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May 20, 2014

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D. C. 20555

Serial No. NA3-14-012
Docket No. 52-017
COL/RGM

**DOMINION VIRGINIA POWER**
**NORTH ANNA UNIT 3 COMBINED LICENSE APPLICATION**
**MARKUPS TO FSAR SECTIONS 3.7 AND 3.8 AND COLA PART 10**

On December 18, 2013 Dominion submitted an update to the North Anna 3 Combined License Application (COLA) (ML14007A541).

Dominion has since determined that portions of FSAR Sections 3.7 and 3.8 and Part 10 require revisions for the following reasons:

- The sliding stability analysis for the Fire Water Service Complex (FWSC) incorrectly considered the resistance provided by the engineered backfill, resulting in an error in the value of the maximum lateral pressure demand on the FWSC shear keys
- Incorrect stiffness and damping values were used in the SASSI model for the cracked state of the Reactor Building/Fuel Building exterior walls and some circular reinforced members
- ISRS results were adjusted using a revised methodology to address coupling between rotations and translations
- There were several editorial errors identified, including transposition errors of numbers in two FSAR tables and duplication of one figure in the FSAR

The need for these revisions has been discussed with the NRC North Anna 3 project manager. None of the revisions result in changes to the design of the plant.

An enclosure with the revised pages is included to facilitate the NRC's review of the North Anna 3 COLA. The revised pages are shown in text markup format. These changes will be incorporated in a future COLA submission.

D089
NRO

Please contact Regina Borsh at (804) 273-2247 (regina.borsh@dom.com) if you have questions.

Very truly yours,

Mark D. Mitchell

Mark D. Mitchell

COMMONWEALTH OF VIRGINIA

COUNTY OF HENRICO

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by Mark D. Mitchell, who is Vice President – Generation Construction of Virginia Electric and Power Company (Dominion Virginia Power). He has affirmed before me that he is duly authorized to execute and file the foregoing document on behalf of the Company, and that the statements in the document are true to the best of his knowledge and belief.

Acknowledged before me this 15th day of May, 2014
My registration number is 253183 and my
Commission expires: Sept. 30, 2016

Kathy W. Prokopis
Notary Public

KATHY W. PROKOPIS
NOTARY PUBLIC
MY COMMISSION NUMBER 253183
COMMONWEALTH OF VIRGINIA

Enclosure:

Markups to FSAR Sections 3.7 and 3.8 and COLA Part 10

Commitments made by this letter:

This information will be incorporated in a future submission of the North Anna Unit 3 COLA.

cc: U. S. Nuclear Regulatory Commission, Region II
C. P. Patel, NRC
T. S. Dozier, NRC
G. J. Kolcum, NRC
D. Paylor, VDEQ
W. T. Lough, SCC
P. W. Smith, DTE
M. K. Brandon, DTE
R. J. Bell, NEI

Serial No. NA3-14-012
Docket No. 52-017

# ENCLOSURE

## Markups to FSAR Sections 3.7 and 3.8 and COLA Part 10

## REVISION SUMMARY

| Section | Changes | Reason for Change |
|---|---|---|
| 3.7.2.4.1 | Related SSI analysis to SASSI structural model | Editorial |
| 3.7.2.4.1.1 | Adjusted content for clarity | Editorial |
| 3.7.2.4.1.3 | Provided additional details related to structural modeling | Editorial |
| 3.7.2.4.1.4 | Clarification that the site-specific SSI analyses modeled the concrete fill below the FWSC consistent with the mesh size of plate elements for basemat and exterior walls. Added description of effects using cracked concrete properties. | Editorial<br><br>Error in 3D stick model for RB/FB |
| 3.7.2.4.1.5 | Provided additional details related to structural modeling | Editorial |
| 3.7.2.4.1.6.1 | Revised summary associated with Vent Wall stresses to reflect re-analysis with updated values cracked stiffness and damping. Corrected summary of Unit 3 site-specific SSI enveloping maximum horizontal accelerations for the RB/FB Wall Out-of-plane Oscillators. | Error in 3D stick model for RB/FB |
| 3.7.2.4.1.6.2 | Adjusted content for clarity | Editorial |
| 3.7.2.4.1.7 | Adjusted content for clarity | Editorial |
| 3.7.2.4.1.8 | Changed Table 3.7.2-219 to Table 3.7.2-209 | Editorial |
| Table 3.7.2-201 | Adjusted table title | Editorial |
| Tables 3.7.2-205 thru 3.7.2-209 | Changed title from “Ratio with DCD Enveloping...” to “Ratios of Enveloping...” Corrected table values (revised values are marked as inserts) | Error in tabulated values due to incorrect values used for cracked stiffness and damping in some outer walls of the RB/FB |
| Table 3.7.2-210 | Changed title from “Ratio with DCD Max. Vertical Acceleration: RB/FB” to “Ratios of Enveloping Maximum Vertical Accelerations: RB/FB.” Changed “Loads” to “Acceleration” in (b) subheading. Corrected table values. (revised values are marked as inserts) | Error in tabulated values due to incorrect values used for cracked stiffness and damping in some outer walls of the RB/FB |

| Section | Changes | Reason for Change |
|---|---|---|
| Tables 3.7.2-211 thru 3.7.2-214 | Changed title from "Ratio with DCD Maximum Vertical Acceleration:..." to "Ratios of Enveloping Maximum Vertical Accelerations:..." Changed "Loads" to "Acceleration" in (b) subheading. Corrected table values. (revised values are marked as inserts) | Error in tabulated values due to incorrect values used for cracked stiffness and damping in some outer walls of the RB/FB |
| Table 3.7.2-215 | Changed title from "Ratio with DCD Maximum Horizontal Acceleration:..." to "Ratios of Enveloping Maximum Horizontal Accelerations:..." Changed "Loads" to "Acceleration" in (b) subheading. Corrected table values. (revised values are marked as inserts) | Error in tabulated values due to incorrect values used for cracked stiffness and damping in some outer walls of the RB/FB |
| Table 3.7.2-216 | Corrected table values due to incorrect values used for cracked stiffness and damping in some outer walls of the RB/FB. Added notes to (c) Pedestal Wall and (d) Vent Wall. (revised values are marked as inserts) Added (g) Wall Oscillator table | Error in tabulated values due to incorrect values used for cracked stiffness and damping in some outer walls of the RB/FB. (g) wall added due to revised analysis required for the cracked member. |
| | Added units of kN and g where appropriate. | Editorial |
| Table 3.7.2-217 | Changed title from "Ratio with DCD..." to "Ratios of...". Changed "Envelop" to "Enveloping" in (a) subheading. Revised the CB enveloping loads (revised values are marked as inserts) | Error in tabulated values.<br>Error in table revision level<br>Transposition error |
| Table 3.7.2-218 | Changed title from "Ratio with DCD Enveloping Maximum Vertical Acceleration..." to "Ratios of Enveloping Maximum Vertical Accelerations...". Changed subheading (a) from "Site-Specific Envelop..." to "Site-Specific Enveloping..." Changed subheading (b) from "...Loads" to "Acceleration". | Editorial |
| Table 3.7.2-219 | Revised the CB stress test calculations. (revised values are marked as inserts) Added units of "kN" and "g" in column headings where appropriate. Added notes to (b) Slabs table | Transposition error and Editorial |

| Section | Changes | Reason for Change |
|---|---|---|
| Table 3.7.2-220 | Changed title from "Ratio with DCD..." to "Ratios of...". Changed subheading (a) from "Site-Specific Envelop..." to "Site-Specific Enveloping..."<br>Revised node number for FWS at 4.65 m elevation | Editorial<br>Transposition error |
| Table 3.7.2-221 | Changed title from "Ratio with DCD..." to "Ratios of...". Changed subheading (a) from "Site-Specific Envelop..." to "Site-Specific Enveloping...".<br>Corrected tables associated with FPE model | Editorial<br>Error in tabulated values |
| Table 3.7.2-222 | Changed title from "Ratio with DCD...: FWSC Stick" to "Ratios of...: FWS". Changed subheading (a) from "Site-Specific Envelop..." to "Site-Specific Enveloping...". | Editorial |
| Table 3.7.2-223 | Changed title from "Ratio with DCD Enveloping Max. Vertical Acceleration..." to "Ratios of Enveloping Maximum Vertical Accelerations...". Changed subheading (a) from "Site-Specific Envelop..." to "Site-Specific Enveloping...". Changed subheading (b) from "...DCD Loads" to "...DCD Acceleration." | Editorial |
| Table 3.7.2-224 | Changed title from "Ratio with DCD Enveloping Max. Vertical Acceleration..." to "Ratios of Enveloping Maximum Vertical Accelerations...". Changed subheading (a) from "Site-Specific Envelop..." to "Site-Specific Enveloping...". Changed subheading (b) from "...DCD Loads" to "...DCD Acceleration." | Editorial |
| Figure 3.7.2-201 | Added x-y orientation to RB/FB Basemat plan view | Editorial |
| Figure 3.7.2-202 | Changed "FG" to "RG" in item (a) caption | Error in layout presented |
| Figure 3.7.2-203 | Added modeling notes for RB/FB SASSI 2010 Model | Editorial |
| Figures 3.7.2-203 & 3.7.2-204 | Added x-y orientation to CB Basemat plan view | Editorial |
| Figure 3.7.2-205 | Added 'SASSI2010' to title | Editorial |

| Section | Changes | Reason for Change |
|---|---|---|
| Figure 3.7.2-206 | Added modeling notes for CB SASSI 2010 Model | Editorial |
| Figure 3.7.2-207 | Added x-y orientation and column lines to FWSC Basemat plan view | Editorial |
| Figure 3.7.2-209 | Added modeling notes for FWSC SASSI 2010 Model | Editorial |
| Figure 3.7.2-210 | Corrected RB/FB Figure associated with cracked elements | Error in figure |
| Figures 3.7.2-211 thru 3.7.2-282 | Corrected figure content to correspond with updated analysis | Updated analysis |
| 3.7.3.13 | Revised to designate Tier 2* content | Editorial |
| 3.8 | Deleted "stress" from second sentence | Editorial |
| 3.8.4.5.6 | Clarified walls applied in the evaluations of "below grade" wall designs. Defined results reflected in Figures 3.8.4-205 through 3.8.4-208. | Editorial |
| 3.8.5.5.1 | Revised to neglect engineered backfill to calculate resistance for FWSC. Defined evaluation results for foundation stability. | Consistency with seismic analysis strategy<br>Editorial |
| 3.8.5.5.2 | Added clarifying detail | Editorial |
| Table 3.8.5-201 | Revised units for lateral pressure | Editorial |
| Table 3.8.5-202 | Revised units for lateral pressure | Editorial |
| Table 3.8.5-203 | Revised units for lateral pressure | Editorial |
| Tables 3.8.5-204 thru 3.8.5-206 | Revised calculated values due to updated analysis (revised values are marked as inserts) | Updated analysis |
| Figures 3.8.4-201 & 3.8.4-202 | Revised figure title to correct column lines | Updated analysis |
| Figure 3.8.4-203 | Deleted extra floor level elevations axis values for building lateral soil pressure. Changed "FG" to "FF" in title. | Editorial<br>Error in column designations<br>Updated analysis |
| Figure 3.8.4-204 | Revised to correct CB column line designation | Updated analysis |

SSI analyses serve as basis for development of Unit 3 site-specific ISRS for all locations in the Seismic Category I buildings.

This section presents the approach and methodology used for the site-specific SSI analyses and the reconciliation of the ESBWR standard plant design for the Unit 3 site-specific conditions. Site-specific ISRS are also presented in this section for representative locations.

Add the following at the end of Section 3.7.2.4.

**NAPS DEP 3.7-1**

### 3.7.2.4.1 Site-Specific Soil-Structure Interaction Analysis

This section presents the site-specific SSI analyses of the Seismic Category I RB/FB, CB, and FWSC. The site-specific SSI analyses are performed to address the Unit 3 site-specific conditions.

The methodology used for site-specific SSI analyses is consistent with the methodology used for the SSI analyses for the ESBWR Standard Plant design. The site-specific SSI analysis is performed using the SASSI2010 computer program that is an updated version of the SASSI2000 computer program used for the standard plant SSI analysis. The structural dynamic models used for the site-specific SSI analyses are developed based on the standard design basis models described in DCD Appendix 3A and are coupled with the Unit 3 site-specific strain compatible dynamic subsurface properties developed in Section 3.7.1.

The site-specific SSI analyses consider the RB/FB embedded into the Zone III rock and include the surrounding concrete fill. The effect of the structural fill above the top of the Zone III rock at DCD Elevation -0.68 m (273 ft NAVD88) on the seismic response of RB/FB is neglected as of minor importance (the DCD Elevation value is relative to the standard plant finished ground level grade EL 4.5 m per DCD Table 3.4-1, while the value following in parentheses is the corresponding elevation at the NA3 site for which EL 289.5 ft NAVD88 is the finished ground level grade). Concrete fill used to fill the gap between the RB/FB and adjacent buildings and excavated in-situ rock up to the top of Zone III rock is included in the SASSI structural model. The input control motion is applied to the SSI model at the bottom of the RB/FB foundation.

The site-specific SSI analyses of the CB consider the building embedded into the Zone III rock and include the surrounding concrete fill in the SASSI structural model. The CB is founded on concrete fill layer resting on the surface of the Zone III/IV rock. The effect of the structural fill above the top of the Zone III rock at DCD Elevation -3.12 m (265 ft NAVD88) on the seismic response of CB is neglected as of minor importance. Concrete fill is used to fill the gap between the CB and adjacent buildings and excavated in-situ rock up to the top of Zone III rock. and the concrete fill layer under the CB that is resting on the surface of the Zone III/IV rock are all included in the SASSI structural model. The input control motion is applied to the SSI model at the bottom of the CB foundation resting on the concrete fill layer.

The site-specific SSI analyses consider the FWSC as a surface founded structure at DCD Elevation 2.15 m (282 ft NAVD88) where the input control motion is applied. The SASSI structural model also includes the concrete fill layer placed on the surface of the Zone III/IV rock up to the bottom of the FWSC basemat. The concrete fill has the same width of the basemat and is surrounded by structural fill with properties similar to the properties of the excavated embedded in in-situ soil material.

The site-specific SSI analyses results are presented and compared with the seismic responses obtained from the standard design SSI analysis presented in DCD Appendix 3A in the following subsections. These comparisons serve as basis for validation of the applicability of the ESBWR Standard Plant for the Unit 3 site-specific conditions as shown in Section 3.7.2.4.1.6. The responses obtained from the site-specific SSI analyses serve as basis for development of Unit 3 site-specific ISRS. In addition, the below grade exterior walls of the RB/FB and the CB are evaluated for seismic lateral pressure demands in Section 3.8.4. the The foundation stability and the dynamic bearing pressure demands are evaluated in Section 3.8.5 for the RB/FB, CB and FWSC based on the site-specific SSI analyses results.

#### 3.7.2.4.1.1 Strain Compatible Dynamic Subsurface Material Properties

The geology of the Unit 3 site is discussed in detail in Section 2.5.1. The subsurface materials encountered at the Unit 3 and the engineering properties of these subsurface materials site are discussed in detail in Section 2.5.4.

Three subsurface material profiles, a best estimate (BE) profile, a lower bound (LB) profile, and an upper bound (UB) profile, are used in the SSI analyses to account for variability in the subsurface materials properties at the Unit 3 site. The development of the site-specific strain compatible dynamic subsurface material properties associated with the BE, LB, and UB profiles ~~are~~ is discussed in Section 3.7.1.1.4 and ~~are~~ is in accordance with requirements of ISG-017. The strain compatible dynamic properties used for the BE, LB, and UB subsurface profiles used in the site-specific SSI analyses are provided in Table 3.7.1-201 for RB/FB, Table 3.7.1-203 for CB, and Table 3.7.1-205 for FWSC. The concrete fill is included in the SSI analyses structural model as 3-D solid elements as shown in Figures 3.7.2-202 and 3.7.2-203 for RB/FB, in Figures 3.7.2-205 and 3.7.2-206 for CB, and in Figures 3.7.2-208 and 3.7.2-209 for FWSC.

#### 3.7.2.4.1.2 SSI Input Response Spectra Compatible Ground Motion Time Histories

Section 3.7.1.1.5 describes development of the site-specific ground motion time histories used as input control motion in the site-specific SSI analyses. Each site-specific SSI analysis is performed using a single set of three ground motion time histories for the three orthogonal components (two horizontal and one vertical) that are applied to the SSI model as free field ground motion at the corresponding foundation bottom elevations. In accordance with ISG-017, the NEI method serves as basis for the development of in-column motion acceleration time histories used as input control motion for the site-specific SSI analyses of RB/FB and CB. The in-column motion time histories at the basemat bottom elevation are developed for each subsurface profile. The site-specific SSI analysis of the FWSC surface mounted model uses a single set of time histories for the three components of the out-crop motion at plant grade. The duration of time history is 29.98 seconds and the time step is 0.005 seconds.

#### 3.7.2.4.1.3 Soil-Structure Interaction Analysis Method

The SSI analysis is performed using the SASSI2010 computer program, an updated version of SASSI2000 computer program used for the standard design SSI analysis described in DCD Appendix 3A. The explicit direct (excavated volume) method is used for the computation of the foundation impedance of the embedded RB/FB and CB models. The same method is also used for the surface founded FWSC ~~including~~ to calculate the impedances of the concrete fill block underneath the foundation that is embedded in in-situ soil. The effects of the ground motion incoherency that reduce the responses at higher frequencies are conservatively neglected by considering coherent input ground motion. As shown in Table 3.7.2-201, the cut-off frequency of 50 Hz is used for all site-specific SSI analyses except for the SSI analysis of FWSC with LB profile that uses cut-off frequency of 29 Hz. This LB cutoff frequency is sufficient to capture a low and intermediate frequency range of significance that is typically associated with softer subsurface profiles. The number of FFT points is 8192.

#### 3.7.2.4.1.4 **SSI Analysis Structural Models**

The site-specific SSI structural models for the RB/FB, CB and FWSC are constructed from the building stick models coupled with the foundation finite element model following the methodology described in DCD Section 3A.7.3. The RB/FB, CB and FWSC stick models are shown in DCD Figures 3A.7-4, 3A.7-6, and 3A.7-7, respectively. The plate elements for basemat and basement exterior walls, and overall site-specific SSI structural models are shown in Figures 3.7.2-201 through 3.7.2-203 for the RB/FB, Figures 3.7.2-204 through 3.7.2-206 for the CB, and Figures 3.7.2-207 through 3.7.2-209 for the FWSC. These figures also present the excavated soil volume elements that are part of the SASSI structural models. The excavated soil volumes have mesh that is consistent with the FE mesh of the basemats and basement exterior walls finite elements. The excavated soil elements are assigned with in-situ strain compatible soil properties as the ones used in the site profile models.

SASSI2010 criteria that the size of the elements shall be at least one fifth of the wave length to be able to accurately pass the seismic wave is used to determine the mesh size of the site and excavated volume models. The passing and cut-off frequencies are shown in Table 3.7.2-201. The meshes of the ~~foundation~~ embedded finite element models used for site-specific SSI analyses of the RB/FB and CB are refined enough to ensure passage of seismic waves with 50 Hz frequency in all directions for all subsurface profiles. The mesh of the finite element models of excavated volume and concrete fill under the FWSC foundation ~~model is~~ are identical and are sized to pass waves with 50 Hz frequency in all directions for the UB subsurface profile. Based on the SASSI2010 criteria, the FWSC models used for the SSI analyses of LB and BE soil profiles are capable of transmitting frequencies up to 19 Hz and 33 Hz, respectively. The SSI analyses for these two soil profiles are performed for frequencies up to 50 Hz and 29 Hz that are 50 percent higher than the SASSI2010 criteria. The review of the transfer function results from these two analyses indicate that the use of frequencies of analysis beyond those specified in the SASSI2010 manual does not compromise the accuracy of the results.

The in-situ subgrade in the SSI models is represented by horizontally infinite layers resting on surface of elastic half space. The site models used for the SSI analyses of the RB/FB, CB and FWSC model consist of 13, 17 and 22 layers, respectively. These layers are developed to match the original site profile using the equivalent wave travel time procedure for adjusted shear and compression wave velocities as shown below.

$$Vs_{ave} = \frac{H}{\sum_i d_i / Vs_i} \qquad Vp_{ave} = \frac{H}{\sum_i d_i / Vp_i}$$

where: H is the thickness of the adjusted layer, $d_i$, $Vs_i$ and $Vp_i$ are the thickness, shear wave and compression wave velocities of the layers in the original site profiles. The unit weight and damping ratios of the adjusted layers are determined as weighted averages with respect to the layer thickness.

The top of the half space in the RB/FB, CB and FWSC models is established at DCD elevation -42.7 m (135 ft NAVD88), -45.8 m (125 ft NAVD88) and -45.5 m (126 ft NAVD88), respectively. Consistent with SASSI manual recommendations, the half-space simulation consists of additional ten layers with viscous dashpots added at the base of the site finite element model to account for the dissipation of energy at the model lower boundary. The half-space model has a thickness of 1.5 $V_S$/ f, where Vs is the shear wave velocity of the halfspace and f is the frequency of the analysis. The total depth of the site model used for SSI analyses of RB/FB, CB and FWSC is more than 95.9 m, 104.1 m and 116.3 m, respectively, which is close or exceeds two times the footprint dimension of the analyzed structure.

Reduced cracked concrete Concrete stiffness properties are assigned to the lumped mass stick model elements based on the SASSI stress results for in-plane shear and out-of-plane bending moment. The shear stiffness of the stick elements is reduced based on the cracking criteria (shear stress of rupture of concrete: by 50 percent, if the member in-plane shear stress exceeds concrete rupture stress ($3 \times f_c'^{0.5}$ psi, where $f_c'$ is specified compressive strength of concrete, psi). The cracking criteria defined in ACI 349-01, Section 9.5.2.3, is used as basis for reduction of the out of plane bending stiffness based on comparison with the bending moment results. The cracking criteria defined in ACI 349-01, Section 9.5.2.3 are used as the basis for reduction of the out-of-plane bending stiffness by 50 percent based on comparison with the bending moment results. The stress check to determine the state of concrete cracking is performed for the seismic response corresponding to obtained from the SSI analysis of the BE profile. This is to maintain consistency with best estimate properties considered in the structural models.

Figure 3.7.2-210 shows in red the elements of the RB/FB lumped mass stick model that are assigned with reduced cracked concrete stiffness properties and SSE damping. The RB/FB SDOF oscillators that are shown in red are also assigned with reduced cracked concrete stiffness properties and SSE damping. Reduced cracked concrete stiffness properties and SSE damping are assigned to all stick elements of the CB lumped mass stick. The FWSC model is assigned full (uncracked concrete) stiffness properties and OBE damping.

The concrete fill surrounding the RB/FB, CB and FWSC is included in the structural models. In the site-specific SSI analyses, the concrete fill surrounding the RB/FB, CB, and below the FWSC is modeled consistent with the mesh size of plate elements for basemat and exterior walls. 3-D spring elements are established at the interface between the concrete fill solid elements and the building shell elements. These spring elements are assigned global stiffness properties high enough to ensure they do not affect the dynamic properties of the analyzed SSI system. The interface spring elements provide spring force results that serve as input for calculation of the site-specific wall lateral pressure and foundation bearing pressure demands in Sections 3.8.4.5.6 and 3.8.5.5.2, respectively. The spring forces results also serve as input for calculation of seismic driving forces for the site-specific stability evaluations in Section 3.8.5.5.1.

