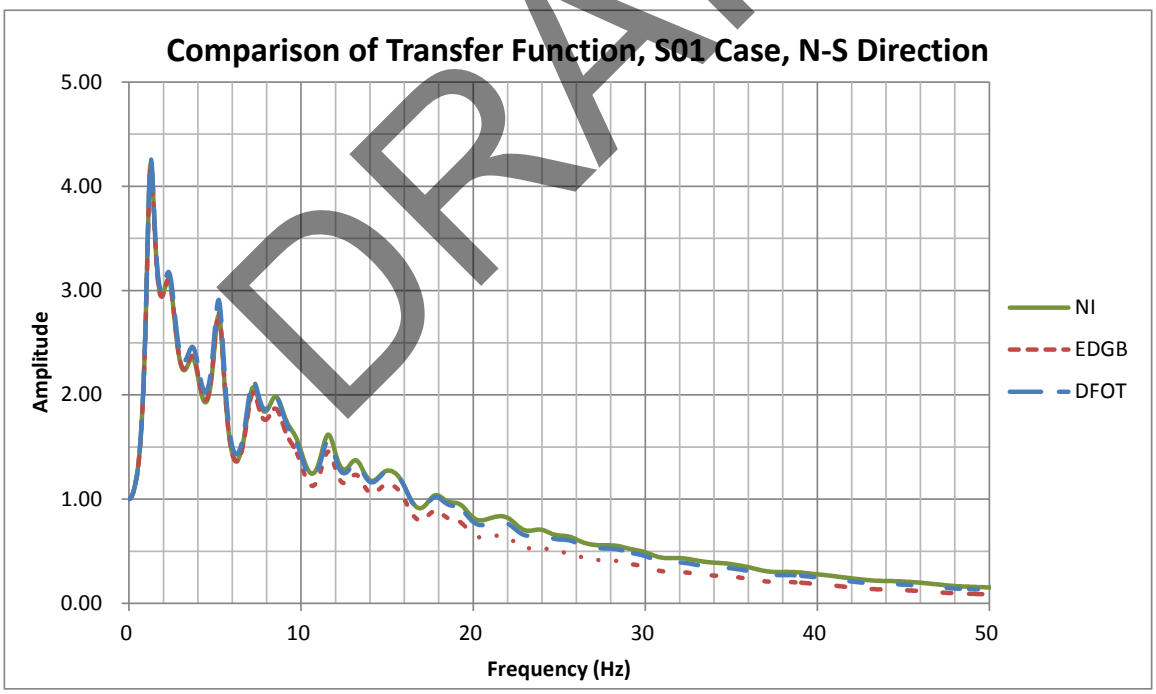

Figure 2: Comparison of Transfer Function for NI, EDGB and DFOT, S01 Case, N-S Direction

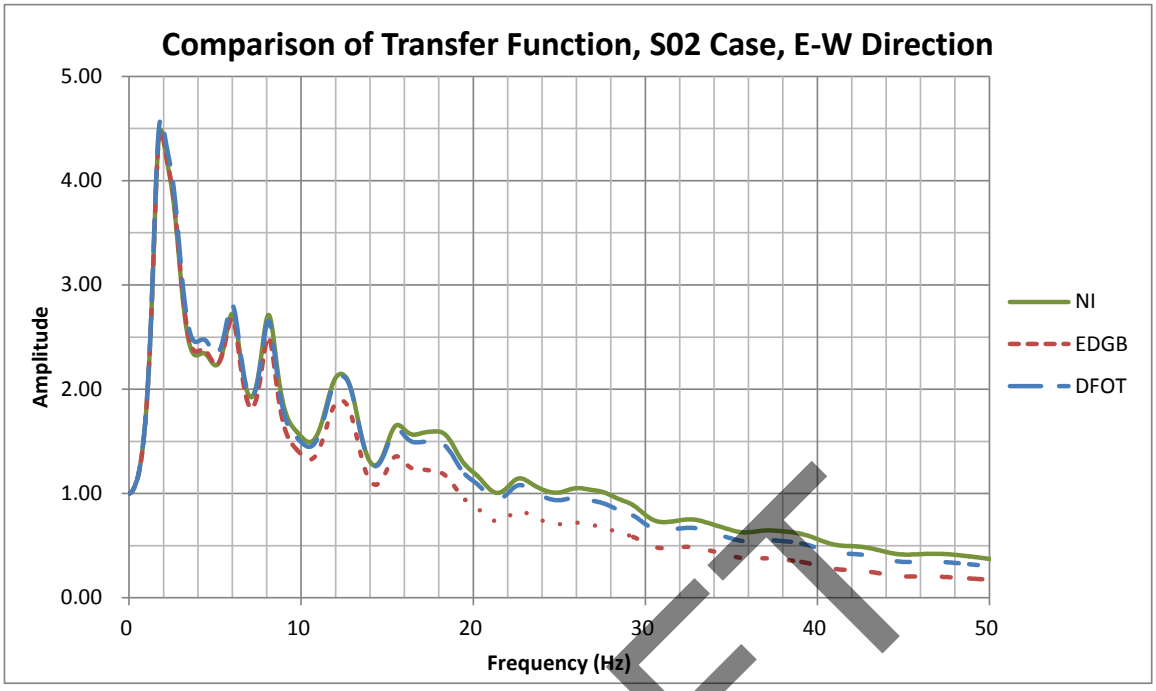

Figure 3: Comparison of Transfer Function for NI, EDGB and DFOT, S02 Case, E-W Direction

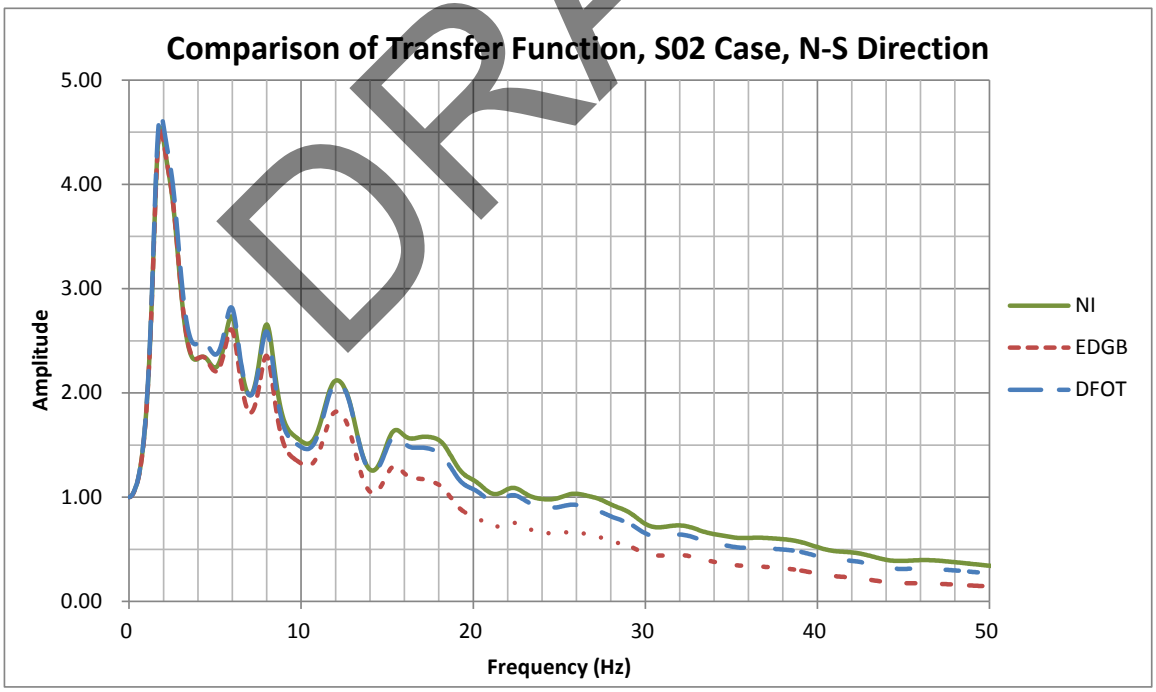

Figure 4: Comparison of Transfer Function for NI, EDGB and DFOT, S02 Case, N-S Direction

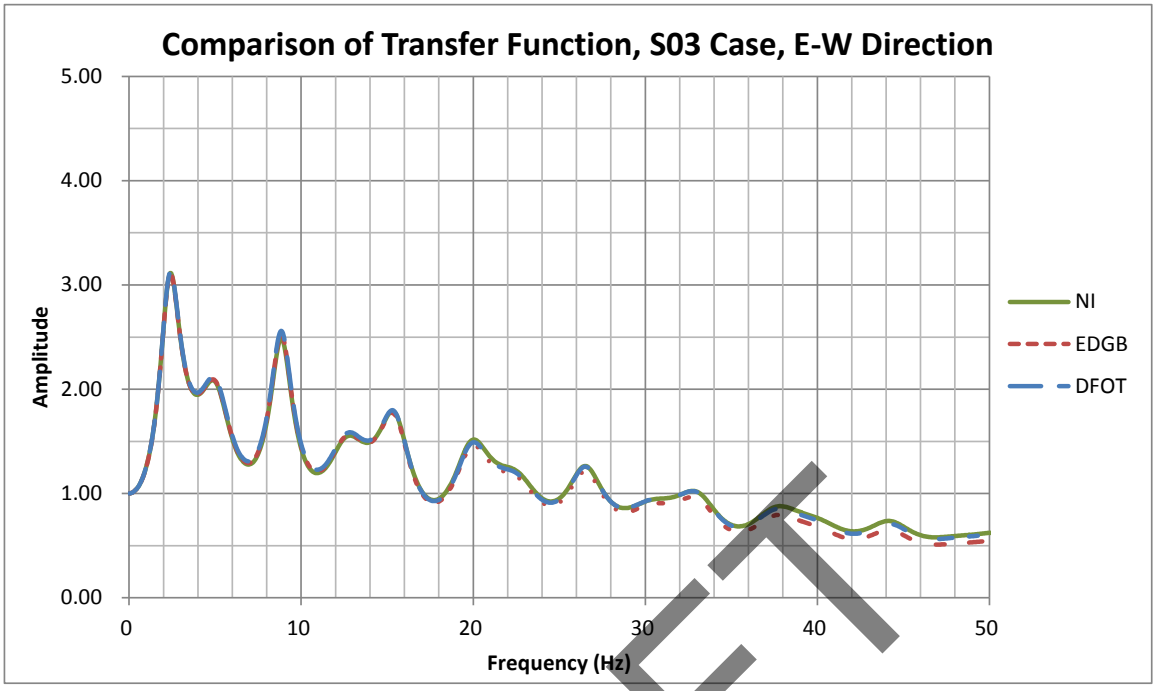

Figure 5: Comparison of Transfer Function for NI, EDGB and DFOT, S03 Case, E-W Direction

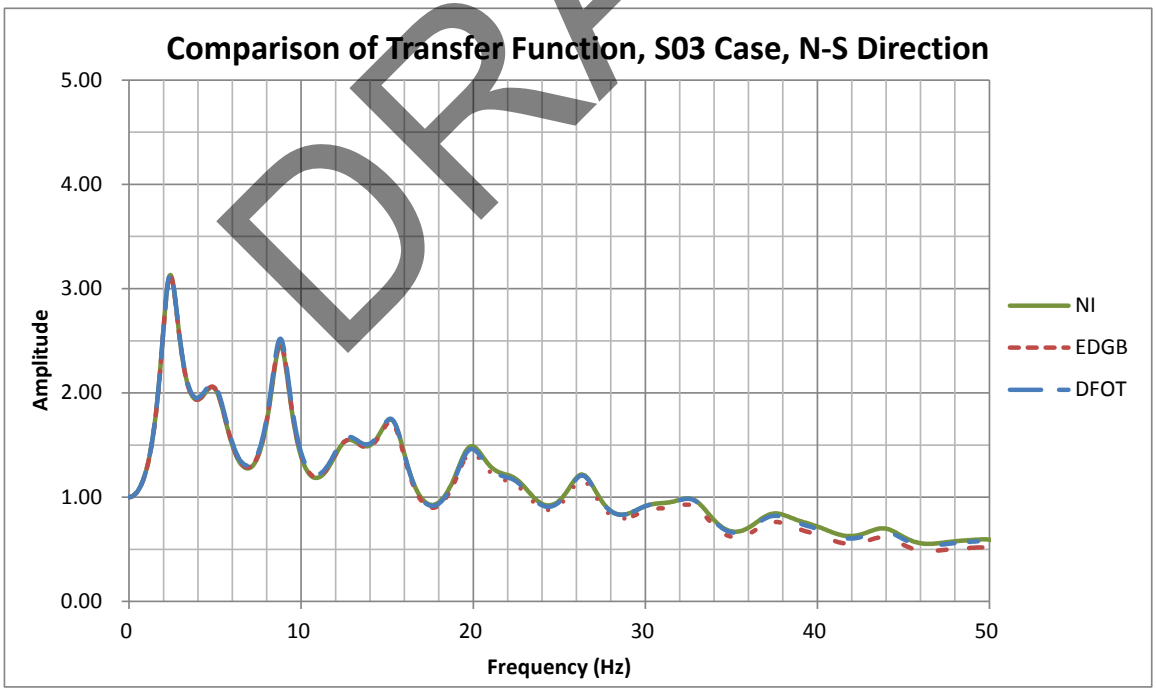

Figure 6: Comparison of Transfer Function for NI, EDGB and DFOT, S03 Case, N-S Direction

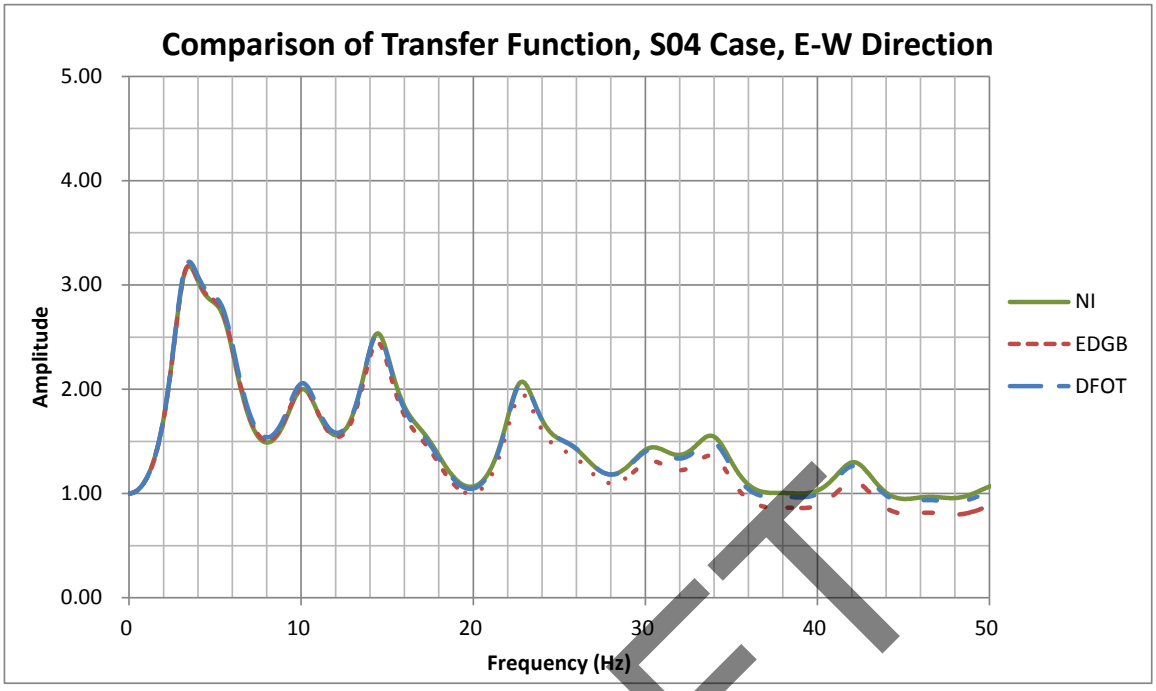

Figure 7: Comparison of Transfer Function for NI, EDGB and DFOT, S04 Case, E-W Direction

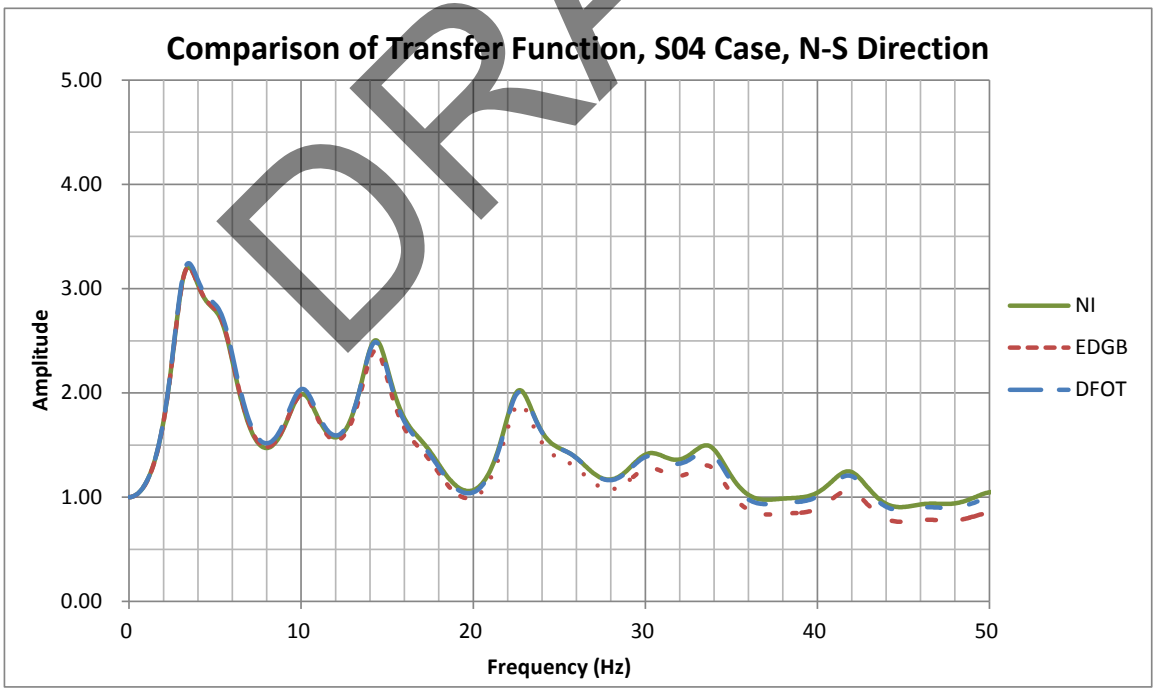

Figure 8: Comparison of Transfer Function for NI, EDGB and DFOT, S04 Case, N-S Direction

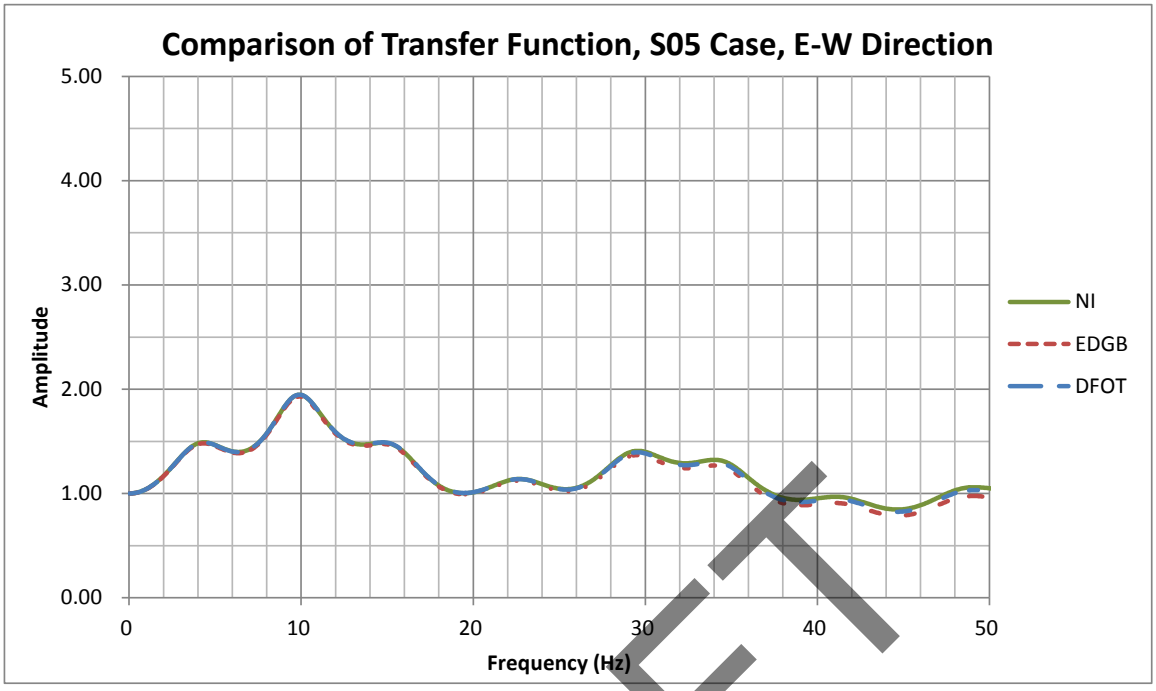

Figure 9: Comparison of Transfer Function for NI, EDGB and DFOT, S05 Case, E-W Direction

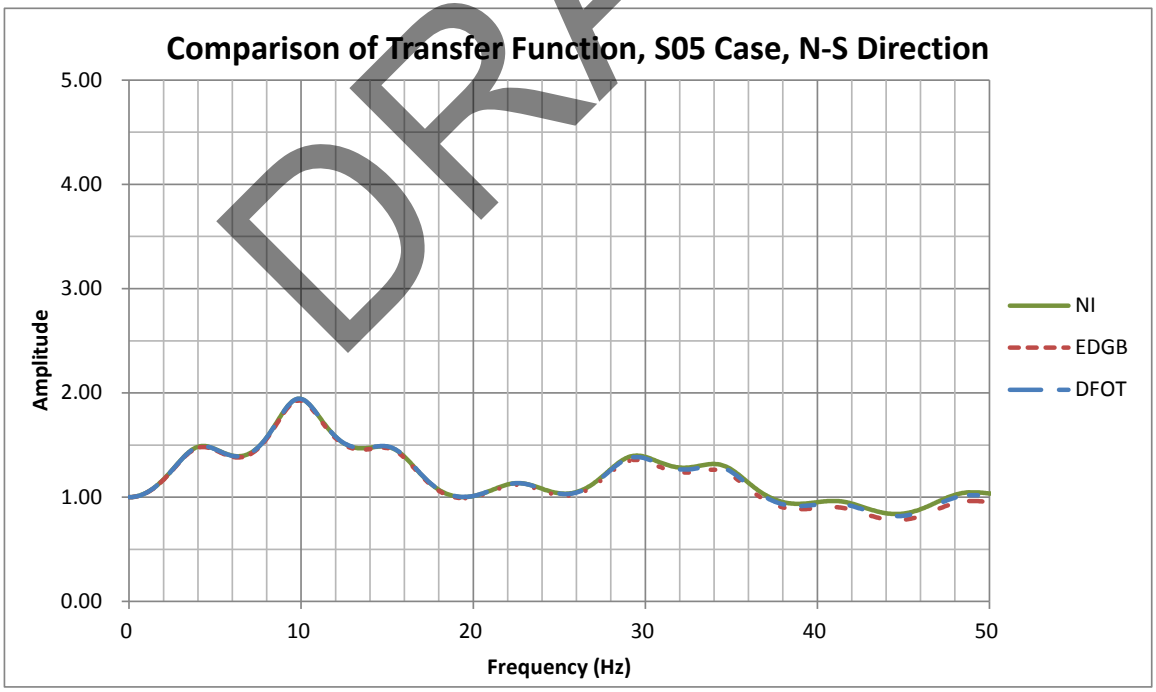

Figure 10: Comparison of Transfer Function for NI, EDGB and DFOT, S05 Case, N-S Direction

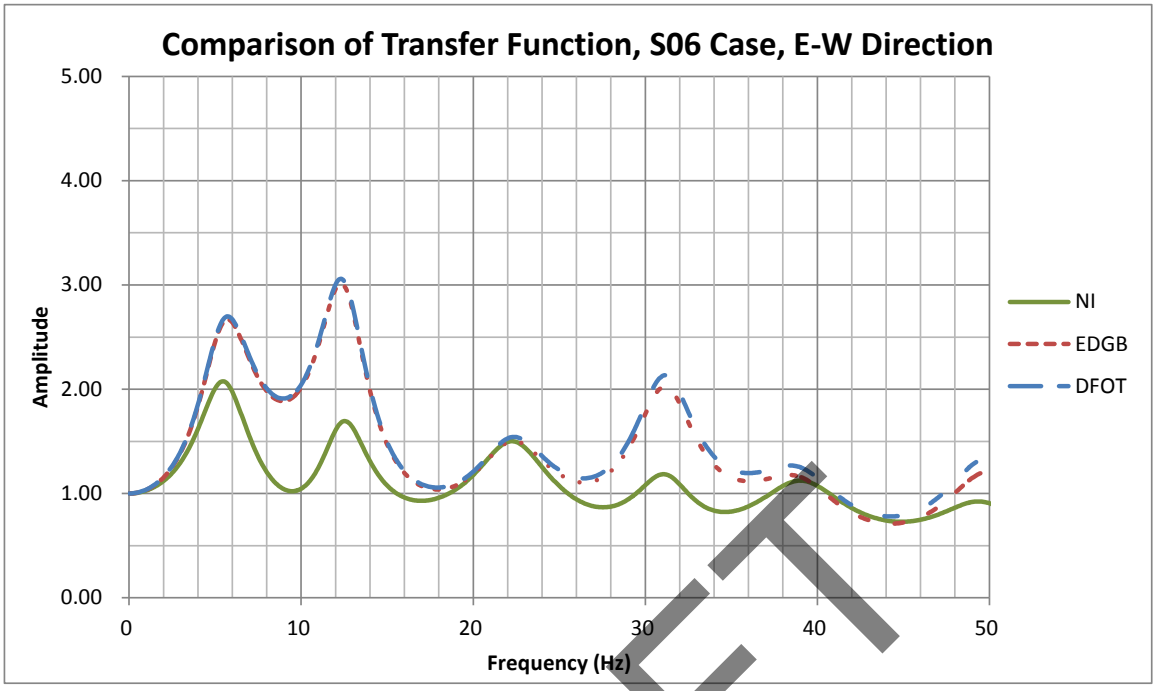

Figure 11: Comparison of Transfer Function for NI, EDGB and DFOT, S06 Case, E-W Direction

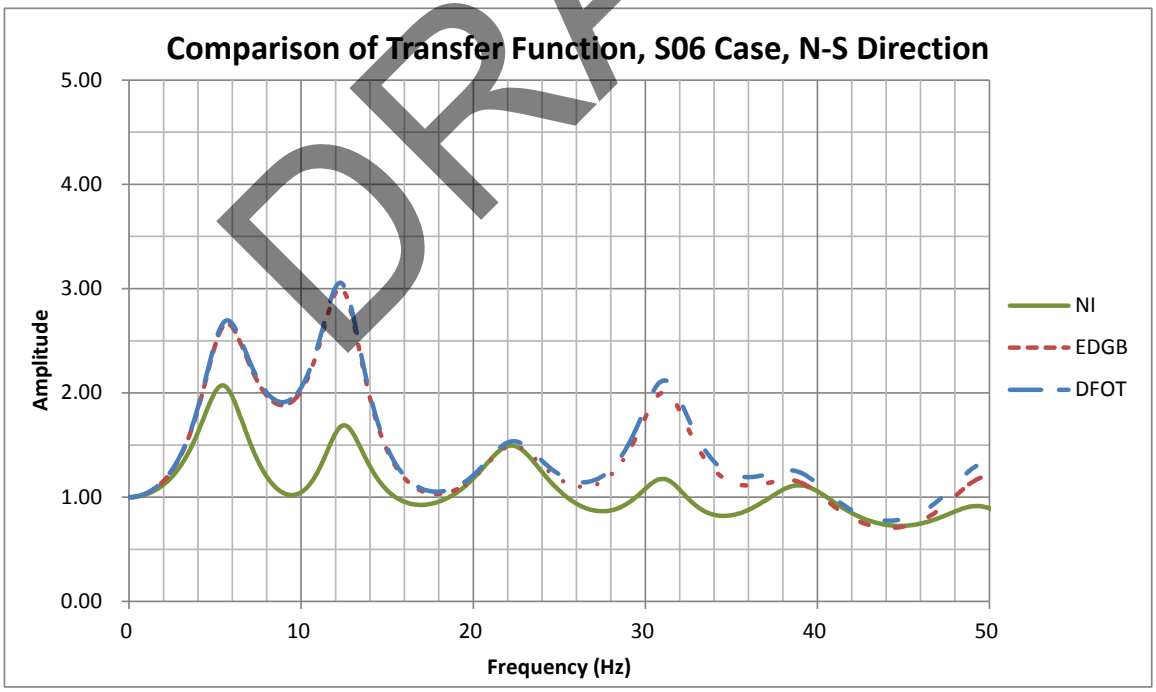

Figure 12: Comparison of Transfer Function for NI, EDGB and DFOT, S06 Case, N-S Direction

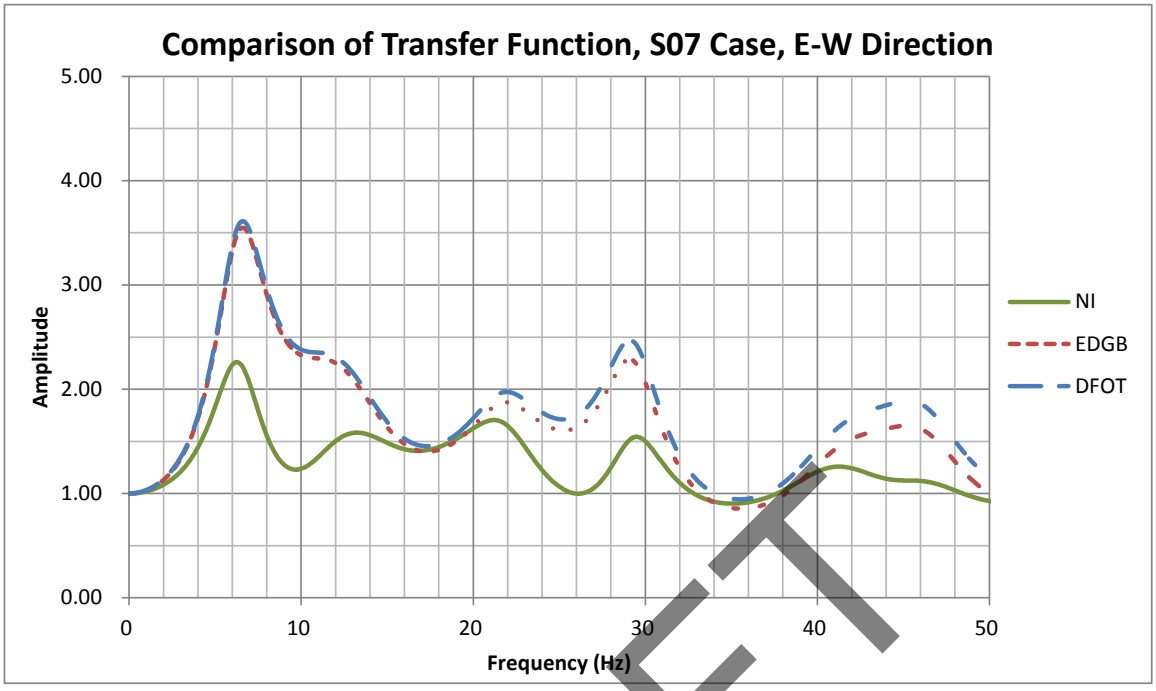

Figure 13: Comparison of Transfer Function for NI, EDGB and DFOT, S07 Case, E-W Direction