The SASSI2010 model X-direction and Y-direction represent plant north-south (NS) and east-west (EW) directions, respectively. The positive X-axis is oriented to the south. The positive Y-axis is oriented to the east. The positive Z- axis is oriented upward.

#### 3.7.2.4.1.5 **Soil-Structure Interaction Analysis Cases**

The site-specific SSI analyses cases are summarized in Table 3.7.2-202 for the RB/FB, Table 3.7.2-203 for the CB, and Table 3.7.2-204 for the

FWSC. To account for variability in the subsurface material properties, BE, LB, and UB profiles are considered.

Each analysis case consists of three directions of excitation (two horizontal and one vertical) applied independently to the SSI model. The calculated resulting co-directional ISRS in the X-, Y-, and Z directions are combined using the SRSS method,. The ISRS are developed for responses at the edges of the building by taking into account coupling effects between vertical and rocking and between lateral and torsion motions. The co-directional response structural loads from each direction of excitation for each case are combined using the algebraic sum method in the time domain to obtain the total response. The co-directional response structural loads from each direction of excitation for each case are combined using the algebraic sum method in the time domain or the SRSS method to obtain the response due to the three components of the earthquake. The ISRS in results obtained from the analysis of the BE, LB and UB profiles are enveloped to have develop site-specific design ISRS having the maximum amplitude for each frequency. The structural responses obtained from the SSI analyses of BE, LB, and UB profiles are enveloped to obtain the site-specific design basis values for the maximum enveloping member forces, accelerations and displacements.

3.7.2.4.1.6 **Soil-Structure Interaction Analysis Results**

The following sections present the results of the site-specific SSI analyses for the BE, LB, and UB subsurface profiles. The site-specific SSI analyses results for response at key locations are compared herein with the standard seismic design envelopes presented in DCD Appendix 3A. Comparisons are provided for maximum seismic structural loads and ISRS.

The results of the SSI analyses for the spring contact forces at the foundation bottom are used to evaluate the potential loss of contact with the subgrade due to foundation uplift. The plots of the contact pressures at the bottom of the foundation at the critical instances of time show that the contact ratio remains above 80 percent thus demonstrating that the potential uplift of the foundations have a negligible effect on the results of the SSI analyses.

#### 3.7.2.4.1.6.1 **SSI Enveloping Maximum Structural Loads**

For the RB/FB model, the enveloping seismic loads from the site-specific SSI analyses based on the BE, LB, and UB subsurface profiles (herein called Unit 3 site-specific SSI enveloping seismic loads) are presented in Tables 3.7.2-205 through 3.7.2-209.

The site-specific SSI enveloping seismic loads for the RB/FB are presented in Table 3.7.2-205. The site-specific SSI enveloping seismic loads are compared with the enveloping seismic loads provided in DCD Table 3A.9-1a for the RB/FB stick model. Table 3.7.2-205 also presents the percentage ratio of the site-specific SSI enveloping seismic loads to the seismic loads used for the standard design of RB/FB structures. Table 3.7.2-205 shows that the site-specific seismic loads for the RB/FB are partially larger than the corresponding standard design loads. Table 3.7.2-216(a) shows the result of stress checks using a scale factor for RB/FB Wall. Scale factors are calculated as the maximum value of the ratios of site-specific to standard design structural load components. This is a conservative approach since not all load components contributing to stresses experience the same degree of increase. The calculated scale factors are then applied to the worst stress ratio of the standard design governing seismic load combination to Code allowable stress. This approach provides upper bound estimate for Unit 3 stresses since the scale factor determined from the seismic load alone is applied to the combined stress of seismic plus other loads. The estimates of site-specific stresses ratio would be smaller if the scale factor is applied to the seismic stress component only. All values of Unit 3 stress ratio are confirmed to be within the code allowable stress limits which demonstrate the applicability of the standard design of RB/FB structures for Unit 3 site conditions.

The site-specific SSI seismic loads for the Reinforced Concrete Containment Vessel (RCCV) stick model are presented in Table 3.7.2-206. The site-specific SSI seismic loads are compared with the corresponding standard design seismic loads provided in DCD Table 3A.9-1b. Table 3.7.2-206 also presents the percentage ratio of the site-specific SSI seismic loads to the seismic loads used for standard design of the RCCV. Table 3.7.2-206 shows that the site-specific seismic loads for the RCCV are partially larger than the standard design seismic loads. Table 3.7.2-216(b) shows the result of stress check using a scale factor for RCCV Wall. All values of stress are confirmed to be within allowable stress, thus demonstrating the applicability of the standard design of the RCCV structures for Unit 3 site conditions.

The site-specific seismic loads for the Vent Wall/Pedestal stick model are presented in Table 3.7.2-207. The site-specific seismic loads are compared with the corresponding seismic loads provided in DCD Table 3A.9-1c and used for the standard design of Vent Wall/Pedestal structural members. Table 3.7.2-207 also presents the percentage ratio of the site-specific seismic loads to the seismic loads used for standard design of the Vent Wall/Pedestal structural members. Table 3.7.2-207 shows that the site-specific seismic loads for the Vent Wall/Pedestal are partially larger than the corresponding standard design seismic loads. Table 3.7.2-216(c) and (d) shows the result of the stress check using a scale factor for the Vent Wall/Pedestal Wall. ~~All the values of stress are confirmed to be within stress allowables, thus demonstrating the applicability of the standard design of the Vent Wall/Pedestal wall for Unit 3 site conditions.~~ The stresses at the Vent Wall and Pedestal bottom slightly exceed the allowable stress when the scale factor is applied to the combined stress of seismic plus others. However, when the scale factor is applied to the seismic stress alone, the combined stress of the Vent Wall/Pedestal structure is confirmed to be within stress allowables, thus demonstrating the applicability of the standard design of the Vent Wall/Pedestal wall for Unit 3 site conditions.

The site-specific seismic loads for the Reactor Shield Wall (RSW) are presented in Table 3.7.2-208. The site-specific seismic loads are compared with the corresponding RSW standard design seismic loads provided in DCD Table 3A.9-1d. Table 3.7.2-208 also presents for the RSW the percentage ratio of the site-specific seismic loads to the standard design enveloping seismic loads. Table 3.7.2-208 shows that the RSW site-specific seismic loads are partially larger than the corresponding seismic loads in DCD Table 3A.9-1d. Table 3.7.2-216(e) shows the result of a stress check using a scale factor. The RSW stress exceeds the allowable stress when the scale factor is applied to the combined stress of seismic plus others. However, when the scale factor is applied to seismic stress alone the combined stress of the RSW structure is confirmed to be within stress allowables, thus demonstrating the applicability of the standard design of the RSW structure for Unit 3 site conditions.

As described in DCD Sections 3.7.2 and 3.7.2.3, the reactor pressure vessel (RPV) is not a primary structural component. A lumped mass stick model of the RPV is included in the SSI model to capture its dynamic interaction with the supporting structure. Although this model is not used for the design of the RPV, the responses obtained from the RPV lumped mass stick model are considered for the purpose of this site-specific evaluation. The site-specific SSI enveloping loads for the RPV stick model are presented in Table 3.7.2-209. The site-specific SSI enveloping seismic loads are compared with the standard design seismic loads provided in DCD Table 3A.9-1e for the RPV lumped mass stick model. Table 3.7.2-209 presents the percentage ratio of the site-specific SSI enveloping seismic loads to the standard design SSI analysis enveloping seismic loads for the RPV stick model. Table 3.7.2-209 shows that the site-specific SSI enveloping seismic loads for the RPV stick model exceed the DCD standard design SSI analysis enveloping seismic loads. To address these exceedances of the RPV seismic loads, a decoupled model of the RPV subsystem is analyzed using input SSE loads based on the results of the site-specific SSI analysis.

The site-specific seismic loads for CB stick model are presented in Table 3.7.2-217. The site-specific seismic loads are compared with the corresponding CB standard design seismic loads provided in DCD Table 3A.9-1f. Table 3.7.2-217 also presents the percentage ratio of the site-specific seismic loads to the corresponding seismic loads used for standard design of the CB structure. Table 3.7.2-217 shows that the CB site-specific seismic loads are partially larger than the corresponding standard design seismic loads. Table 3.7.2-219 shows the result of the stress check using a scale factor. As shown in Table 3.7.2-219, it is confirmed that all stresses are lower than stress allowables except for the wall between DCD elevations -7.4 m and -2.0 m. However, further evaluation with the scale factor applied to seismic load alone confirms that the combined stress in this wall also remains within stress allowables, thus demonstrating the applicability of the standard design of the CB structure for Unit 3 site conditions.

For the FWSC model, the site-specific seismic loads obtained from site-specific SSI analyses of the Fire Water Storage Tank (FWS) and Fire Pump Enclosure (FPE) stick models are presented in Tables 3.7.2-220 and 3.7.2-221 respectively. These site-specific seismic loads are compared with the corresponding FWSC standard design seismic loads provided in DCD Tables 3A.9-1g and 3A.9-1h. Table 3.7.2-220 and Table 3.7.2-221 also presents the percentage ratio of the site-specific seismic loads to the seismic loads used for the standard design of the FWSC structure. Tables 3.7.2-220 and 3.7.2-221 show that the site-specific FWSC seismic loads are lower than the corresponding standard design seismic loads except for torsion. The structural design considers seismic torsion loads that include both torsion loads due to eccentricities of the SSI analysis model and accidental torsion that is calculated as a product of 5 percent of the largest plan dimension of the building and the floor horizontal load. The comparisons in Table 3.7.2-222 demonstrate that the total torsion loads used in the standard design envelope the site-specific total torsion loads. The comparisons in Tables 3.7.2-220, 3.7.2-221, and 3.7.2-222 demonstrate the applicability of the standard design of the FWSC structures for Unit 3 site conditions.

The Unit 3 site-specific SSI enveloping maximum vertical accelerations for the RB/FB stick model are presented in Table 3.7.2-210. The Unit 3 site-specific SSI enveloping maximum vertical accelerations are compared with the enveloping maximum vertical accelerations provided in DCD Table 3A.9-3a, for the RB/FB stick model. Table 3.7.2-210 also presents the percentage ratio of the site-specific SSI enveloping maximum vertical accelerations to the enveloping maximum vertical accelerations of the DCD for the RB/FB stick model. Table 3.7.2-210 shows that the Unit 3 site-specific SSI enveloping maximum vertical accelerations for the RB/FB stick model are partially larger than the DCD enveloping maximum vertical accelerations. Table 3.7.2-216(a) shows the result of the stress check using a scale factor for RB/FB Wall. All values of stress are confirmed to be within stress allowables.

The Unit 3 site-specific SSI enveloping maximum vertical accelerations for the RCCV stick model are presented in Table 3.7.2-211. The Unit 3 site-specific SSI enveloping maximum vertical accelerations are compared with the enveloping maximum vertical accelerations provided in DCD Table 3A.9-3b, for the RCCV stick model. Table 3.7.2-211 also presents the percentage ratio of the Unit 3 site-specific SSI enveloping maximum vertical accelerations to the DCD enveloping maximum vertical accelerations for the RCCV stick model. Table 3.7.2-211 shows that the site-specific SSI enveloping maximum vertical accelerations for the RCCV stick model are partially larger than the DCD enveloping maximum vertical accelerations. Table 3.7.2-216(b) shows the result of the stress check using a scale factor for RCCV Wall. All values of stress are confirmed to be within stress allowables.

The site-specific SSI enveloping maximum vertical accelerations for the Vent Wall/Pedestal stick model are presented in Table 3.7.2-212. The site-specific SSI enveloping maximum vertical accelerations are compared with the enveloping maximum vertical accelerations provided in DCD Table 3A.9-3c, for the Vent Wall/Pedestal stick model. Table 3.7.2-212 also presents the percentage ratio of the site-specific SSI enveloping maximum vertical accelerations to the DCD enveloping maximum vertical accelerations for the Vent Wall/Pedestal stick model. Table 3.7.2-212 shows that the site-specific SSI enveloping maximum vertical accelerations for the Vent Wall/Pedestal stick model are partially larger than the DCD enveloping maximum vertical accelerations. Table 3.7.2-216(c) and (d) shows the result of the stress check using a scale factor for Vent Wall/Pedestal. ~~All values of stress are confirmed to be within stress allowables.~~ The stresses at the Vent Wall and Pedestal bottom slightly exceed the allowable stress when the scale factor is applied to the combined stress of seismic plus others. However, when the scale factor is applied to the seismic stress alone, the combined stress of the Vent Wall/Pedestal structure is confirmed to be within stress allowables, thus demonstrating the applicability of the standard design of the Vent Wall/Pedestal structure for Unit 3 site conditions.

The site-specific SSI enveloping maximum vertical accelerations for the RSW stick model are presented in Table 3.7.2-213. The ~~Unit 3~~ site-specific ~~SSI~~ enveloping maximum vertical accelerations are compared with the enveloping maximum vertical accelerations provided in the DCD Table 3A.9-3d~~, for the RSW stick model~~. Table 3.7.2-213 also presents the percentage ratio of the ~~Unit 3~~ site-specific ~~SSI~~ enveloping maximum vertical accelerations to the DCD enveloping maximum vertical accelerations for the RSW stick model. Table 3.7.2-213 shows that the ~~Unit 3~~ site-specific ~~SSI~~ enveloping maximum vertical accelerations for the RSW stick model are larger than the DCD enveloping maximum vertical accelerations. Table 3.7.2-216(e) shows the result of a stress check using a scale factor. The RSW stress exceeds the allowable stress when the scale factor is applied to the combined stress of seismic plus others. However, when the scale factor is applied to seismic stress alone, the combined stress of the RSW structure is confirmed to be within stress allowables, thus demonstrating the applicability of the standard design of the RSW structure for Unit 3 site conditions.

The site-specific SSI enveloping maximum vertical accelerations for the RB/FB Flexible Slab Oscillators are presented in Table 3.7.2-214. The site-specific SSI enveloping maximum vertical accelerations are compared with the enveloping maximum vertical accelerations provided in the DCD Table 3A.9-3e, for the RB/FB Flexible Slab Oscillators. Table 3.7.2-214 also presents the percentage ratio of the site-specific SSI enveloping maximum vertical accelerations to the DCD enveloping maximum vertical accelerations for the RB/FB Flexible Slab Oscillators. Table 3.7.2-214 shows that the site-specific SSI enveloping maximum vertical accelerations for the RB/FB Flexible Slab Oscillators are partially larger than the DCD enveloping seismic loads. Table 3.7.2-216(f) shows the result of the stress ~~check using a scale factor~~ checks of RB/FB flexible slabs performed using scale factors. Only the site-specific stress demands on the Suppression Pool (S/P) slab is larger than allowable stress. However, when the scale factor is applied to seismic stress alone, the combined stress of the S/P slab is only 6 percent larger than allowable. Because the strains under combined primary and secondary forces meet the ASME Code Section CC-3422.1(d) requirements, the design adequacy of the S/P is confirmed.

The site-specific SSI enveloping maximum horizontal accelerations for the RB/FB Wall Out-of-Plane Oscillators are presented in Table 3.7.2-215. The site-specific SSI enveloping maximum horizontal accelerations are compared with the enveloping maximum horizontal accelerations provided in DCD Table 3A.9-3f, for the RB/FB Wall Out-of-Plane Oscillators. Table 3.7.2-215 also presents the percentage ratio of the Unit 3 site-specific SSI enveloping maximum horizontal accelerations to the DCD enveloping maximum horizontal accelerations for the RB/FB Wall Out-of-Plane Oscillators. Table 3.7.2-215 shows that the Unit 3 site-specific SSI enveloping maximum horizontal accelerations for the RB/FB Wall Out-of-plane Oscillators are partially larger than the standard design values with a maximum exceedance of approximately ~~84~~ 69 percent. These exceedances of the oscillator accelerations affect only the magnitude of the out-of plane loads related to the mass participation of the particular flexible mode of vibration of the wall. The design of the wall is performed using a total out of plane load that include the contribution of all flexible modes of vibrations represented by the oscillators and the remaining rigid mass response of the wall. ~~The site specific stress evaluations of the RB/FB walls based on the total out of plane loads conformed that the combined stresses are within the stress allowables.~~ The site-specific stress evaluations of the RB/FB flexible walls presented in Table 3.7.1-216(g) are based on the consideration of total out-of plane loads. These evaluations confirm that the combined site specific stress demands on the RB/FB flexible walls are all lower than the stress allowables.

The results of the Unit 3 site-specific SSI enveloping maximum vertical accelerations for the CB stick model are presented in Table 3.7.2-218. The ~~SSI~~ enveloping maximum vertical accelerations are compared with the enveloping maximum vertical accelerations provided in the DCD Table 3A.9-3g, for the CB stick model. Table 3.7.2-218 also presents the percentage ratio of the site-specific SSI enveloping maximum vertical accelerations to the DCD enveloping maximum vertical accelerations for the CB stick model. Table 3.7.2-218 shows that the site-specific SSI enveloping maximum vertical accelerations for the CB stick model are partially larger than the DCD enveloping seismic loads. The stress checks in Table 3.7.2-219(a) performed using scale factors conservatively applied on the total load show that the stresses in all walls but one are below the stress allowable. Only the stresses in the wall between DCD elevations -7.4 m and -2.0 m are larger than allowable stresses. However, further evaluation with the scale factor applied to seismic load alone confirms that the combined stress in this wall also remains within stress allowable. The stress checks in Table 3.7.2-219(b) using scale factors applied on the total slab load confirm that the stress in the CB slabs are all lower than the stress allowable thus demonstrating the applicability of the standard design of the CB slabs for Unit 3 site.

The results of Unit 3 site-specific SSI analysis of FWSC stick model for enveloping maximum vertical accelerations at FWS and FPE lumped mass locations are presented in Tables 3.7.2-223 and 3.7.2-224 respectively. These site-specific enveloping maximum vertical accelerations are compared with those provided in the DCD Tables 3A.9-3h and 3A.9-3i. The percentage ratio of the FWSC site-specific enveloping maximum vertical accelerations to the DCD enveloping maximum vertical accelerations in Tables 3.7.2-223 and 3.7.2-224 show that the site-specific accelerations are lower than the DCD values thus demonstrating the applicability of standard design of FWS and FPE slabs for the Unit 3 conditions.

#### 3.7.2.4.1.6.2 Comparison of the Site-Specific SSI Floor Response Spectra

The 5 percent damping ISRS obtained from the site-specific SSI analyses of RB/FB, CB and FWSC models for the BE, LB, and UB subsurface profiles are compared with the standard design enveloping ISRS presented in DCD Section 3A.9.2. ~~The site specific ISRS are developed following the same methodology as the standard design ISRS.~~

Figures 3.7.2-211 through 3.7.2-228 compare the 5 percent damping site-specific ISRS obtained from the site-specific SSI analysis of the RB/FB model with the corresponding standard design ISRS in DCD Section 3A.9.2. The comparisons show that the site-specific ISRS exceed the standard design ISRS for a range of frequencies. Peak broadened site-specific design ISRS are developed ~~as envelope of~~ for all locations within the RB/FB to envelop the results obtained from the SSI analyses of RB/FB for the three site-specific subgrade conditions ~~following the same methodology as the standard design~~. The RB/FB site-specific SSE design floor response spectra at selected locations for critical damping ratios of 2, 3, 4, 5, 7, 10 and 20 percent are shown in Figures 3.7.2-229 through 3.7.2-246.

Figures 3.7.2-247 through 3.7.2-252 present the comparisons of, the 5 percent damping site-specific SSI ISRS obtained from the site-specific SSI analyses of the CB with the corresponding standard design ISRS presented in DCD Section 3A.9.2. The comparisons show that the CB site-specific SSI ISRS exceed the standard design ISRS for a range of frequencies. Peak broadened site-specific design ISRS are developed ~~as envelope of~~ for all locations within the CB to envelop the results obtained from the SSI analyses of CB for the three site-specific subgrade conditions ~~following the same methodology as the standard design~~. The CB site-specific SSE design floor response spectra at selected locations for critical damping ratios of 2, 3, 4, 5, 7, 10 and 20 percent are shown in Figures 3.7.2-253 through 3.7.2-258.

Figure 3.7.2-259 through 3.7.2-270 present the comparison of the 5 percent damping site-specific ISRS obtained from the site-specific SSI analysis of the FWSC model with the corresponding standard design

ISRS presented in DCD Section 3A.9.2. The comparisons show that FWSC site-specific ISRS exceed the standard design ISRS for a range of frequencies. Peak broadened site-specific design ISRS are developed ~~as envelope of~~ for all locations within the FWSC to envelop the results obtained from the SSI analyses of FWSC for the three site-specific subgrade conditions ~~following the same methodology as the standard design~~. The FWSC site-specific SSE design floor response spectra at selected locations for critical damping ratios of 2, 3, 4, 5, 7, 10 and 20 percent are shown in Figures 3.7.2-271 through 3.7.2-282.

#### 3.7.2.4.1.7 Site-Specific SSI Analyses Conclusions

Based on the site-specific SSI analyses, the following conclusions apply to the Unit 3 site:

- The structural design of the ESBWR Standard Plant based on the CSDRS ground motion and generic subgrade conditions, is applicable to the RB/FB, CB and FWSC Seismic Category I structures at the Unit 3 site.
- Site-specific ISRS are developed ~~and adopted for the design~~ for all damping values and locations ~~of~~ within RB/FB, CB and FWSC and adopted for the design since the site-specific ISRS exceed the standard plant design basis ISRS at some locations for a range of frequencies. Site-specific seismic qualification and analyses are performed for the equipment and components at these locations to demonstrate that their standard design is applicable for Unit 3 site-specific conditions.

#### 3.7.2.4.1.8 Site-Specific Seismic Design and Analysis of Structures, Systems, and Components

The Unit 3 seismic design and analysis of structures, systems, and components (SSCs), are based on SSE defined by the following two sets of the free-field outcrop spectra at the foundation level (bottom of the base slab):

1) the CSDRS shown in the DCD Figures 2.0-1 and 2.0-2; and

2) the site-specific FIRS for each individual structure (RB/FB, CB, and FWSC) defined in Figures 2.5.2-307, 2.5.2-308, and 2.5.2-312

Thus, where a SSC is required to meet Seismic Category I requirements or to withstand SSE, the two sets of spectra define the SSE for design and analysis of these SSCs for Unit 3.

However, as specified in DCD Section 2.0, liquefaction potential and slope stability evaluations are exceptions for each site and use the site-specific SSE.

The seismic design of systems and components is evaluated to both the ISRS input from the standard design CSDRS and the ISRS input from the Unit 3 FIRS. As described in Section 3.7.2.4.1.6.2, the ISRS obtained from the site-specific SSI analyses exceed the standard design ISRS at certain locations within the building for a range of frequencies. Peak broadened site-specific design floor response spectra are developed for these locations and used for seismic design and qualification of substructure, components and equipment. Since PCCS Condenser site-specific floor response spectra exceed the standard design spectra, additional analyses are performed using the methodology described in DCD Section 3G.1.5.4.1.5 to confirm that the acceptance criteria in DCD Tier 1 ITAAC 5 in Table 2.15.4-2 are met. The site-specific ISRS also exceed the standard design floor response spectra at the locations of the new fuel storage rack and spent fuel storage rack in the deep pit. Additional analyses are also performed for these nuclear fuel racks using the methodology described in DCD Reference 9.1-1 to confirm that the acceptance criteria in DCD Tier 1 ITAAC 1 and 2 in Table 2.5.6-1 are met.