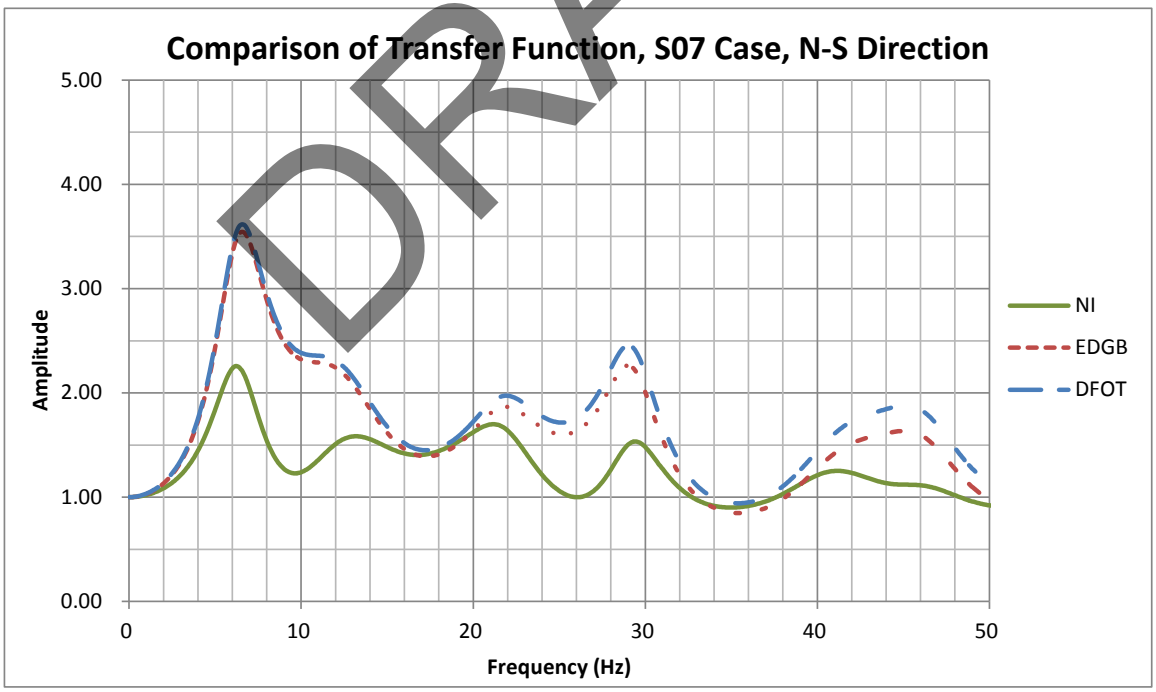

Figure 14: Comparison of Transfer Function for NI, EDGB and DFOT, S07 Case, N-S Direction

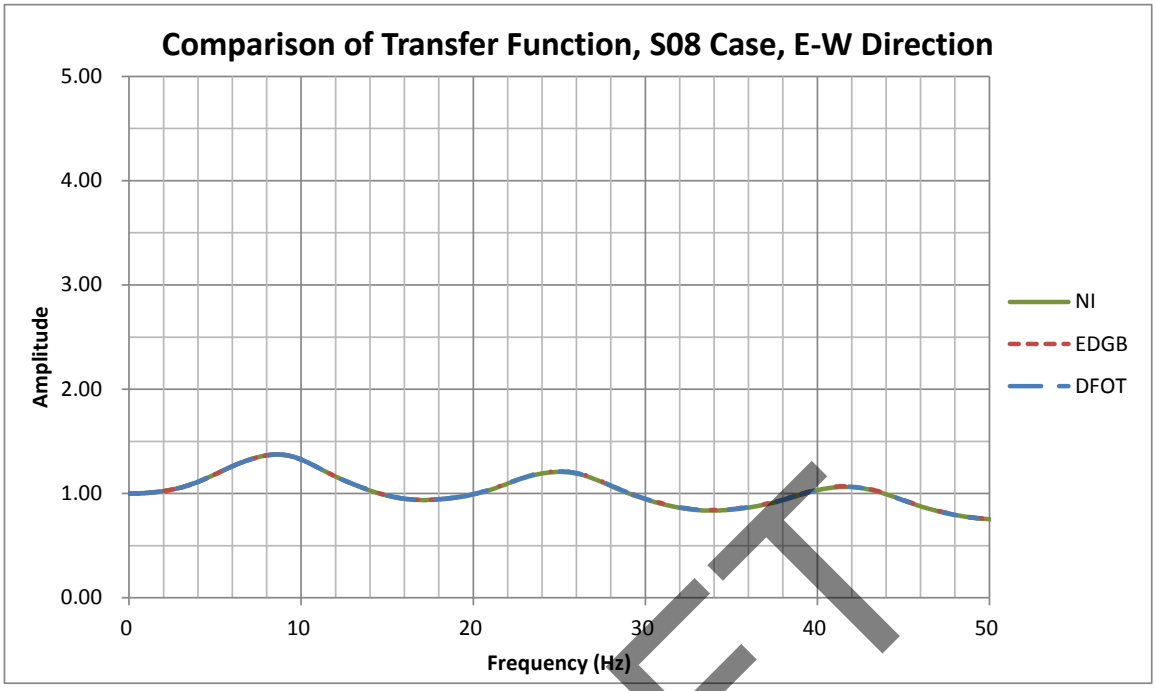

Figure 15: Comparison of Transfer Function for NI, EDGB and DFOT, S08 Case, E-W Direction

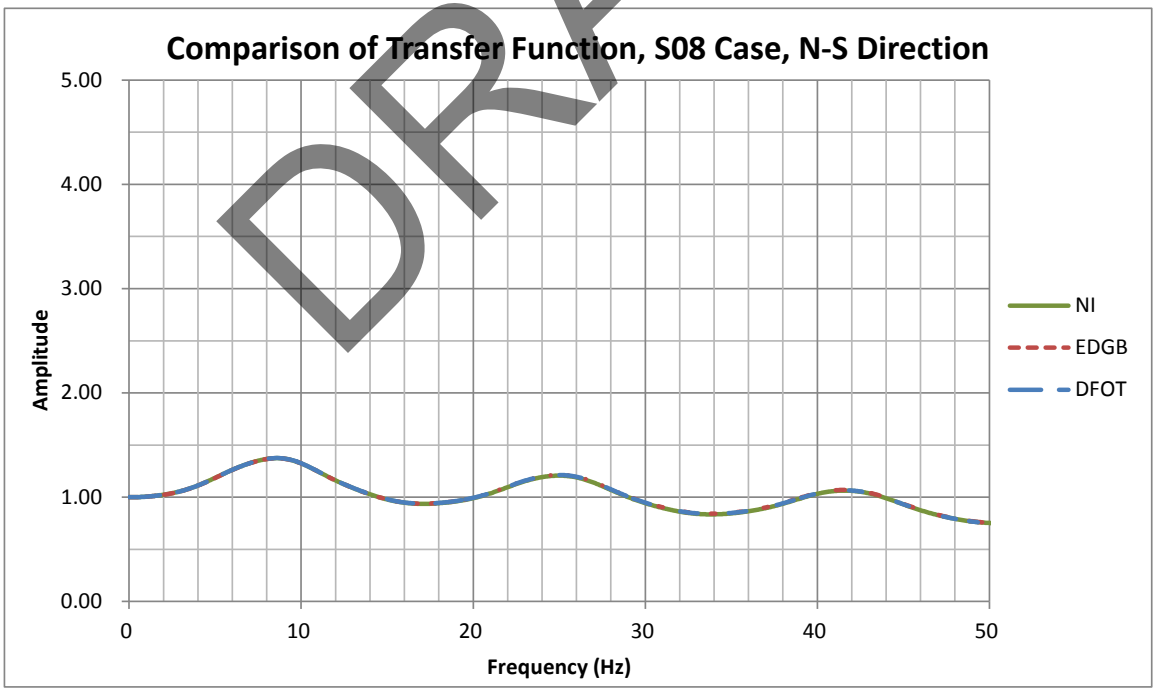

Figure 16: Comparison of Transfer Function for NI, EDGB and DFOT, S08 Case, N-S Direction

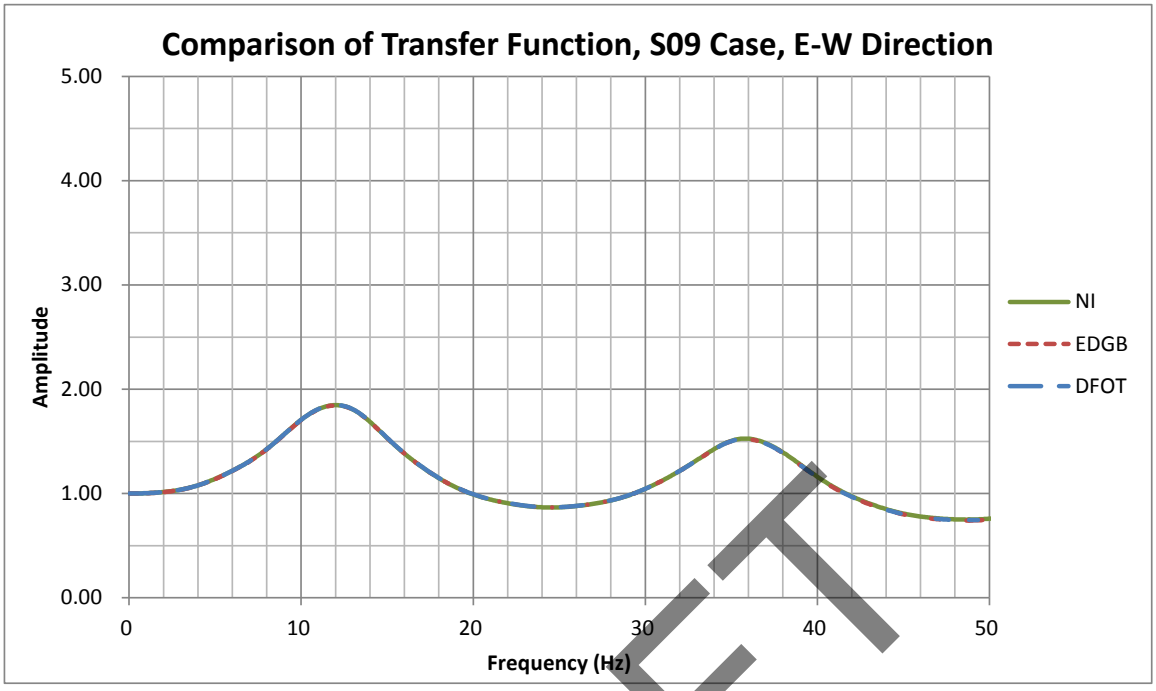

Figure 17: Comparison of Transfer Function for NI, EDGB and DFOT, S09 Case, E-W Direction

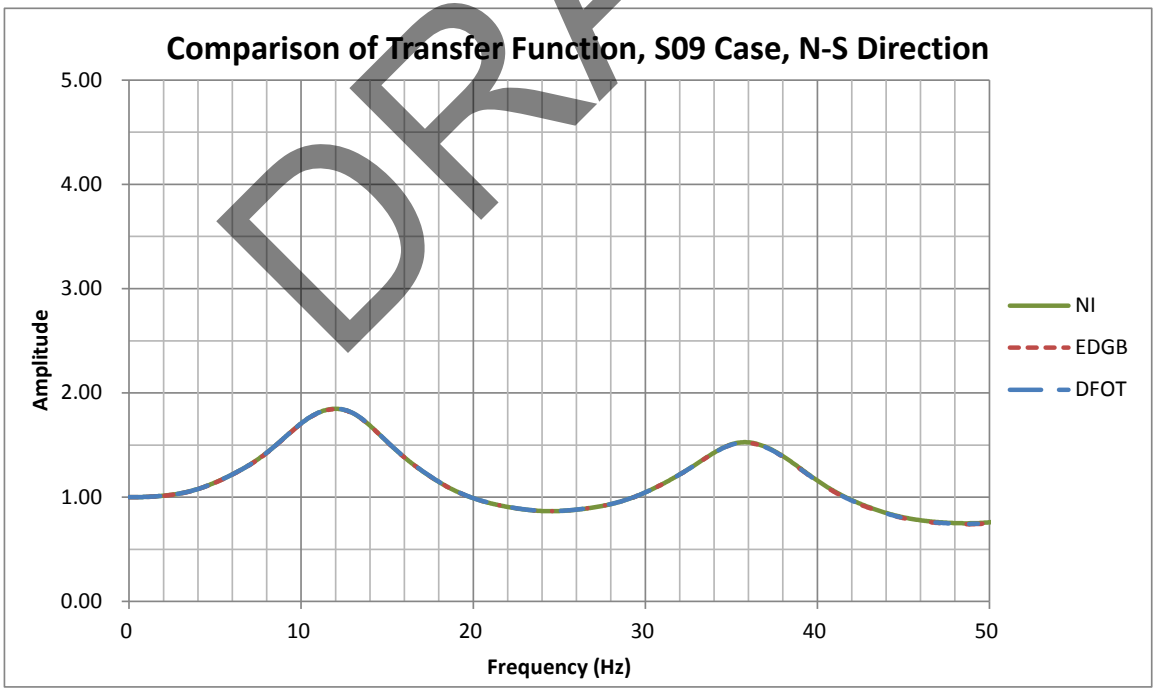

Figure 18: Comparison of Transfer Function for NI, EDGB and DFOT, S09 Case, N-S Direction

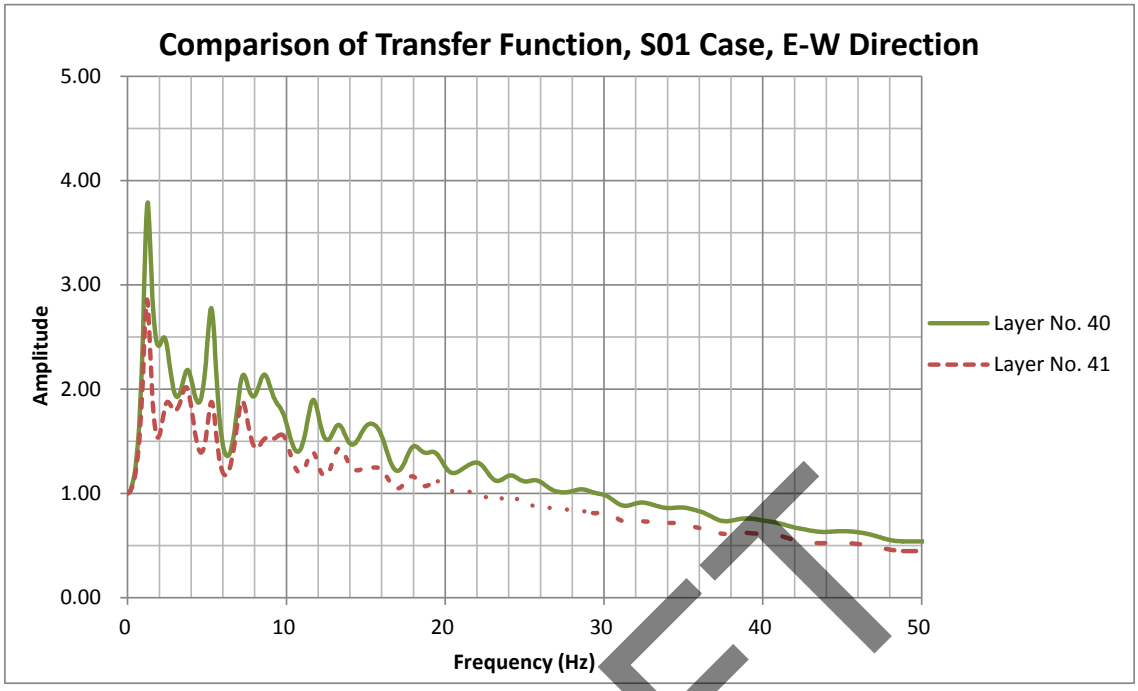

Figure 19: Comparison of Transfer Function for 40th and 41th Layer, S01 Case, E-W Direction

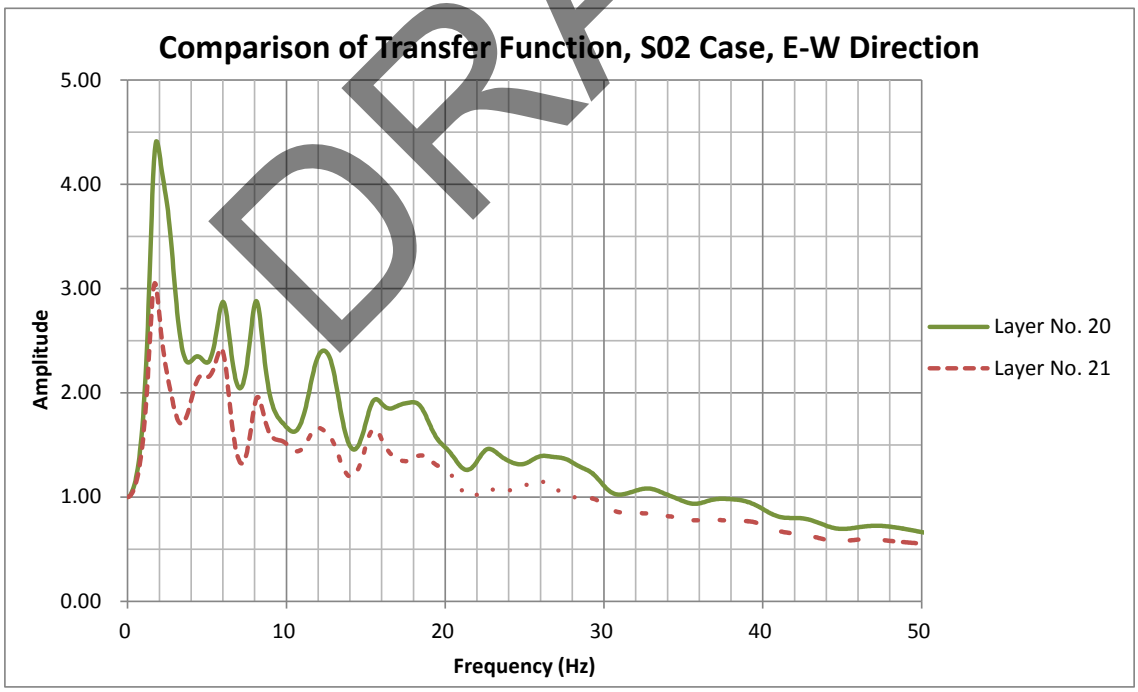

Figure 20: Comparison of Transfer Function for 20th and 21th Layer, S02 Case, E-W Direction

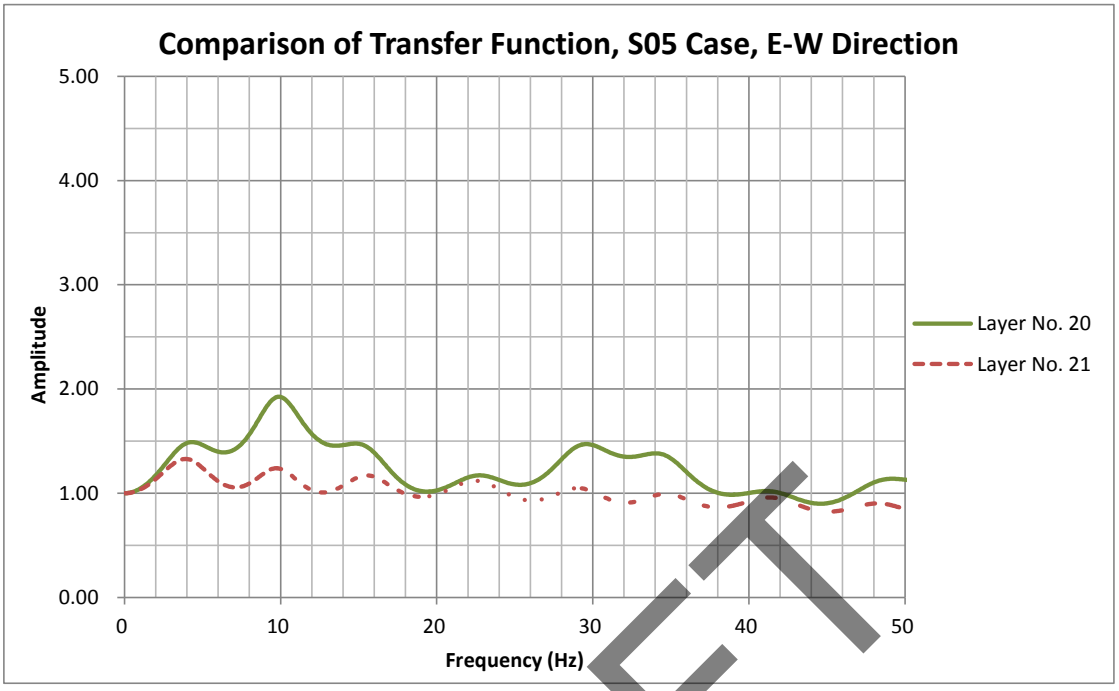

Figure 21: Comparison of Transfer Function for 20th and 21th Layer, S05 Case, E-W Direction

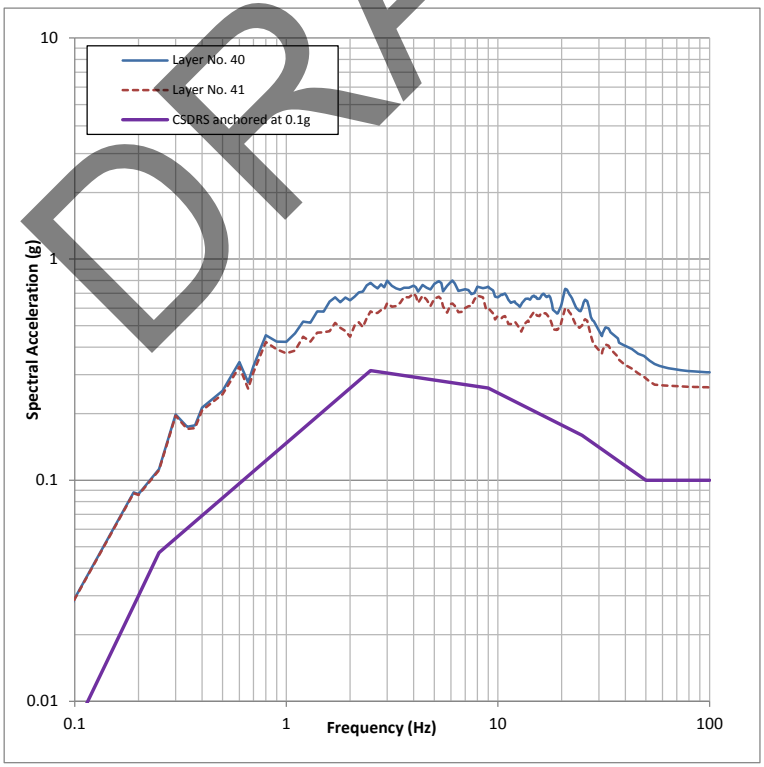

Figure 22: Comparison of Response Spectra for 40th and 41th Layer, S01 Case, E-W Direction

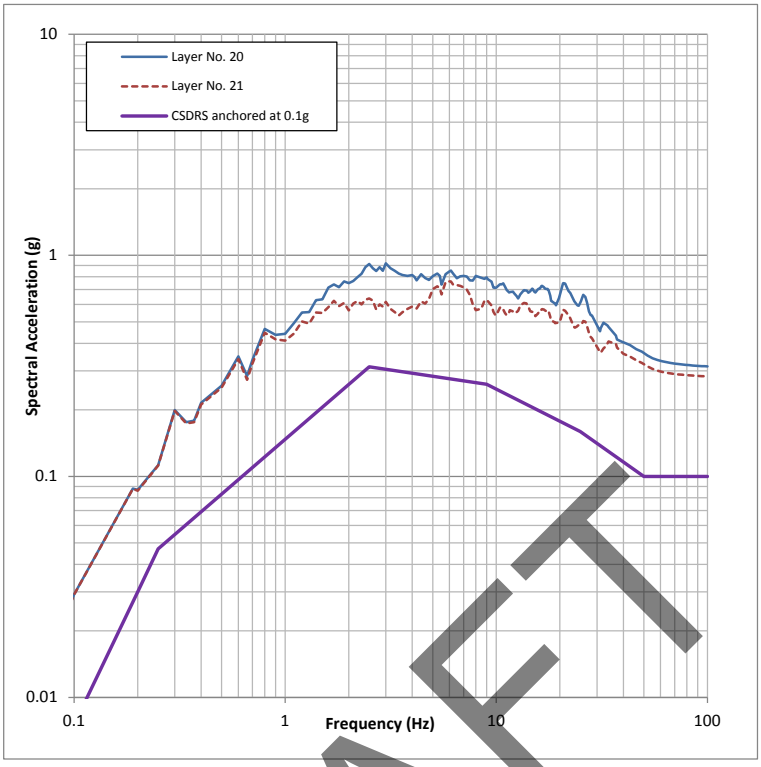

Figure 23: Comparison of Response Spectra for 20th and 21th Layer, S02 Case, E-W Direction

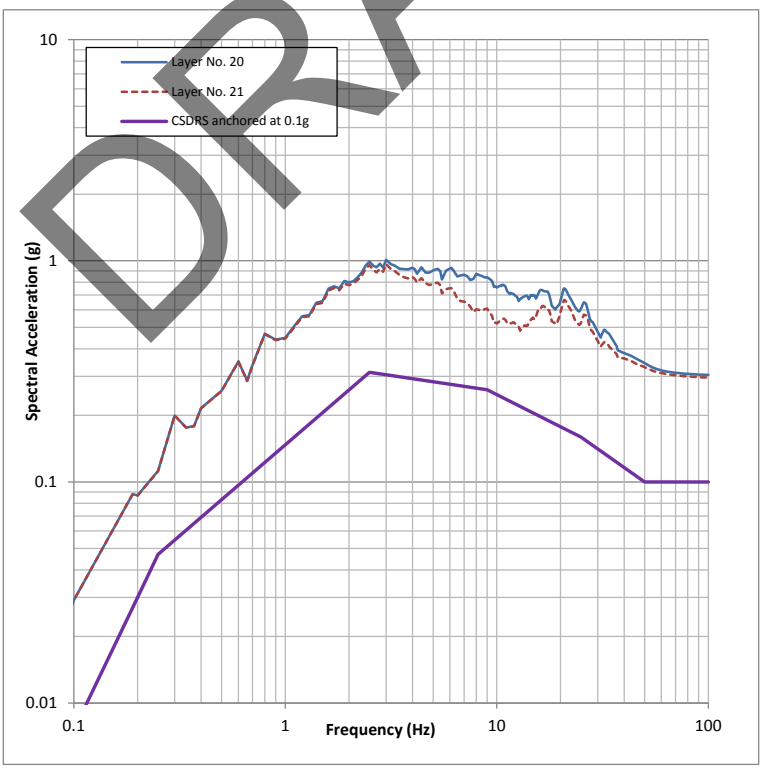

Figure 24: Comparison of Response Spectra for 20th and 21th Layer, S05 Case, E-W Direction

Impact on DCD

DCD Tier 2 Section 3.7.1.1.1 and Figures 3.7A-12 through 3.7A-14 will be revised, as indicated in the attachment associated with this response.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

Technical report APR1400-E-S-NR-14001-P/NP, Rev. 0, Figures 5-25 through 5-31 will be revised, as indicated in the attachment associated with this response.

3.7.1.1 Design Ground Motion

The design response spectra of the site-independent SSE are now referred to as the certified seismic design response spectra (CSDRS). The CSDRS and design time histories compatible with CSDRS are described in the following subsections.

3.7.1.1.1 Design Ground Motion Response Spectra

The peak ground acceleration (PGA) of the CSDRS has been established as 0.3g for the APR1400 design for both the horizontal and vertical directions.

The horizontal and vertical CSDRS for the APR1400 are based on the NRC Regulatory Guide (RG) 1.60 (Reference 3) response spectra, enriched in the high frequency range in the following manner.

a. The spectral amplitudes of the horizontal and vertical response spectra at control frequencies 9 Hz and below are equal to those of the NRC RG 1.60 response spectra.

b. The control frequency at which the PGA is reached is changed from 33 Hz to 50 Hz for both the horizontal and vertical spectra.

c. A control frequency at 25 Hz is added. The spectral amplitudes at 25 Hz are set to the NRC RG 1.60 response spectra at 25 Hz scaled by a factor of 1.30 for both the horizontal and vertical spectra.

d. Linearly vary the modified spectra, on a log-log-scale, between the control frequencies 9 Hz, 25 Hz, and 50 Hz.

The digitized values of the resulting APR1400 horizontal and vertical CSDRS for 2, 3, 4, 5, 7, and 10 percent damping values are provided in Table 3.7-1. The APR1400 horizontal and vertical CSDRS are presented in Figures 3.7-1 and 3.7-2, respectively.

The CSDRS are applied at the finished grade in the free-field as an additional requirement from 10 CFR Part 50, Appendix S. ~~Figures 3.7A-12 and 3.7A-13~~ in Appendix 3.7A show

Figures 3.7A-12 (1 of 3 and 2 of 3), 3.7A-13 (1 of 3 and 2 of 3), and 3.7A-14 (1 of 3 and 2 of 3)

that the horizontal components of CSDRS in the free-field at the foundation level of the APR1400 standard plant seismic Category I structures satisfy the PGA of at least 0.1g. The vertical component of CSDRS in the free-field at the foundation level of the APR1400 standard plant seismic Category I structures is presented in ~~Figure 3.7A-14~~ in Appendix 3.7A.