~~Table 3.7.2-210~~ Table 3.7.2-209 shows that the site-specific SSI analysis yield enveloping seismic loads for the RPV that exceed the corresponding DCD standard design enveloping seismic loads. The seismic capability of the RPV subsystem is verified through the DCD Tier 1, Table 2.1.1-3, ITAAC 6 based on the results of seismic analysis of a decoupled model of the RPV subsystem that use input SSE loads developed from the results of site-specific SSI analysis of the RB/FB model.

Based on the results of the site-specific SSI analysis for enveloping, seismic loads, it is demonstrated in Section 3.7.2.4.1.6.1 that the standard design of Seismic Category I structures envelops the Unit 3 site-specific structural demands. The site-specific SSE loads for the Seismic Category II, and Radwaste Building structures are developed in the same manner as for the Category I structures based on the results of site specific SSI analyses. The SSI analyses for the Seismic Category II and Radwaste Building structures are identified as site-specific ITAAC in COLA Part 10.

**Table 3.7.2-201 ~~The passing and cut-off frequencies~~ Passing and Cut-off Frequencies**

| Building | RB/FB | | | CB | | | FWSC | | |
|---|---|---|---|---|---|---|---|---|---|
| Site Condition | BE | UB | LB | BE | UB | LB | BE*) | UB | LB*) |
| Passing Frequency | 83 Hz | 112 Hz | 61 Hz | 72 Hz | 95 Hz | 55 Hz | 33 Hz | 53 Hz | 19 Hz |
| Cut-off Frequency | 50 Hz | 50 Hz | 50 Hz | 50 Hz | 50 Hz | 50 Hz | 50 Hz | 50 Hz | 29 Hz |

Note: *) Cut-off frequency is determined to be 1.5 times ~~of~~ the model passing frequency determined based on SASSI criteria

**Table 3.7.2-202 RB/FB SSI Analysis Cases**

| Building | Case ID No. | Structural Damping | Concrete Cracking | Site Condition | | |
|---|---|---|---|---|---|---|
| | | | | BE | UB | LB |
| RB/FB | RBFB-1a | SSE and OBE | Partially Cracked | X | — | — |
| | RBFB-2a | | | — | X | — |
| | RBFB-3a | | | — | — | X |

**Table 3.7.2-203 CB SSI Analysis Cases**

| Building | Case ID No. | Structural Damping | Concrete Cracking | Site Condition | | |
|---|---|---|---|---|---|---|
| | | | | BE | UB | LB |
| CB | CB-1a | SSE | Cracked | X | — | — |
| | CB-2a | | | — | X | — |
| | CB-3a | | | — | — | X |

**Table 3.7.2-204 FWSC SSI Analysis Cases**

| Building | Case ID No. | Structural Damping | Concrete Cracking | Site Condition | | |
|---|---|---|---|---|---|---|
| | | | | BE | UB | LB |
| FWSC | FWSC-1 | OBE | Uncracked | X | — | — |
| | FWSC-2 | | | — | X | — |
| | FWSC-3 | | | — | — | X |

**Table 3.7.2-205 ~~Ratio with DCD~~ Ratios of Enveloping Seismic Loads: RB/FB**

(a) Site-Specific Enveloping Seismic Loads

| Elev. (m) | Elem No. | Node No. | Shear X-Dir. (MN) | Shear Y-Dir. (MN) | Moment X-Dir. (MN-m) | Moment Y-Dir. (MN-m) | Torsion (MN-m) |
|---|---|---|---|---|---|---|---|
| 52.40 | 1110 | 110 | | | 2330 | 2425 | |
| | | 109 | 140.7 | 102.8 | 4500 | 3861 | 1122 |
| 34.00 | 1109 | 109 | | | 5782 | 4288 | |
| | | 108 | 113.8 | 84.0 | 6055 | 4359 | 1557 |
| 27.00 | 1108 | 108 | | | 5713 | 4562 | |
| | | 107 | 253.3 | 183.6 | 5960 | 4726 | 1893 |
| 22.50 | 1107 | 107 | | | 6872 | 4955 | |
| | | 106 | 273.1 | 211.1 | 7441 | 5266 | 3065 |
| 17.50 | 1106 | 106 | | | 8057 | 5561 | |
| | | 105 | 287.4 | 231.3 | 8674 | 5969 | 2280 |
| 13.57 | 1105 | 105 | | | 9147 | 6155 | |
| | | 104 | 298.3 | 235.0 | 9903 | 6697 | 2426 |
| 9.06 | 1104 | 104 | | | 10189 | 6812 | |
| | | 103 | 292.0 | 258.2 | 10831 | 7299 | 2639 |
| 4.65 | 1103 | 103 | | | 6955 | 4105 | |
| | | 102 | 259.7 | 233.9 | 7641 | 4676 | 2397 |
| -1.00 | 1102 | 102 | | | 5634 | 3547 | |
| | | 101 | 239.7 | 204.1 | 6036 | 3803 | 1942 |
| -6.40 | 1101 | 101 | | | 4129 | 2657 | |
| -11.50 | | 2 | 202.0 | 240.5 | 4242 | 2679 | 1293 |

(b) Ratio with DCD ((a)/DCD Loads)

| Elev. (m) | Elem No. | Node No. | Shear X-Dir. | Shear Y-Dir. | Moment X-Dir. | Moment Y-Dir. | Torsion |
|---|---|---|---|---|---|---|---|
| 52.40 | 1110 | 110 | | | 142% | 134% | |
| | | 109 | 93% | 65% | 105% | 86% | 81% |
| 34.00 | 1109 | 109 | | | 104% | 78% | |
| | | 108 | 59% | 55% | 93% | 69% | 65% |
| 27.00 | 1108 | 108 | | | 74% | 64% | |
| | | 107 | 60% | 46% | 66% | 55% | 57% |
| 22.50 | 1107 | 107 | | | 69% | 54% | |
| | | 106 | 56% | 46% | 65% | 47% | 50% |
| 17.50 | 1106 | 106 | | | 65% | 47% | |
| | | 105 | 54% | 42% | 63% | 43% | 45% |
| 13.57 | 1105 | 105 | | | 64% | 43% | |
| | | 104 | 52% | 39% | 60% | 40% | 46% |
| 9.06 | 1104 | 104 | | | 60% | 40% | |
| | | 103 | 48% | 39% | 56% | 37% | 44% |
| 4.65 | 1103 | 103 | | | 36% | 20% | |
| | | 102 | 31% | 27% | 33% | 19% | 21% |
| -1.00 | 1102 | 102 | | | 24% | 14% | |
| | | 101 | 28% | 22% | 22% | 13% | 17% |
| -6.40 | 1101 | 101 | | | 15% | 9% | |
| -11.50 | | 2 | 22% | 23% | 13% | 8% | 11% |

**Table 3.7.2-206 ~~Ratio with DCD~~ Ratios of Enveloping Seismic Loads: RCCV**

(a) Site-Specific Enveloping Seismic Loads

| Elev. (m) | Elem No. | Node No. | Shear X-Dir. (MN) | Shear Y-Dir. (MN) | Moment X-Dir. (MN-m) | Moment Y-Dir. (MN-m) | Torsion (MN-m) |
|---|---|---|---|---|---|---|---|
| 34.00 | 1209 | 209 | | | 212 | 633 | |
| | | 208 | 106.8 | 106.2 | 850 | 1015 | 23 |
| 27.00 | 1208 | 208 | | | 1663 | 1843 | |
| | | 206 | 121.0 | 116.6 | 2203 | 2259 | 958 |
| 17.50 | 1206 | 206 | | | 2550 | 2585 | |
| | | 205 | 144.4 | 113.2 | 2821 | 2766 | 900 |
| 13.57 | 1205 | 205 | | | 3067 | 2949 | |
| | | 204 | 160.5 | 121.6 | 3381 | 3278 | 1013 |
| 9.06 | 1204 | 204 | | | 3692 | 3514 | |
| | | 203 | 164.7 | 138.3 | 4020 | 3936 | 1157 |
| 4.65 | 1203 | 203 | | | 4288 | 4150 | |
| | | 202 | 156.4 | 139.9 | 4329 | 4466 | 1241 |
| -1.00 | 1202 | 202 | | | 4527 | 4628 | |
| | | 201 | 62.1 | 69.8 | 4577 | 4587 | 492 |
| -6.40 | 1201 | 201 | | | 4684 | 4645 | |
| -11.50 | | 2 | 60.9 | 66.3 | 4656 | 4589 | 218 |

(b) Ratio with DCD ((a)/DCD Loads)

| Elev. (m) | Elem No. | Node No. | Shear X-Dir. | Shear Y-Dir. | Moment X-Dir. | Moment Y-Dir. | Torsion |
|---|---|---|---|---|---|---|---|
| 34.00 | 1209 | 209 | | | 109% | 109% | |
| | | 208 | 78% | 58% | 80% | 68% | 65% |
| 27.00 | 1208 | 208 | | | 97% | 73% | |
| | | 206 | 73% | 47% | 74% | 52% | 53% |
| 17.50 | 1206 | 206 | | | 77% | 55% | |
| | | 205 | 63% | 39% | 68% | 48% | 45% |
| 13.57 | 1205 | 205 | | | 71% | 50% | |
| | | 204 | 61% | 37% | 63% | 45% | 46% |
| 9.06 | 1204 | 204 | | | 66% | 47% | |
| | | 203 | 54% | 38% | 59% | 44% | 44% |
| 4.65 | 1203 | 203 | | | 61% | 45% | |
| | | 202 | 69% | 48% | 54% | 42% | 43% |
| -1.00 | 1202 | 202 | | | 56% | 43% | |
| | | 201 | 23% | 21% | 49% | 37% | 17% |
| -6.40 | 1201 | 201 | | | 49% | 37% | |
| -11.50 | | 2 | 23% | 22% | 43% | 32% | 11% |

**Table 3.7.2-207 ~~Ratio with DCD~~ Ratios of Enveloping Seismic Loads: Vent Wall/Pedestal**

(a) Site-Specific Enveloping Seismic Loads

| Elev. (m) | Elem No. | Node No. | Shear X-Dir. (MN) | Shear Y-Dir. (MN) | Moment X-Dir. (MN-m) | Moment Y-Dir. (MN-m) | Torsion (MN-m) |
|---|---|---|---|---|---|---|---|
| 17.50 | 701 | 701 | | | 111 | 94 | |
| | | 702 | 28.1 | 25.5 | 108 | 140 | 33 |
| 14.50 | 702 | 702 | | | 127 | 159 | |
| | | 703 | 24.3 | 23.0 | 183 | 194 | 32 |
| 11.50 | 703 | 703 | | | 190 | 206 | |
| | | 704 | 24.9 | 24.6 | 232 | 256 | 35 |
| 8.50 | 704 | 704 | | | 242 | 258 | |
| | | 705 | 26.1 | 25.3 | 260 | 277 | 37 |
| 7.4625 | 705 | 705 | | | 289 | 248 | |
| 4.65 | | 706,303 | 13.3 | 16.6 | 312 | 271 | 20 |
| 4.65 | 1303 | 303 | | | 535 | 506 | |
| | | 377 | 39.2 | 34.5 | 549 | 489 | 61 |
| 2.4165 | 1377 | 377 | | | 668 | 597 | |
| | | 302 | 58.3 | 51.4 | 642 | 746 | 74 |
| -1.00 | 1302 | 302 | | | 625 | 530 | |
| | | 376 | 20.9 | 26.3 | 569 | 509 | 25 |
| -2.75 | 1376 | 376 | | | 569 | 509 | |
| | | 301 | 21.6 | 27.1 | 541 | 471 | 25 |
| -6.40 | 1301 | 301 | | | 500 | 470 | |
| -11.50 | | 2 | 26.4 | 24.5 | 510 | 458 | 13 |

(b) Ratio with DCD ((a)/DCD Loads)

| Elev. (m) | Elem No. | Node No. | Shear X-Dir. | Shear Y-Dir. | Moment X-Dir. | Moment Y-Dir. | Torsion |
|---|---|---|---|---|---|---|---|
| 17.50 | 701 | 701 | | | 143% | 111% | |
| 14.50 | | 702 | 80% | 69% | 95% | 103% | 28% |
| 14.50 | 702 | 702 | | | 107% | 108% | |
| 11.50 | | 703 | 67% | 59% | 81% | 75% | 27% |
| 11.50 | 703 | 703 | | | 83% | 76% | |
| 8.50 | | 704 | 67% | 59% | 68% | 66% | 29% |
| 8.50 | 704 | 704 | | | 71% | 65% | |
| 7.4625 | | 705 | 69% | 57% | 69% | 63% | 31% |
| 7.4625 | 705 | 705 | | | 80% | 57% | |
| 4.65 | | 706,303 | 33% | 41% | 68% | 52% | 20% |
| 4.65 | 1303 | 303 | | | 92% | 81% | |
| | | 377 | 119% | 77% | 92% | 73% | 43% |
| 2.4165 | 1377 | 377 | | | 91% | 73% | |
| | | 302 | 121% | 78% | 82% | 81% | 43% |
| -1.00 | 1302 | 302 | | | 74% | 55% | |
| | | 376 | 32% | 32% | 61% | 48% | 17% |
| -2.75 | 1376 | 376 | | | 61% | 48% | |
| | | 301 | 33% | 33% | 49% | 35% | 17% |
| -6.40 | 1301 | 301 | | | 43% | 35% | |
| -11.50 | | 2 | 25% | 20% | 31% | 23% | 11% |

**Table 3.7.2-208 ~~Ratio with DCD~~ Ratios of Enveloping Seismic Loads: RSW**

(a) Site-Specific Enveloping Seismic Loads

| Elev. (m) | Elem No. | Node No. | Shear X-Dir. (MN) | Shear Y-Dir. (MN) | Moment X-Dir. (MN-m) | Moment Y-Dir. (MN-m) | Torsion (MN-m) |
|---|---|---|---|---|---|---|---|
| 24.18 | 707 | 707 | | | 2 | 3 | |
| | | 708 | 2.96 | 3.72 | 14 | 17 | 1 |
| 20.20 | 708 | 708 | | | 19 | 24 | |
| | | 709 | 18.30 | 18.85 | 98 | 104 | 3 |
| 15.775 | 709 | 709 | | | 101 | 113 | |
| | | 710 | 20.28 | 21.10 | 191 | 197 | 4 |
| 11.35 | 710 | 710 | | | 194 | 209 | |
| | | 711 | 21.06 | 24.17 | 277 | 292 | 5 |
| 7.4625 | 711 | 711 | | | 259 | 219 | |
| | | 712 | 30.73 | 38.33 | 312 | 272 | 19 |
| 4.65 | 712 | 712 | | | 118 | 117 | |
| | | 713 | 17.05 | 15.01 | 117 | 106 | 13 |
| 2.4165 | 713 | 713 | | | 4 | 5 | |
| 1.96 | | 714 | 1.84 | 1.96 | 3 | 5 | 0 |
| 1.96 | 714 | 714 | | | 3 | 4 | |
| -0.80 | | 715 | 1.06 | 1.19 | 1 | 1 | 0 |

(b) Ratio with DCD ((a)/DCD Loads)

| Elev. (m) | Elem No. | Node No. | Shear X-Dir. | Shear Y-Dir. | Moment X-Dir. | Moment Y-Dir. | Torsion |
|---|---|---|---|---|---|---|---|
| 24.18 | 707 | 707 | | | 110% | 168% | |
| 20.20 | | 708 | 98% | 137% | 106% | 136% | 219% |
| 20.20 | 708 | 708 | | | 106% | 143% | |
| 15.775 | | 709 | 126% | 154% | 125% | 152% | 217% |
| 15.775 | 709 | 709 | | | 124% | 159% | |
| 11.35 | | 710 | 117% | 146% | 120% | 147% | 210% |
| 11.35 | 710 | 710 | | | 122% | 153% | |
| 7.4625 | | 711 | 106% | 145% | 117% | 147% | 196% |
| 7.4625 | 711 | 711 | | | 132% | 119% | |
| 4.65 | | 712 | 75% | 108% | 107% | 108% | 80% |
| 4.65 | 712 | 712 | | | 95% | 88% | |
| 2.4165 | | 713 | 120% | 77% | 88% | 70% | 43% |
| 2.4165 | 713 | 713 | | | 119% | 169% | |
| 1.96 | | 714 | 122% | 154% | 119% | 170% | 73% |
| 1.96 | 714 | 714 | | | 120% | 168% | |
| -0.80 | | 715 | 121% | 161% | 104% | 141% | 72% |

**Table 3.7.2-209 ~~Ratio with DCD~~ Ratios of Enveloping Seismic Loads: RPV**

(a) Site-Specific Enveloping Seismic Loads

| Elev. (m) | Elem No. | Node No. | Shear X-Dir. (MN) | Shear Y-Dir. (MN) | Moment X-Dir. (MN-m) | Moment Y-Dir. (MN-m) |
|---|---|---|---|---|---|---|
| 3.215 | 844 | 845 | | | 33 | 42 |
| 2.365 | | 846 | 18.8 | 24.2 | 48 | 61 |
| 8.453 | 871 | 815 | | | 217 | 192 |
| 7.4625 | | 711 | 26.0 | 31.1 | 213 | 192 |

(b) Ratio with DCD ((a)/DCD Loads)

| Elevation (m) | Elem No. | Node No. | Shear X-Dir. | Shear Y-Dir. | Moment X-Dir. | Moment Y-Dir. |
|---|---|---|---|---|---|---|
| 3.215 | 844 | 845 | | | 202% | 295% |
| 2.365 | | 846 | 262% | 345% | 225% | 353% |
| 8.453 | 871 | 815 | | | 151% | 141% |
| 7.4625 | | 711 | 140% | 173% | 151% | 141% |

**Table 3.7.2-210 ~~Ratio with DCD Max.~~ Ratios of Enveloping Maximum Vertical ~~Acceleration~~ Accelerations: RB/FB**

(a) Site-Specific Enveloping Maximum Vertical Acceleration

| Elev. (m) | Node No. | Stick Model | Max. Vertical Acceleration (g) |
|---|---|---|---|
| 52.40 | 110 | RB/FB | 1.43 |
| 34.00 | 109 | RB/FB | 1.02 |
| 27.00 | 108 | RB/FB | 0.80 |
| 22.50 | 107 | RB/FB | 0.69 |
| 17.50 | 106 | RB/FB | 0.64 |
| 13.57 | 105 | RB/FB | 0.67 |
| 9.06 | 104 | RB/FB | 0.66 |
| 4.65 | 103 | RB/FB | 0.68 |
| -1.00 | 102 | RB/FB | 0.70 |
| -6.40 | 101 | RB/FB | 0.65 |
| -11.50 | 2 | RB/FB | 0.56 |
| -15.50 | 1 | RB/FB | 0.55 |

(b) Ratio with DCD ((a)/DCD ~~Loads~~ Acceleration)

| Elev. (m) | Node No. | Stick Model | Max. Vertical Acceleration |
|---|---|---|---|
| 52.40 | 110 | RB/FB | 113% |
| 34.00 | 109 | RB/FB | 123% |
| 27.00 | 108 | RB/FB | 109% |
| 22.50 | 107 | RB/FB | 95% |
| 17.50 | 106 | RB/FB | 88% |
| 13.57 | 105 | RB/FB | 91% |
| 9.06 | 104 | RB/FB | 90% |
| 4.65 | 103 | RB/FB | 88% |
| -1.00 | 102 | RB/FB | 92% |
| -6.40 | 101 | RB/FB | 96% |
| -11.50 | 2 | RB/FB | 90% |
| -15.50 | 1 | RB/FB | 109% |

**Table 3.7.2-211 ~~Ratio with DCD~~ Ratios of Enveloping Maximum Vertical ~~Acceleration~~ Accelerations: RCCV**

(a) Site-Specific Enveloping Maximum Vertical Acceleration

| Elev. (m) | Node No. | Stick Model | Max. Vertical Acceleration (g) |
|---|---|---|---|
| 34.00 | 209 | RCCV | 1.04 |
| 27.00 | 208 | RCCV | 0.95 |
| 17.50 | 206 | RCCV | 0.77 |
| 13.57 | 205 | RCCV | 0.76 |
| 9.06 | 204 | RCCV | 0.70 |
| 4.65 | 203 | RCCV | 0.65 |
| -1.00 | 202 | RCCV | 0.61 |
| -6.40 | 201 | RCCV | 0.59 |

(b) Ratio with DCD ((a)/DCD ~~Loads~~ Acceleration)

| Elev. (m) | Node No. | Stick Model | Max. Vertical Acceleration |
|---|---|---|---|
| 34.00 | 209 | RCCV | 116% |
| 27.00 | 208 | RCCV | 108% |
| 17.50 | 206 | RCCV | 105% |
| 13.57 | 205 | RCCV | 98% |
| 9.06 | 204 | RCCV | 108% |
| 4.65 | 203 | RCCV | 92% |
| -1.00 | 202 | RCCV | 103% |
| -6.40 | 201 | RCCV | 100% |

**Table 3.7.2-212 ~~Ratio with DCD~~ Ratios of Enveloping Maximum Vertical ~~Acceleration~~ Accelerations: VW/Pedestal**

(a) Site-Specific Enveloping Maximum Vertical Acceleration

| Elev. (m) | Node No. | Stick Model | Max. Vertical Acceleration (g) |
|---|---|---|---|
| 17.50 | 701 | VW | 0.86 |
| 14.50 | 702 | VW | 0.83 |
| 11.50 | 703 | VW | 0.84 |
| 8.50 | 704 | VW | 0.81 |
| 7.4625 | 705 | VW | 0.81 |
| 4.65 | 706,303 | Pedestal | 0.81 |
| -1.00 | 302 | Pedestal | 0.64 |
| -6.40 | 301 | Pedestal | 0.59 |

(b) Ratio with DCD ((a)/DCD ~~Loads~~ Acceleration)

| Elev. (m) | Node No. | Stick Model | Max. Vertical Acceleration |
|---|---|---|---|
| 17.50 | 701 | VW | 78% |
| 14.50 | 702 | VW | 80% |
| 11.50 | 703 | VW | 90% |
| 8.50 | 704 | VW | 105% |
| 7.4625 | 705 | VW | 114% |
| 4.65 | 706,303 | Pedestal | 120% |
| -1.00 | 302 | Pedestal | 109% |
| -6.40 | 301 | Pedestal | 117% |

**Table 3.7.2-213 ~~Ratio with DCD~~ Ratios of Enveloping Maximum Vertical ~~Acceleration~~ Accelerations: RSW**

(a) Site-Specific Enveloping Maximum Vertical Acceleration

| Elev. (m) | Node No. | Stick Model | Max. Vertical Acceleration (g) |
|---|---|---|---|
| 24.18 | 707 | RSW | 1.03 |
| 20.20 | 708 | RSW | 1.01 |
| 15.775 | 709 | RSW | 0.96 |
| 11.35 | 710 | RSW | 0.87 |
| 7.4625 | 711 | RSW | 0.81 |
| 4.65 | 712 | RSW | 0.81 |
| 2.4615 | 713 | RSW | 0.75 |
| 1.96 | 714 | RSW | 0.75 |
| -0.80 | 715 | RSW | 0.76 |