Figures 3.7A-12 (3 of 3), 3.7A-13 (3 of 3), and 3.7A-14 (3 of 3)

The site-specific seismic design can be developed for other seismic Category I and II SSCs, which are not included in the APR1400 standard plant design, at the combined license (COL) stage using the site-specific SSE derived from the ground motion response spectra (GMRS) in accordance with NRC RG 1.208 (Reference 4). In this case, the COL applicant is to determine the site-specific SSE and OBE that are applied to the seismic design of the site-specific seismic Category I and II SSCs and to the basis for the plant shutdown and is to verify the appropriateness of the site-specific SSE and OBE (COL 3.7(1)).

The COL applicant is to confirm that the horizontal components of the site-specific SSE ground motion in the free-field at the foundation level of the structures that are not included in the APR1400 standard plant design satisfy a PGA of at least 0.1g (COL 3.7(2)).

3.7.1.1.2 Design Ground Motion Time History

The three design acceleration time histories composed of two horizontal (H1 and H2) and one vertical components (VT), which envelop the CSDRS, are applied in both soil-structure interaction analyses and fixed-base analyses of seismic Category I structures. The initial seed motions that were modified to create the design time histories are actual seed-recorded Northridge earthquake time histories.

The design time histories are generated with an increment of time size of 0.005 second to provide a Nyquist frequency of 100 Hz. Figures 3.7-3, 3.7-4, and 3.7-5 show the acceleration, velocity, and displacement time histories for H1, H2, and VT components for each time step, respectively. The design time histories, H1, H2, and VT, are applied in the east-west (E-W) direction, north-south (N-S) direction, and vertical direction, respectively. The absolute values of correlation coefficients for each pair of the design time histories are as follows:

Correlation coefficient for H1 and H2 = 0.032

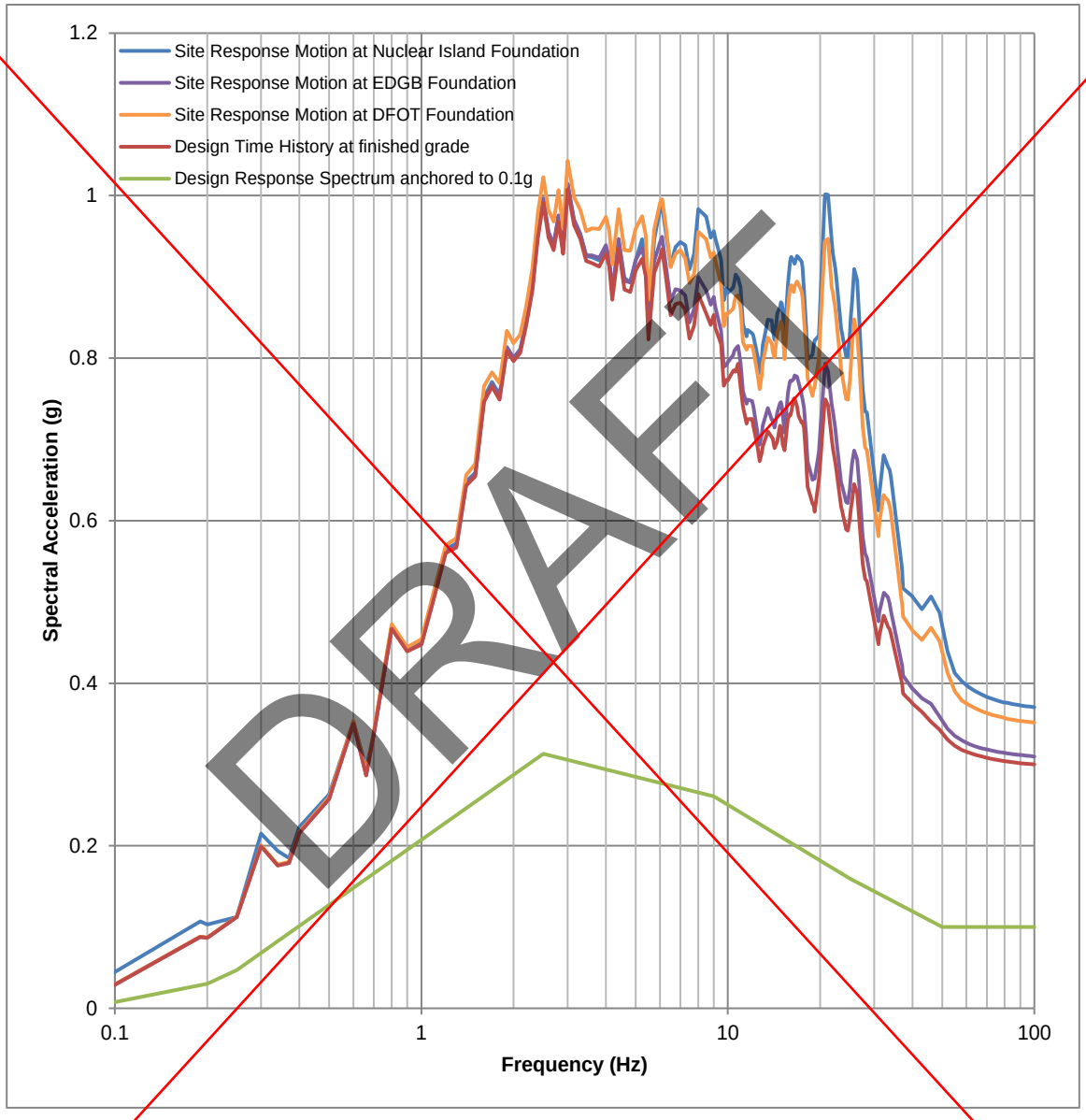

Figure 3.7A-12 Comparison of Design Time History Compatible with CSDRS with Site Response Motion at Foundation Base Elevation of Seismic Category I Structures, E-W Motion, 5% damping

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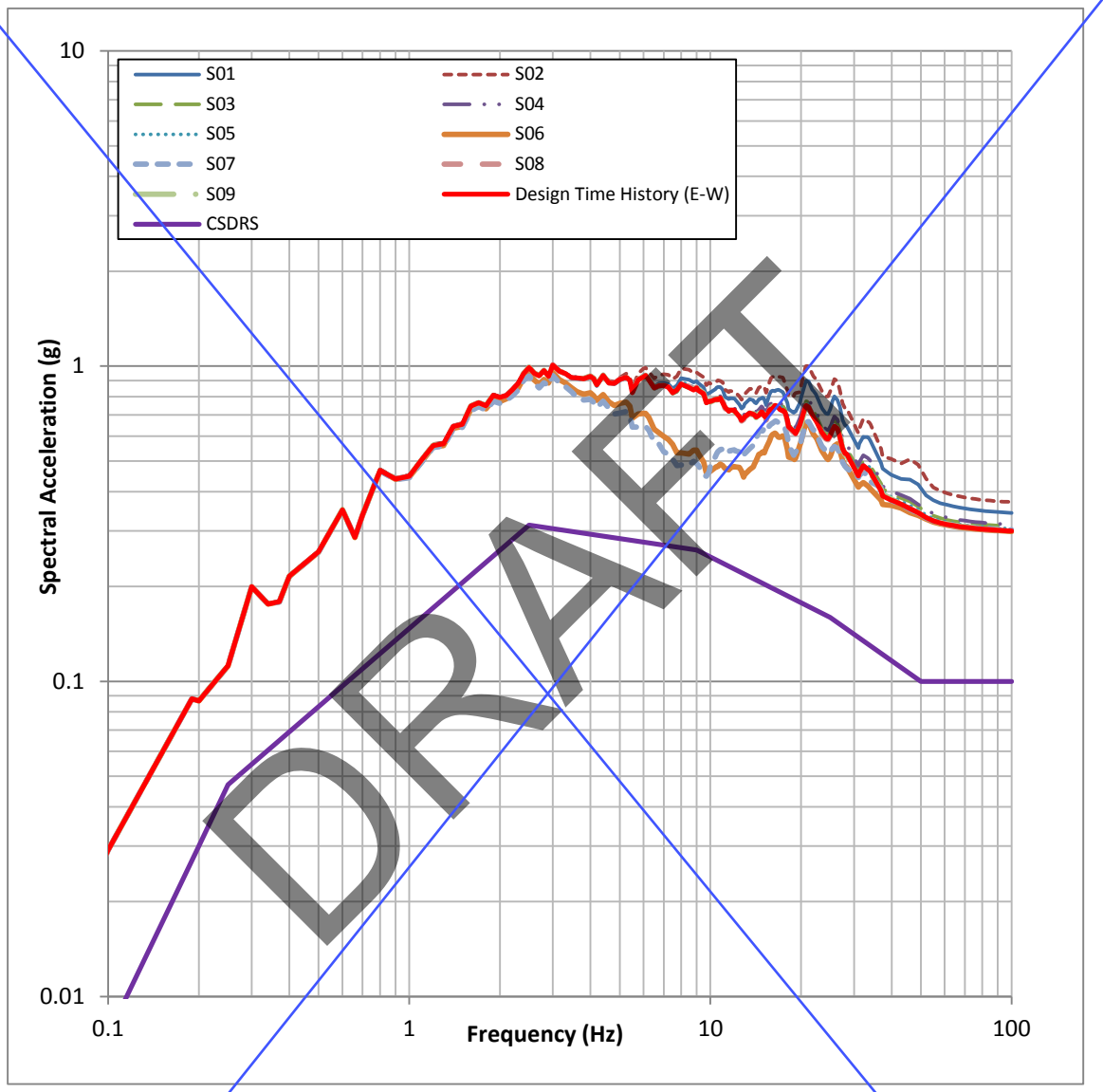

Figure 3.7A-12 Comparison of Design Time History Compatible with CSDRS with Site Response Motion at Foundation Base Elevation of Nuclear Island Structure, E-W Motion, 5% damping
(1 of 3)

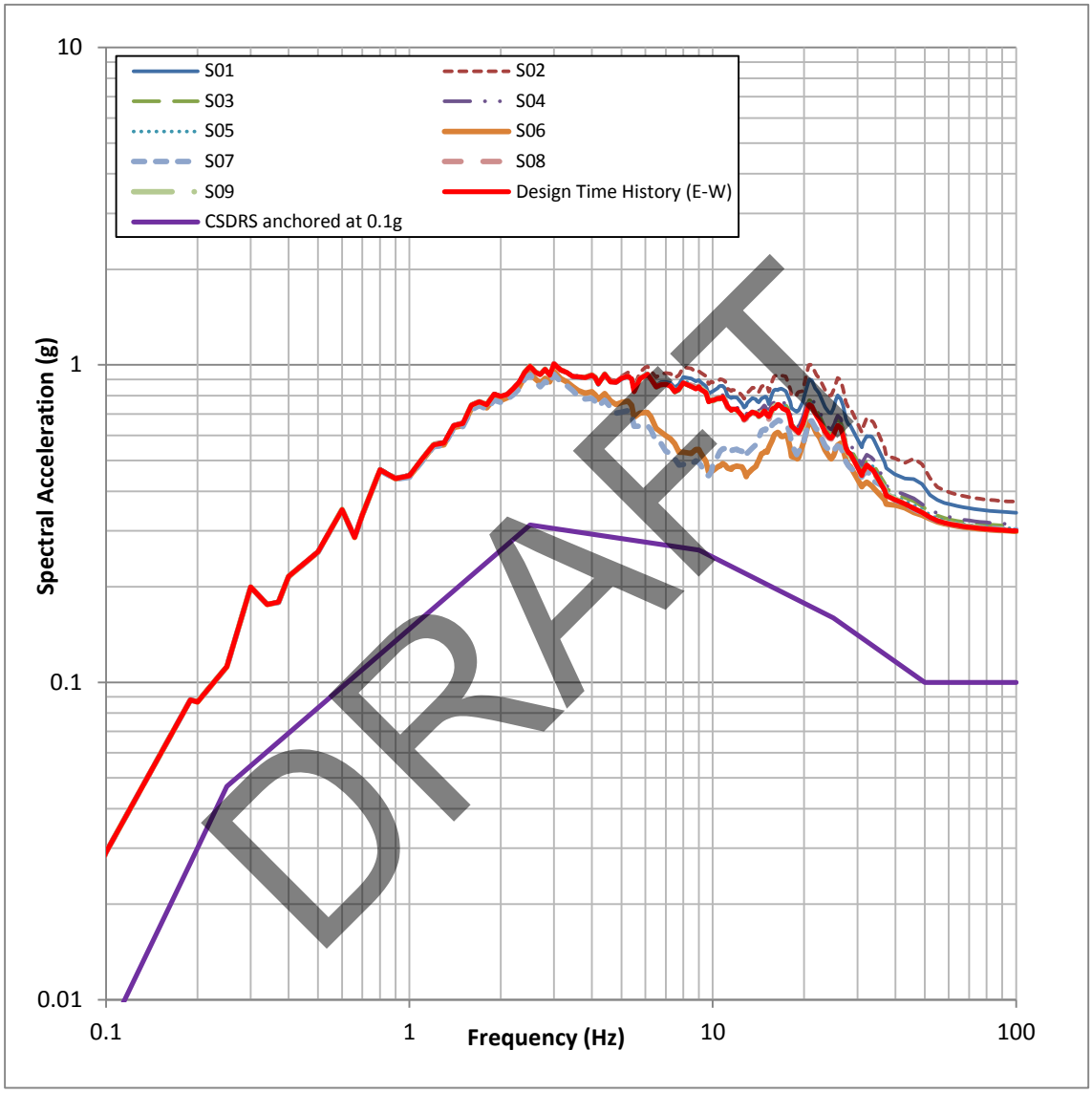

Figure 3.7A-12 Comparison of Design Time History Compatible with CSDRS with Site Response Motion at Foundation Base Elevation of Nuclear Island Structure, E-W Motion, 5% damping
(1 of 3)

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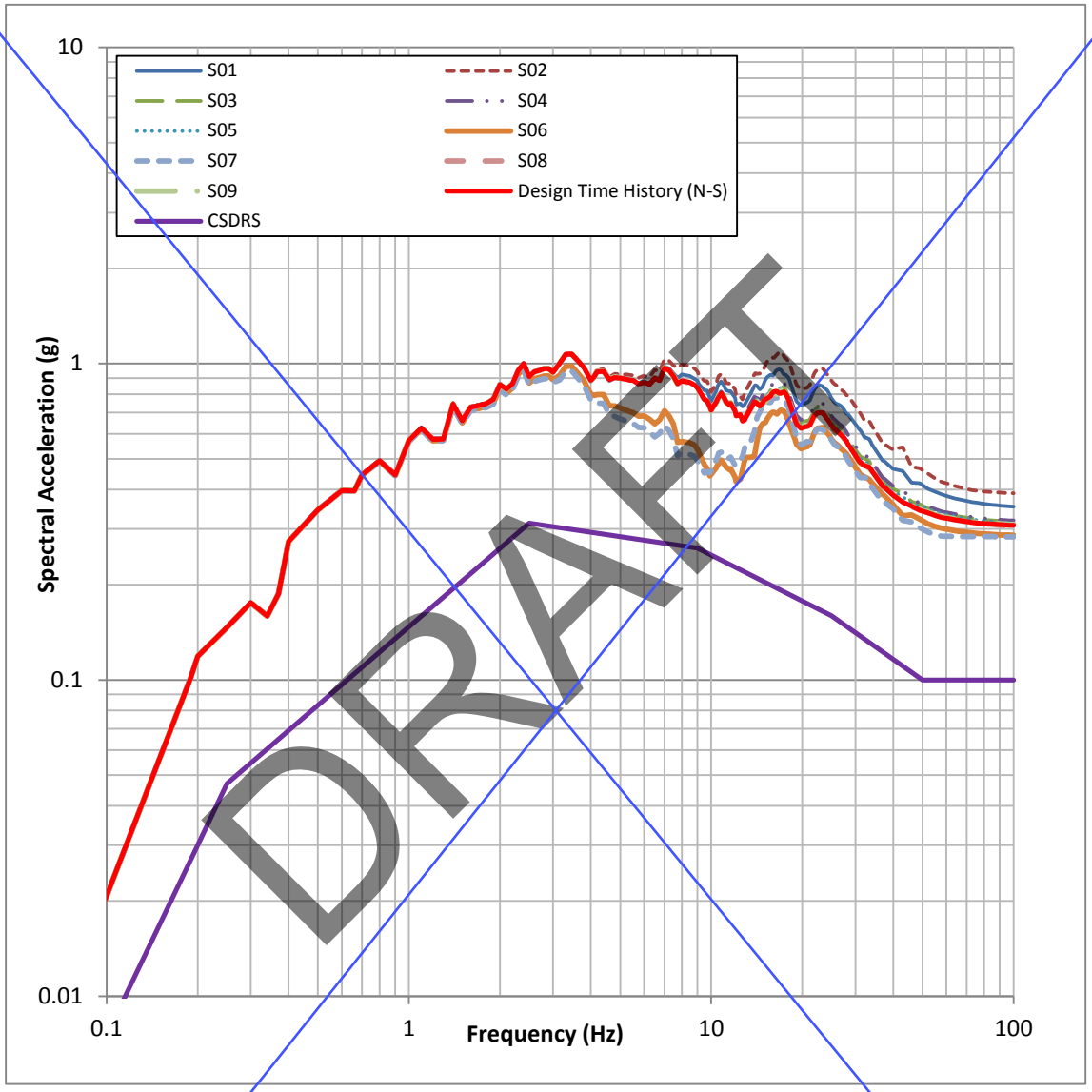

Figure 3.7A-12 Comparison of Design Time History Compatible with CSDRS with Site Response Motion at Foundation Base Elevation of Nuclear Island Structure, N-S Motion, 5% damping
(2 of 3)

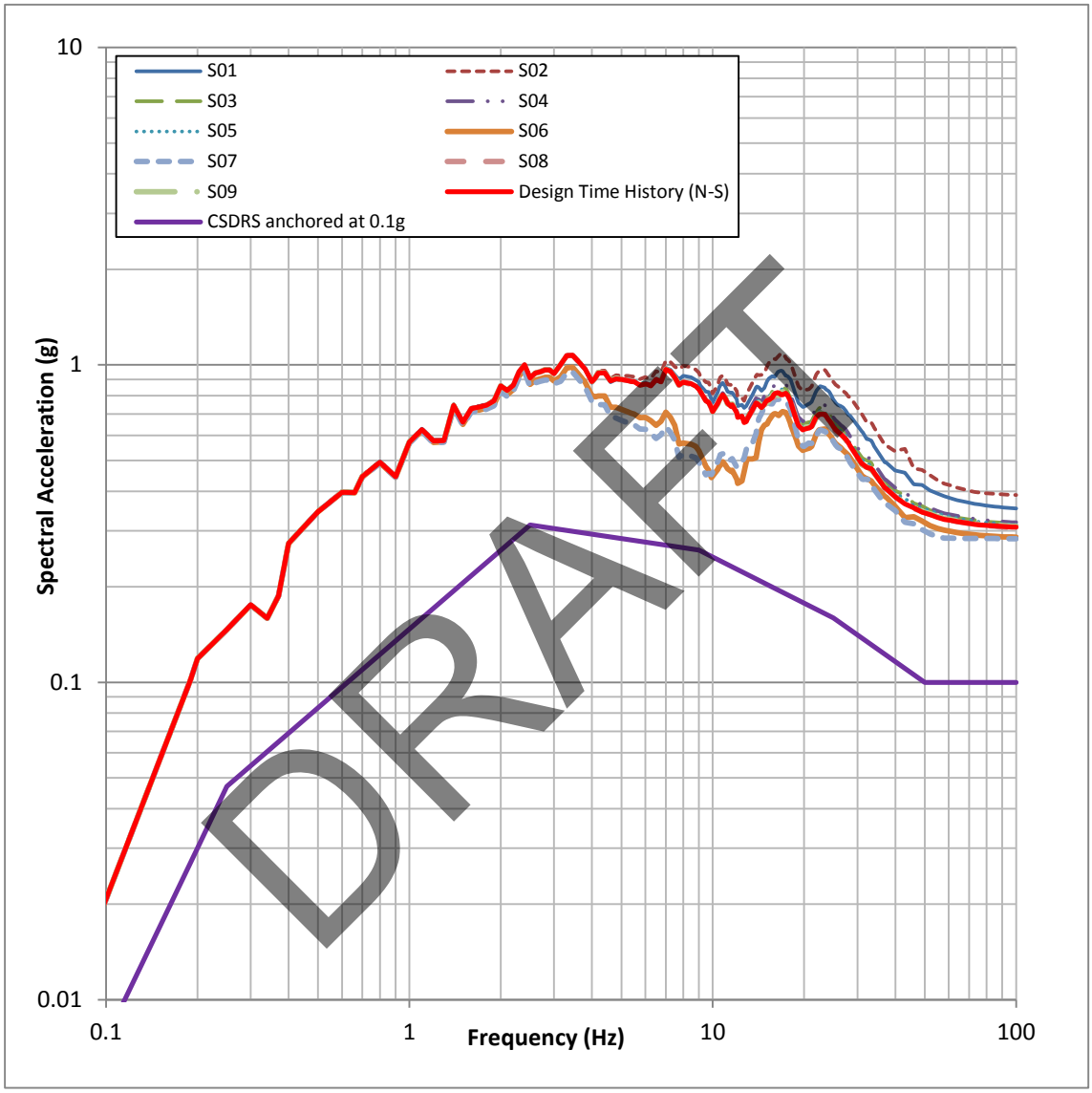

Figure 3.7A-12 Comparison of Design Time History Compatible with CSDRS with Site Response Motion at Foundation Base Elevation of Nuclear Island Structure, N-S Motion, 5% damping
(2 of 3)

Replace with next page

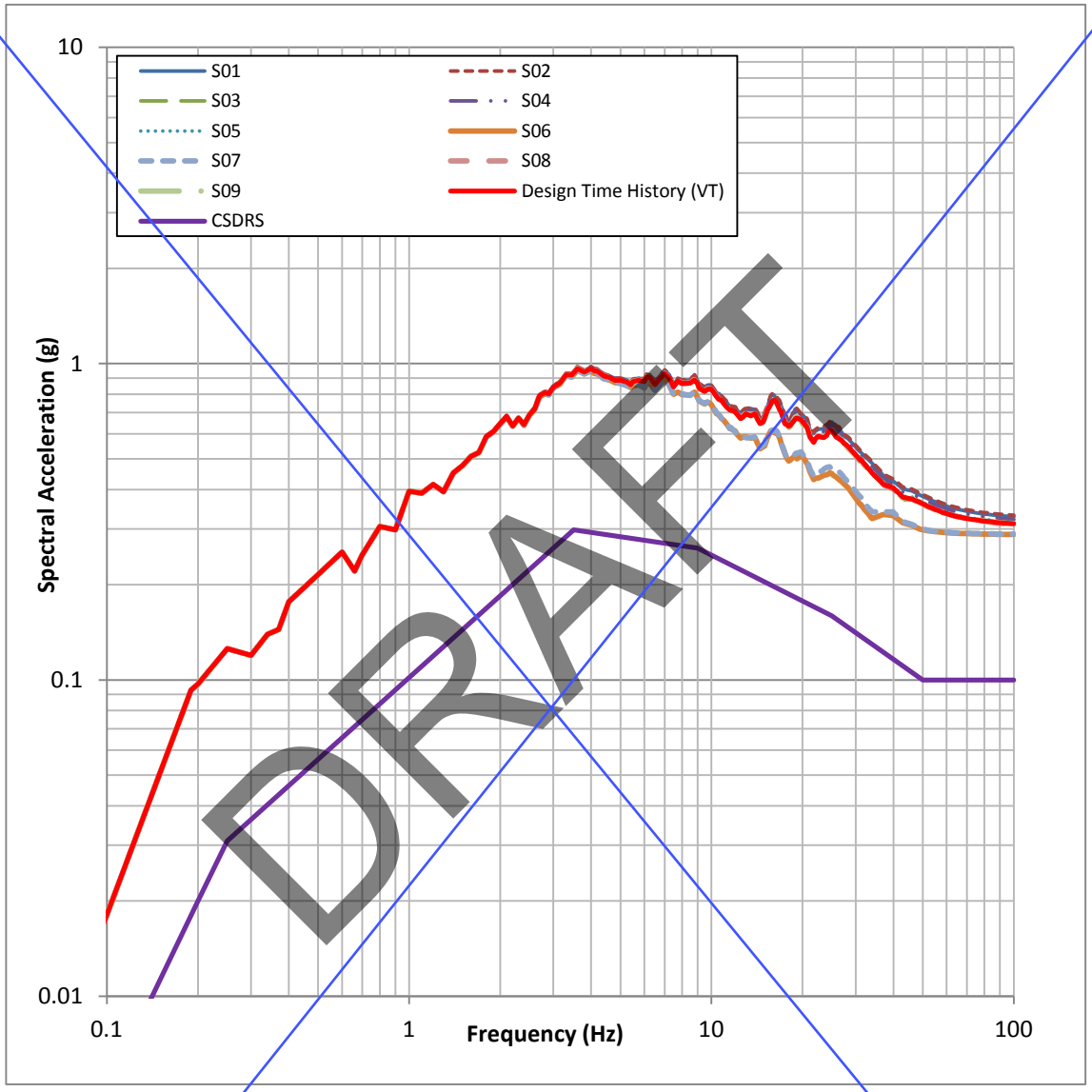

Figure 3.7A-12 Comparison of Design Time History Compatible with CSDRS with Site Response Motion at Foundation Base Elevation of Nuclear Island Structure, Vertical Motion, 5% damping
(3 of 3)

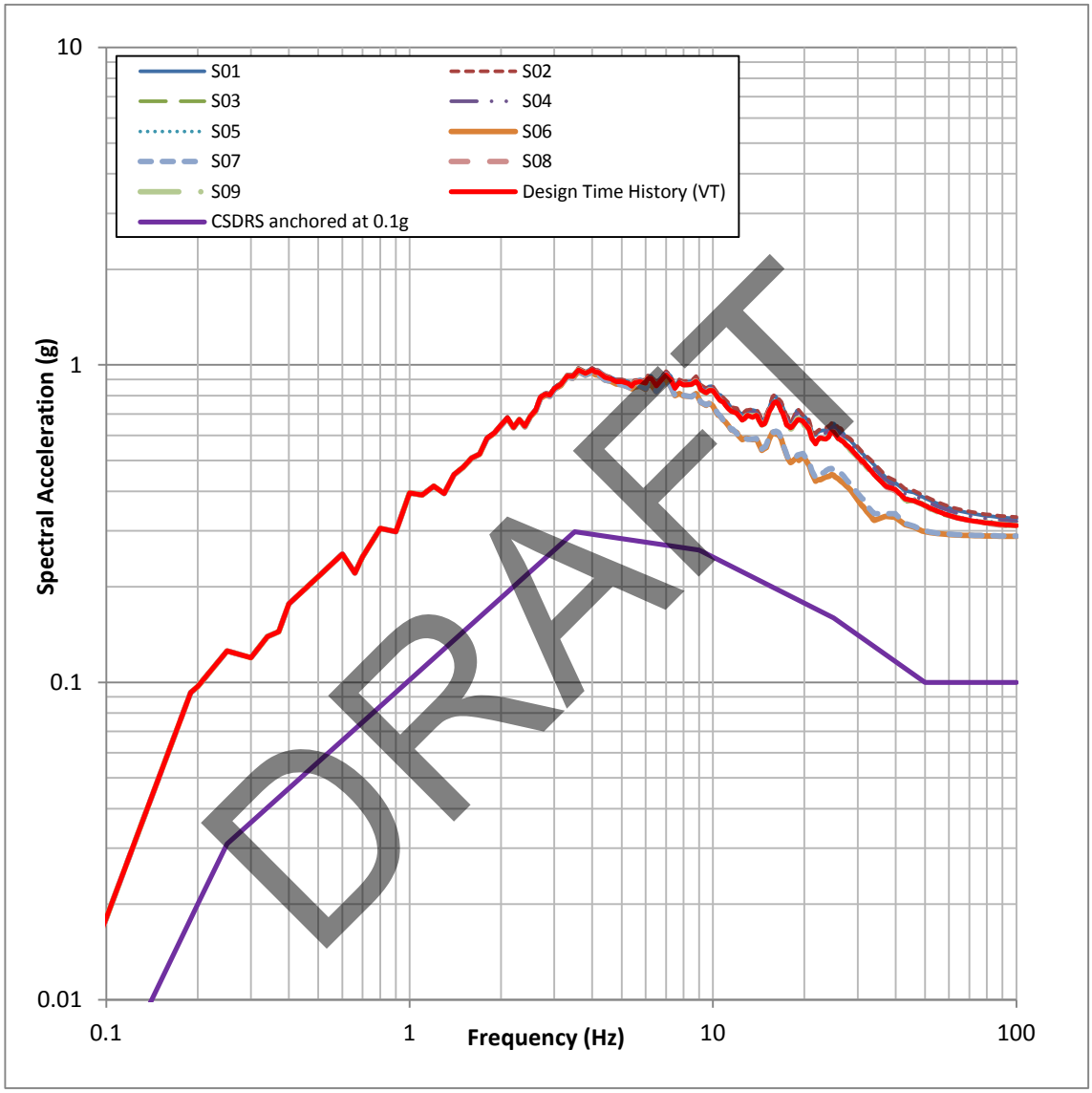

Figure 3.7A-12 Comparison of Design Time History Compatible with CSDRS with Site Response Motion at Foundation Base Elevation of Nuclear Island Structure, Vertical Motion, 5% damping
(3 of 3)

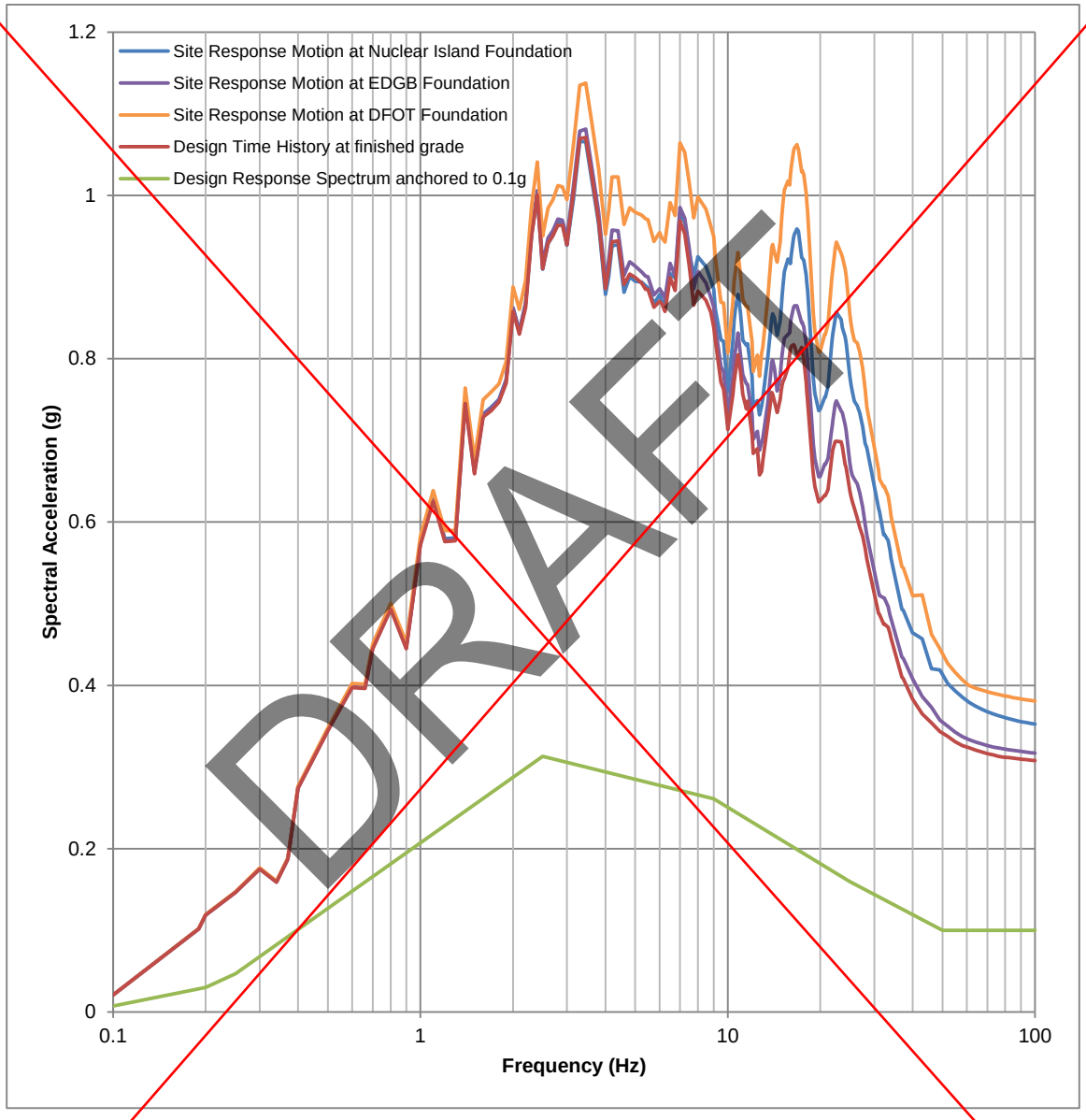

Figure 3.7A-13 Comparison of Design Time History Compatible with CSDRS with Site Response Motion at Foundation Base Elevation of Seismic Category I Structures, N-S Motion, 5% damping

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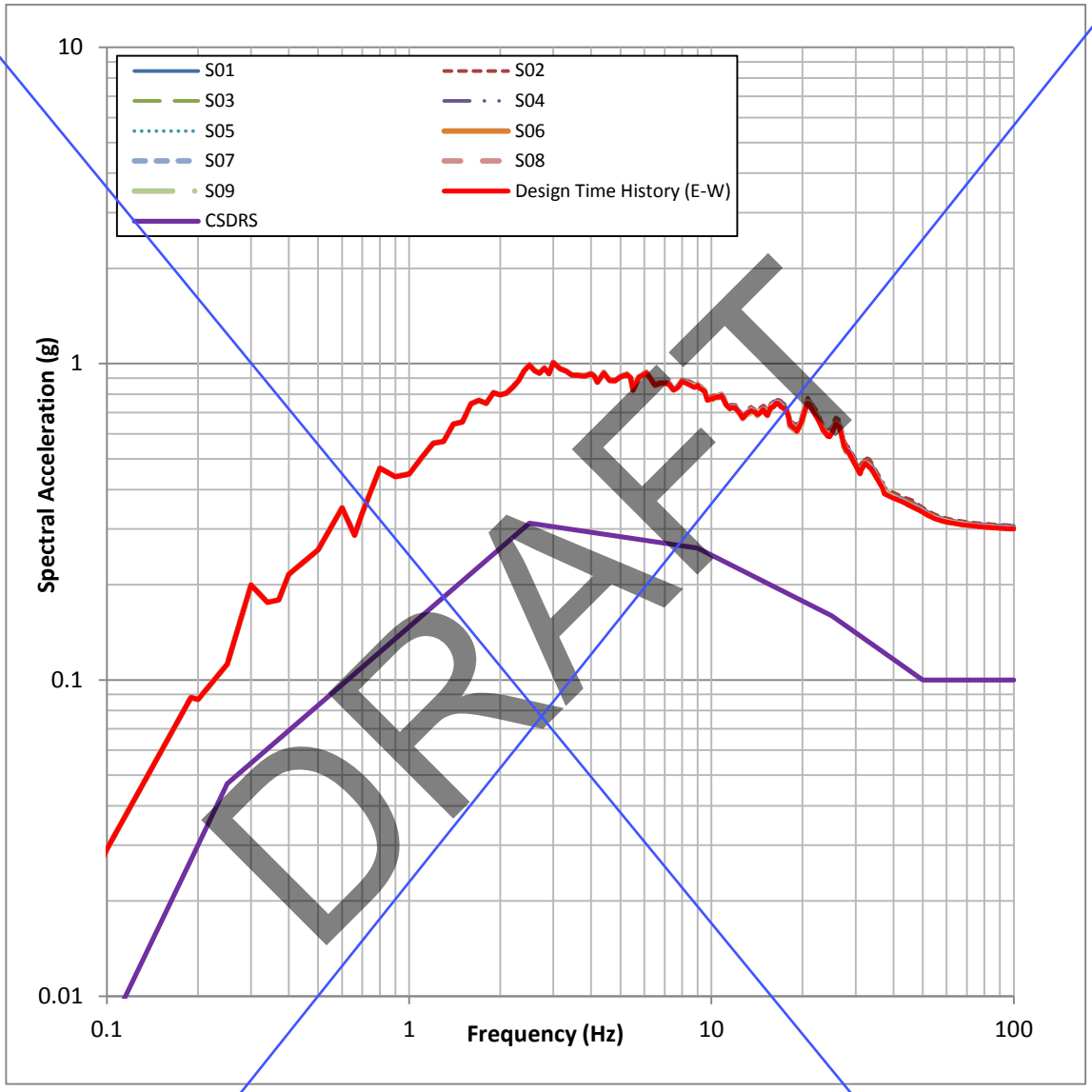

Figure 3.7A-13 Comparison of Design Time History Compatible with CSDRS with Site Response Motion at Foundation Base Elevation of Emergency Diesel Generator Building, E-W Motion, 5% damping
(1 of 3)

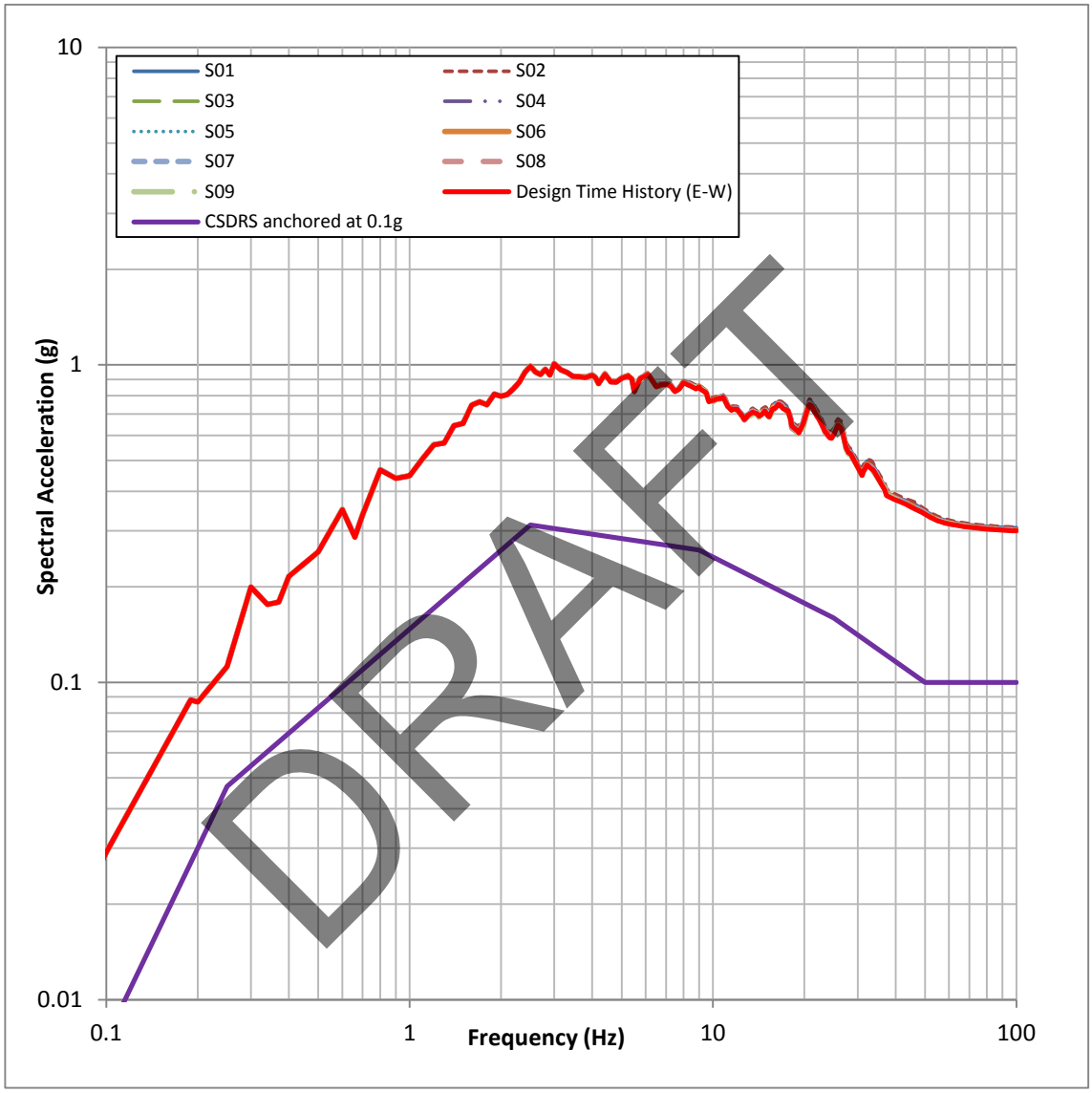

Figure 3.7A-13 Comparison of Design Time History Compatible with CSDRS with Site Response Motion at Foundation Base Elevation of Emergency Diesel Generator Building, E-W Motion, 5% damping
(1 of 3)

Replace with next page

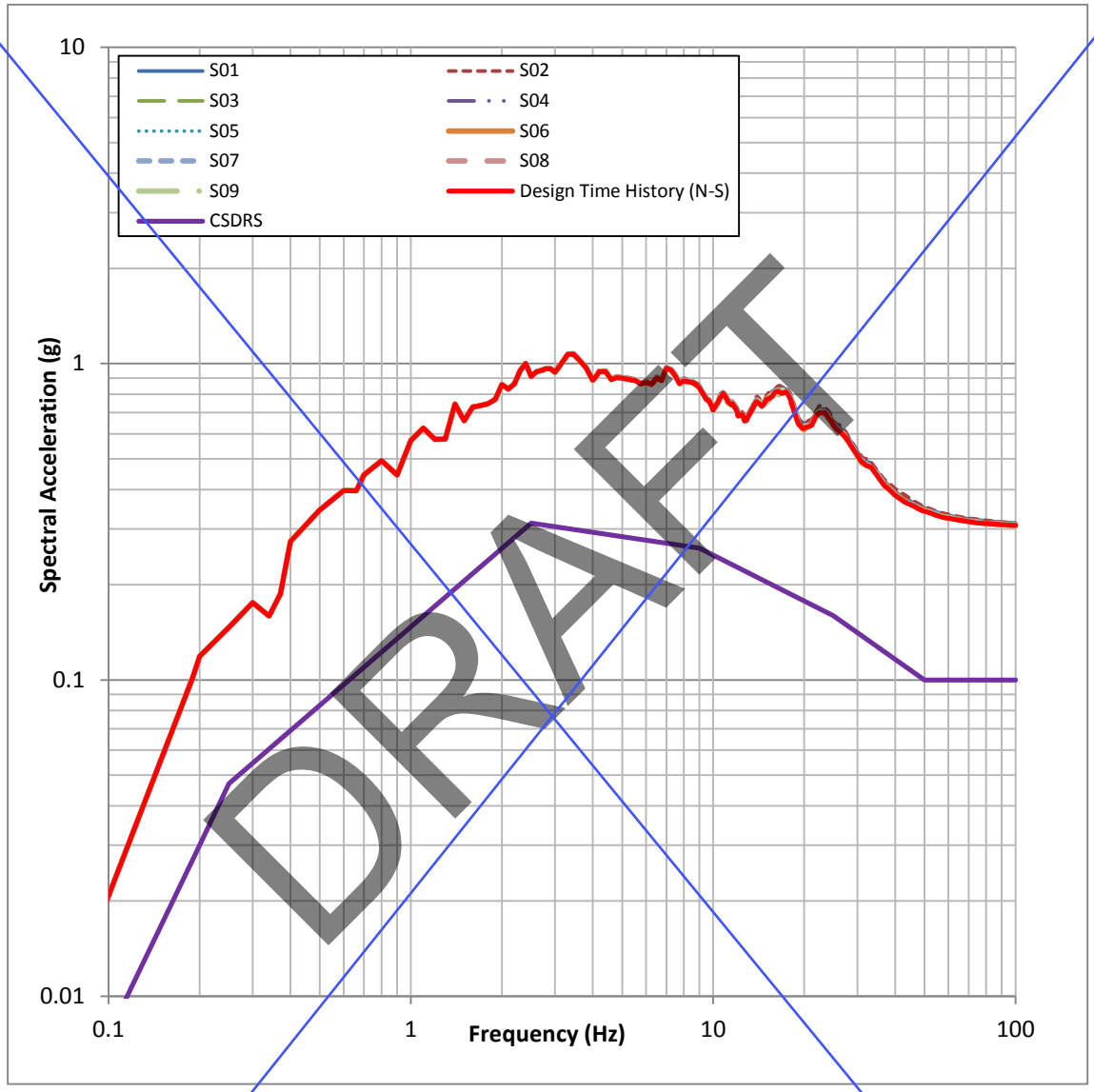

Figure 3.7A-13 Comparison of Design Time History Compatible with CSDRS with Site Response Motion at Foundation Base Elevation of Emergency Diesel Generator Building, N-S Motion, 5% damping
(2 of 3)

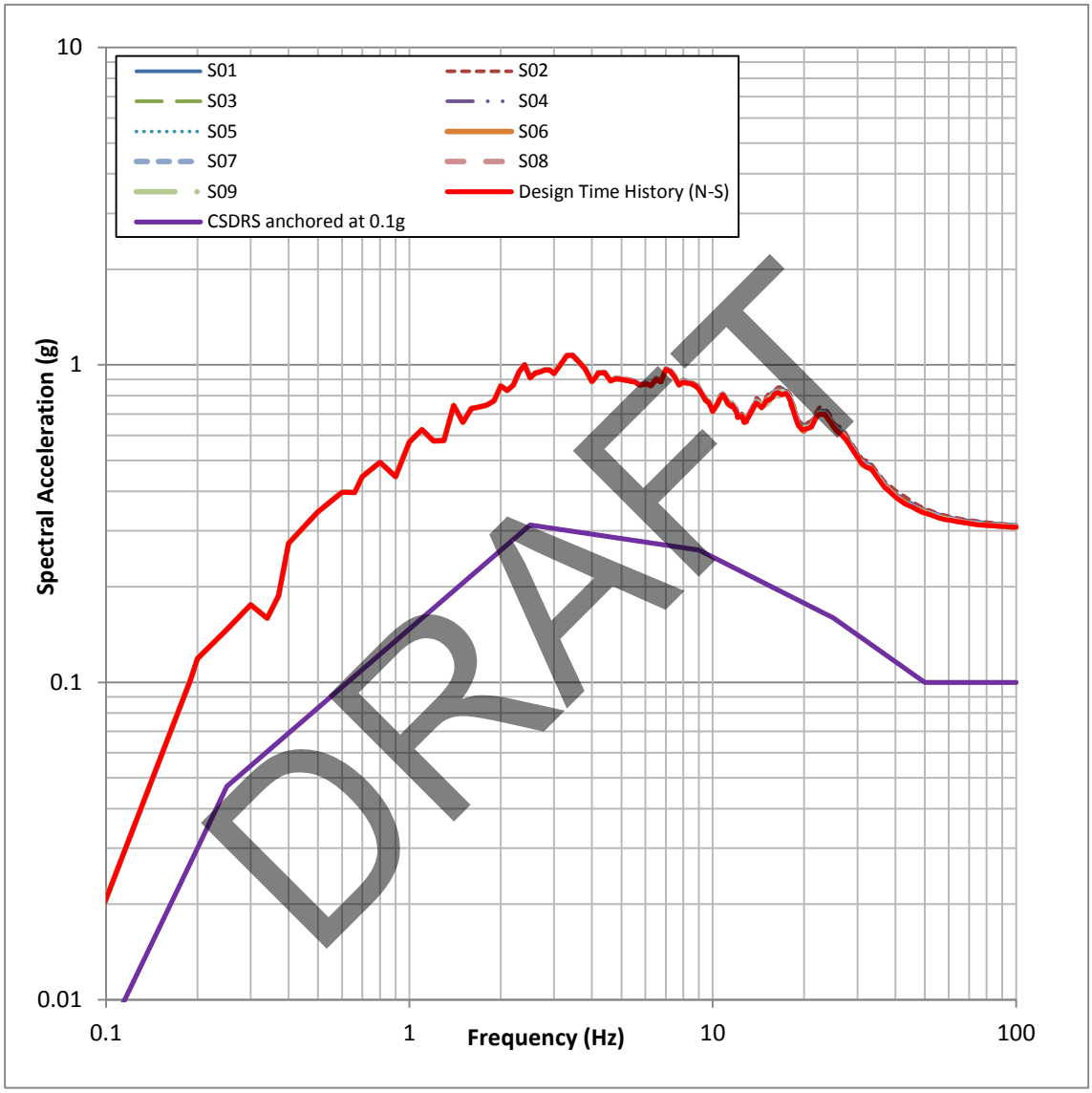

Figure 3.7A-13 Comparison of Design Time History Compatible with CSDRS with Site Response Motion at Foundation Base Elevation of Emergency Diesel Generator Building, N-S Motion, 5% damping
(2 of 3)

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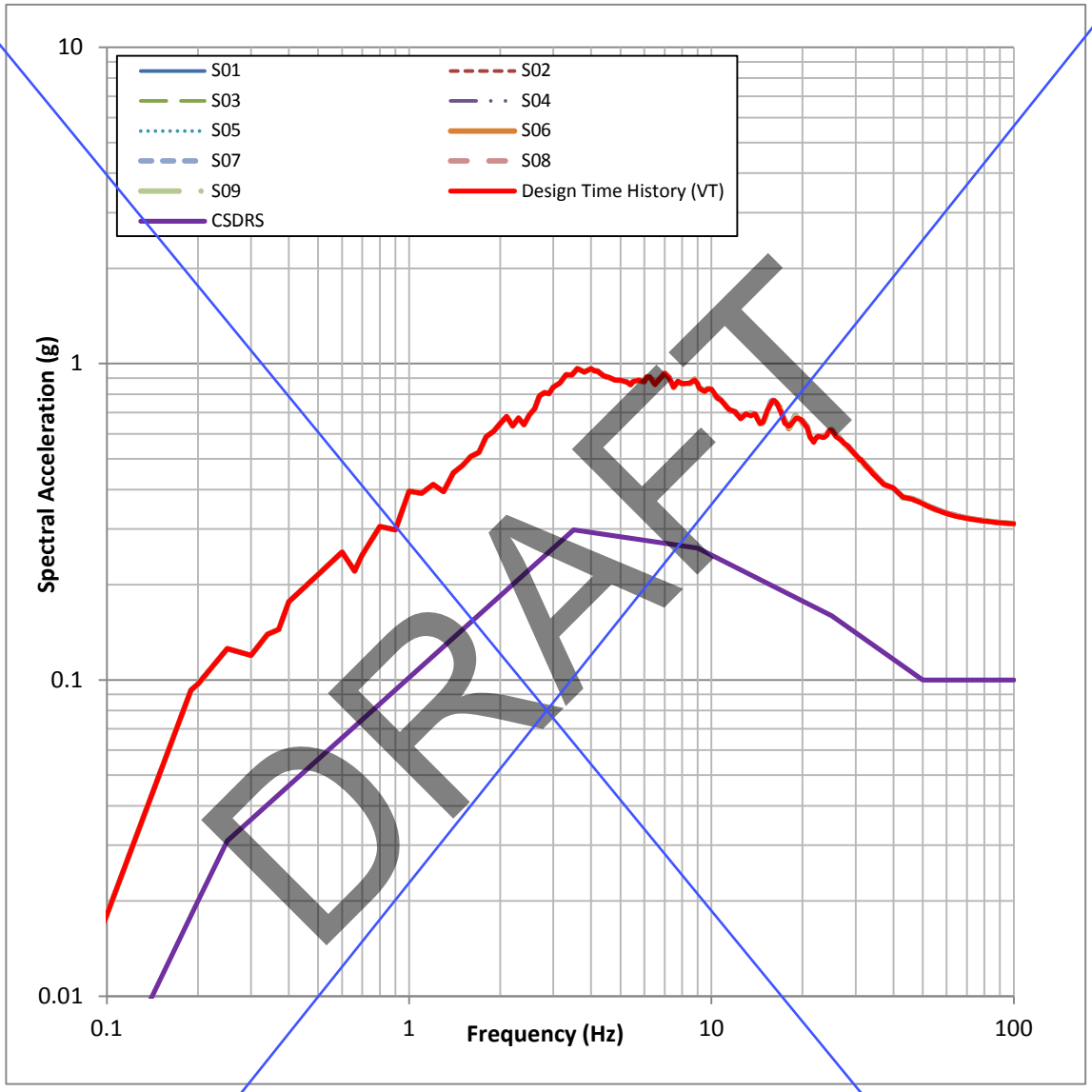

Figure 3.7A-13 Comparison of Design Time History Compatible with CSDRS with Site Response Motion at Foundation Base Elevation of Emergency Diesel Generator Building, Vertical Motion, 5% damping
(3 of 3)

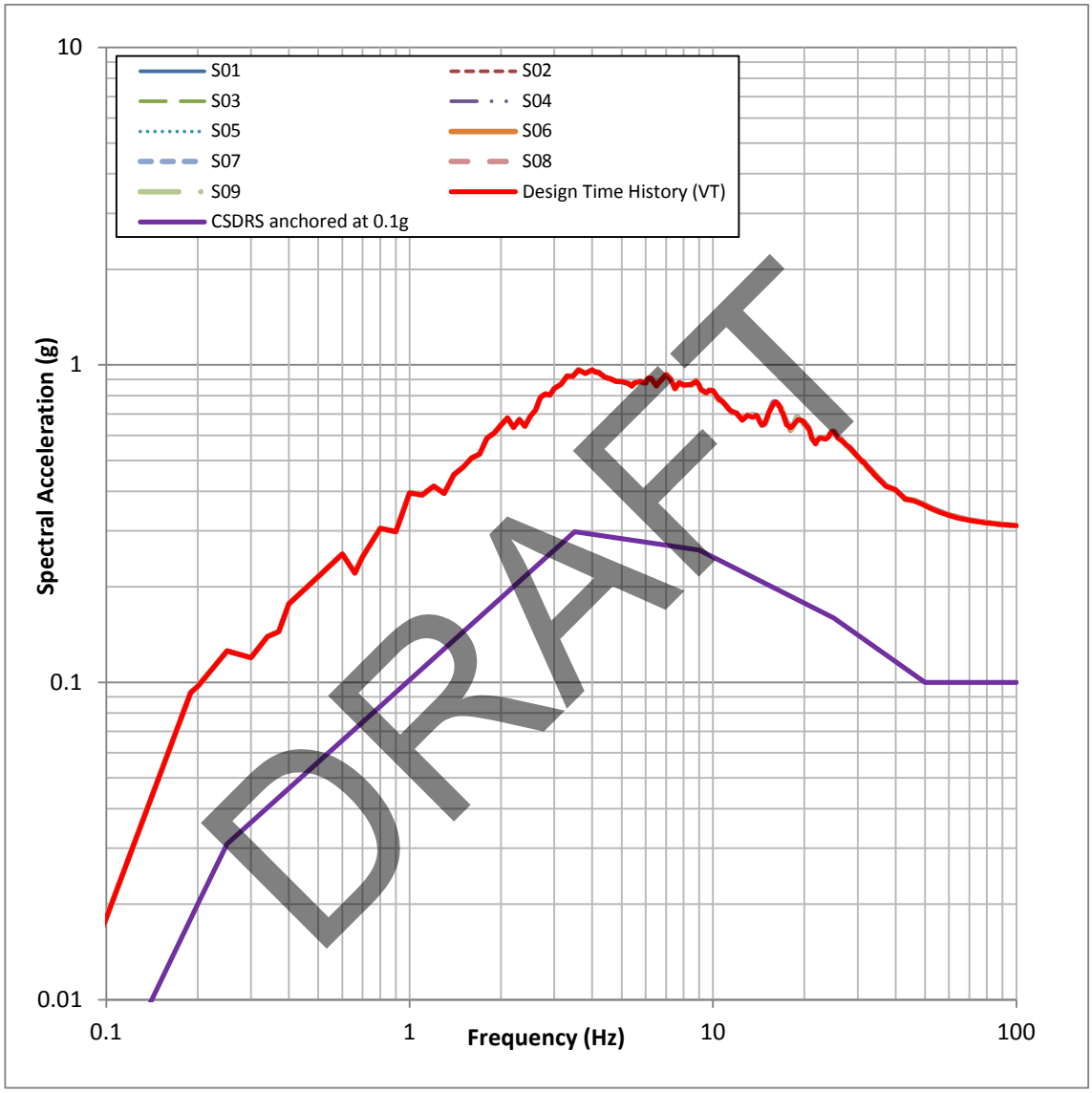

Figure 3.7A-13 Comparison of Design Time History Compatible with CSDRS with Site Response Motion at Foundation Base Elevation of Emergency Diesel Generator Building, Vertical Motion, 5% damping
(3 of 3)

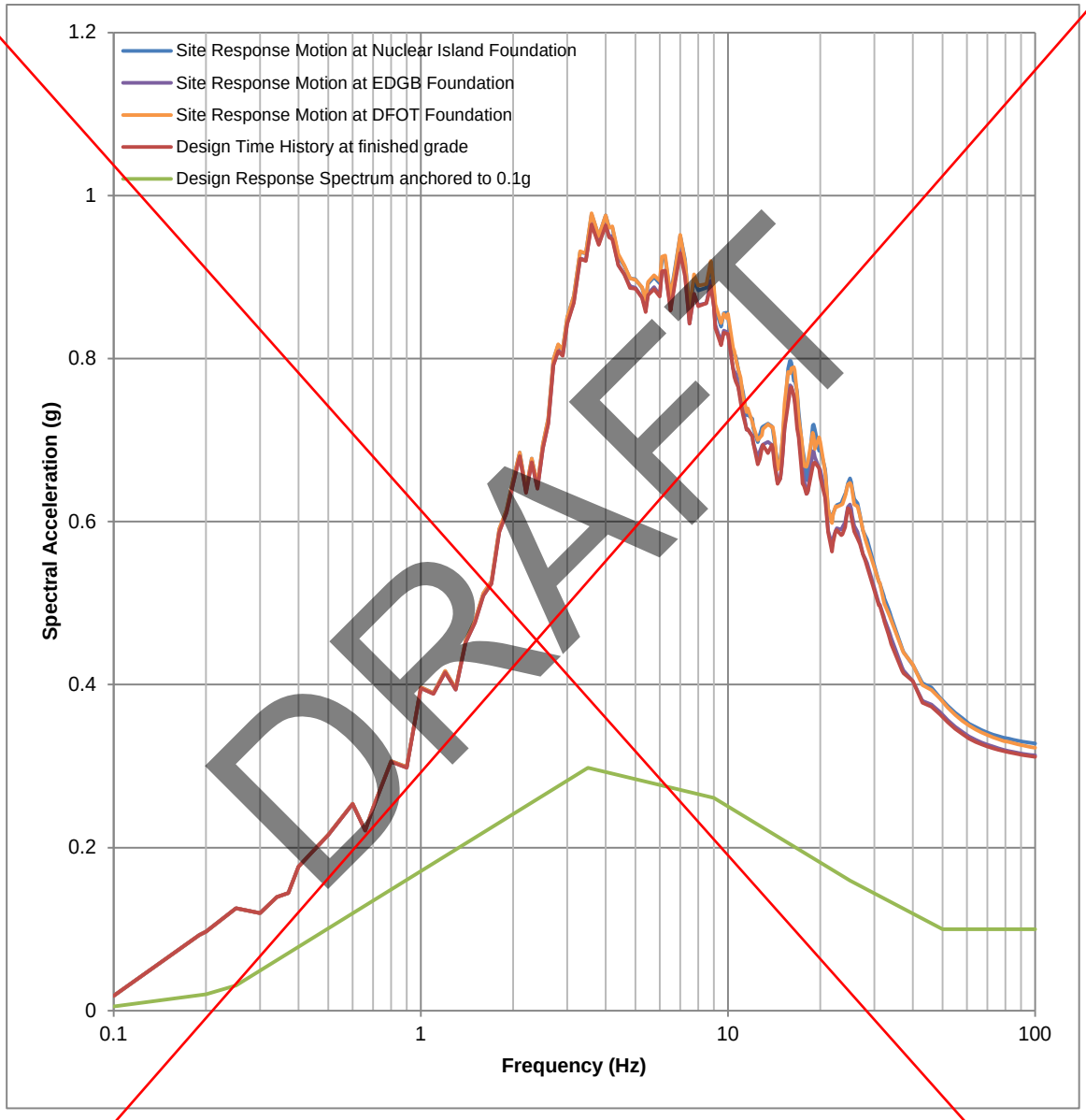

Figure 3.7A-14 Comparison of Design Time History Compatible with CSDRS with Site Response Motion at Foundation Base Elevation of Seismic Category I Structure, Vertical Motion, 5% damping