(b) Ratio with DCD ((a)/DCD ~~Loads~~ Acceleration)

| Elev. (m) | Node No. | Stick Model | Max. Vertical Acceleration |
|---|---|---|---|
| 24.18 | 707 | RSW | 107% |
| 20.20 | 708 | RSW | 108% |
| 15.775 | 709 | RSW | 114% |
| 11.35 | 710 | RSW | 114% |
| 7.4625 | 711 | RSW | 114% |
| 4.65 | 712 | RSW | 120% |
| 2.4615 | 713 | RSW | 118% |
| 1.96 | 714 | RSW | 118% |
| -0.80 | 715 | RSW | 117% |

**Table 3.7.2-214 ~~Ratio with DCD~~ Ratios of Enveloping Maximum Vertical ~~Acceleration~~ Accelerations: RB/FB Flexible Slab Oscillators**

(a) Site-Specific Enveloping Maximum Vertical Acceleration

| Elev. (m) | Node No. | Stick Model | Max. Vertical Acceleration (g) |
|---|---|---|---|
| 52.40 | 9101 | Oscillator | 0.37 |
| | 9102 | Oscillator | 1.30 |
| | 9103 | Oscillator | 3.66 |
| | 9104 | Oscillator | 3.57 |
| | 9105 | Oscillator | 3.24 |
| | 9106 | Oscillator | 3.66 |
| | 9107 | Oscillator | 2.46 |
| | 9108 | Oscillator | 1.72 |
| 34.00 | 9091 | Oscillator | 1.56 |
| | 9092 | Oscillator | 1.26 |
| 27.00 | 9081 | Oscillator | 1.45 |
| | 9082 | Oscillator | 1.21 |
| | 9083 | Oscillator | 1.51 |
| | 9084 | Oscillator | 1.49 |
| | 9085 | Oscillator | 1.11 |
| 22.50 | 9071 | Oscillator | 0.96 |
| | 9072 | Oscillator | 2.01 |
| | 9073 | Oscillator | 2.16 |
| | 9074 | Oscillator | 1.25 |
| | 9075 | Oscillator | 2.00 |
| 17.50 | 9061 | Oscillator | 1.41 |
| | 9062 | Oscillator | 3.10 |
| | 9063 | Oscillator | 1.31 |
| | 9064 | Oscillator | 1.59 |
| | 9065 | Oscillator | 1.43 |
| 13.57 | 9051 | Oscillator | 1.34 |
| | 9052 | Oscillator | 1.13 |

(b) Ratio with DCD ((a)/DCD ~~Loads~~ Acceleration)

| Elev. (m) | Node No. | Stick Model | Max. Vertical Acceleration |
|---|---|---|---|
| 52.40 | 9101 | Oscillator | 31% |
| | 9102 | Oscillator | 72% |
| | 9103 | Oscillator | 117% |
| | 9104 | Oscillator | 146% |
| | 9105 | Oscillator | 140% |
| | 9106 | Oscillator | 122% |
| | 9107 | Oscillator | 88% |
| | 9108 | Oscillator | 66% |
| 34.00 | 9091 | Oscillator | 121% |
| | 9092 | Oscillator | 117% |
| 27.00 | 9081 | Oscillator | 125% |
| | 9082 | Oscillator | 122% |
| | 9083 | Oscillator | 139% |
| | 9084 | Oscillator | 113% |
| | 9085 | Oscillator | 115% |
| 22.50 | 9071 | Oscillator | 60% |
| | 9072 | Oscillator | 153% |
| | 9073 | Oscillator | 107% |
| | 9074 | Oscillator | 96% |
| | 9075 | Oscillator | 173% |
| 17.50 | 9061 | Oscillator | 79% |
| | 9062 | Oscillator | 208% |
| | 9063 | Oscillator | 160% |
| | 9064 | Oscillator | 86% |
| | 9065 | Oscillator | 100% |
| 13.57 | 9051 | Oscillator | 165% |
| | 9052 | Oscillator | 78% |

**Table 3.7.2-214 ~~Ratio with DCD~~ Ratios of Enveloping Maximum Vertical ~~Acceleration~~ Accelerations: RB/FB Flexible Slab Oscillators** *(continued)*

(a) Site-Specific Enveloping Maximum Vertical Acceleration

| Elev. (m) | Node No. | Stick Model | Max. Vertical Acceleration (g) |
|---|---|---|---|
| 9.06 | 9041 | Oscillator | 1.36 |
| | 9042 | Oscillator | 1.10 |
| 4.65 | 9031 | Oscillator | 2.10 |
| | 9032 | Oscillator | 1.33 |
| | 9033 | Oscillator | 1.30 |
| | 9034 | Oscillator | 2.45 |
| | 9035 | Oscillator | 1.36 |
| -1.00 | 9021 | Oscillator | 1.58 |
| | 9022 | Oscillator | 3.08 |
| | 9023 | Oscillator | 1.31 |
| | 9024 | Oscillator | 1.67 |
| | 9025 | Oscillator | 1.54 |
| | 9026 | Oscillator | 2.00 |
| | 9027 | Oscillator | 0.97 |
| -6.40 | 9011 | Oscillator | 1.17 |
| | 9012 | Oscillator | 1.53 |
| | 9013 | Oscillator | 2.01 |

(b) Ratio with DCD ((a)/DCD ~~Loads~~ Acceleration)

| Elev. (m) | Node No. | Stick Model | Max. Vertical Acceleration |
|---|---|---|---|
| 9.06 | 9041 | Oscillator | 154% |
| | 9042 | Oscillator | 78% |
| 4.65 | 9031 | Oscillator | 179% |
| | 9032 | Oscillator | 137% |
| | 9033 | Oscillator | 127% |
| | 9034 | Oscillator | 162% |
| | 9035 | Oscillator | 99% |
| -1.00 | 9021 | Oscillator | 142% |
| | 9022 | Oscillator | 212% |
| | 9023 | Oscillator | 130% |
| | 9024 | Oscillator | 189% |
| | 9025 | Oscillator | 115% |
| | 9026 | Oscillator | 127% |
| | 9027 | Oscillator | 111% |
| -6.40 | 9011 | Oscillator | 127% |
| | 9012 | Oscillator | 167% |
| | 9013 | Oscillator | 149% |

**Table 3.7.2-215 ~~Ratio with DCD~~ Ratios of Enveloping Maximum Horizontal ~~Acceleration~~ Accelerations: RB/FB Flexible Wall Oscillators**

(a) Site-Specific Enveloping Maximum Horizontal Acceleration

| Elev. (m) | Node No. | Stick Model | Max. Horizontal Acceleration (g) |
|---|---|---|---|
| 42.00 | 99981 | Oscillator | 1.81 |
| (X-dir) | 99982 | Oscillator | 1.13 |
| 42.00 | 99983 | Oscillator | 1.28 |
| (Y-dir) | 99984 | Oscillator | 0.97 |
| | 99985 | Oscillator | 0.83 |
| 13.57 | 99971 | Oscillator | 1.25 |
| (X-dir) | 99972 | Oscillator | 2.13 |
| | 99973 | Oscillator | 1.77 |
| | 99974 | Oscillator | 1.64 |
| 13.57 | 99975 | Oscillator | 1.29 |
| (Y-dir) | 99976 | Oscillator | 1.66 |

(b) Ratio with DCD ((a)/DCD ~~Loads~~ Acceleration)

| Elev. (m) | Node No. | Stick Model | Max. Horizontal Acceleration |
|---|---|---|---|
| 42.00 | 99981 | Oscillator | 118% |
| (X-dir) | 99982 | Oscillator | 87% |
| 42.00 | 99983 | Oscillator | 75% |
| (Y-dir) | 99984 | Oscillator | 62% |
| | 99985 | Oscillator | 67% |
| 13.57 | 99971 | Oscillator | 91% |
| (X-dir) | 99972 | Oscillator | 156% |
| | 99973 | Oscillator | 154% |
| | 99974 | Oscillator | 166% |
| 13.57 | 99975 | Oscillator | 101% |
| (Y-dir) | 99976 | Oscillator | 169% |

**Table 3.7.2-216 Stress Check for RB/FB**

(a) RB/FB Walls

| RB | Concrete | Rebar | NA3 Stress Estimate | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Wall Elevations (m) | DCD/ Allowable | DCD/ Allowable | Ratio of NA3 to DCD | | | | | | Max Ratio of NA3 to DCD | Ratio of NA3 to Allowable |
| | | | X-Shear | Y-Shear | X-Moment | Y-Moment | Torsion | Acceler-ation | | |
| El. -11.5 to -10.5 | 0.69 | 0.96 | 0.22 | 0.23 | 0.13 | 0.08 | 0.11 | 0.90 | 0.90 | 0.86 |
| El. 4.65 to 6.60 | 0.45 | 0.96 | 0.48 | 0.39 | 0.56 | 0.37 | 0.44 | 0.88 | 0.88 | 0.84 |
| El. 22.5 to 24.6 | 0.37 | 0.82 | 0.60 | 0.46 | 0.66 | 0.55 | 0.57 | 0.95 | 0.95 | 0.78 |

(b) RCCV Wall

| RCCV | Concrete | Rebar | NA3 Stress Estimate | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Wall Elevations (m) | DCD/ Allowable | DCD/ Allowable | Ratio of NA3 to DCD | | | | | | Max Ratio of NA3 to DCD | Ratio of NA3 to Allowable |
| | | | X-Shear | Y-Shear | X-Moment | Y-Moment | Torsion | Acceler-ation | | |
| Below RCCV bot | 0.72 | 0.89 | 0.23 | 0.22 | 0.43 | 0.32 | 0.11 | | 0.43 | 0.38 |
| Below RCCV mid | 0.46 | 0.73 | 0.23 | 0.21 | 0.49 | 0.37 | 0.17 | 1.00 | 1.00 | 0.73 |
| Below RCCV top | 0.82 | 0.59 | 0.69 | 0.48 | 0.54 | 0.42 | 0.43 | 1.03 | 1.03 | 0.84 |
| Wetwell bot | 0.63 | 0.63 | 0.54 | 0.38 | 0.59 | 0.44 | 0.44 | 0.92 | 0.92 | 0.58 |
| Wetwell mid | 0.42 | 0.66 | 0.61 | 0.37 | 0.63 | 0.45 | 0.46 | 1.08 | 1.08 | 0.72 |
| Drywell-Wetwell | 0.66 | 0.88 | 0.63 | 0.39 | 0.68 | 0.48 | 0.45 | 0.98 | 0.98 | 0.86 |
| Drywell | 0.47 | 0.77 | 0.73 | 0.47 | 0.74 | 0.52 | 0.53 | 1.05 | 1.05 | 0.81 |

(c) Pedestal Wall

| Pedestal | Concrete | Rebar | NA3 Stress Estimate | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Wall Elevations (m) | DCD/ Allowable | DCD/ Allowable | Ratio of NA3 to DCD | | | | | | Max Ratio of NA3 to DCD | Ratio of NA3 to Allowable |
| | | | X-Shear | Y-Shear | X-Moment | Y-Moment | Torsion | Acceler-ation | | |
| Pedestal bot | 0.70 | 0.87 | 0.25 | 0.20 | 0.31 | 0.23 | 0.11 | 1.17 | 1.17 | 1.02 |
| Pedestal mid | 0.51 | 0.46 | 0.32 | 0.32 | 0.61 | 0.48 | 0.17 | 1.09 | 1.09 | 0.55 |
| Pedestal top | 0.78 | 0.73 | 1.19 | 0.77 | 0.92 | 0.73 | 0.43 | 1.20 | 1.20 | 0.93 |

Note: The Pedestal bot. stress ratio to the allowable stress is less than 1.0 when the scale factor is applied to the seismic stress alone.

**Table 3.7.2-216 Stress Check for RB/FB** *(continued)*

(d) Vent Wall

| Vent Wall | Steel | NA3 Stress Estimate | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Ratio of NA3 to DCD | | | | | | Max Ratio of NA3 to DCD | Ratio of NA3 to Allowable |
| Wall Elevations (m) | DCD/ Allowable | X-Shear | Y-Shear | X-Moment | Y-Moment | Torsion | Acceler-ation | | |
| Vent Wall | 0.71 | 0.80 | 0.69 | 1.43 | 1.11 | 0.31 | 1.14 | 1.43 | 1.02 |

Note: The Vent Wall stress ratio to the allowable stress is less than 1.0 when the scale factor is applied to the seismic stress alone.

(e) RSW Wall

| RSW | Steel | NA3 Stress Estimate | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Ratio of NA3 to DCD | | | | | | Max Ratio of NA3 to DCD | Ratio of NA3 to Allowable |
| Wall Elevations (m) | DCD/ Allowable | X-Shear | Y-Shear | X-Moment | Y-Moment | Torsion | Acceler-ation | | |
| RSW | 0.71 | 1.27 | 1.55 | 1.33 | 1.66 | 2.19 | 1.20 | 2.19 | 1.55 |

Note: The RSW stress ratio to the allowable stress is less than 1.0 from a refined evaluation in which when the scale factor is applied to the seismic stress alone.

**Table 3.7.2-216 Stress Check for RB/FB** *(continued)*

(f) Slab

| Slab Elevations (m) | Location | Concrete DCD/ Allowable | Rebar DCD/ Allowable | sWi (kN) | Oscillator | Acceleration (g) | sAeq (g) | wW (kN) | Acceleration (g) | wAeq (g) | NA3 sAave (g) | DCD sAave (g) | Ratio of NA3 to DCD | Ratio of NA3 to Allowable |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Concrete | Rebar | NA3 Stress Estimate | | | | | | | | | | |
| El. 4.65 | RCCV | 0.69 | 0.57 | 51608 | 9032 | 1.33 | 1.33 | 16193 | 0.68 | 0.67 | 1.11 | 0.95 | 1.17 | 0.81 |
| | | | | 5579 | 9035 | 1.36 | | 11812 | 0.65 | | | | | |
| | S/P | 0.88 | 0.94 | 32416 | 9033 | 1.30 | 1.30 | 48175 | 0.81 | 0.81 | 1.01 | 0.80 | 1.26 | 1.19 |
| El. 17.5 | MS Tunnel | 0.28 | 0.59 | 5798 | 9061 | 1.41 | 1.75 | 12732 | 0.64 | 0.64 | 1.04 | 1.10 | 0.95 | 0.56 |
| | | | | 1465 | 9062 | 3.10 | | | | | | | | |
| | RCCV | 0.52 | 0.74 | 9707 | 9063 | 1.31 | 1.34 | 12732 | 0.64 | 0.74 | 0.85 | 0.78 | 1.10 | 0.81 |
| | | | | 3877 | 9065 | 1.43 | | 46092 | 0.77 | | | | | |
| | D/F | 0.97 | | 33373 | 9064 | 1.59 | 1.59 | | | | 1.59 | 1.84 | 0.86 | 0.84 |
| El. 27.0 | Topslab | 0.52 | 0.72 | 39043 | 9081 | 1.45 | 1.30 | 69949 | 0.95 | 0.95 | 1.15 | 0.98 | 1.18 | 0.85 |
| | | | | 52533 | 9082 | 1.21 | | | | | | | | |
| | | | | 5413 | 9085 | 1.11 | | | | | | | | |
| | RCCV | 0.46 | 0.41 | 8768 | 9083 | 1.51 | 1.51 | 66452 | 0.80 | 0.80 | 0.88 | 0.77 | 1.15 | 0.52 |
| | MS Tunnel | 0.26 | 0.44 | 9163 | 9084 | 1.49 | 1.49 | 48004 | 0.80 | 0.80 | 0.91 | 0.82 | 1.11 | 0.49 |

sWi : Weight of the i-th mass in the dynamic analysis model

sAeq : Equivalent slab acceleration

wW : Slab weights included in the RB/FB and RCCV masses

wAeq : Maximum accelerations of the RB/FB and RCCV masses

sAave : ~~Average~~ Weighted average acceleration

Note: The S/P stress ratio to the allowable stress is reduced to 1.06 when the scale factor is applied to the seismic stress alone. Since the strains under combined primary and secondary forces meet the ASME Code Section CC-3422.1(d) requirements, the design adequacy of the S/P is confirmed.

**Table 3.7.2-216 Stress Check for RB/FB** *(continued)*

(g) Wall Oscillator

| | Concrete | Rebar | NA3 Stress Estimate | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Out-of-plane Elevations (m) | DCD/ Allowable | DCD/ Allowable | wWi (kN) | Oscillator | Acceleration (g) | wAeq (g) | Wb (kN) | Acceleration (g) | NA3 wAave (g) | DCD wAave (g) | Ratio of NA3 to DCD | Ratio of NA3 to Allowable |
| El. 42.00 | 0.40 | 0.70 | 8.13 | 99981 | 1.81 | 1.77 | 7.58 | 1.21 | 1.51 | 1.48 | 1.02 | 0.71 |
| | | | 0.54 | 99982 | 1.13 | | | | | | | |
| | | | 4.56 | 99983 | 1.28 | 1.06 | 8.48 | 0.98 | 1.03 | 1.52 | 0.67 | |
| | | | 5.1 | 99984 | 0.97 | | | | | | | |
| | | | 2.28 | 99985 | 0.83 | | | | | | | |
| El. 13.57 | | | 8.09 | 99971 | 1.25 | 1.46 | 8.87 | 0.84 | 1.18 | 1.19 | 0.99 | |
| | | | 2.38 | 99972 | 2.13 | | | | | | | |
| | | | 0.23 | 99973 | 1.77 | | | | | | | |
| | | | 0.21 | 99974 | 1.64 | | | | | | | |
| | 0.35 | 0.64 | 4.93 | 99975 | 1.29 | 1.34 | 2.69 | 0.83 | 1.18 | 1.09 | 1.08 | 0.69 |
| | | | 0.86 | 99976 | 1.66 | | | | | | | |

wWi : Weight of the i-th oscillator in the dynamic analysis model
wAeq : Equivalent acceleration of all oscillators
Wb : Wall weight
wAave : Weighed average acceleration

**Table 3.7.2-217 ~~Ratio with DCD~~ Ratios of Enveloping Seismic Loads: CB Stick**

(a) Site-Specific ~~Envelop~~ Enveloping Seismic Loads

| Elev. (m) | Node No. | Elem No. | Shear X-Dir. (MN) | Shear Y-Dir. (MN) | Moment X-Dir. (MN-m) | Moment Y-Dir. (MN-m) | Torsion (MN-m) |
|---|---|---|---|---|---|---|---|
| 13.80 | 6 | | | | 140 | 106 | |
| | | 6 | 43.5 | 33.0 | 264 | 185 | 32.0 |
| 9.06 | 5 | | | | 332 | 235 | |
| | | 5 | 76.2 | 61.2 | 617 | 476 | 54.9 |
| 4.65 | 4 | | | | 356 | 173 | |
| | | 4 | 95.8 | 77.1 | 983 | 647 | 52.0 |
| -2.00 | 3 | | | | 472 | 376 | |
| -7.40 | 2 | 3 | 29.2 | 27.9 | 558 | 509 | 20.4 |

(b) Ratio with DCD ((a)/DCD Loads)

| Elev. (m) | Node No. | Elem No. | Shear X-Dir. | Shear Y-Dir. | Moment X-Dir. | Moment Y-Dir. | Torsion |
|---|---|---|---|---|---|---|---|
| 13.80 | 6 | | | | 88% | 86% | |
| | | 6 | 131% | 113% | 106% | 94% | 139% |
| 9.06 | 5 | | | | 92% | 86% | |
| | | 5 | 143% | 112% | 108% | 108% | 122% |
| 4.65 | 4 | | | | 49% | 32% | |
| | | 4 | 127% | 96% | 87% | 66% | 92% |
| -2.00 | 3 | | | | 38% | 36% | |
| -7.40 | 2 | 3 | 23% | 28% | 36% | 33% | 34% |

**Table 3.7.2-218 ~~Ratio with DCD~~ Ratios of Enveloping Maximum Vertical Acceleration: CB**

(a) Site-Specific ~~Envelop~~ Enveloping Maximum Vertical Acceleration

| Elev. (m) | Node No. | Stick Model | Max. Vertical Acceleration (g) |
|---|---|---|---|
| 13.80 | 6 | CB | 1.22 |
| 9.06 | 5 | CB | 1.14 |
| 4.65 | 4 | CB | 1.02 |
| -2.00 | 3 | CB | 0.79 |
| -7.40 | 2 | CB | 0.77 |
| -10.40 | 1 | CB | 0.77 |
| 13.80 | 9001 | Oscillator | 3.31 |
| | 9002 | Oscillator | 1.80 |
| | 9003 | Oscillator | 1.78 |
| 9.06 | 9101 | Oscillator | 3.80 |
| | 9102 | Oscillator | 1.74 |
| | 9103 | Oscillator | 1.76 |
| 4.65 | 9201 | Oscillator | 1.51 |
| | 9202 | Oscillator | 1.59 |
| -2.00 | 9301 | Oscillator | 1.75 |

(b) Ratio with DCD ((a)/DCD ~~Loads~~ Acceleration)

| Elev. (m) | Node No. | Stick Model | Max. Vertical Acceleration |
|---|---|---|---|
| 13.80 | 6 | CB | 122% |
| 9.06 | 5 | CB | 133% |
| 4.65 | 4 | CB | 137% |
| -2.00 | 3 | CB | 140% |
| -7.40 | 2 | CB | 153% |
| -10.40 | 1 | CB | 151% |
| 13.80 | 9001 | Oscillator | 151% |
| | 9002 | Oscillator | 135% |
| | 9003 | Oscillator | 125% |
| 9.06 | 9101 | Oscillator | 190% |
| | 9102 | Oscillator | 138% |
| | 9103 | Oscillator | 123% |
| 4.65 | 9201 | Oscillator | 115% |
| | 9202 | Oscillator | 111% |
| -2.00 | 9301 | Oscillator | 126% |

**Table 3.7.2-219 Stress Check for CB**

(a) Walls

| Wall Elevations (m) | Concrete DCD/ Allowable | Rebar DCD/ Allowable | NA3 Stress Estimate: Ratio of NA3 to DCD: X-Shear | Y-Shear | X-Moment | Y-Moment | Torsion | Accelera-tion | Max Ratio of NA3 to DCD | Ratio of NA3 to Allowable |
|---|---|---|---|---|---|---|---|---|---|---|
| El. -7.4 to -2.0 | 0.49 | 0.77 | 0.23 | 0.28 | 0.38 | 0.36 | 0.34 | 1.53 | 1.53 | 1.18 |
| El. -2.0 to 4.65 | 0.29 | 0.51 | 1.27 | 0.96 | 0.87 | 0.66 | 0.92 | 1.40 | 1.40 | 0.71 |
| El. 4.65 to 9.06 | 0.58 | 0.57 | 1.43 | 1.12 | 1.08 | 1.08 | 1.22 | 1.37 | 1.43 | 0.83 |
| El. 9.06 to 13.8 | 0.60 | 0.63 | 1.31 | 1.13 | 1.06 | 0.94 | 1.39 | 1.33 | 1.39 | 0.88 |