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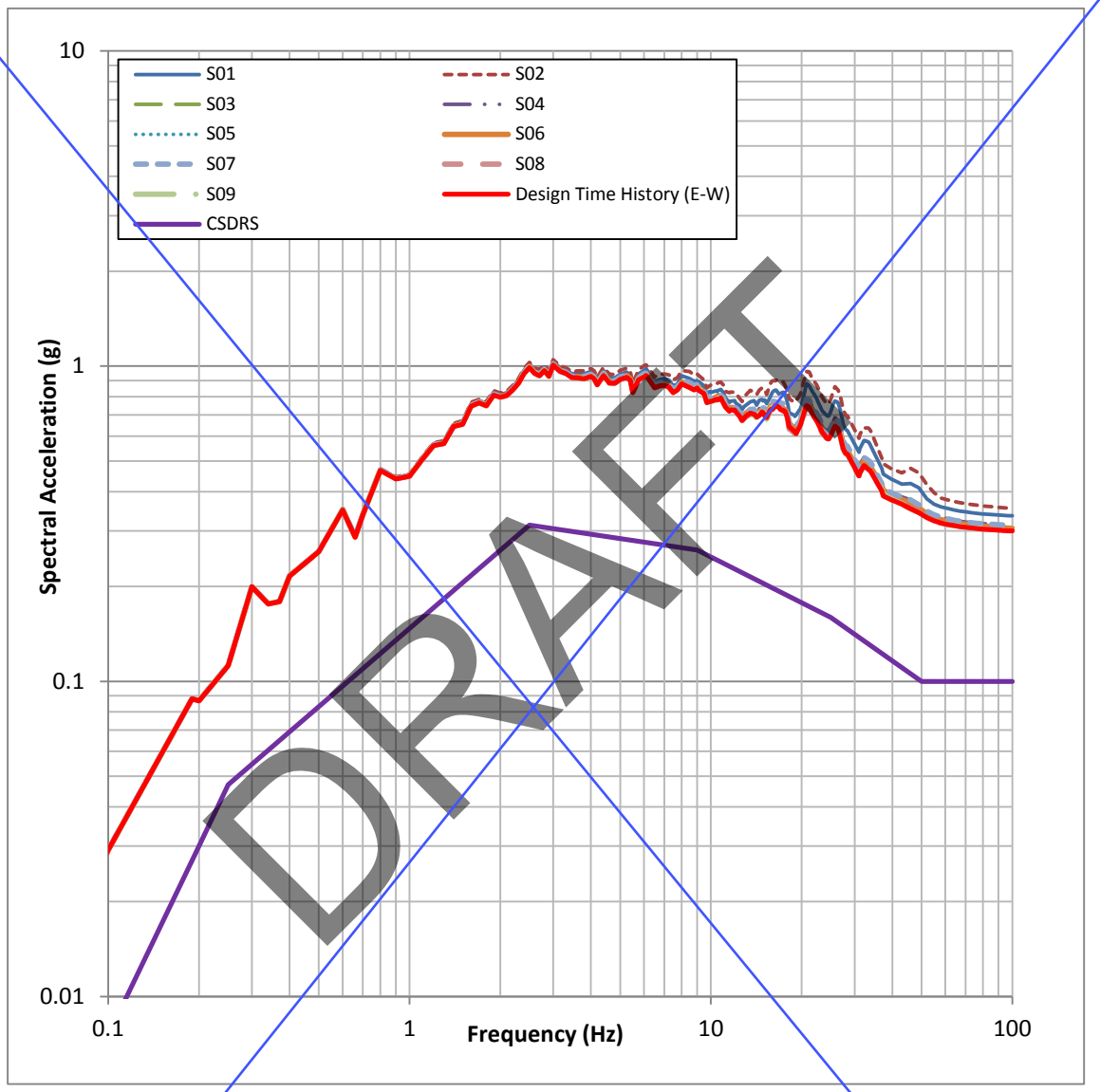

Figure 3.7A-14Comparison of Design Time History Compatible with CSDRS with Site Response Motion at Foundation Base Elevation of Diesel Fuel Oil Tank, E-W Motion, 5% damping
(1 of 3)

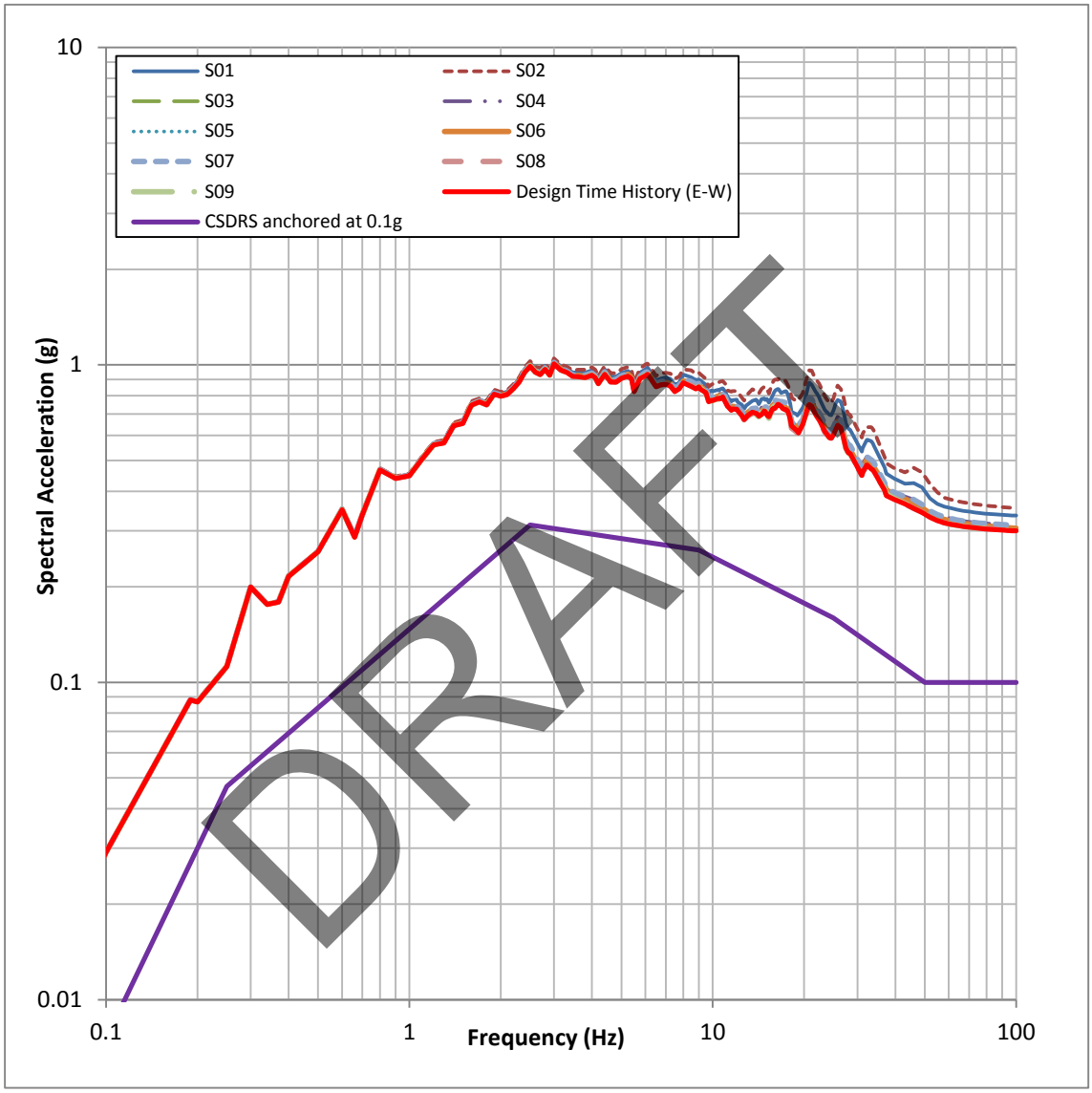

Figure 3.7A-14Comparison of Design Time History Compatible with CSDRS with Site Response Motion at Foundation Base Elevation of Diesel Fuel Oil Tank, E-W Motion, 5% damping
(1 of 3)

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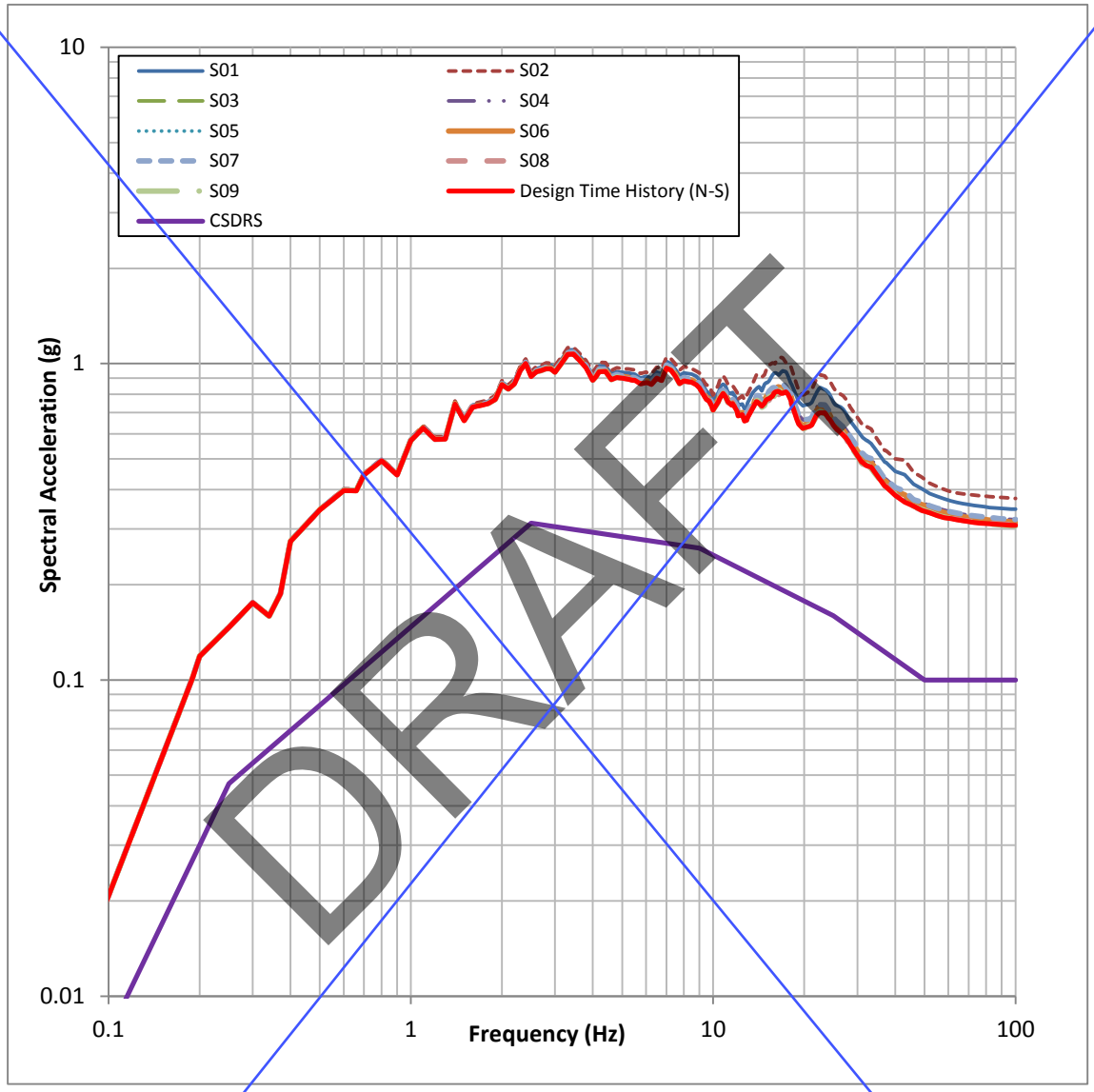

Figure 3.7A-14 Comparison of Design Time History Compatible with CSDRS with Site Response Motion at Foundation Base Elevation of Diesel Fuel Oil Tank, N-S Motion, 5% damping
(2 of 3)

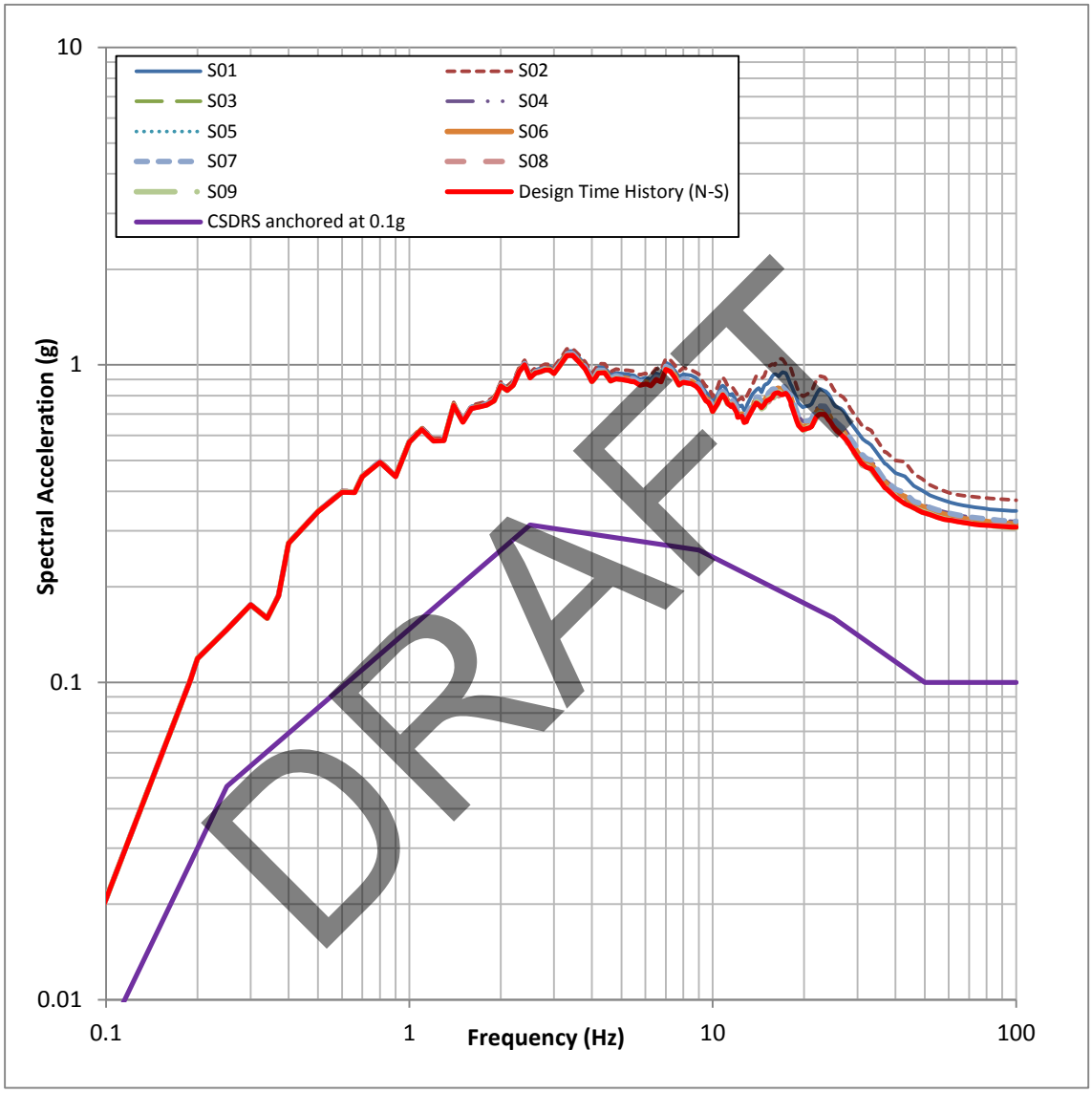

Figure 3.7A-14 Comparison of Design Time History Compatible with CSDRS with Site Response Motion at Foundation Base Elevation of Diesel Fuel Oil Tank, N-S Motion, 5% damping
(2 of 3)

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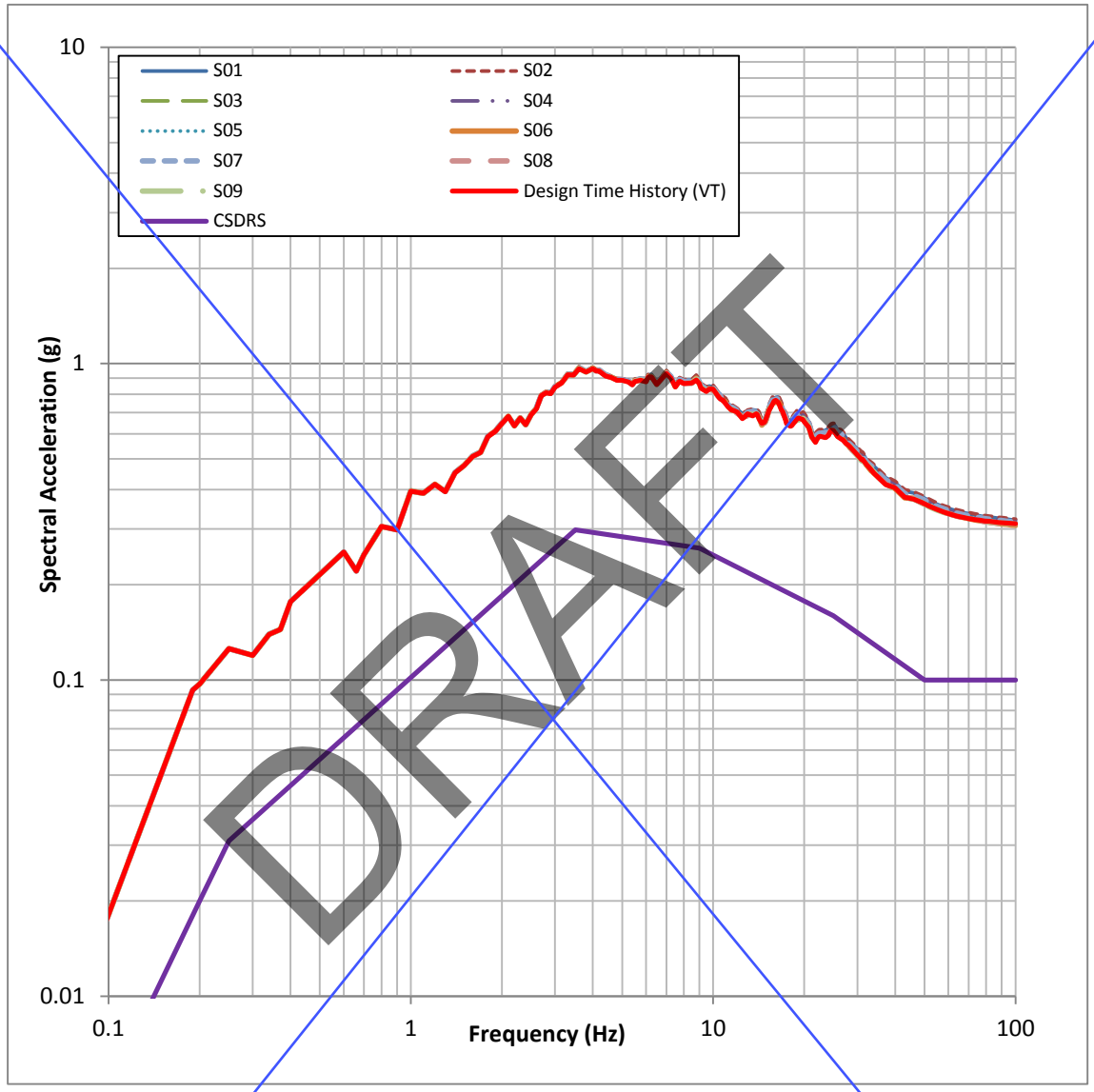

Figure 3.7A-24 Comparison of Design Time History Compatible with CSDRS with Site Response Motion at Foundation Base Elevation of Diesel Fuel Oil Tank, Vertical Motion, 5% damping
(3 of 3)

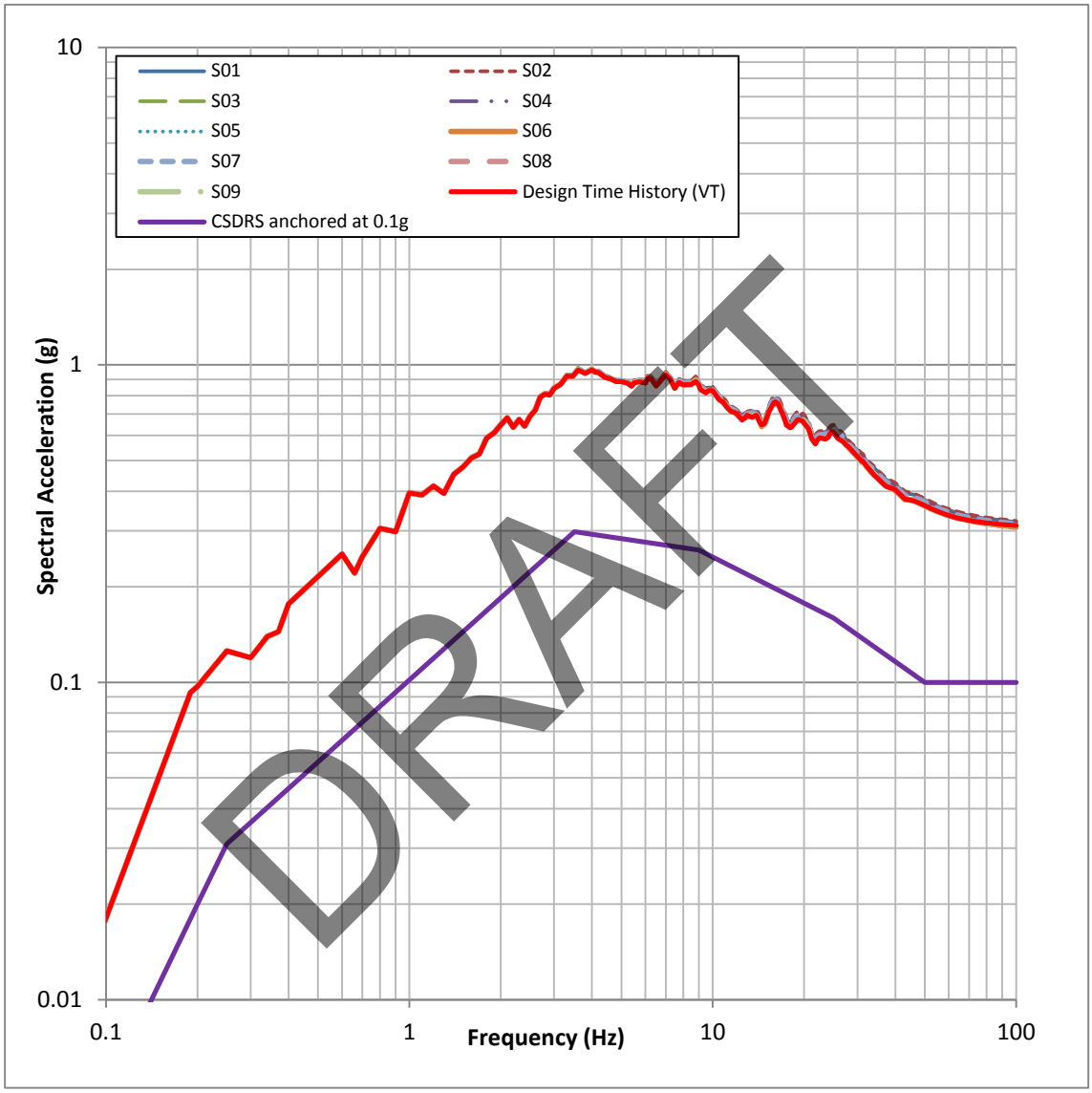

Figure 3.7A-14 Comparison of Design Time History Compatible with CSDRS with Site Response Motion at Foundation Base Elevation of Diesel Fuel Oil Tank, Vertical Motion, 5% damping
(3 of 3)

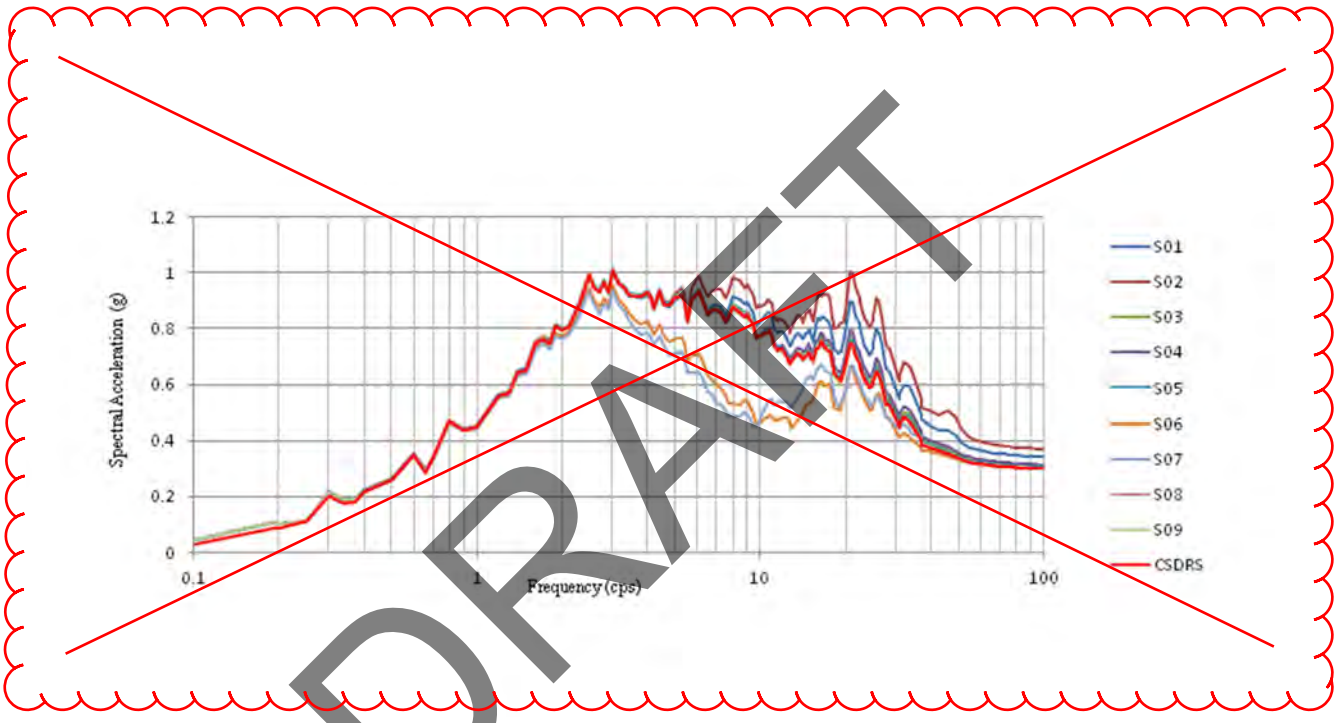

Figure 5-25 Strain-Compatible Response Spectra at Foundation Level of NI Structures (E-W)

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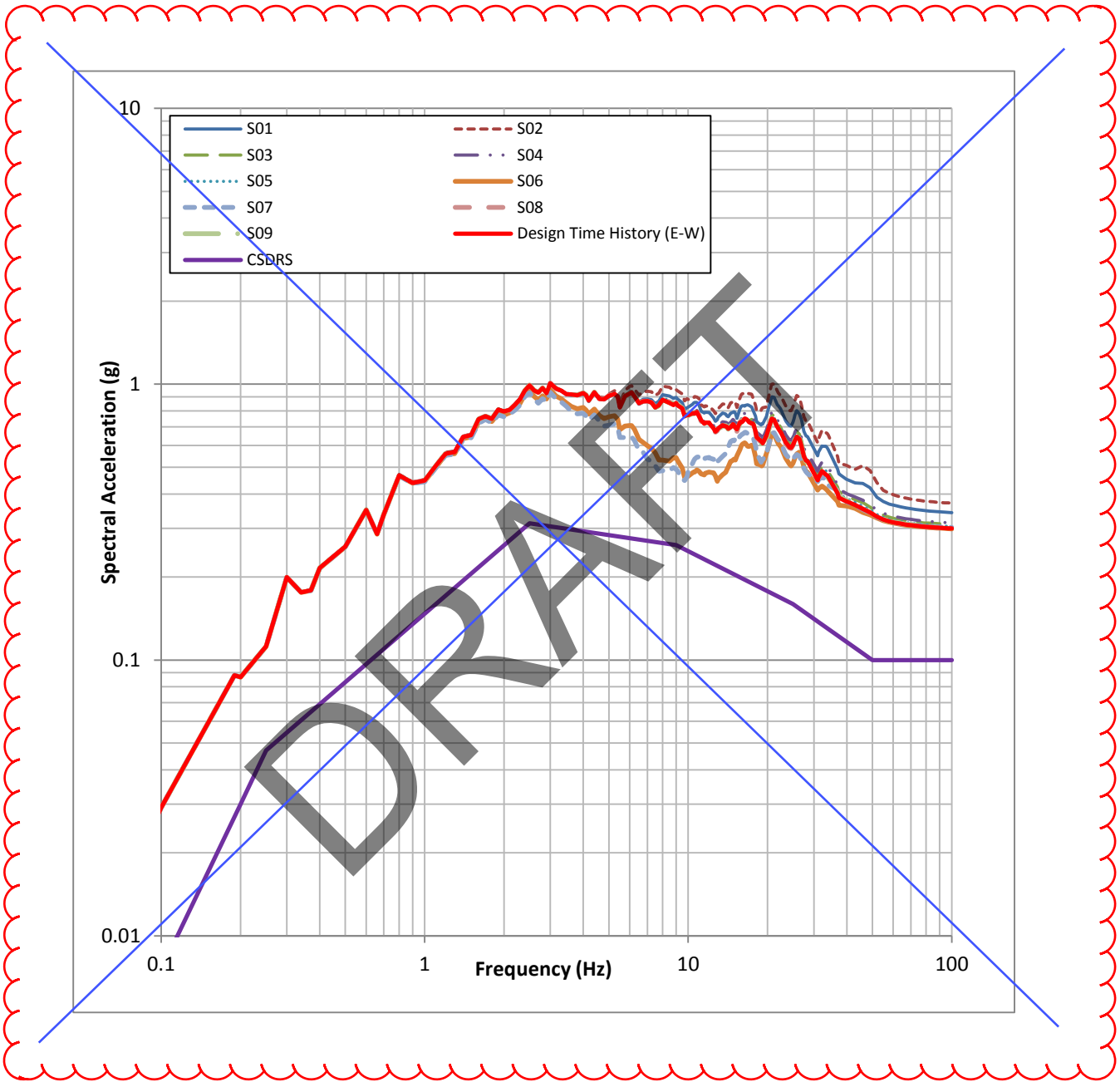

Figure 5-25 Strain-Compatible Response Spectra at Foundation Level of NI Structures (E-W)