(b) Slabs

| Slab Elevations (m) | Concrete DCD/ Allowable | Rebar DCD/ Allowable | NA3 Stress Estimate: sWi (kN) | Oscillator | Acceleration (g) | sAeq (g) | wW (kN) | Acceleration (g) | NA3 sAave (g) | DCD sAave (g) | Ratio of NA3 to DCD | Ratio of NA3 to Allowable |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| El. -2.0 | 0.40 | 0.46 | 4325 | 9301 | 1.75 | 1.75 | 32570 | 0.79 | 0.90 | 0.66 | 1.37 | 0.63 |
| El. 4.65 | 0.67 | 0.45 | 8022 | 9201 | 1.51 | 1.51 | 27986 | 1.02 | 1.13 | 0.87 | 1.30 | 0.87 |
| | | | 227 | 9202 | 1.59 | | | | | | | |
| El. 9.06 | 0.60 | 0.46 | 3494 | 9101 | 3.80 | 2.52 | 19785 | 1.14 | 1.58 | 1.08 | 1.46 | 0.88 |
| | | | 4907 | 9102 | 1.74 | | | | | | | |
| | | | 850 | 9103 | 1.76 | | | | | | | |
| El. 13.8 | 0.56 | 0.48 | 5478 | 9001 | 3.31 | 2.45 | 10745 | 1.22 | 1.89 | 1.39 | 1.36 | 0.76 |
| | | | 6390 | 9002 | 1.80 | | | | | | | |
| | | | 781 | 9003 | 1.78 | | | | | | | |

sWi : Weight of the i-th mass in the dynamic analysis model
sAeq : Equivalent slab acceleration
wW : Slab weights included in the wall masses
sAave : Weighted Average acceleration

**Table 3.7.2-220 ~~Ratio with DCD~~ Ratios of Enveloping Seismic Loads: FWS**

(a) Site-Specific ~~Envelop~~ Enveloping Seismic Loads

| Elev. (m) | Elem No. | Node No. | Shear X-Dir. (MN) | Shear Y-Dir. (MN) | Moment X-Dir. (MN-m) | Moment Y-Dir. (MN-m) | Torsion (MN-m) |
|---|---|---|---|---|---|---|---|
| 19.70 | 9 | 10 | | | 2.3 | 2.2 | |
| 17.25 | | 9 | 4.0 | 3.7 | 11.7 | 11.1 | 0.9 |
| 17.25 | 8 | 9 | | | 16.0 | 15.4 | |
| 15.53 | | 8 | 9.9 | 9.1 | 32.5 | 30.9 | 2.8 |
| 15.53 | 7 | 8 | | | 36.9 | 35.2 | |
| 13.81 | | 7 | 13.9 | 12.7 | 60.2 | 57.0 | 4.6 |
| 13.81 | 6 | 7 | | | 64.1 | 61.2 | |
| 12.10 | | 6 | 17.6 | 15.9 | 94.0 | 88.5 | 6.3 |
| 12.10 | 5 | 6 | | | 96.8 | 91.8 | |
| 11.00 | | 5 | 20.3 | 18.3 | 119.1 | 111.9 | 7.5 |
| 11.00 | 4 | 5 | | | 121.2 | 114.3 | |
| 9.90 | | 4 | 22.2 | 20.0 | 145.7 | 136.3 | 8.4 |
| 9.90 | 3 | 4 | | | 147.7 | 138.7 | |
| 8.81 | | 3 | 24.0 | 21.6 | 173.9 | 162.1 | 9.2 |
| 8.81 | 2 | 3 | | | 176.6 | 165.3 | |
| 6.73 | | 2 | 41.4 | 36.9 | 262.6 | 240.0 | 10.2 |
| 6.73 | 1 | 2 | | | 265.4 | 243.6 | |
| 4.65 | | 1 | 43.8 | 39.0 | 356.5 | 324.6 | 11.0 |

(b) Ratio with DCD ((a)/DCD Loads)

| Elev. (m) | Elem No. | Node No. | Shear X-Dir. | Shear Y-Dir. | Moment X-Dir. | Moment Y-Dir. | Torsion |
|---|---|---|---|---|---|---|---|
| 19.70 | 9 | 10 | | | 53% | 31% | |
| 17.25 | | 9 | 87% | 72% | 82% | 58% | 133% |
| 17.25 | 8 | 9 | | | 72% | 58% | |
| 15.53 | | 8 | 89% | 75% | 83% | 66% | 128% |
| 15.53 | 7 | 8 | | | 81% | 62% | |
| 13.81 | | 7 | 90% | 77% | 85% | 68% | 129% |
| 13.81 | 6 | 7 | | | 84% | 66% | |
| 12.10 | | 6 | 91% | 79% | 87% | 71% | 129% |
| 12.10 | 5 | 6 | | | 87% | 71% | |
| 11.00 | | 5 | 89% | 77% | 89% | 73% | 130% |
| 11.00 | 4 | 5 | | | 89% | 73% | |
| 9.90 | | 4 | 90% | 79% | 89% | 74% | 131% |
| 9.90 | 3 | 4 | | | 89% | 74% | |
| 8.81 | | 3 | 92% | 81% | 90% | 75% | 133% |
| 8.81 | 2 | 3 | | | 90% | 75% | |
| 6.73 | | 2 | 96% | 81% | 94% | 81% | 135% |
| 6.73 | 1 | 2 | | | 94% | 82% | |
| 4.65 | | 1 | 97% | 81% | 97% | 86% | 136% |

**Table 3.7.2-221 ~~Ratio with DCD~~ Ratios of Enveloping Seismic Loads: FPE**

(a) Site-Specific ~~Envelop~~ Enveloping Seismic Loads

| Elev. (m) | Elem No. | Node No. | Shear X-Dir. (MN) | Shear Y-Dir. (MN) | Moment X-Dir. (MN-m) | Moment Y-Dir. (MN-m) | Torsion (MN-m) |
|---|---|---|---|---|---|---|---|
| 8.25 | 402 | 405 | | | 1.0 | 4.6 | |
| 4.65 | 401 | 404 | 2.9 | 4.2 | 9.0 | 16.0 | 4.0 |

(b) Ratio with DCD ((a)/DCD Loads)

| Elev. (m) | Elem No. | Node No. | Shear X-Dir. | Shear Y-Dir. | Moment X-Dir. | Moment Y-Dir. | Torsion |
|---|---|---|---|---|---|---|---|
| 8.25 | 402 | 405 | | | 47% | 48% | |
| 4.65 | 401 | 404 | 36% | 56% | 32% | 59% | 26% |

**Table 3.7.2-222 ~~Ratio with DCD~~ Ratios of Enveloping Seismic Loads considering Accidental Torsion: ~~FWSC Stick~~ FWS**

(a) Site-Specific ~~Envelop~~ Enveloping Seismic Loads

| Elev. (m) | Elem No. | Node No. | Torsion (kN-m) | | |
|---|---|---|---|---|---|
| | | | Calculated | Accidental Torsion | Design Torsion |
| 19.70 | 9 | 10 | | | |
| 17.25 | | 9 | 0.9 | 3.5 | 4.4 |
| 17.25 | 8 | 9 | | | |
| 15.53 | | 8 | 2.8 | 8.7 | 11.5 |
| 15.53 | 7 | 8 | | | |
| 13.81 | | 7 | 4.6 | 12.2 | 16.8 |
| 13.81 | 6 | 7 | | | |
| 12.10 | | 6 | 6.3 | 15.4 | 21.7 |
| 12.10 | 5 | 6 | | | |
| 11.00 | | 5 | 7.5 | 17.7 | 25.3 |
| 11.00 | 4 | 5 | | | |
| 9.90 | | 4 | 8.4 | 19.5 | 27.9 |
| 9.90 | 3 | 4 | | | |
| 8.81 | | 3 | 9.2 | 21.0 | 30.2 |
| 8.81 | 2 | 3 | | | |
| 6.73 | | 2 | 10.2 | 36.2 | 46.4 |
| 6.73 | 1 | 2 | | | |
| 4.65 | | 1 | 11.0 | 38.3 | 49.3 |

(b) Ratio with DCD ((a)/DCD Loads)

| Elev. (m) | Elem No. | Node No. | Torsion | | |
|---|---|---|---|---|---|
| | | | Calculated | Accidental Torsion | Design Torsion |
| 19.70 | 9 | 10 | | | |
| 17.25 | | 9 | 133% | 78% | 86% |
| 17.25 | 8 | 9 | | | |
| 15.53 | | 8 | 128% | 82% | 90% |
| 15.53 | 7 | 8 | | | |
| 13.81 | | 7 | 129% | 84% | 93% |
| 13.81 | 6 | 7 | | | |
| 12.10 | | 6 | 129% | 87% | 96% |
| 12.10 | 5 | 6 | | | |
| 11.00 | | 5 | 130% | 85% | 95% |
| 11.00 | 4 | 5 | | | |
| 9.90 | | 4 | 131% | 88% | 98% |
| 9.90 | 3 | 4 | | | |
| 8.81 | | 3 | 133% | 91% | 100% |
| 8.81 | 2 | 3 | | | |
| 6.73 | | 2 | 135% | 91% | 98% |
| 6.73 | 1 | 2 | | | |
| 4.65 | | 1 | 136% | 91% | 98% |

**Table 3.7.2-223 ~~Ratio with DCD~~ Ratios of Enveloping ~~Max.~~ Maximum Vertical ~~Acceleration~~ Accelerations: FWS**

(a) Site-Specific ~~Envelop~~ Enveloping Maximum Vertical Acceleration

| Elev. (m) | Node No. | Stick Model | Max. Vertical Acceleration (g) |
|---|---|---|---|
| 19.70 | 10 | FWS | 0.8 |
| 17.25 | 9 | FWS | 0.7 |
| 15.53 | 8 | FWS | 0.7 |
| 13.81 | 7 | FWS | 0.7 |
| 12.10 | 6 | FWS | 0.7 |
| 11.00 | 5 | FWS | 0.7 |
| 9.90 | 4 | FWS | 0.7 |
| 8.81 | 3 | FWS | 0.7 |
| 6.73 | 2 | FWS | 0.7 |
| 4.65 | 8002 | FWSC | 0.6 |
| 2.15 | 8001 | FWSC | 0.7 |
| 19.70 | 11 | Oscillator | 1.8 |

(b) Ratio with DCD ((a)/DCD ~~Loads~~ Acceleration)

| Elev. (m) | Node No. | Stick Model | Max. Vertical Acceleration |
|---|---|---|---|
| 19.70 | 10 | FWS | 44% |
| 17.25 | 9 | FWS | 46% |
| 15.53 | 8 | FWS | 47% |
| 13.81 | 7 | FWS | 46% |
| 12.10 | 6 | FWS | 50% |
| 11.00 | 5 | FWS | 58% |
| 9.90 | 4 | FWS | 62% |
| 8.81 | 3 | FWS | 65% |
| 6.73 | 2 | FWS | 66% |
| 4.65 | 8002 | FWSC | 81% |
| 2.15 | 8001 | FWSC | 88% |
| 19.70 | 11 | Oscillator | 57% |

**Table 3.7.2-224 ~~Ratio with DCD~~ Ratios of Enveloping ~~Max.~~ Maximum Vertical ~~Acceleration~~ Accelerations: FPE**

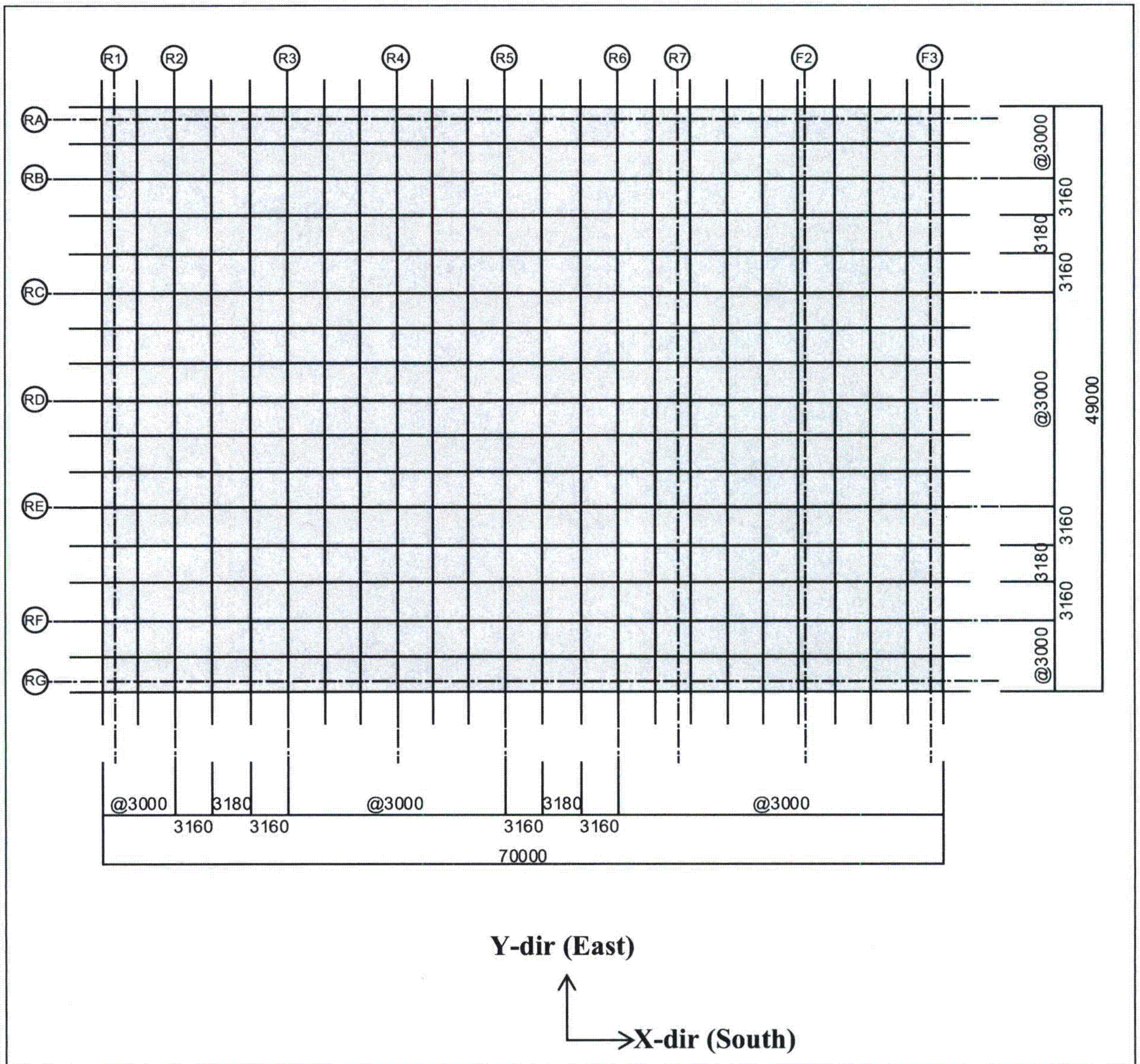
(a) Site-Specific ~~Envelop~~ Enveloping Maximum Vertical Acceleration

| Elev. (m) | Node No. | Stick Model | Max. Vertical Acceleration (g) |
|---|---|---|---|
| 8.25 | 405 | FPE | 0.6 |
| 6.45 | 402 | FPE | 0.6 |

(b) Ratio with DCD ((a)/DCD ~~Loads~~ Acceleration)

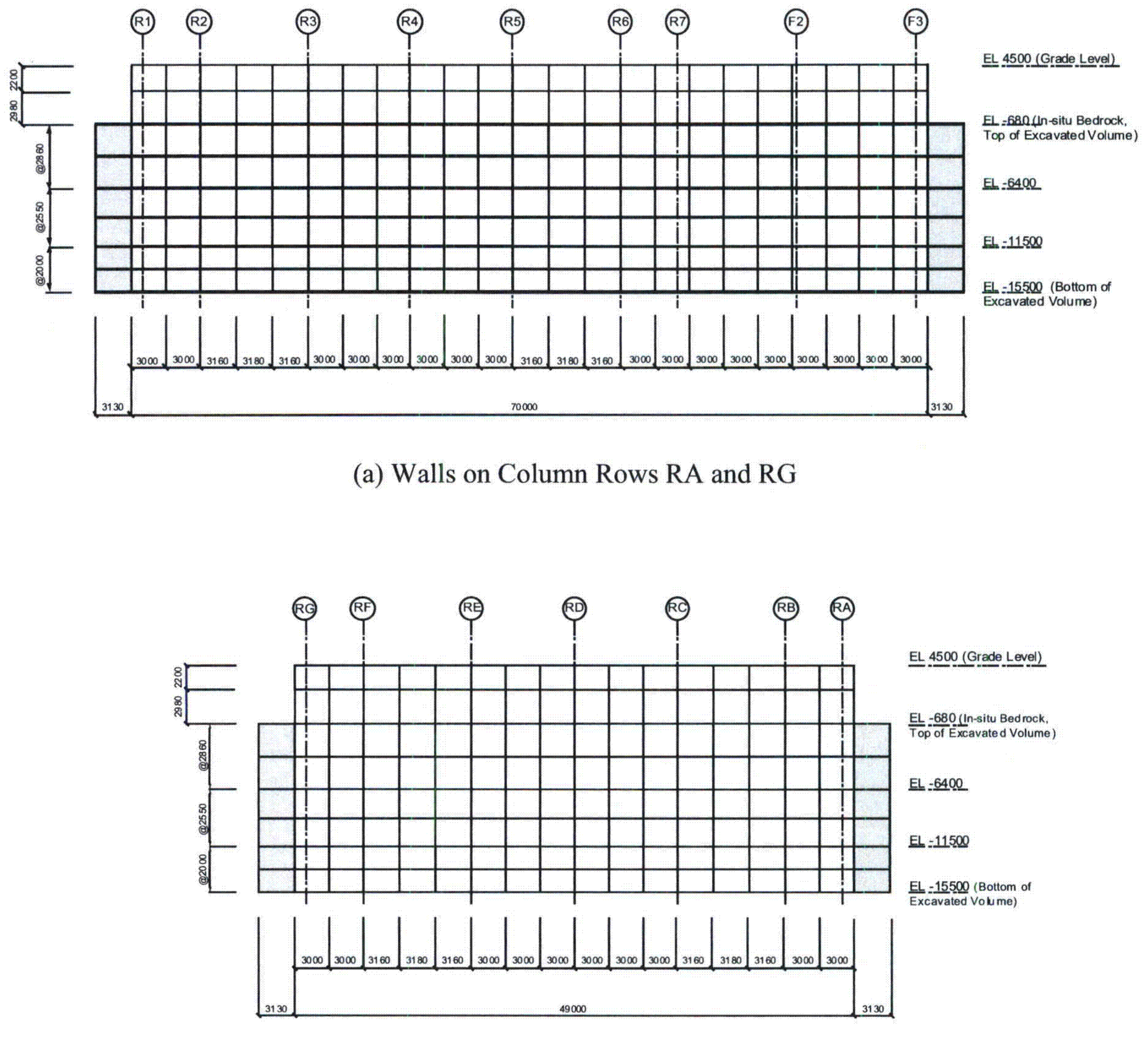
| Elev. (m) | Node No. | Stick Model | Max. Vertical Acceleration |
|---|---|---|---|
| 8.25 | 405 | FPE | 54% |
| 6.45 | 402 | FPE | 55% |

**Figure 3.7.2-201 SASSI2010 Plate Elements for RB/FB Basemat**




(Dimensions are shown in millimeters)

**Figure 3.7.2-202 SASSI2010 Plate Elements for RB/FB Exterior Wall and Solid Element for Concrete Fill**



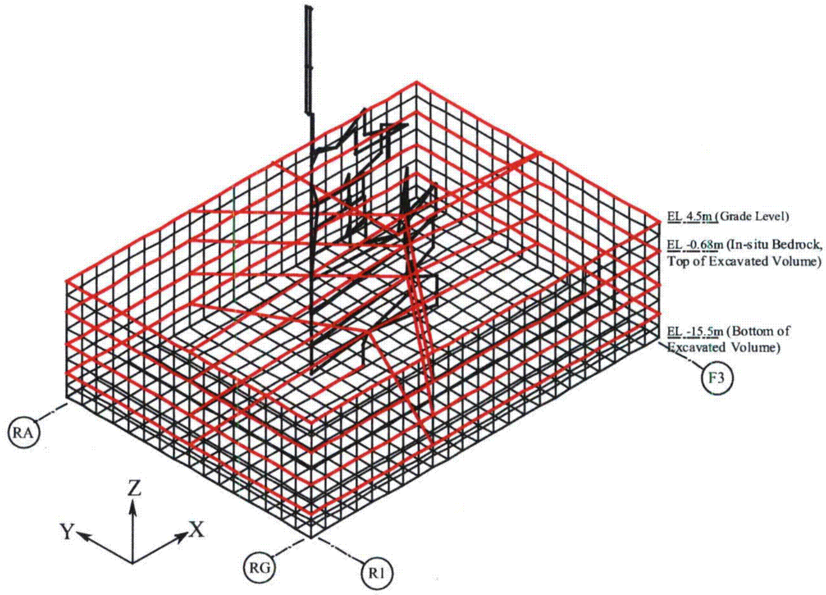

(a) Walls on Column Rows RA and RG



(b) Walls on Column Rows R1 and F3

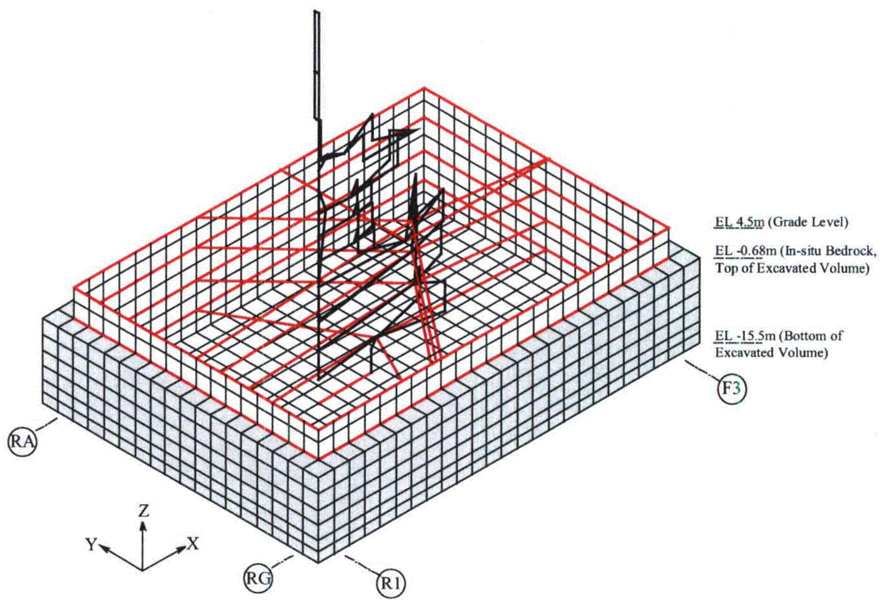
(Dimensions are shown in millimeters)

**Figure 3.7.2-203 Overview of RB/FB SASSI2010 Model**




Note: 1) Wall and basemat are modeled with shell elements.
2) Rigid beams indicated in red are installed at the floor levels.