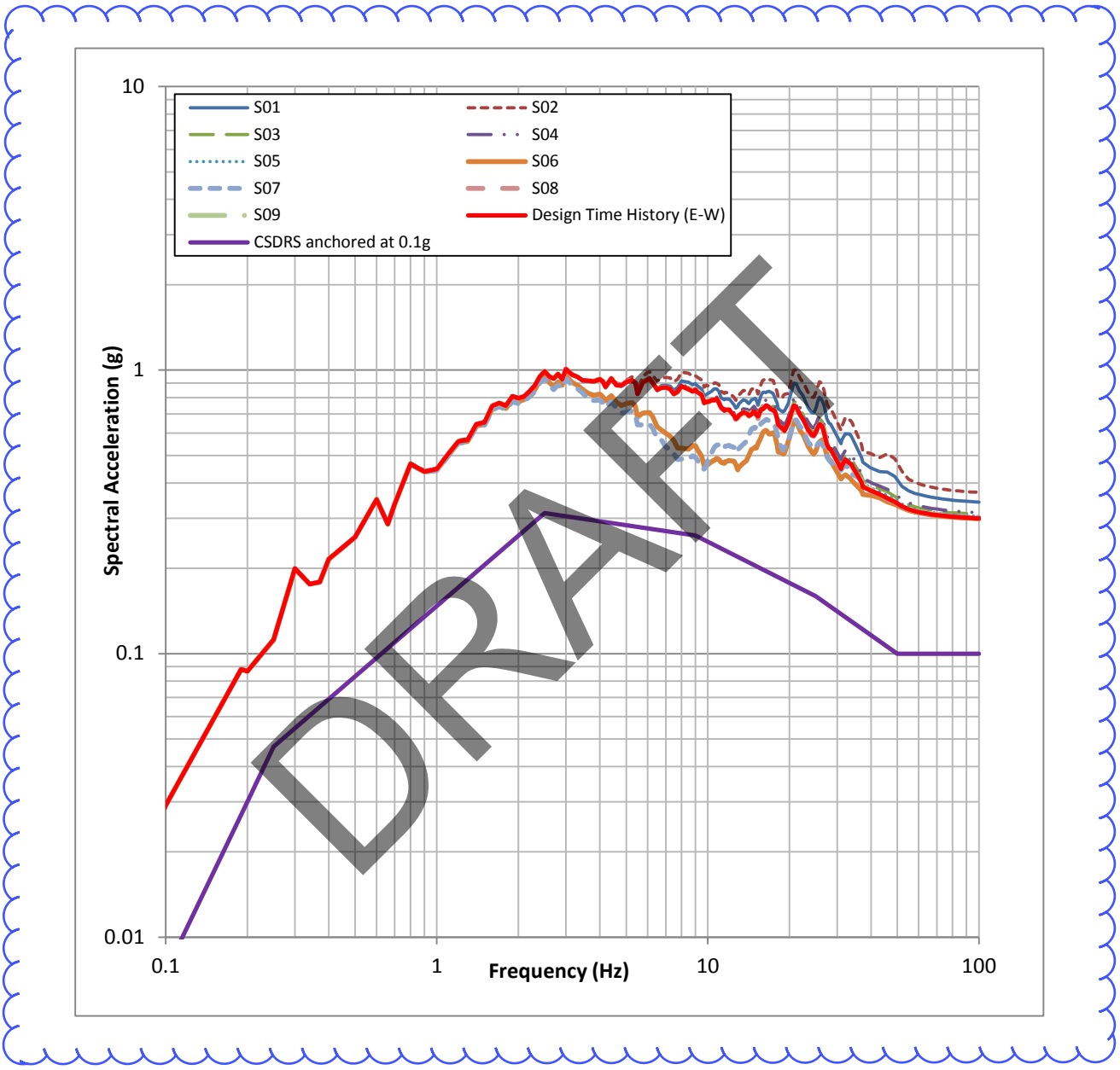

Figure 5-25 Strain-Compatible Response Spectra at Foundation Level of NI Structures (E-W)

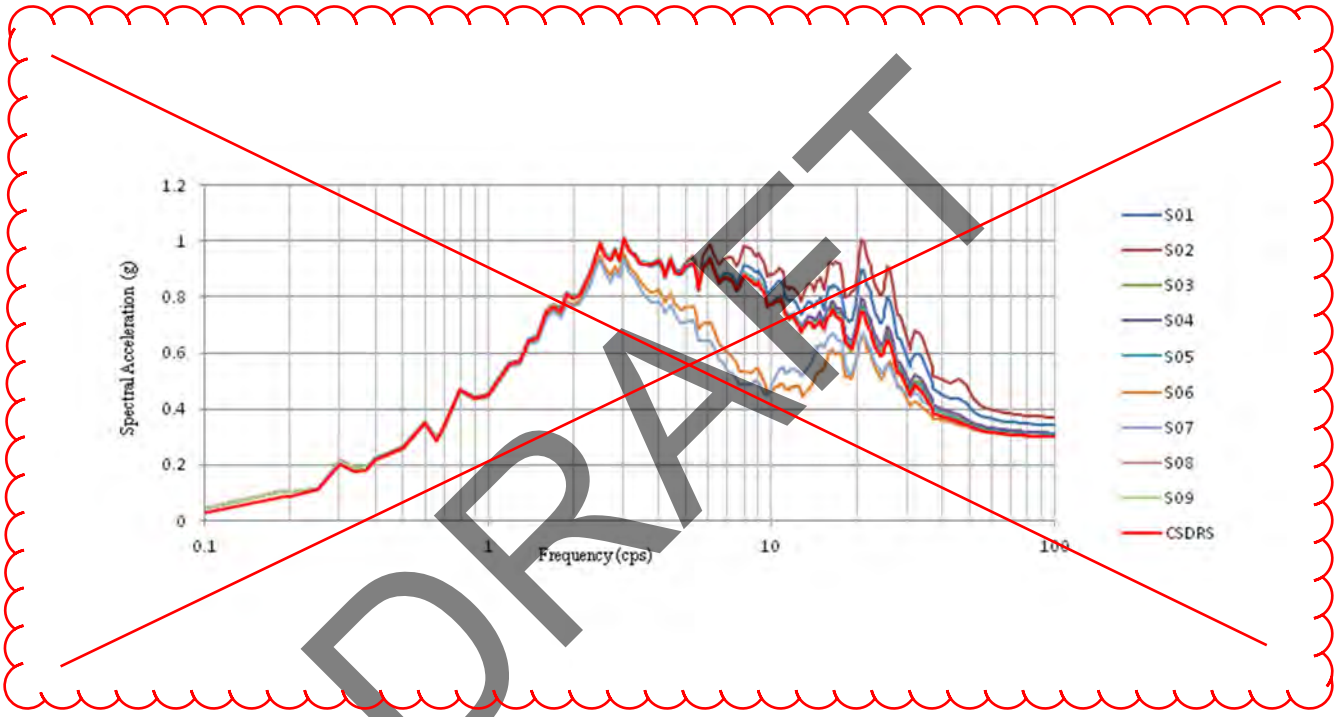

Figure 5-26 Strain-Compatible Response Spectra at Foundation Level of NI Structures (N-S)

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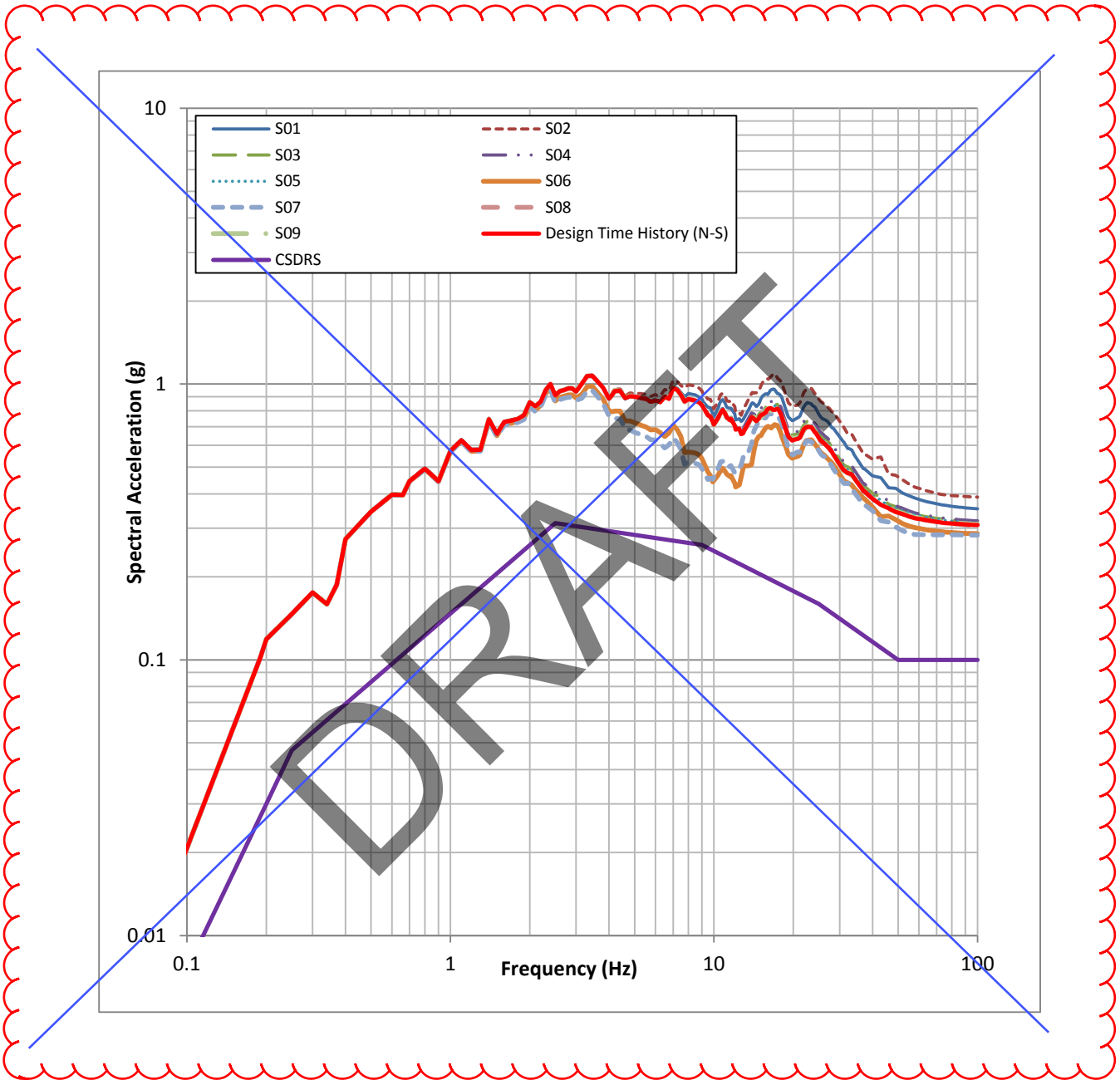

Figure 5-26 Strain-Compatible Response Spectra at Foundation Level of NI Structures (N-S)

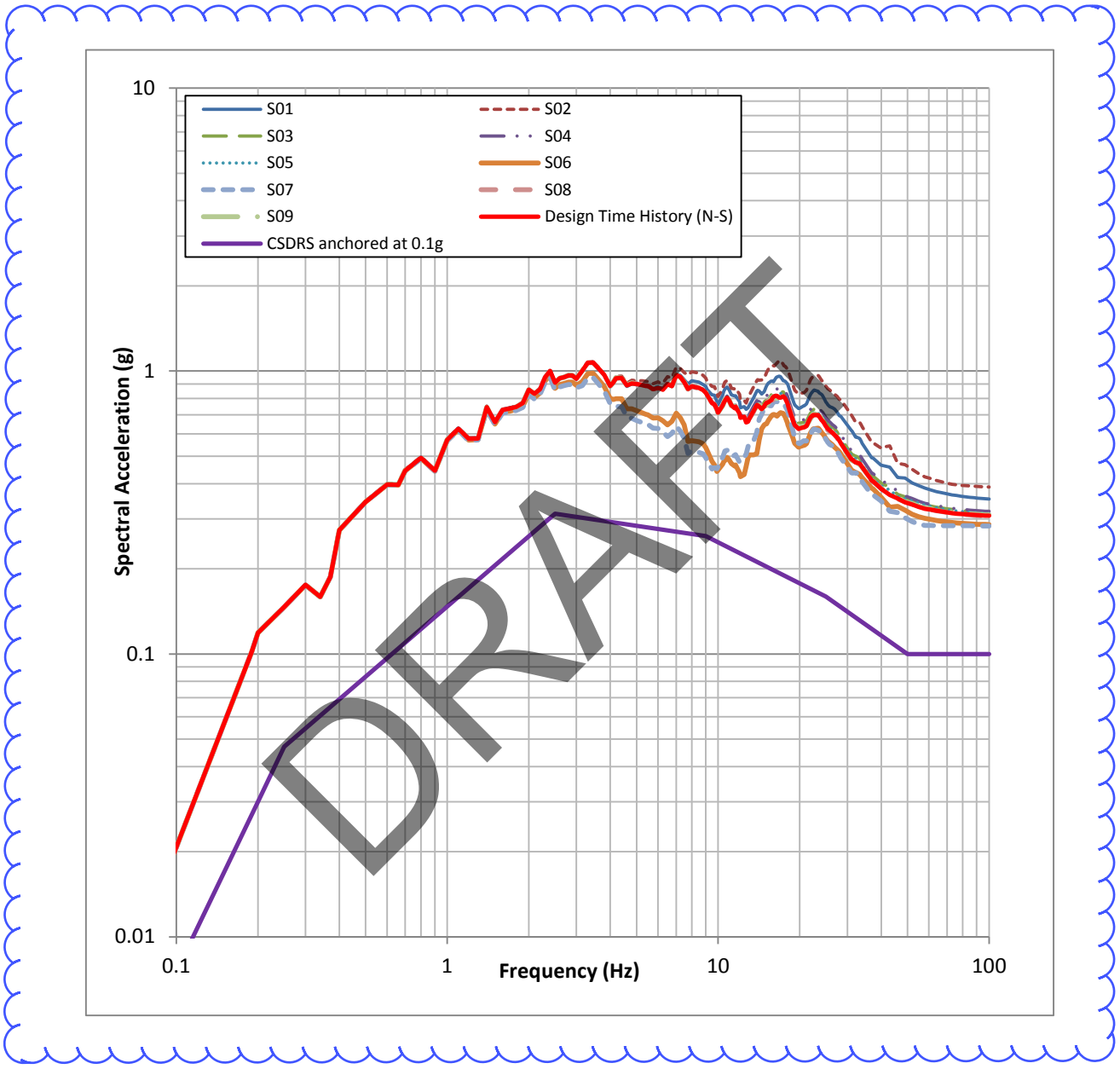

Figure 5-26 Strain-Compatible Response Spectra at Foundation Level of NI Structures (N-S)

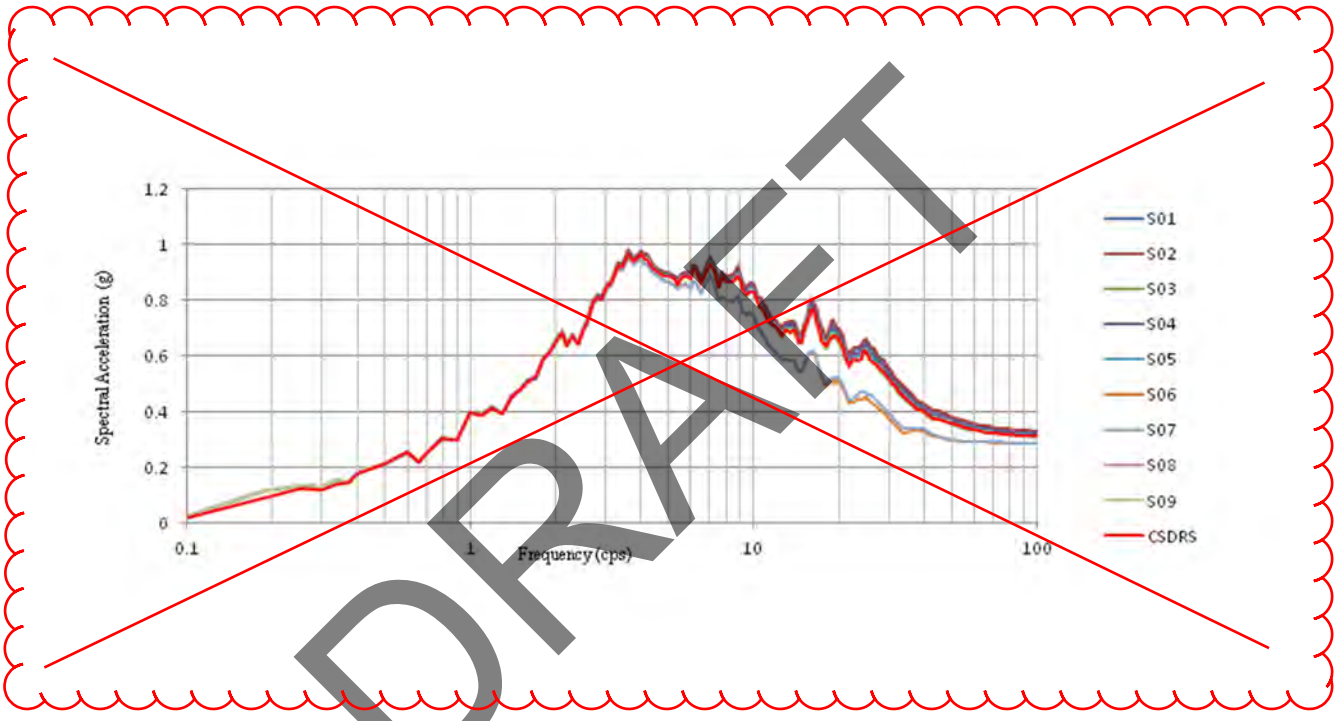

Figure 5-27 Strain-Compatible Response Spectra at Foundation Level of NI Structures (Vertical)

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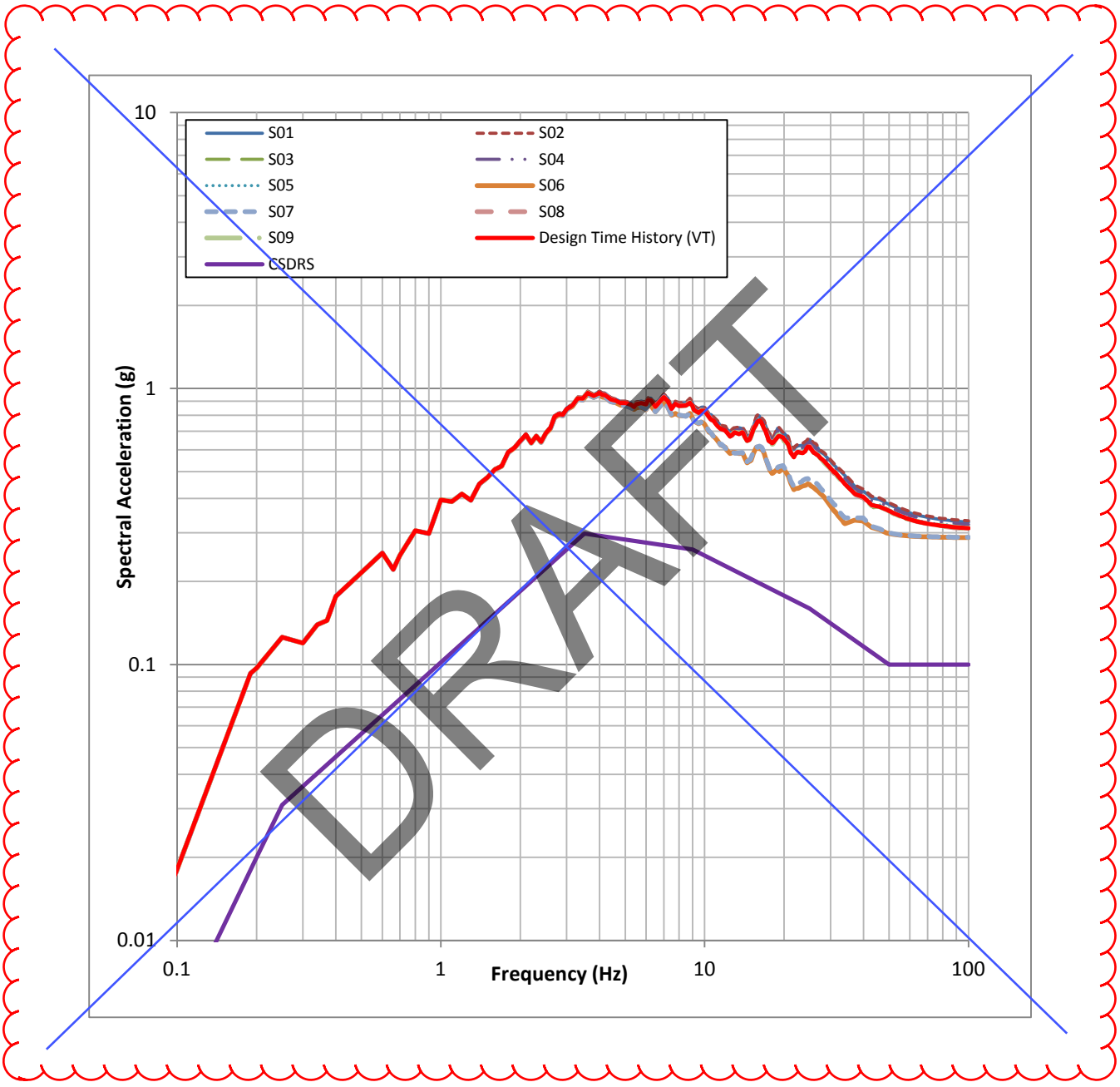

Figure 5-27 Strain-Compatible Response Spectra at Foundation Level of NI Structures (Vertical)

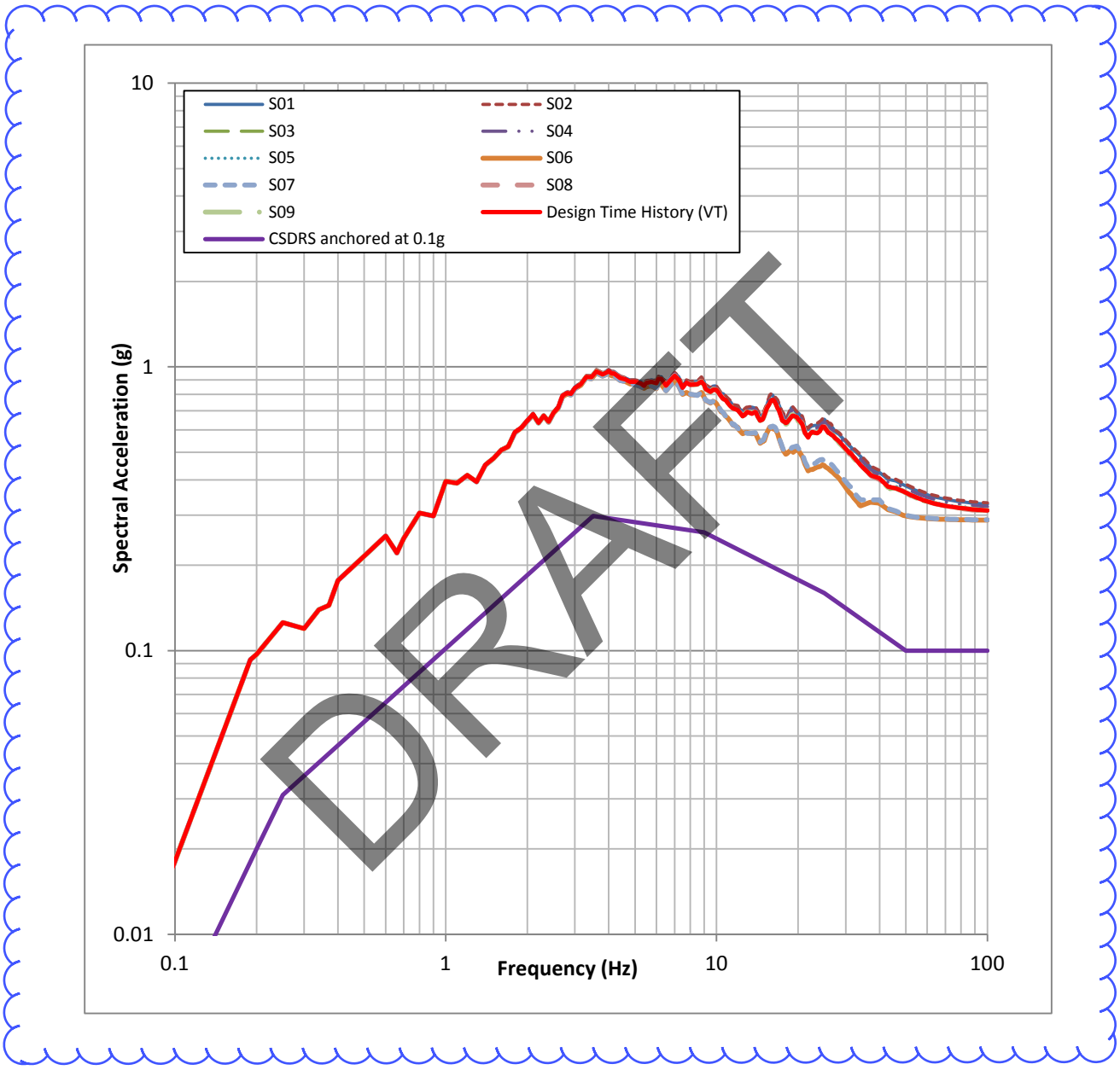

Figure 5-27 Strain-Compatible Response Spectra at Foundation Level of NI Structures (Vertical)

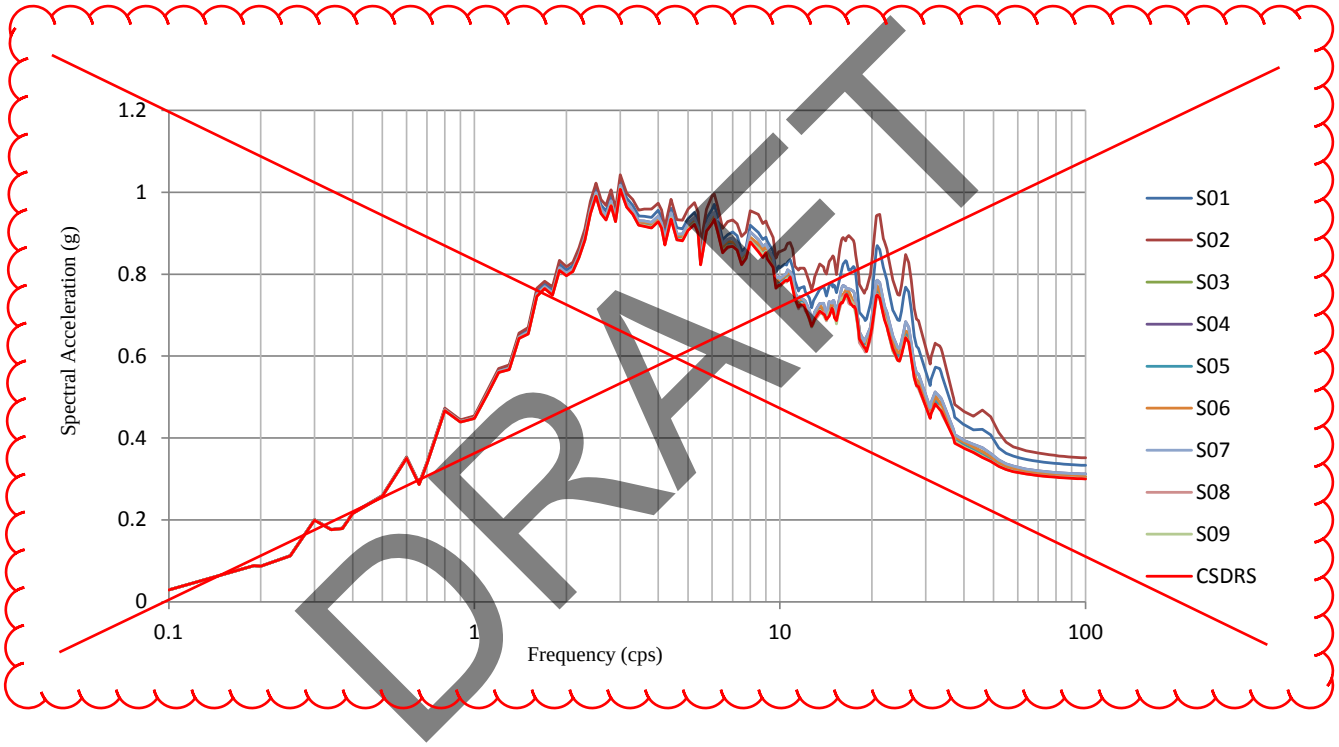

Figure 5-28 Strain-Compatible Response Spectra at Foundation Level of EDGB (E-W)