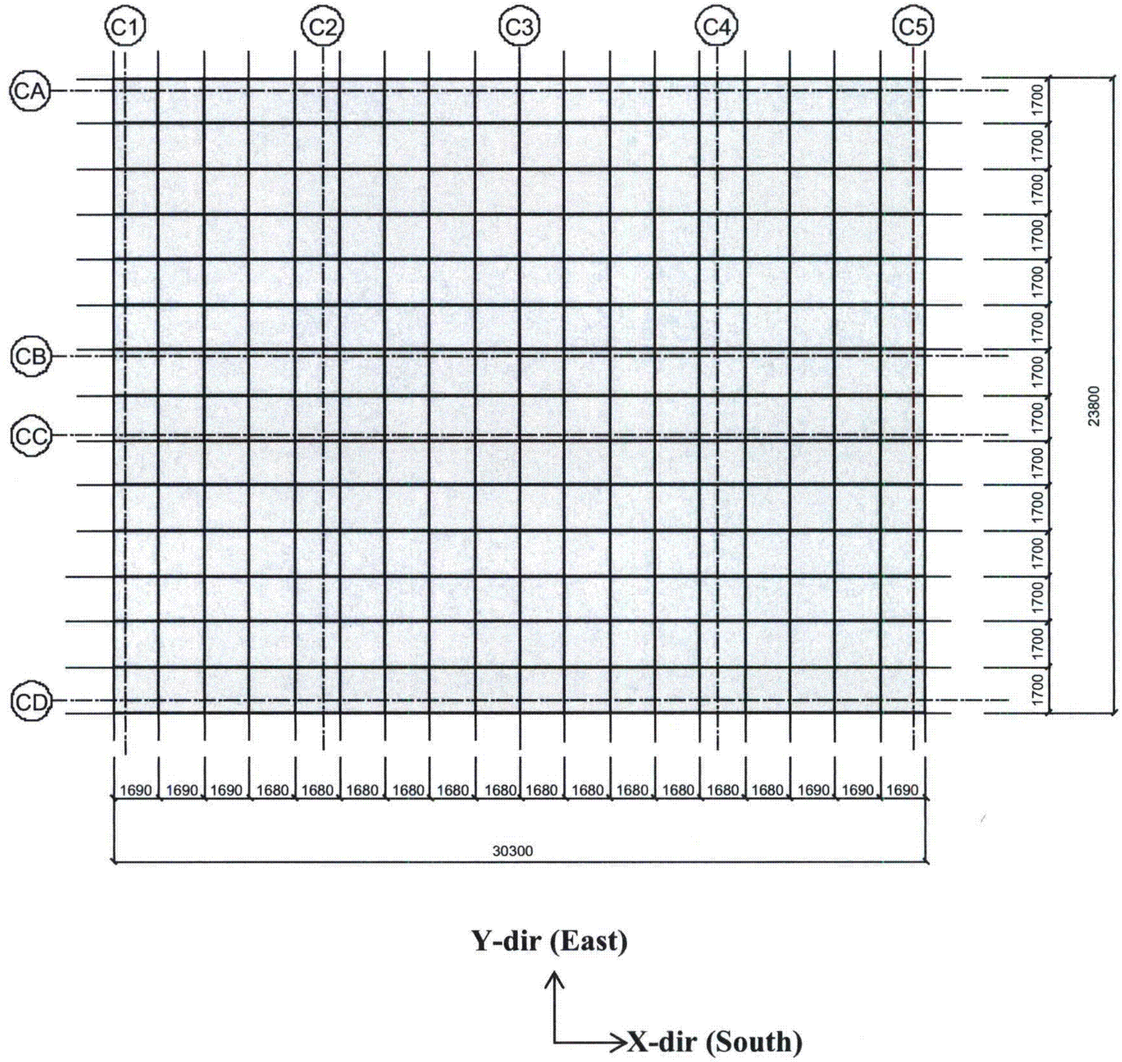
(a) Overview without Concrete Fill




Note: 1) Wall and basemat are modeled with shell elements.
2) Rigid beams indicated in red are installed at the floor levels.

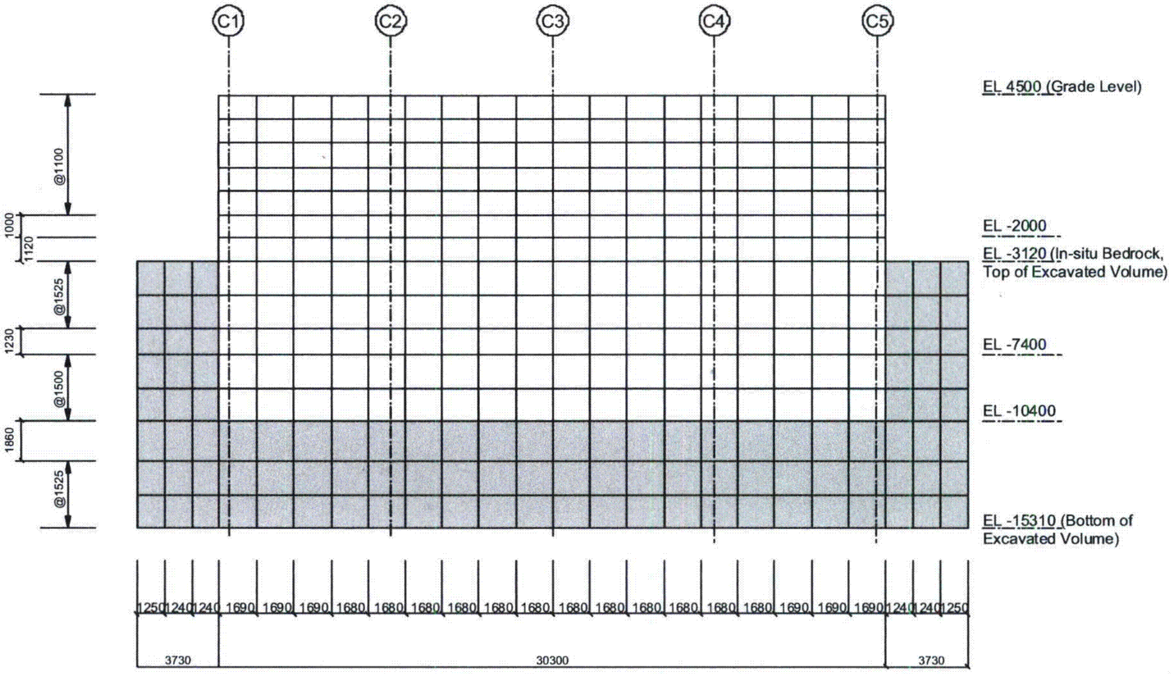
(b) Overview with Concrete Fill

**Figure 3.7.2-204 SASSI2010 Plate Elements for CB Basemat**

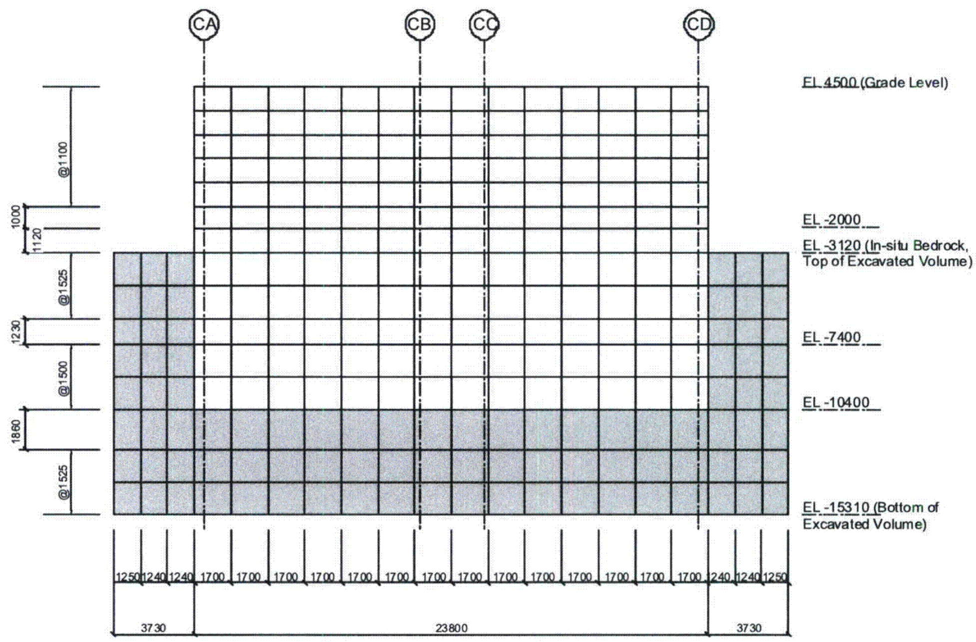



(Dimensions are shown in millimeters)

**Figure 3.7.2-205 SASSI2010 Plate Elements for CB Exterior Wall and Solid Element for Concrete Fill**



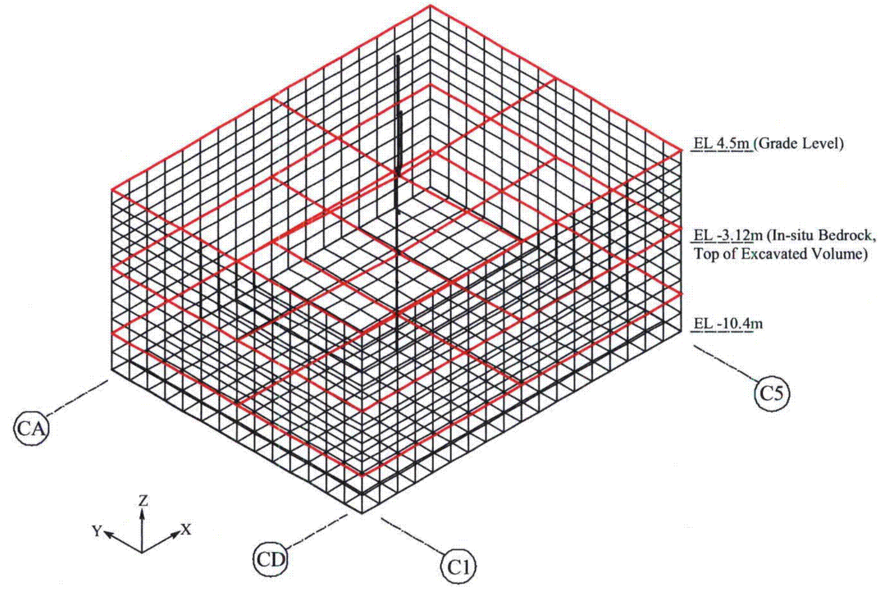

(a) Walls on Column Rows CA and CD




(b) Walls on Column Rows C1 and C5

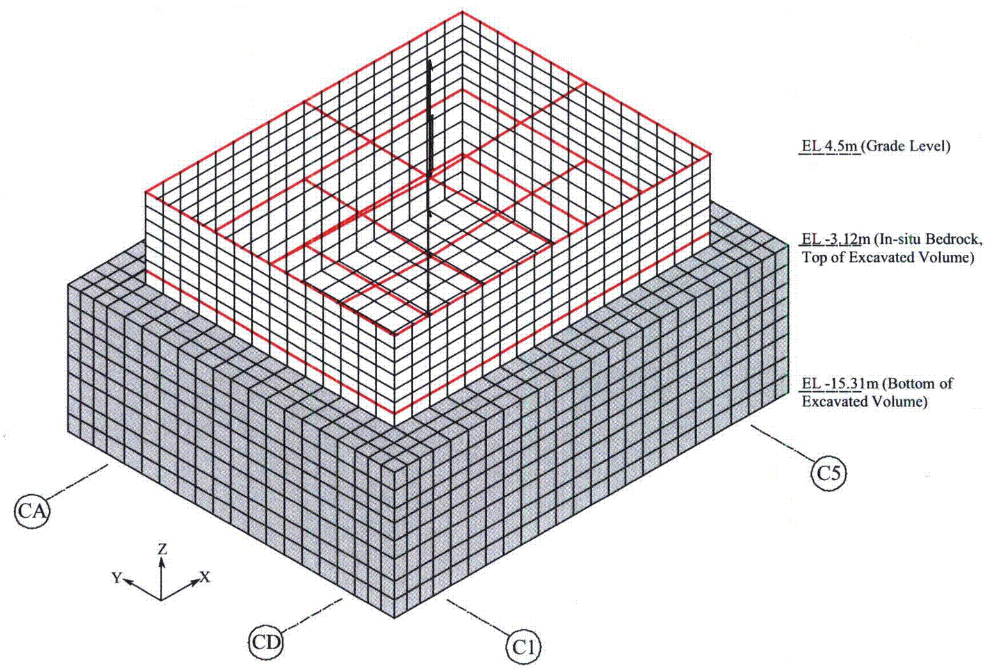
(Dimensions are shown in millimeters)

**Figure 3.7.2-206 Overview of CB SASSI2010 Model**




Note: 1) Wall and basemat are modeled with shell elements.
2) Rigid beams indicated in red are installed at the floor levels.

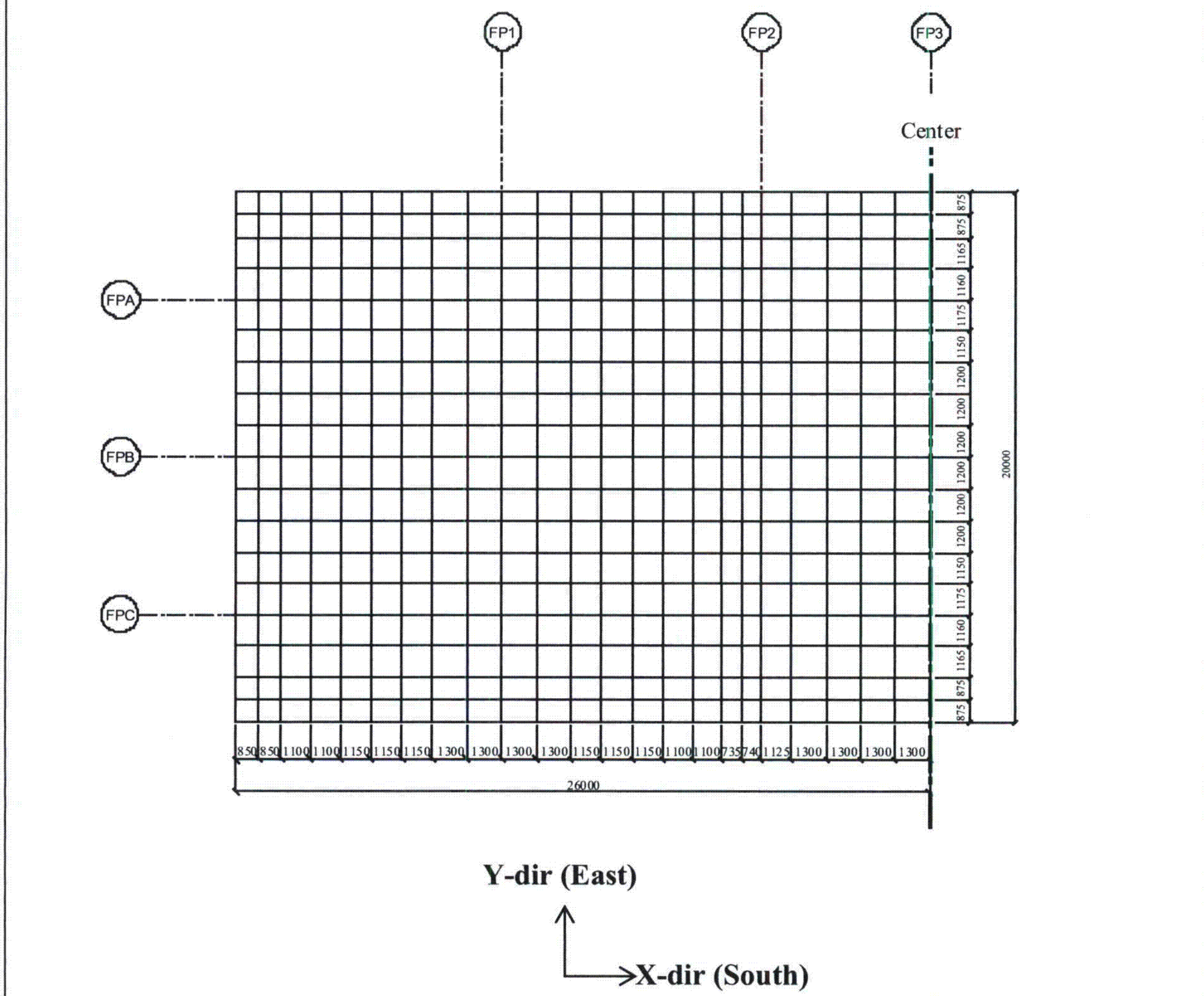
(a) Overview without Concrete Fill




Note: 1) Wall and basemat are modeled with shell elements.
2) Rigid beams indicated in red are installed at the floor levels.

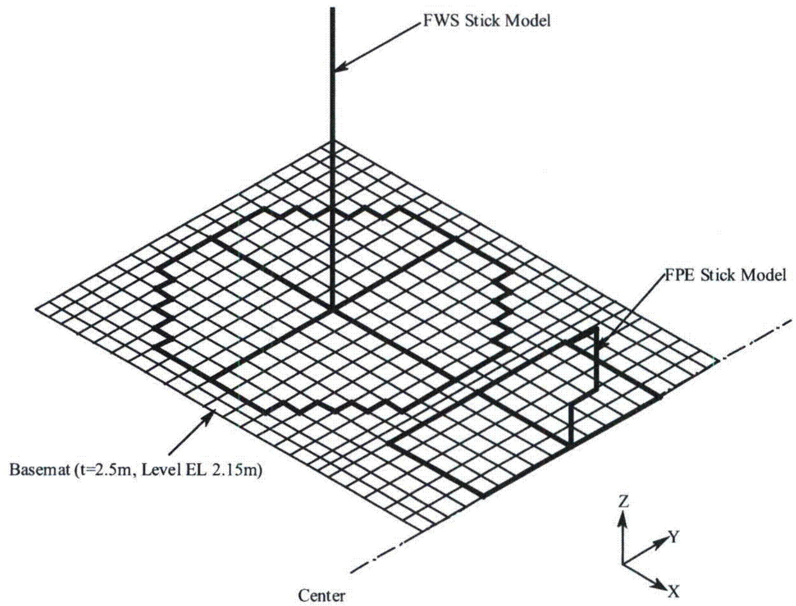
(b) Overview with Concrete Fill

**Figure 3.7.2-207 SASSI2010 Plate Elements for FWSC Basemat**



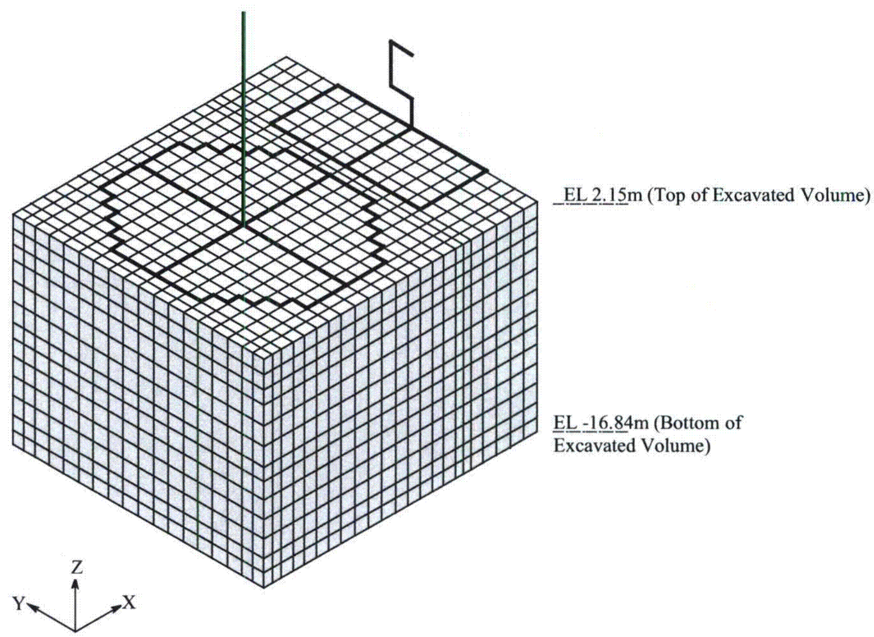

(Dimensions are shown in millimeters)

**Figure 3.7.2-209 Overview of FWSC SASSI2010 Model**




Note: 1) Basemat is modeled with shell elements.

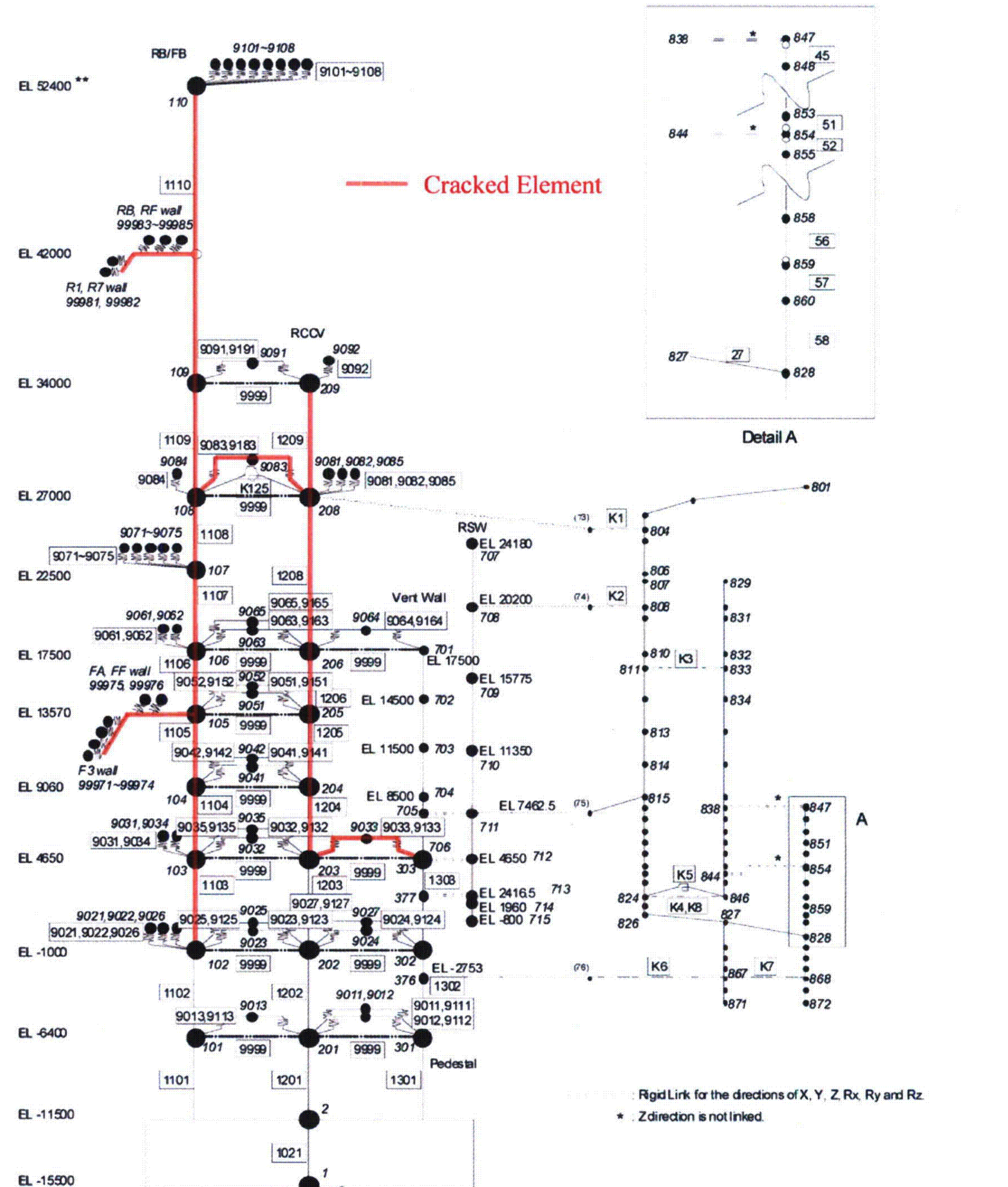
(a) Overview without Concrete Fill




Note: 1) Basemat is modeled with shell elements.

(b) Overview with Concrete Fill

**Figure 3.7.2-210 RB/FB Complex Seismic Model with Cracked Elements**




Note: Refer to Figures 3A.7-1 through 3A.7-3 for eccentricities of individual sticks.

**: The difference between the modeled elevation 52.4 m and the actual elevation 52.7 m at the RB roof is negligibly small.

**Figure 3.7.2-211 Comparison of ISRS - RB/FB Refueling Floor in X-Direction**

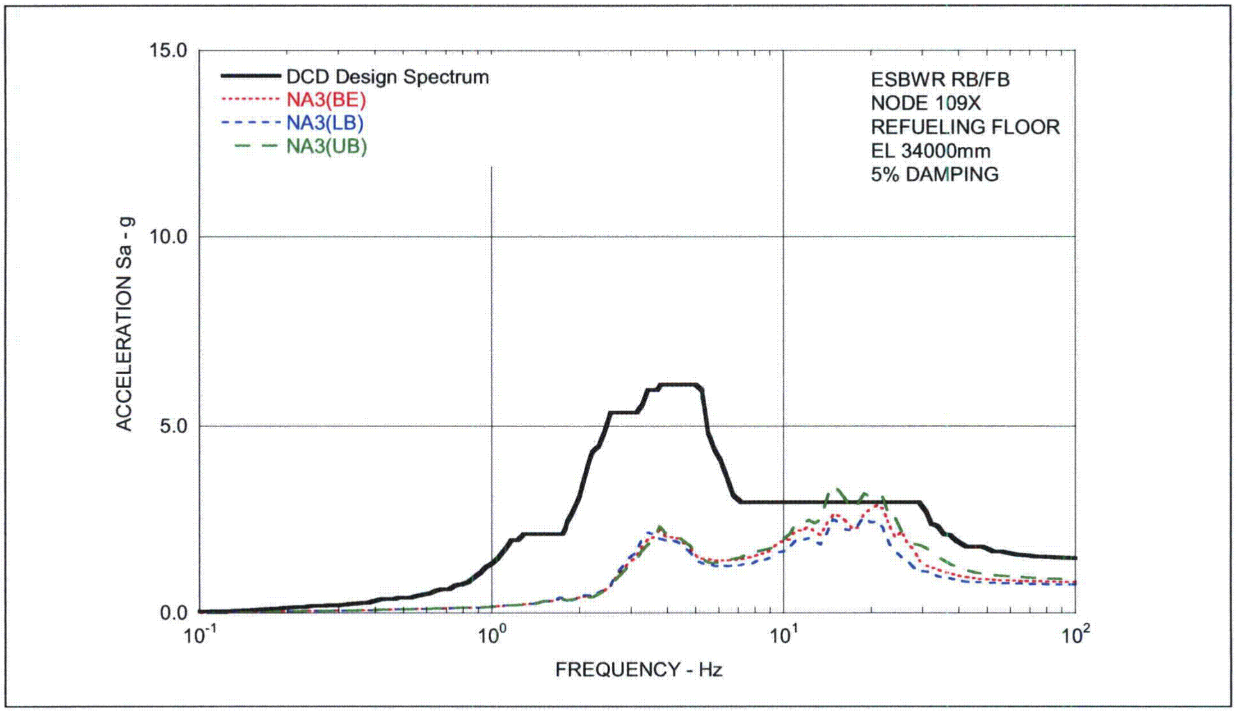



**Figure 3.7.2-212 Comparison of ISRS - RCCV Top Slab in X-Direction**

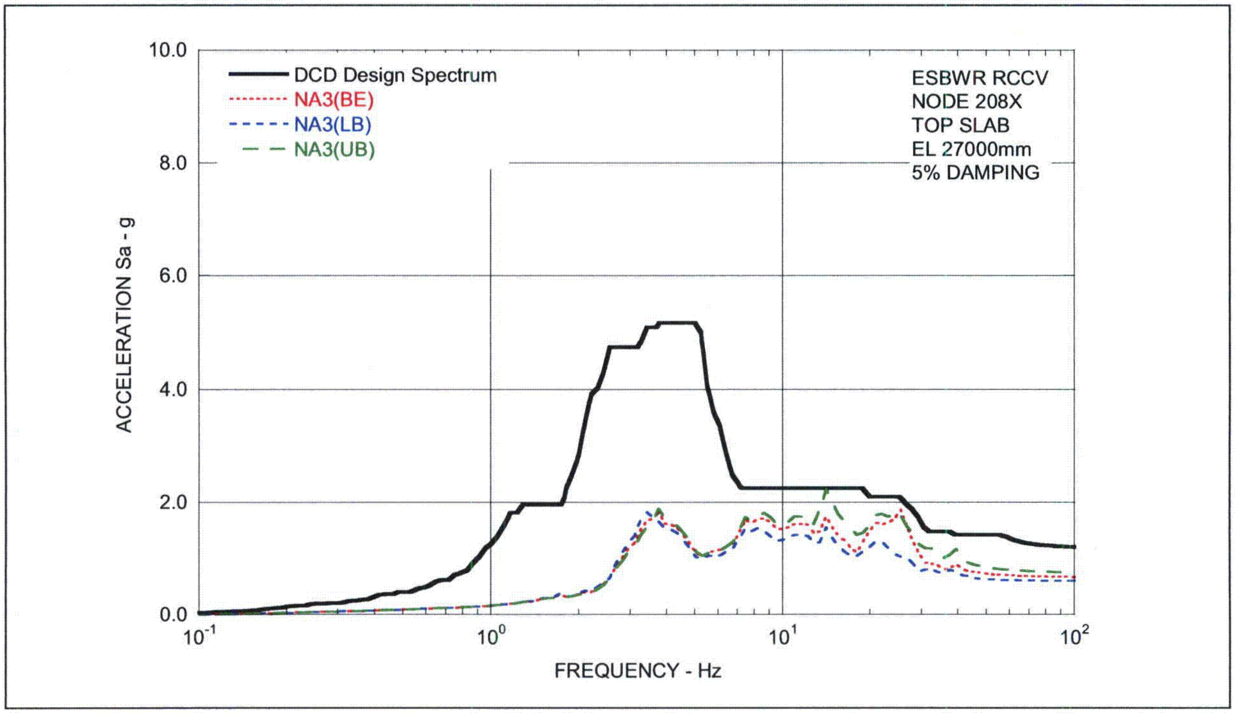


**Figure 3.7.2-213 Comparison of ISRS - Vent Wall Top in X-Direction**

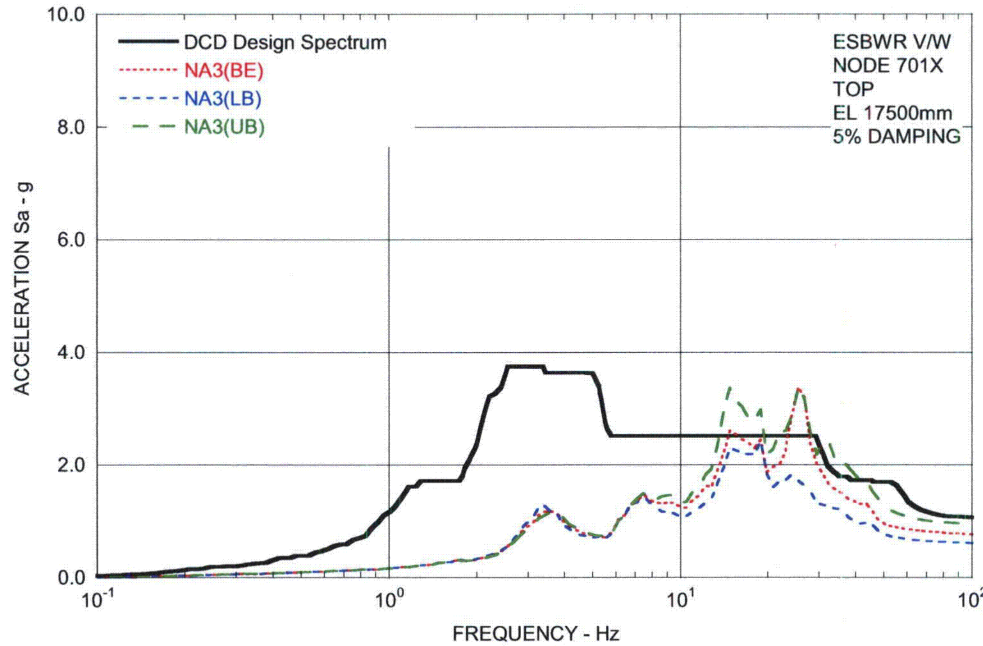



**Figure 3.7.2-214 Comparison of ISRS - RSW Top in X-Direction**

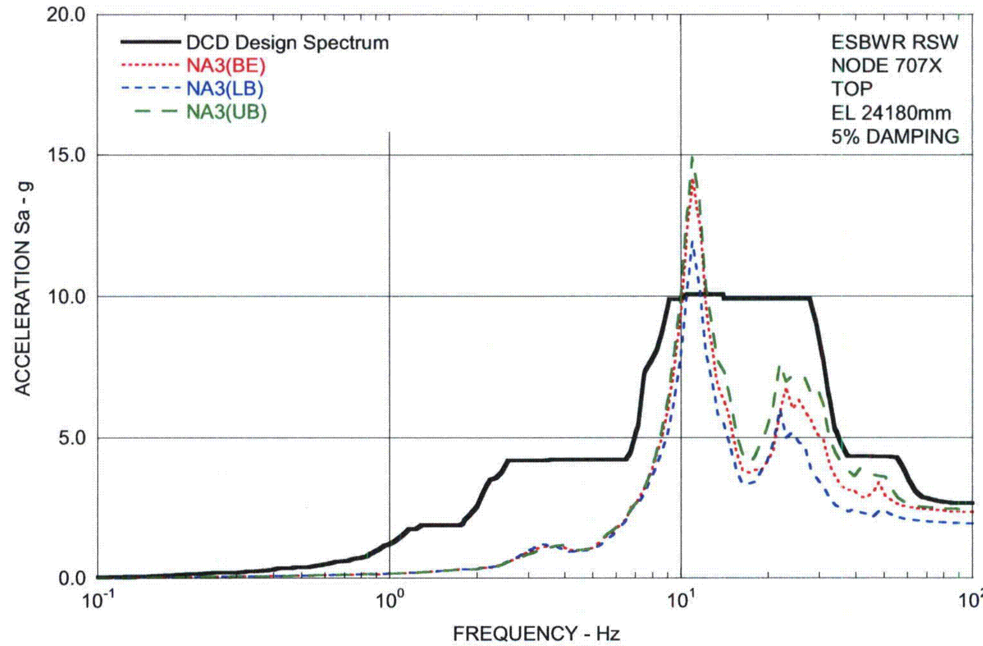


**Figure 3.7.2-215 Comparison of ISRS - RPV Top in X-Direction**

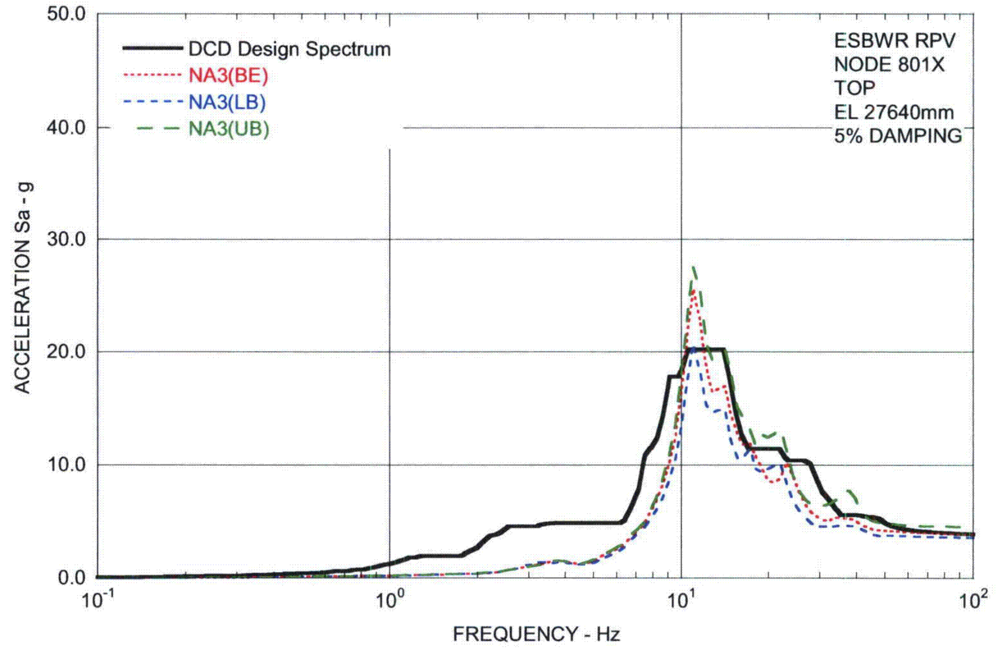



**Figure 3.7.2-216 Comparison of ISRS - RB/FB Basemat in X-Direction**

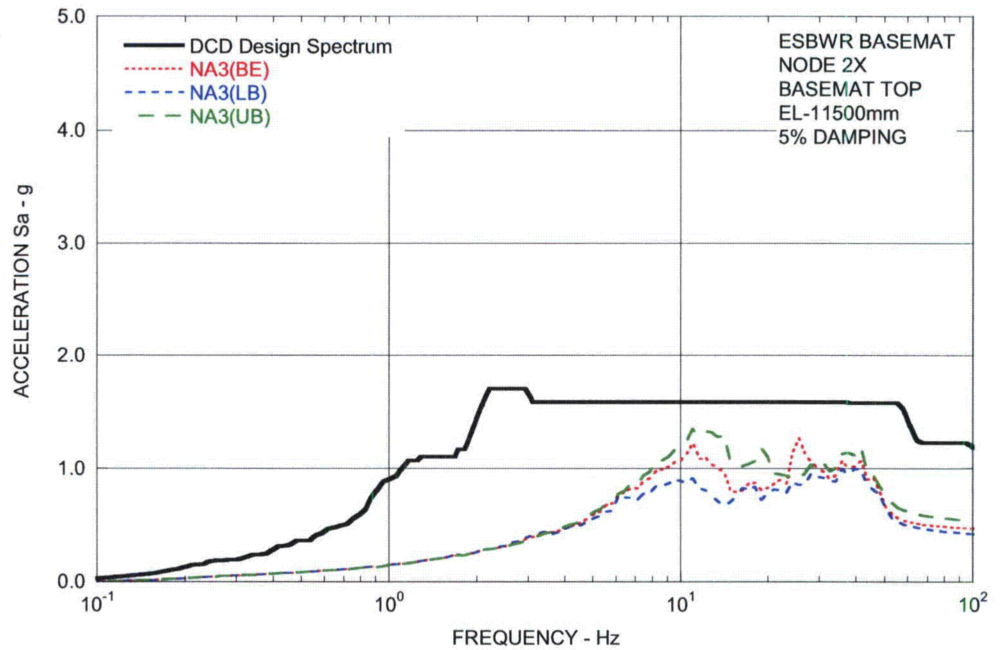


**Figure 3.7.2-217 Comparison of ISRS - RB/FB Refueling Floor in Y-Direction**

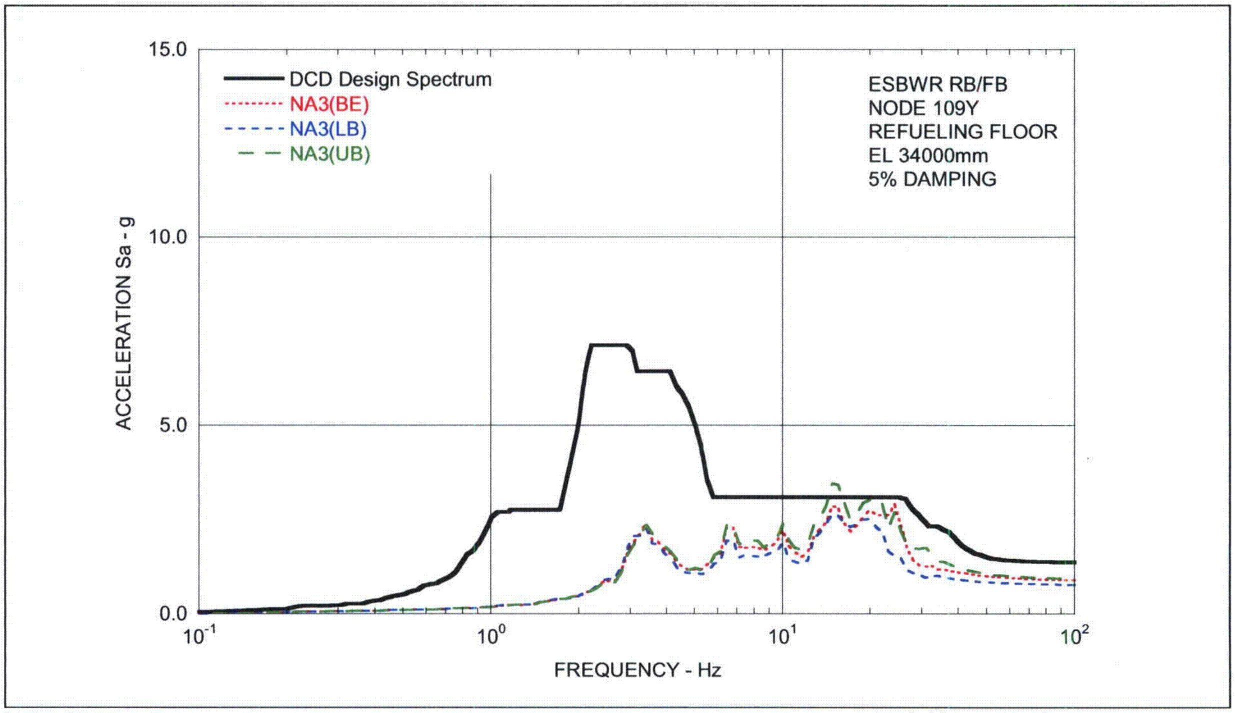