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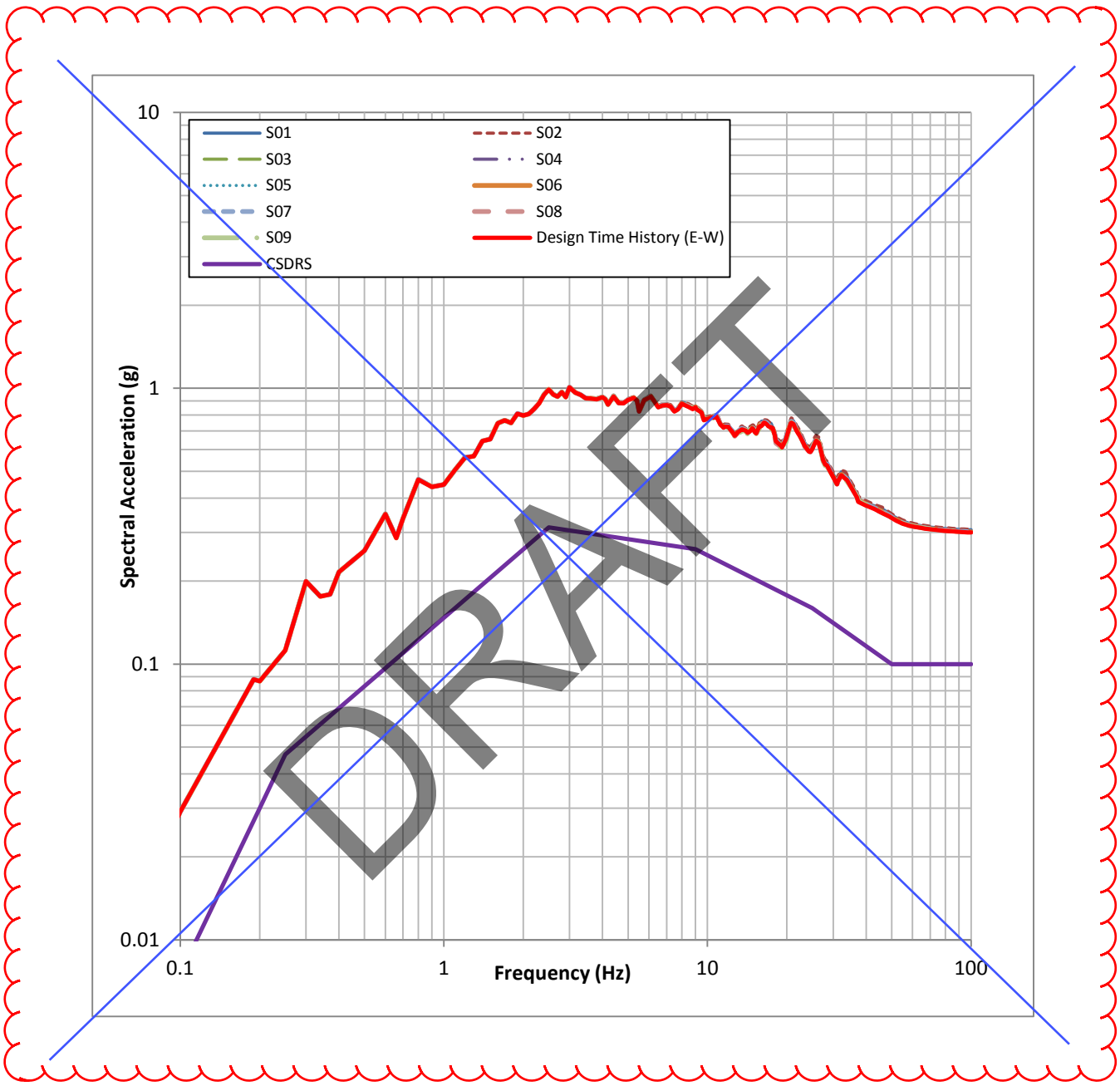

Figure 5-28 Strain-Compatible Response Spectra at Foundation Level of EDGB (E-W)

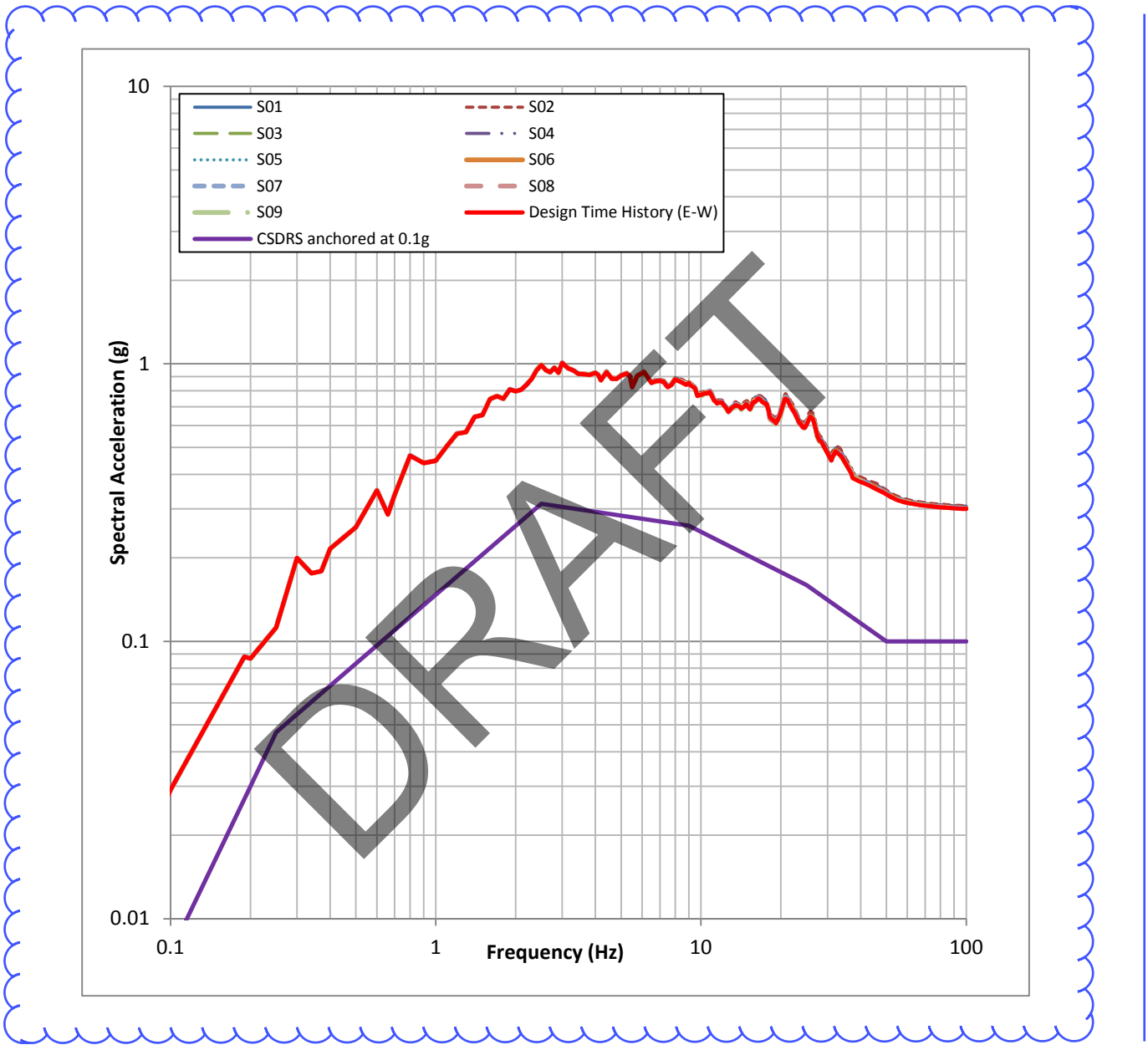

Figure 5-28 Strain-Compatible Response Spectra at Foundation Level of EDGB (E-W)

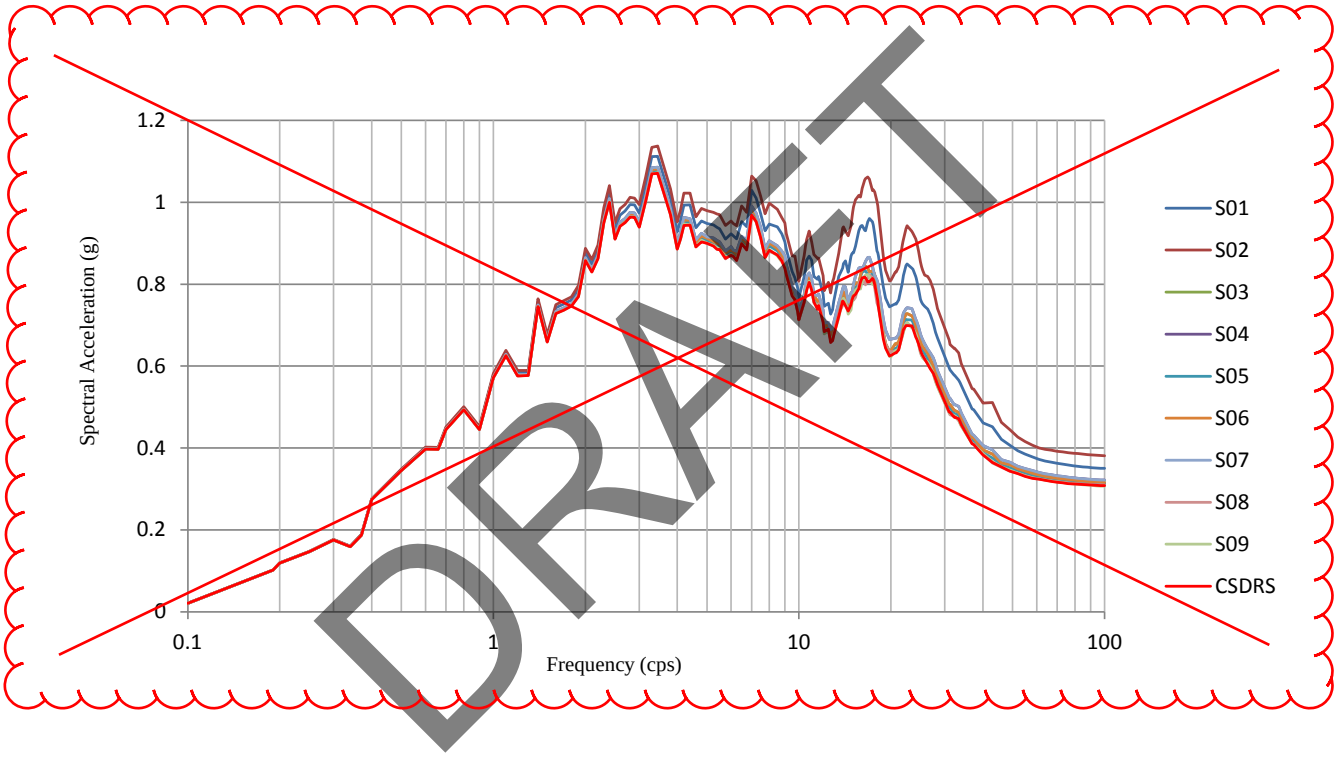

Figure 5-29 Strain-Compatible Response Spectra at Foundation Level of EDGB (N-S)

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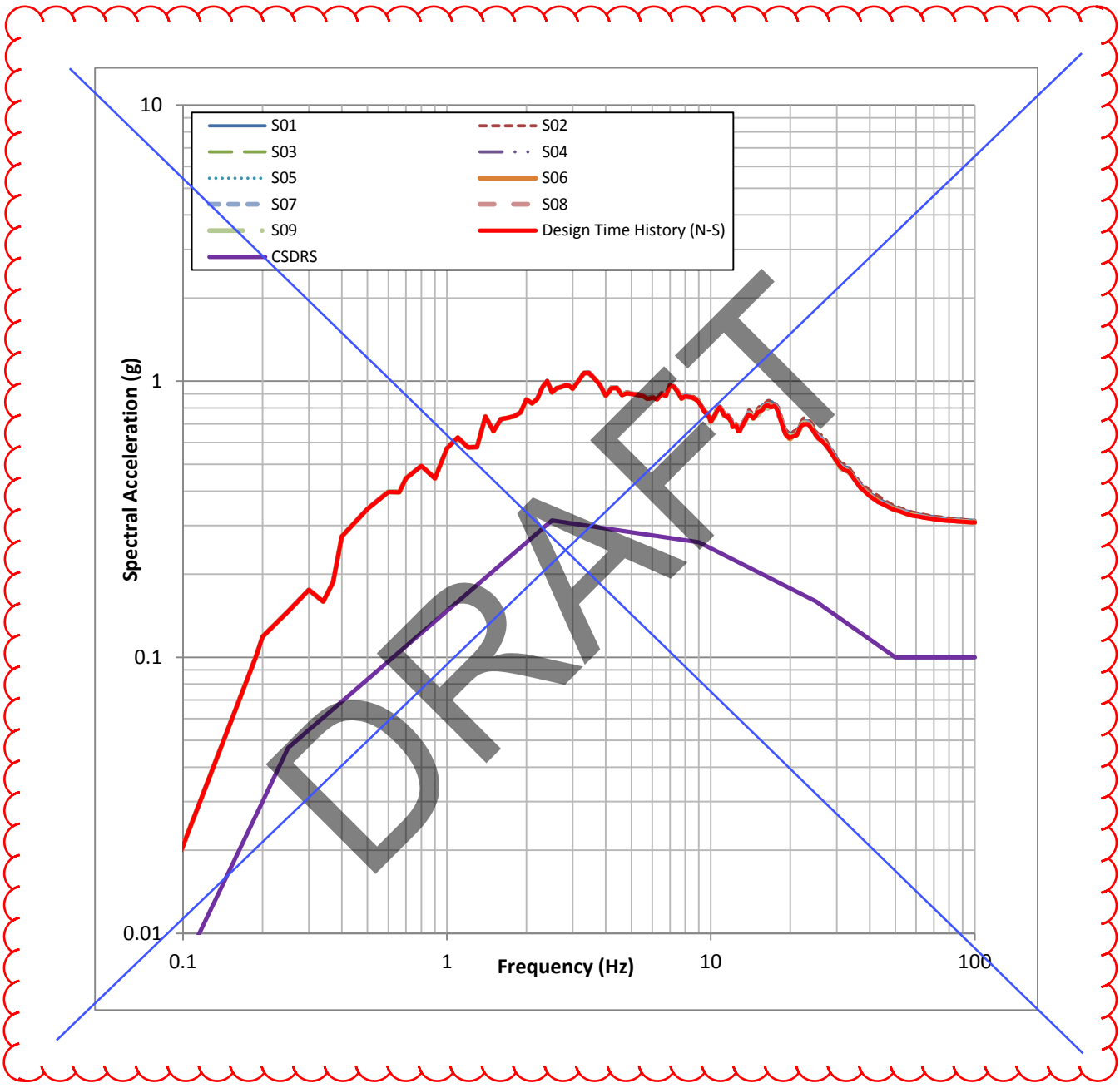

Figure 5-29 Strain-Compatible Response Spectra at Foundation Level of EDGB (N-S)

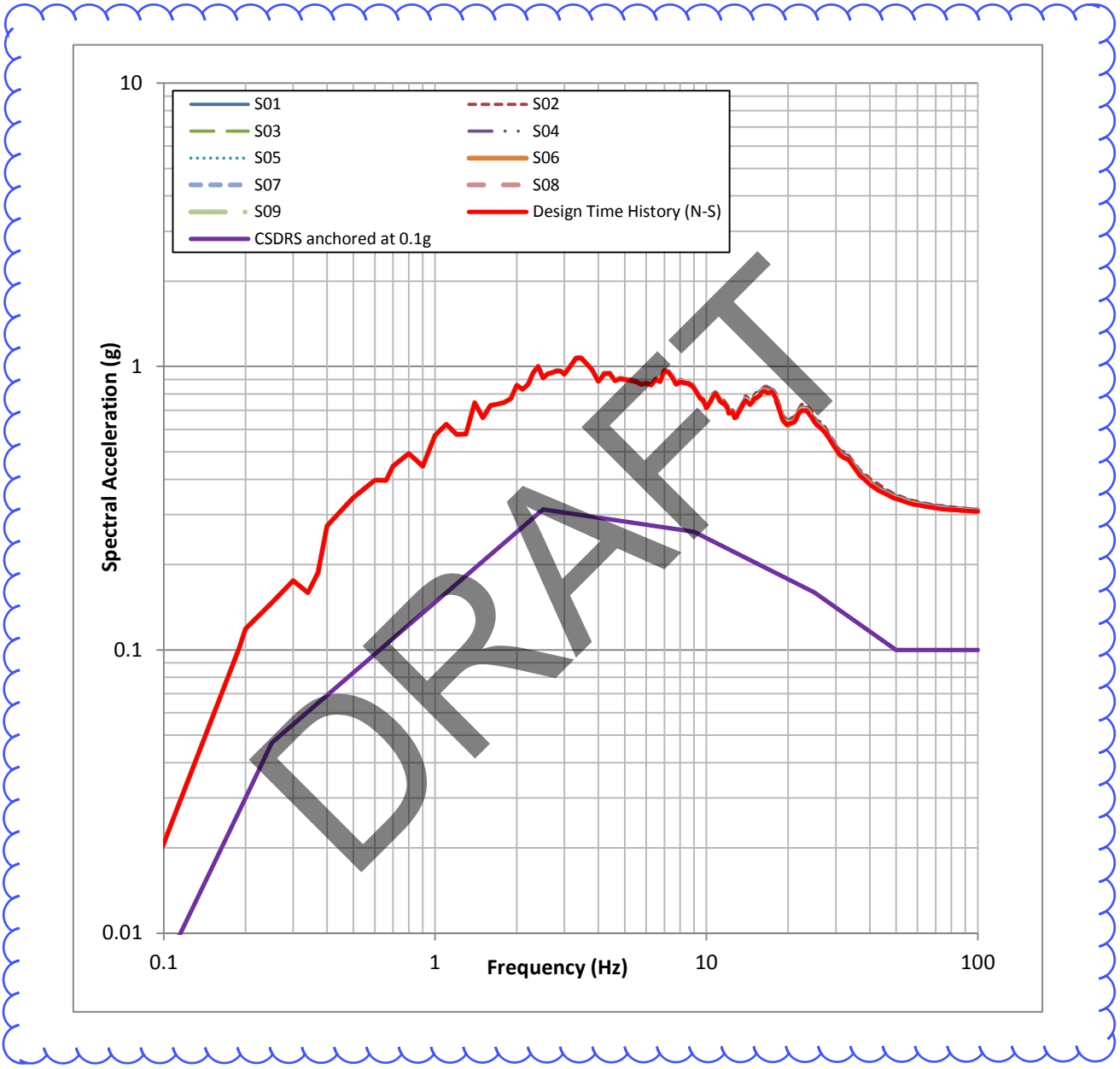

Figure 5-29 Strain-Compatible Response Spectra at Foundation Level of EDGB (N-S)

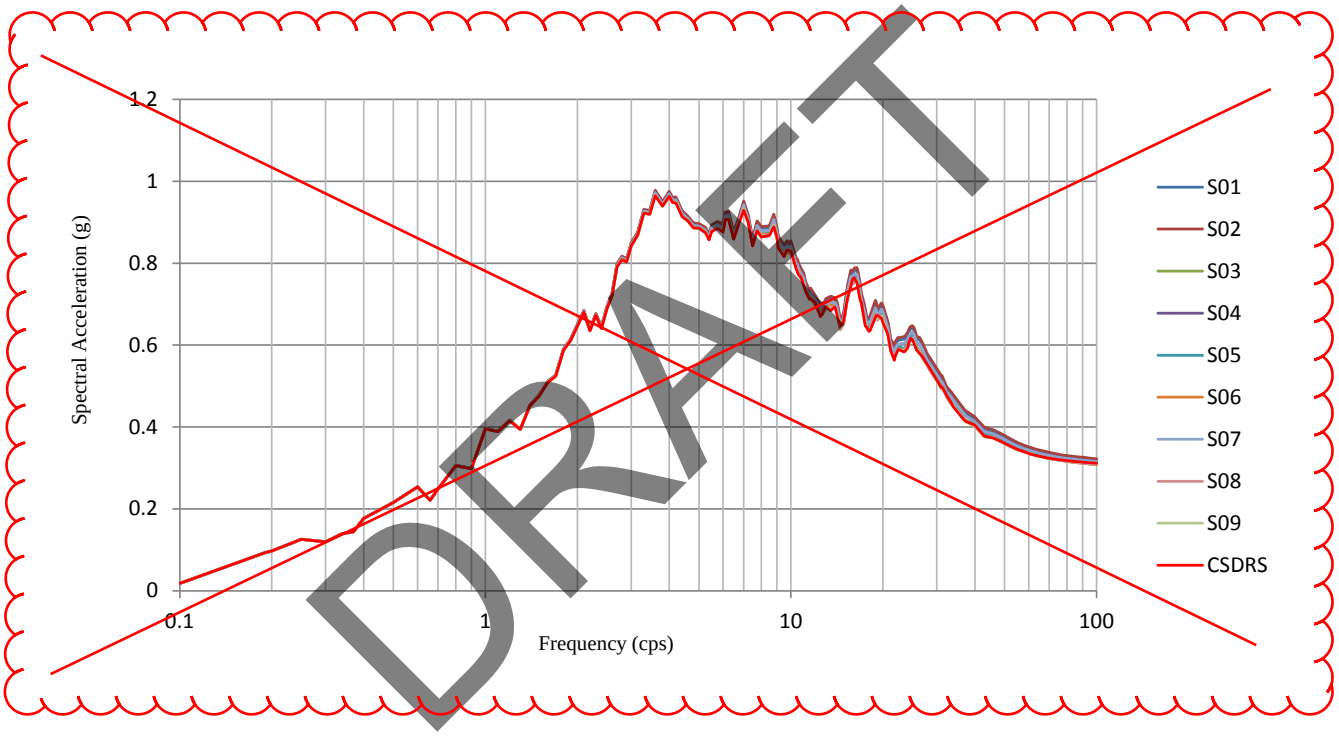

Figure 5-30 Strain-Compatible Response Spectra at Foundation Level of EDGB (Vertical)

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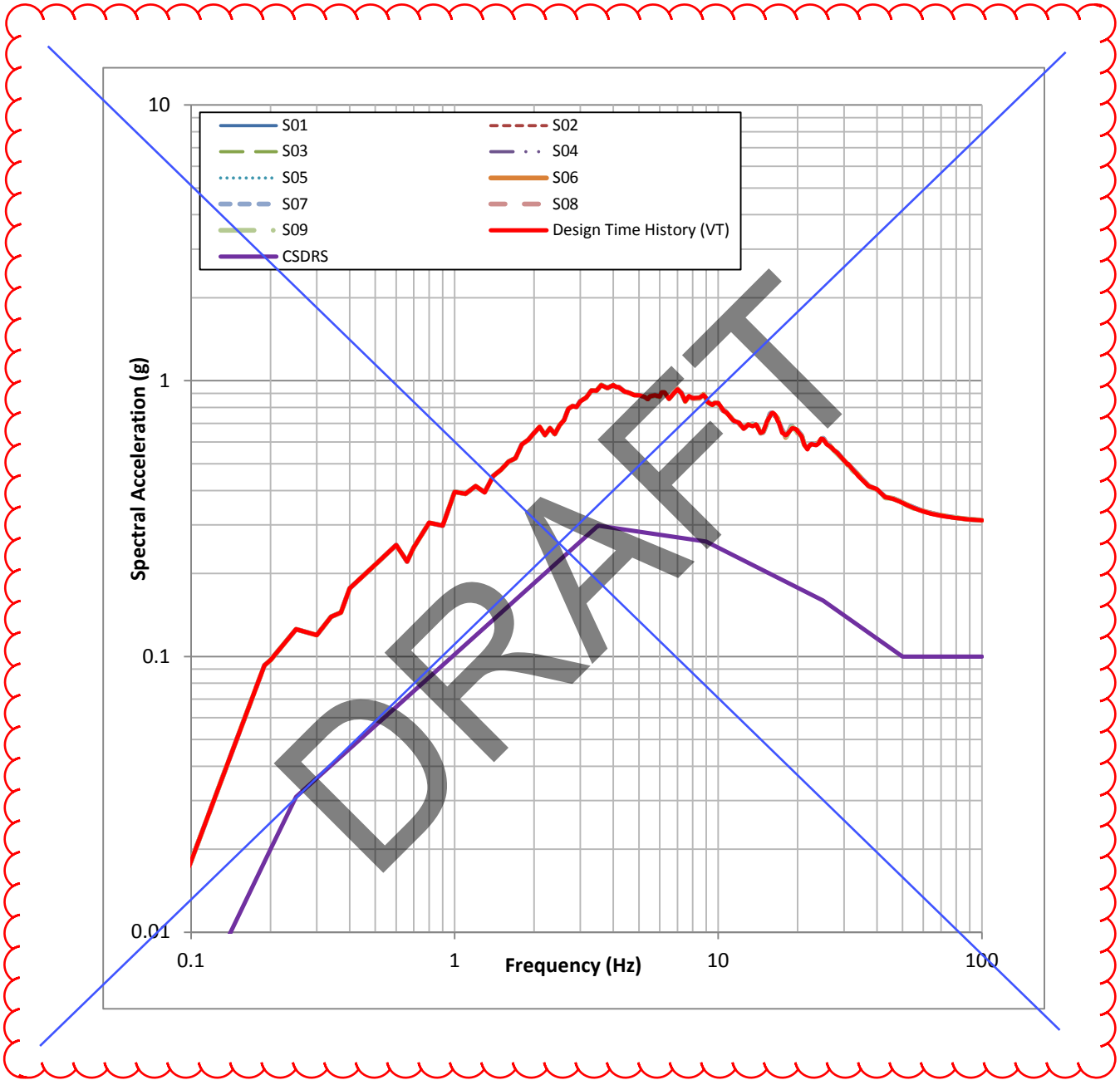

Figure 5-30 Strain-Compatible Response Spectra at Foundation Level of EDGB (Vertical)

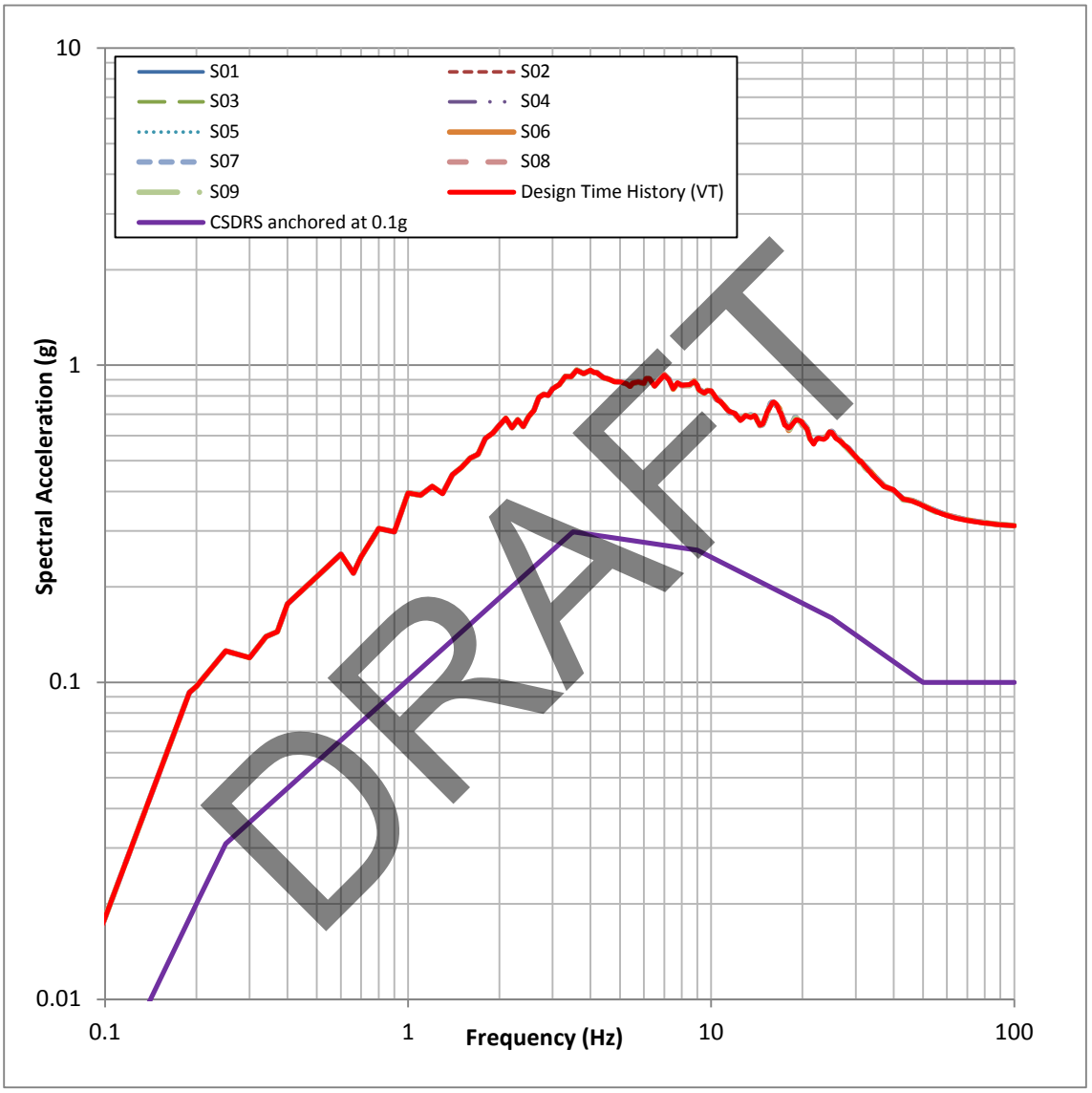

Figure 5-30 Strain-Compatible Response Spectra at Foundation Level of EDGB (Vertical)

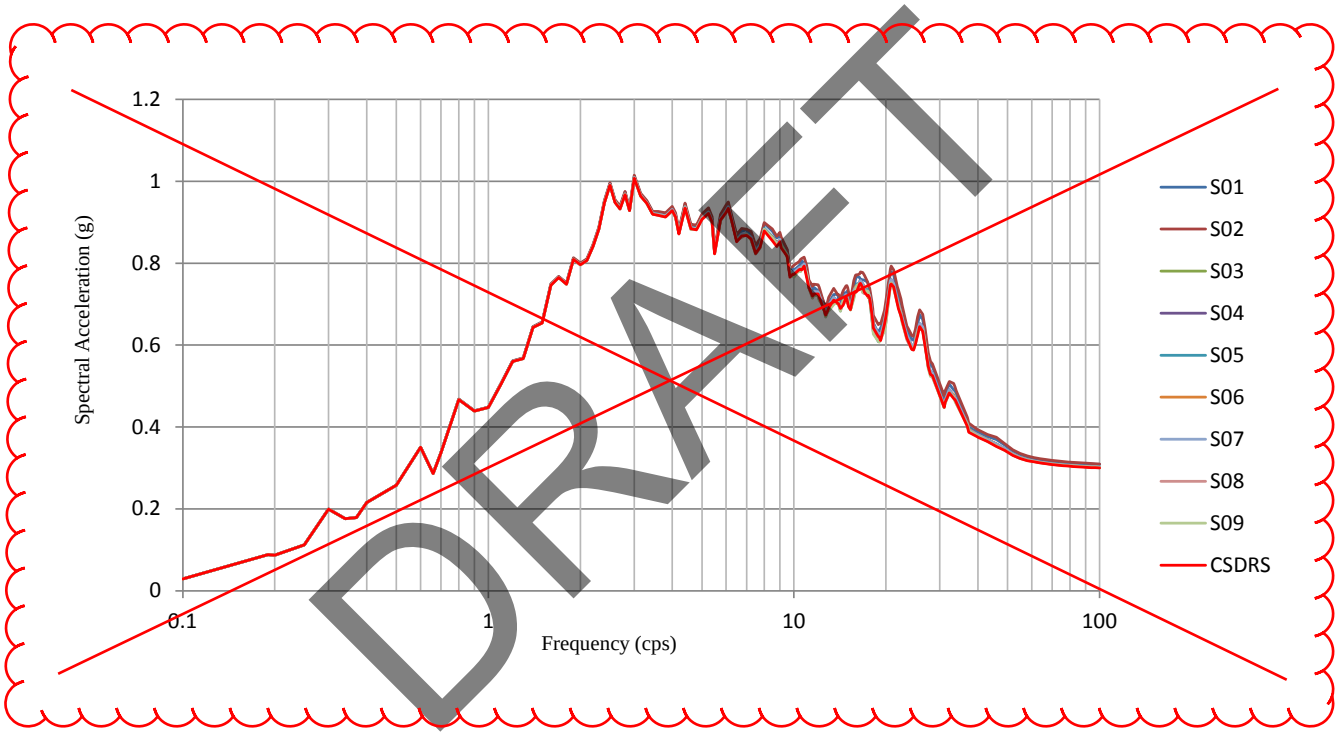

Figure 5-31 Strain-Compatible Response Spectra at Foundation Level of DFOT Room(E-W) (1 of 3)

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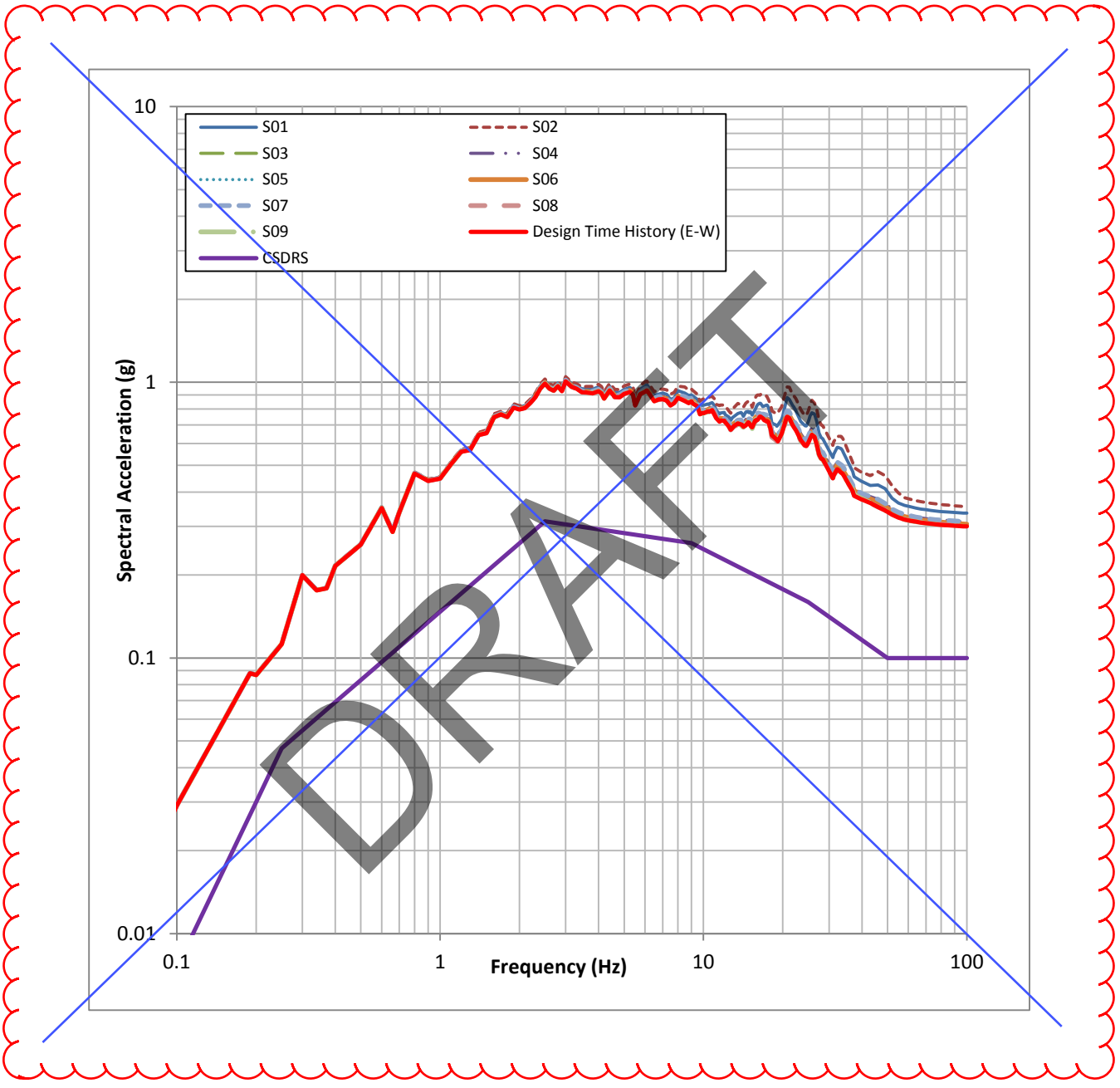

Figure 5-31 Strain-Compatible Response Spectra at Foundation Level of DFOT Room(E-W) (1 of 3)

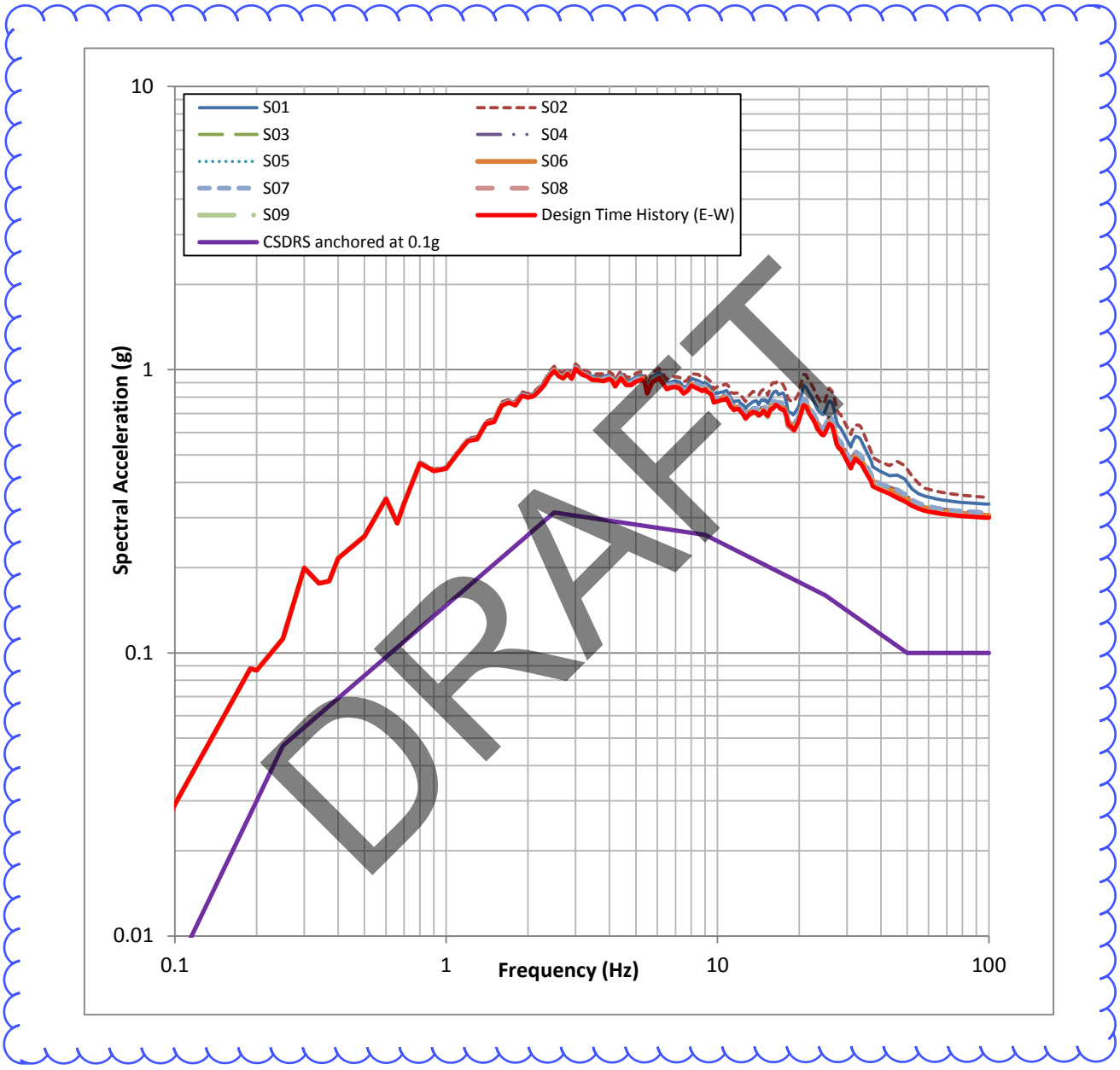

Figure 5-31 Strain-Compatible Response Spectra at Foundation Level of DFOT Room(E-W) (1 of 3)

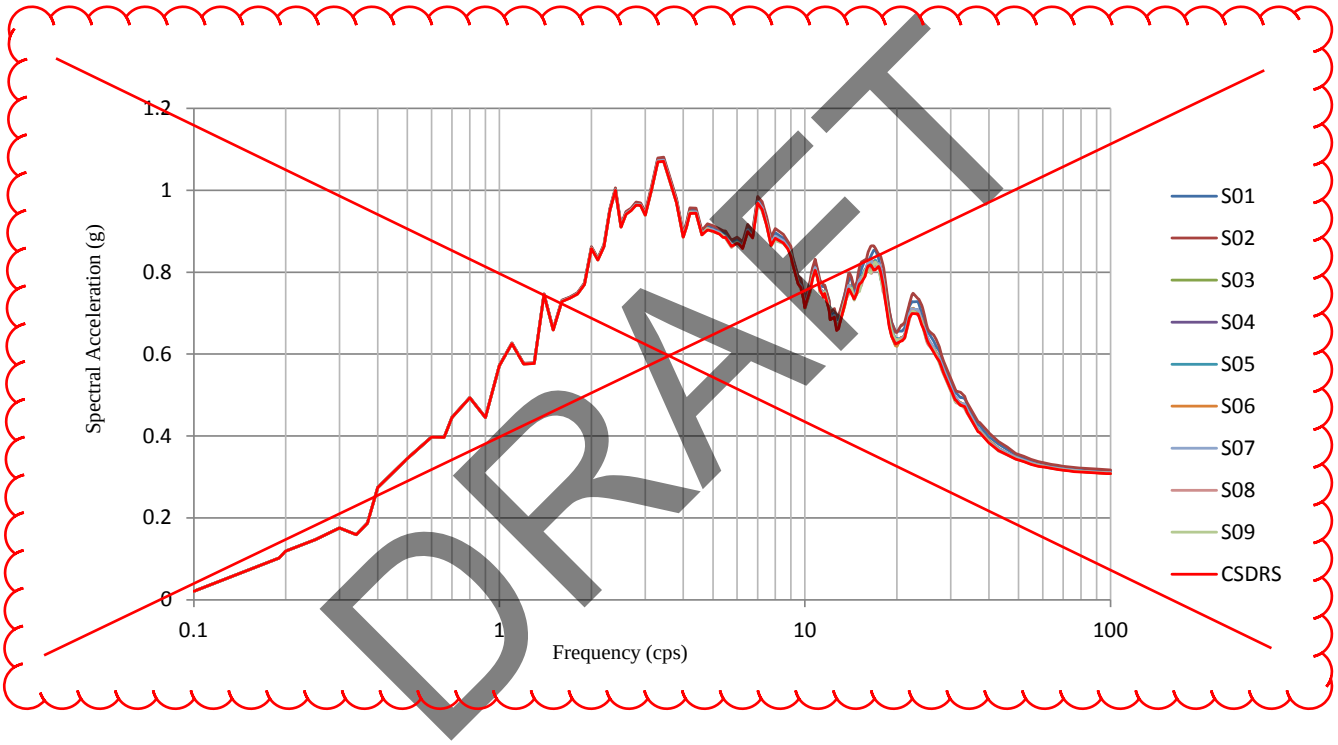

Figure 5-31 Strain-Compatible Response Spectra at Foundation Level of DFOT Room(N-S) (2 of 3)

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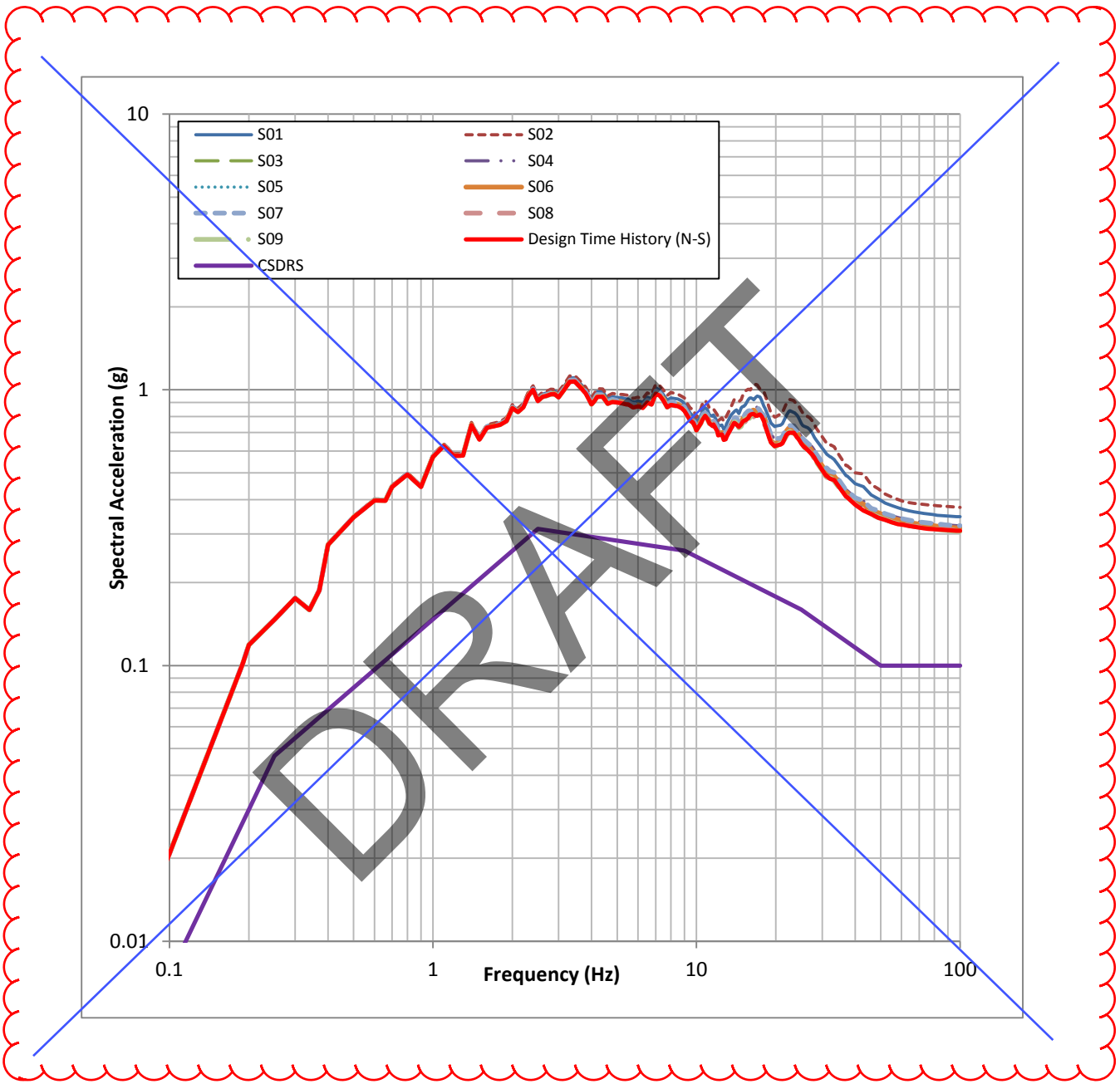

Figure 5-31 Strain-Compatible Response Spectra at Foundation Level of DFOT Room(N-S) (2 of 3)

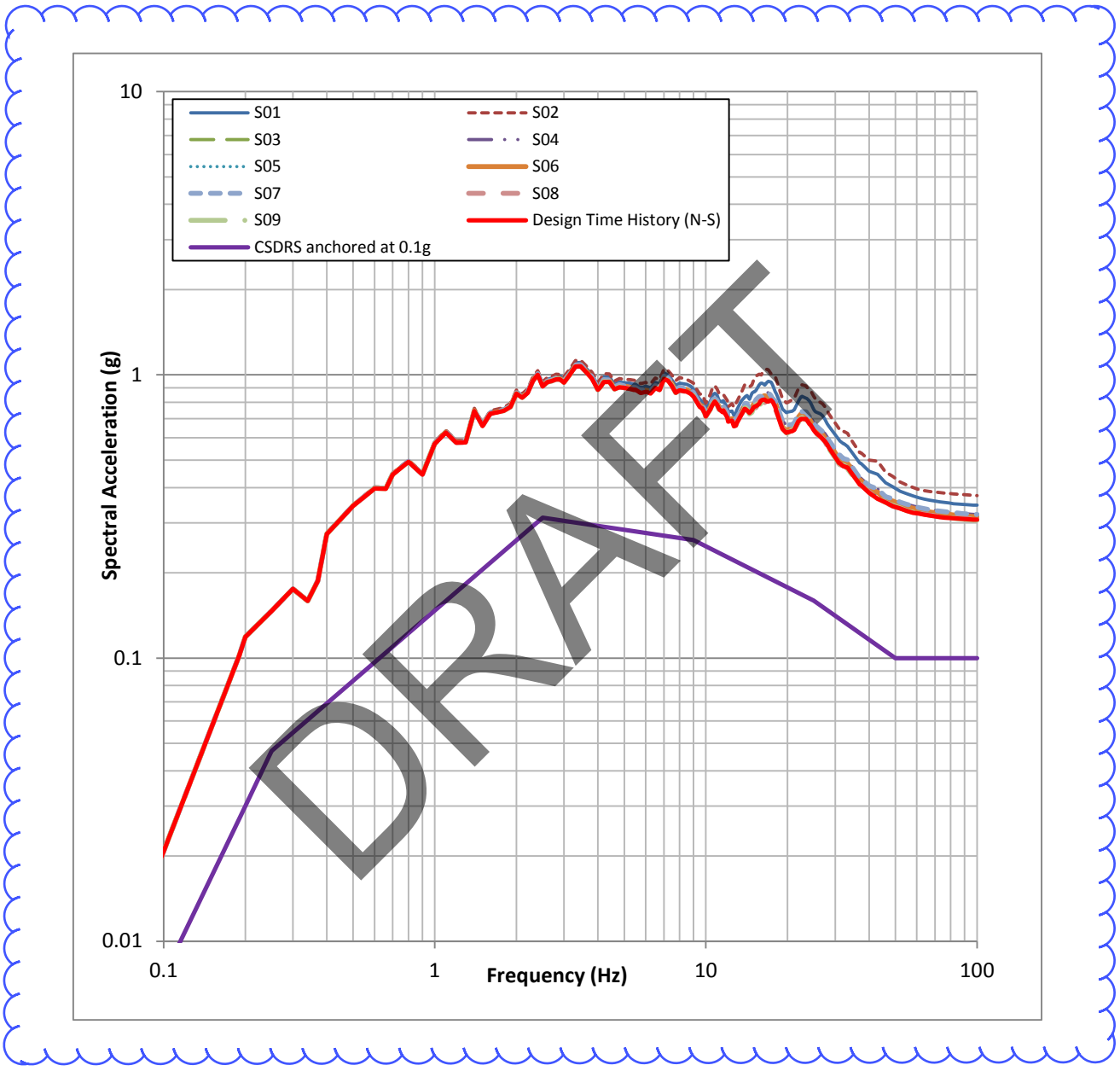

Figure 5-31 Strain-Compatible Response Spectra at Foundation Level of DFOT Room(N-S) (2 of 3)

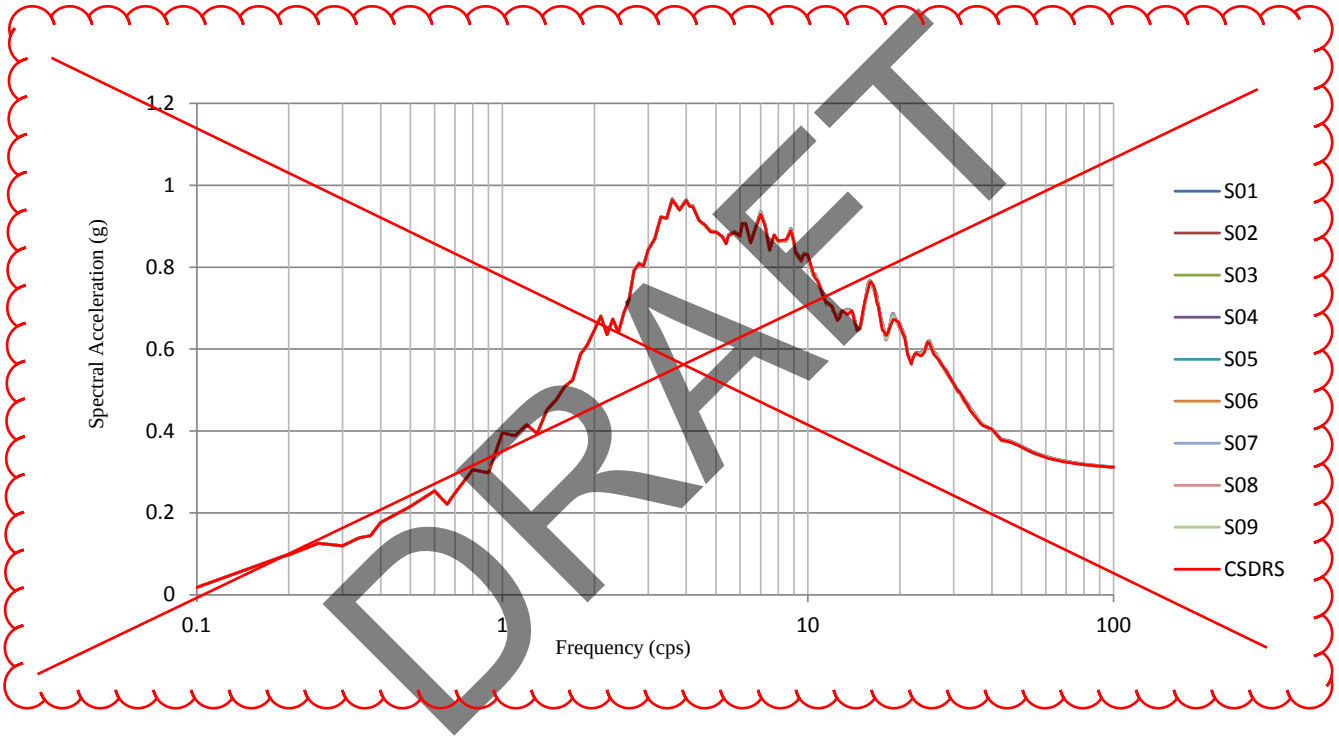

Figure 5-31 Strain-Compatible Response Spectra at Foundation Level of DFOT Room(Vertical) (3 of 3)

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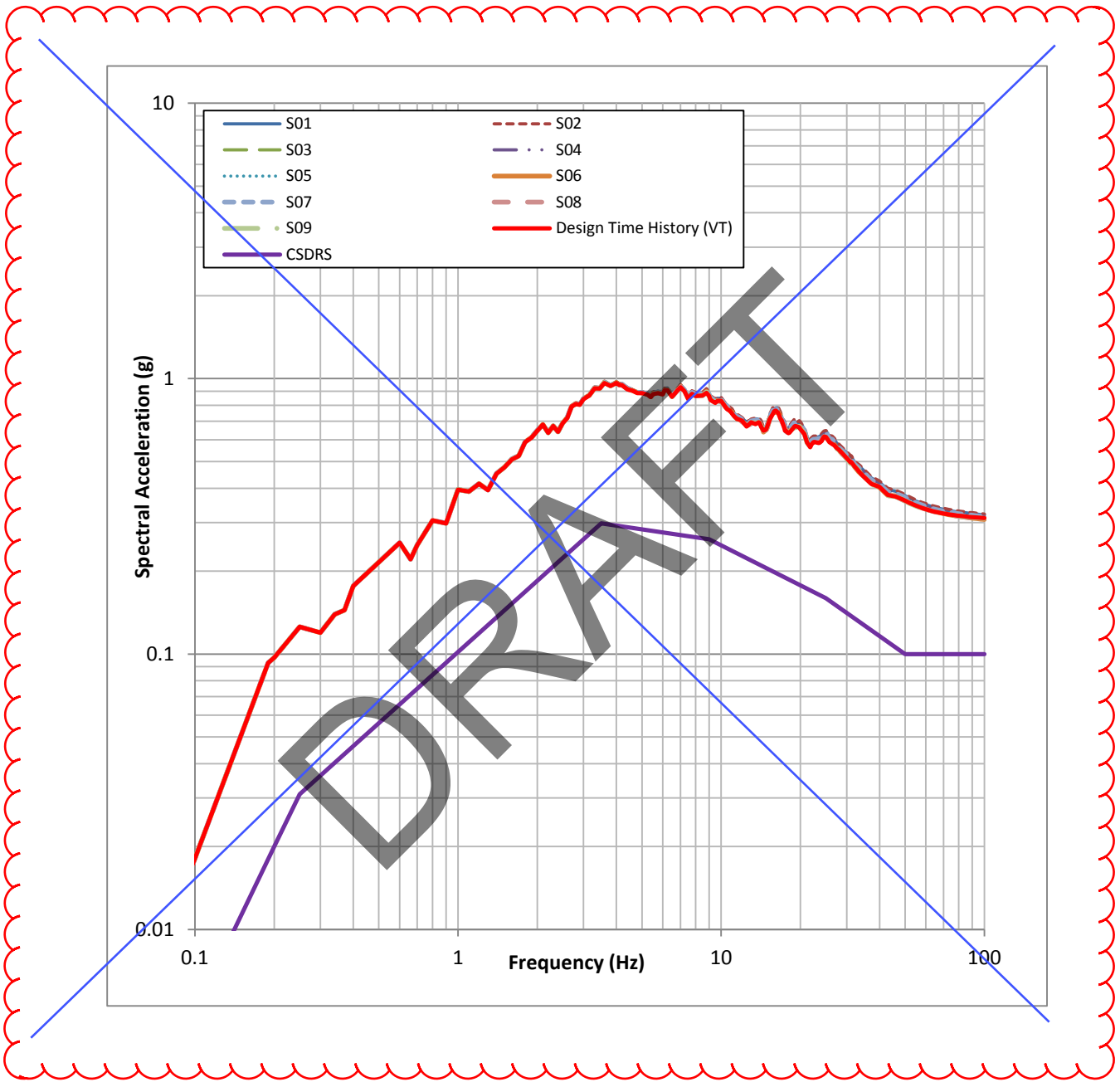

Figure 5-31 Strain-Compatible Response Spectra at Foundation Level of DFOT Room(Vertical) (3 of 3)

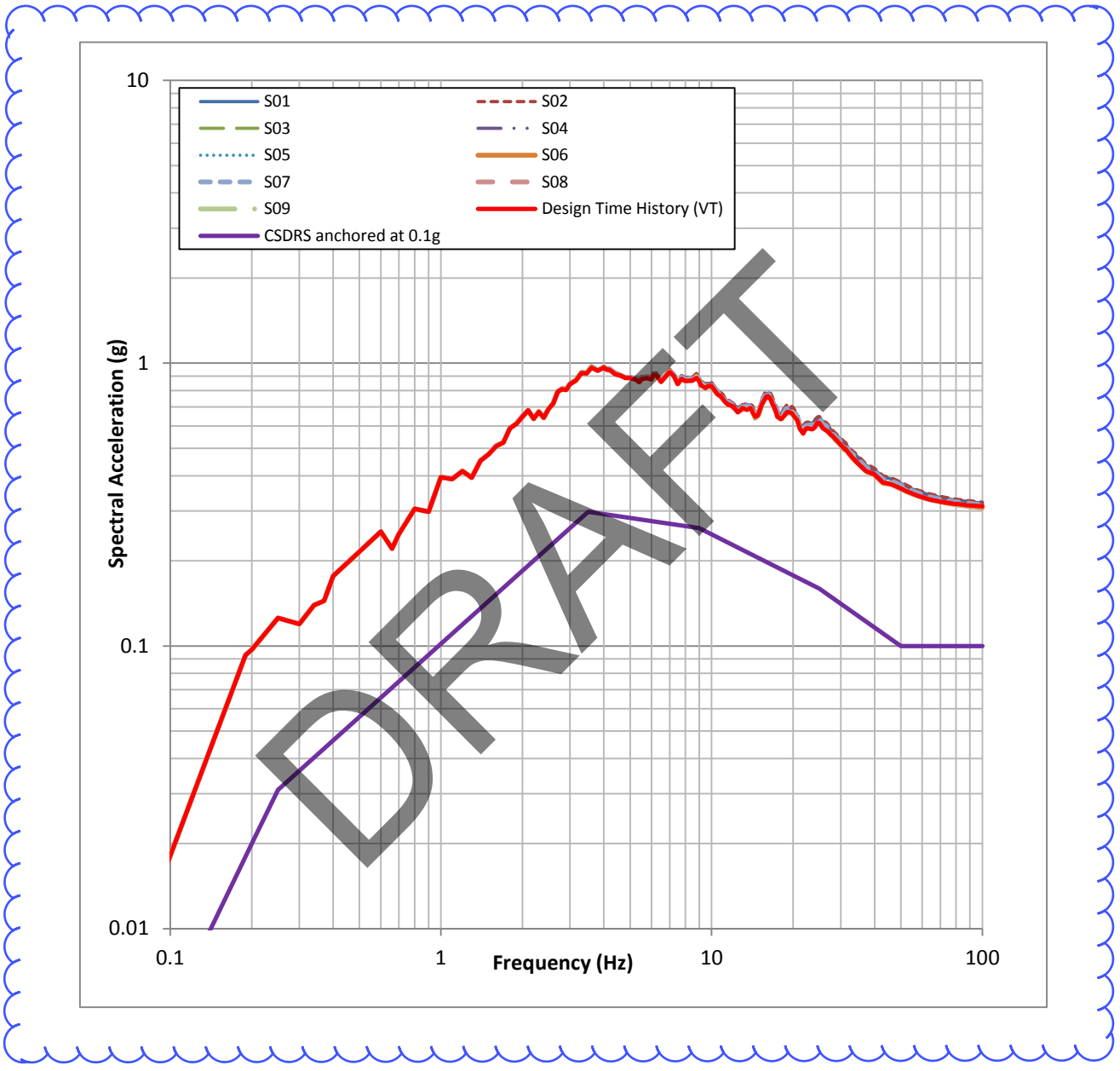

Figure 5-31 Strain-Compatible Response Spectra at Foundation Level of DFOT Room(Vertical) (3 of 3)