**Figure 3.7.2-218 Comparison of ISRS - RCCV Top Slab in Y-Direction**

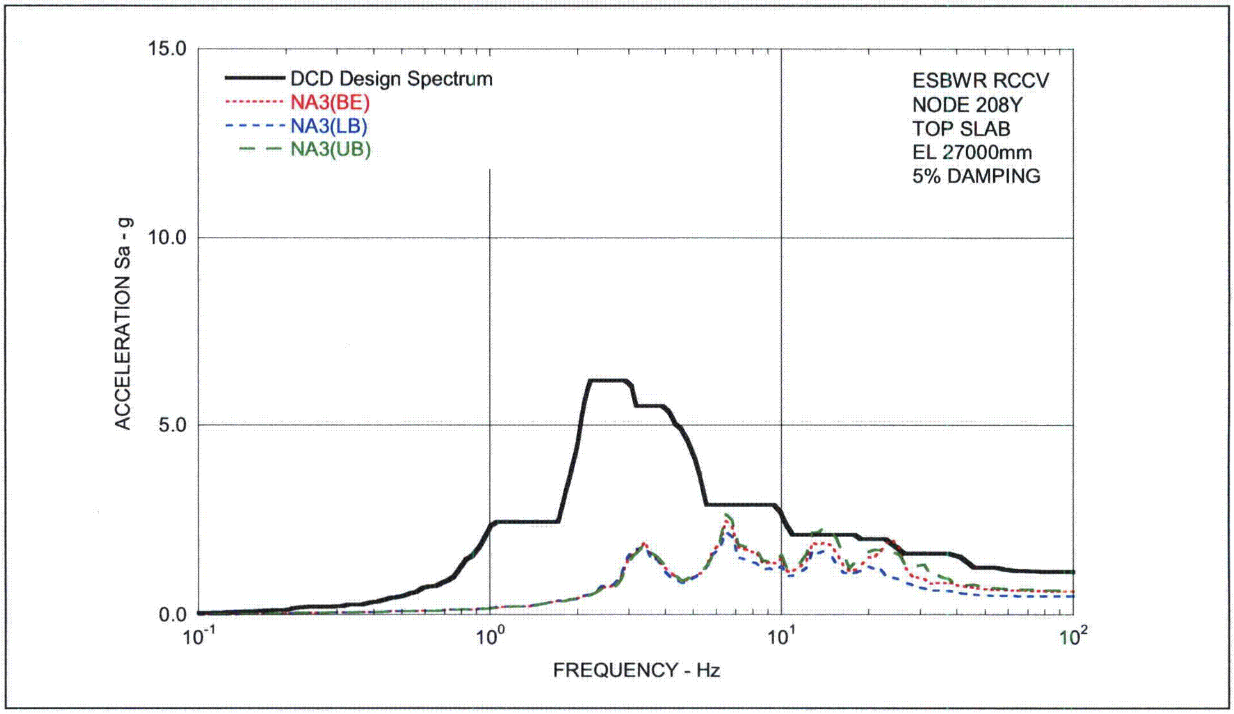


**Figure 3.7.2-219 Comparison of ISRS - Vent Wall Top in Y-Direction**

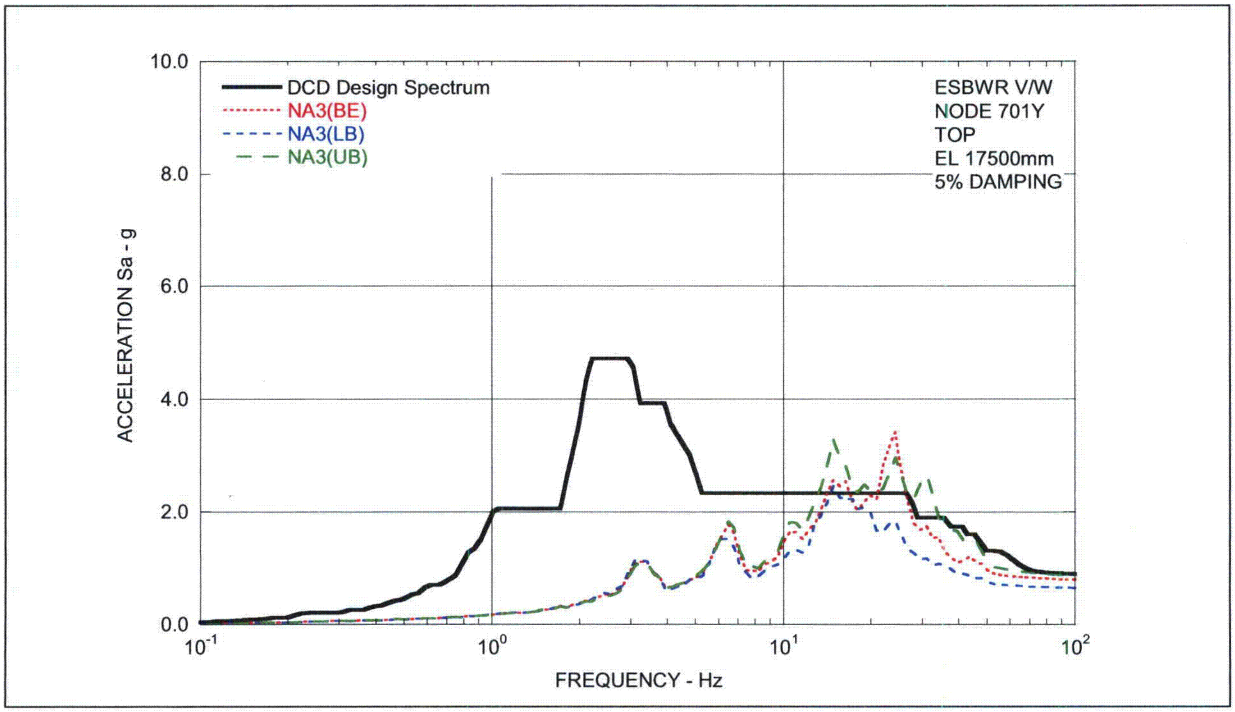



**Figure 3.7.2-220 Comparison of ISRS - RSW Top in Y-Direction**

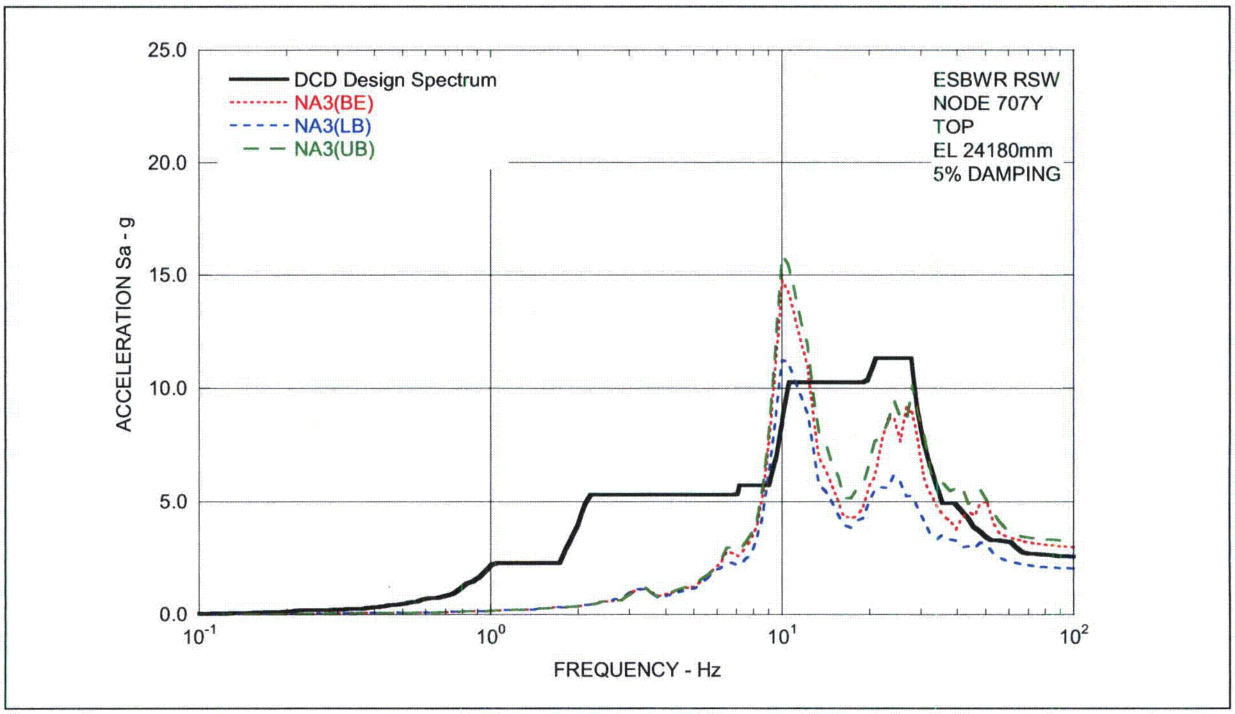


**Figure 3.7.2-221 Comparison of ISRS - RPV Top in Y-Direction**

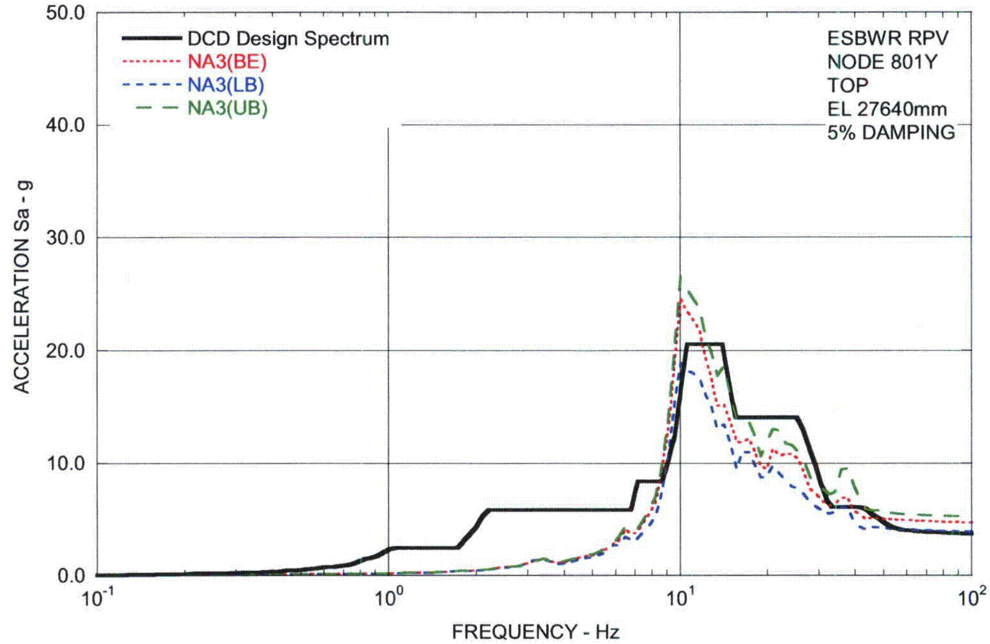
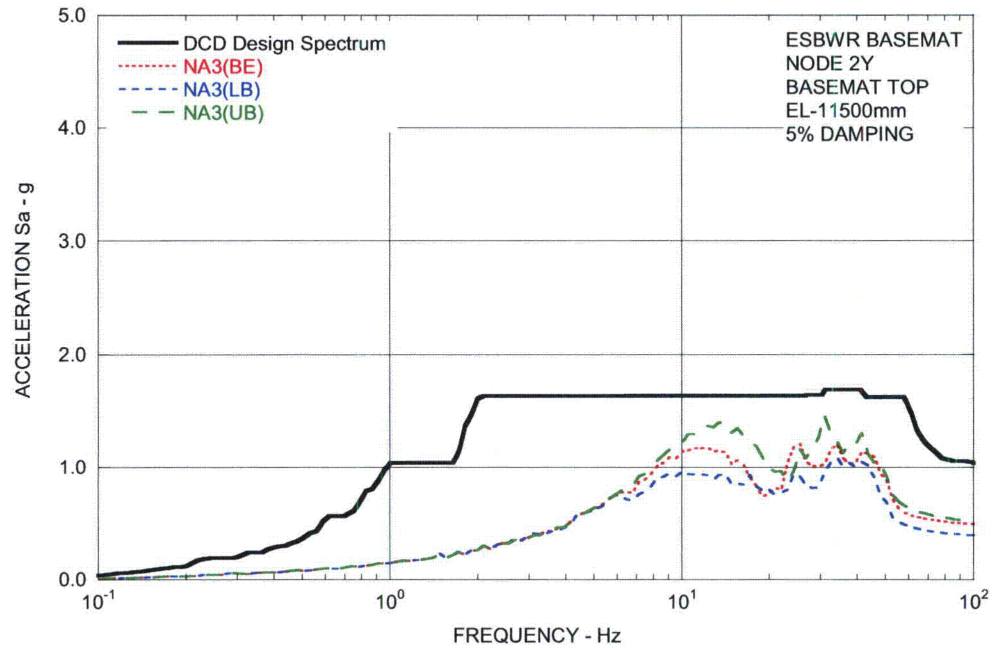



**Figure 3.7.2-222 Comparison of ISRS - RB/FB Basemat in Y-Direction**



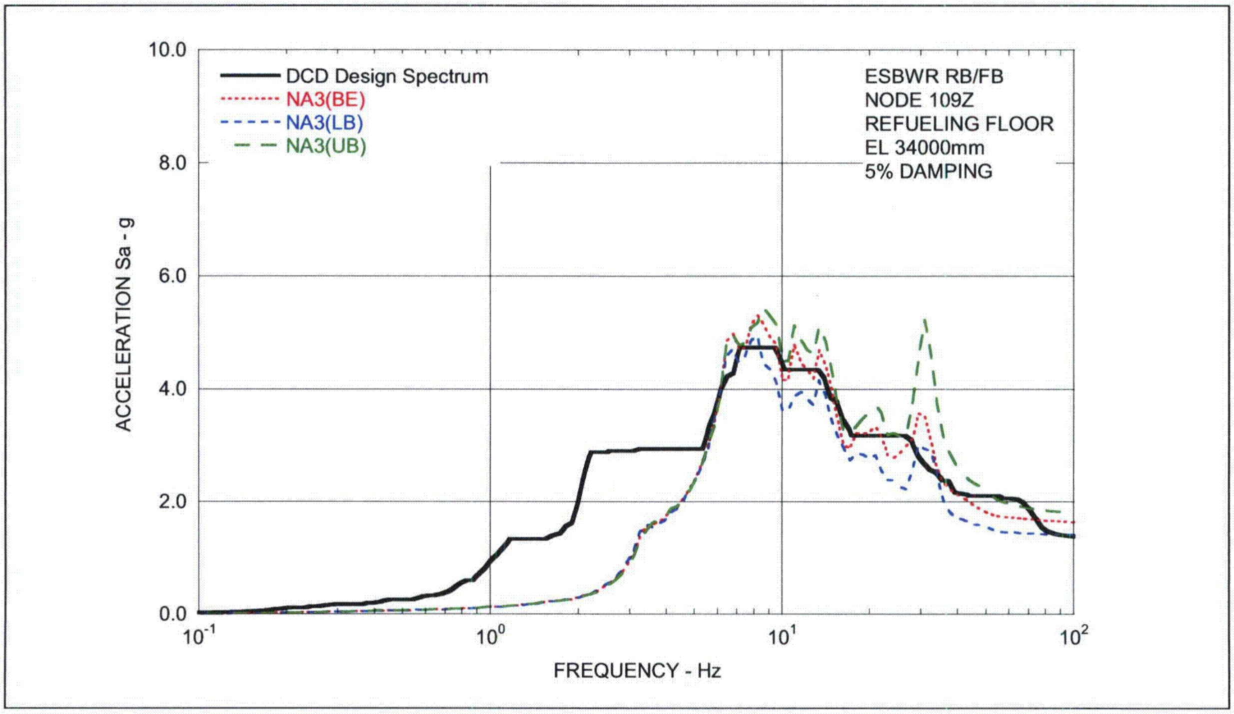



**Figure 3.7.2-223 Comparison of ISRS - RB/FB Refueling Floor in Z-Direction**

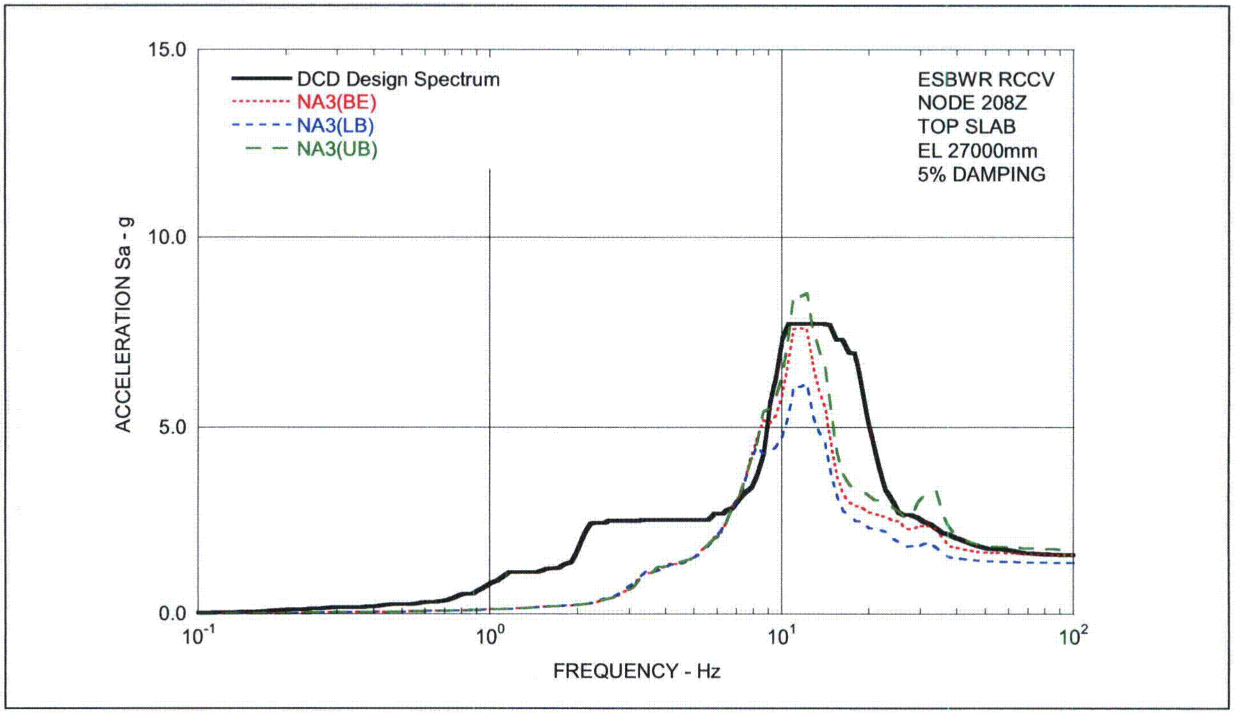



**Figure 3.7.2-224 Comparison of ISRS - RCCV Top Slab in Z-Direction**

**Figure 3.7.2-225 Comparison of ISRS - Vent Wall Top in Z-Direction**

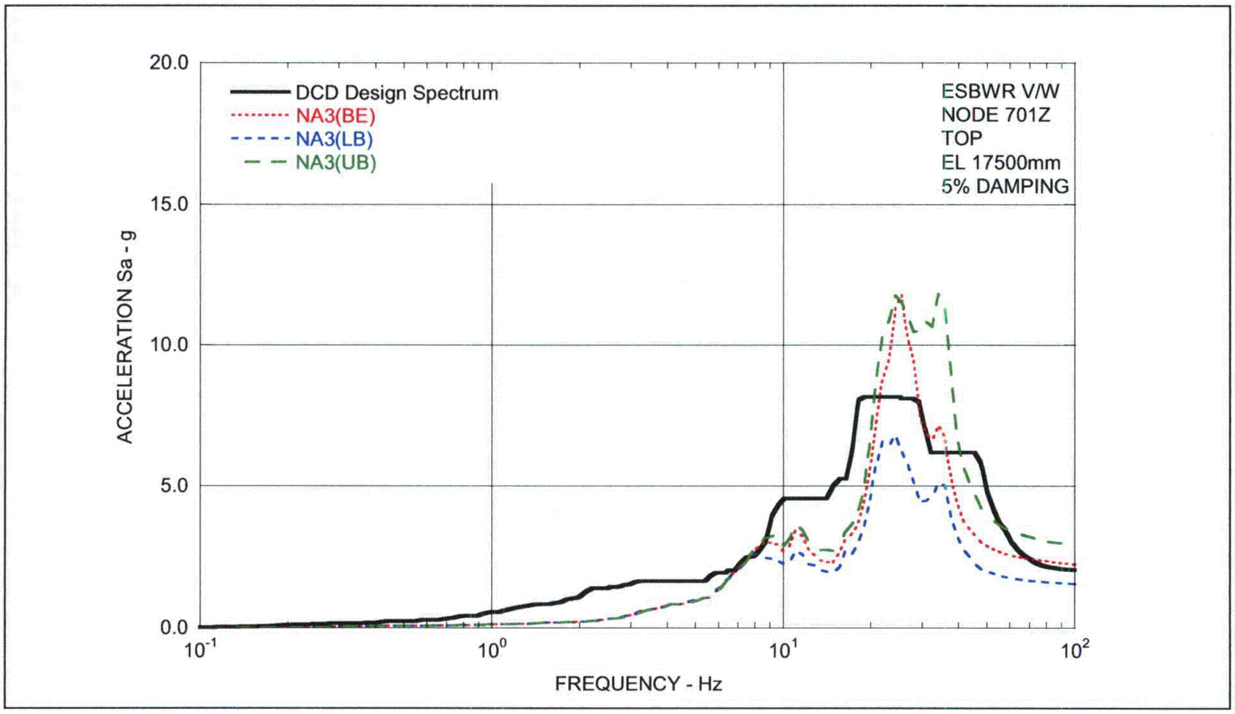



**Figure 3.7.2-226 Comparison of ISRS - RSW Top in Z-Direction**

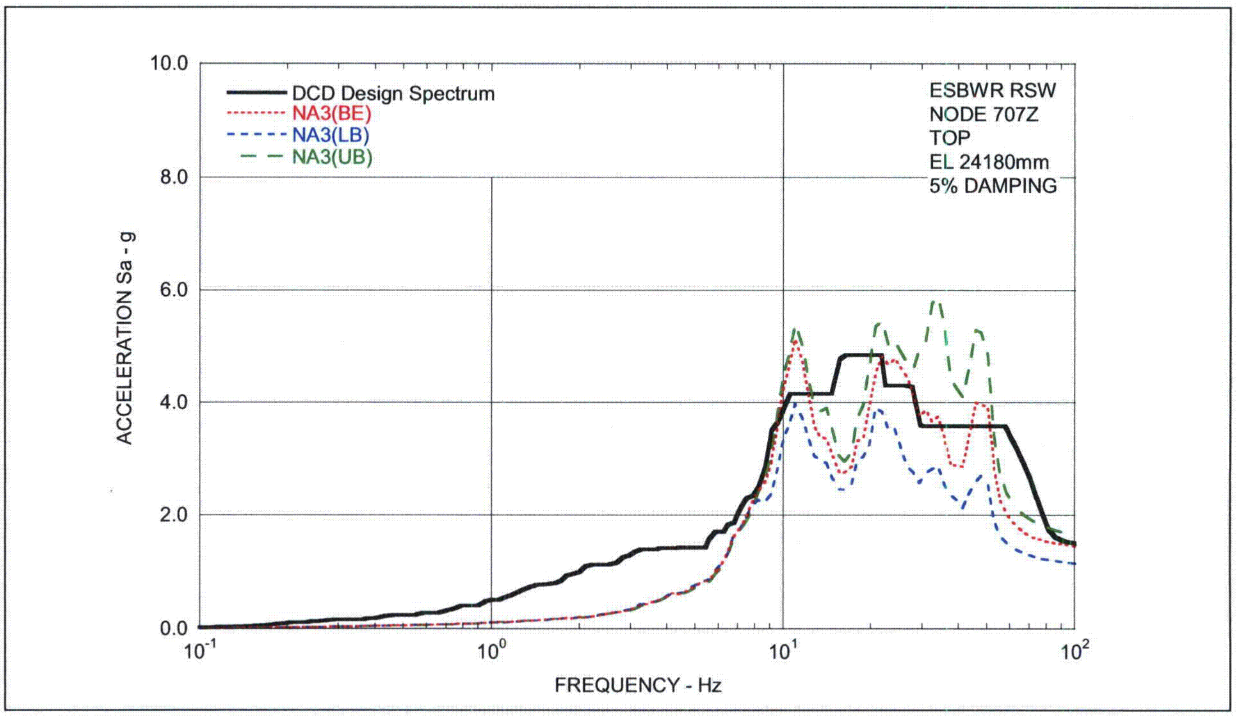


**Figure 3.7.2-227 Comparison of ISRS - RPV Top in Z-Direction**

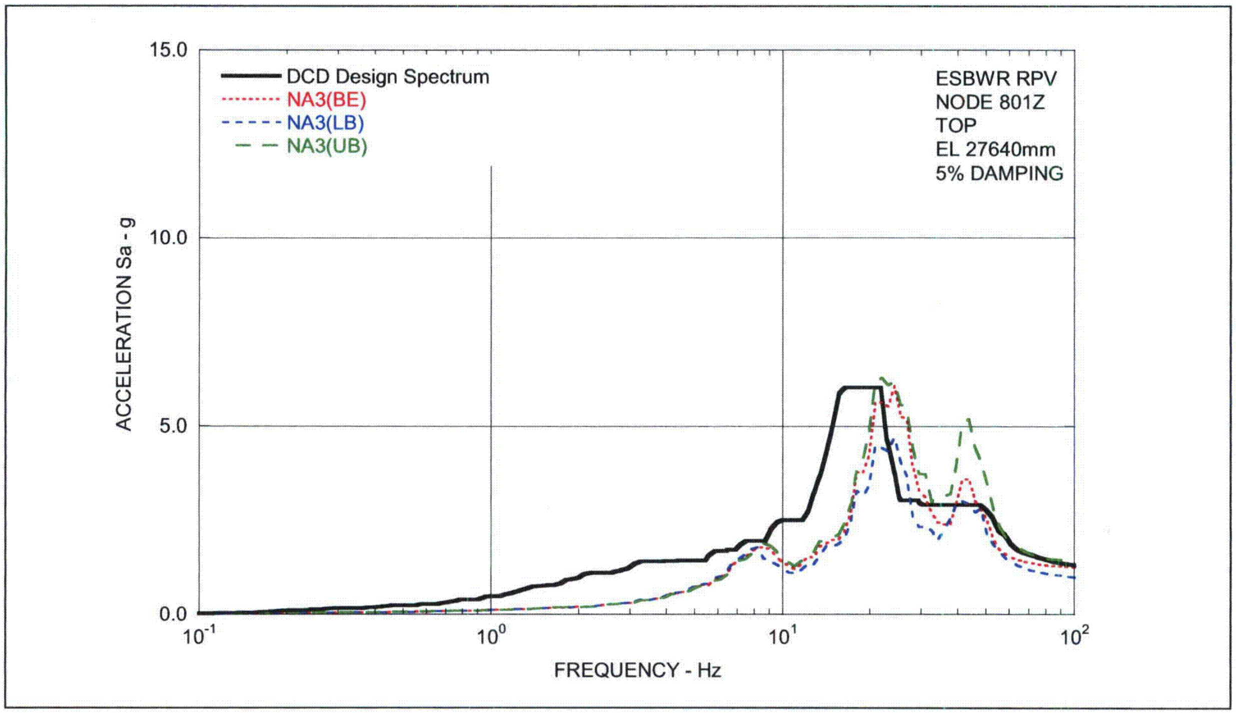



**Figure 3.7.2-228 Comparison of ISRS - RB/FB Basemat in Z-Direction**

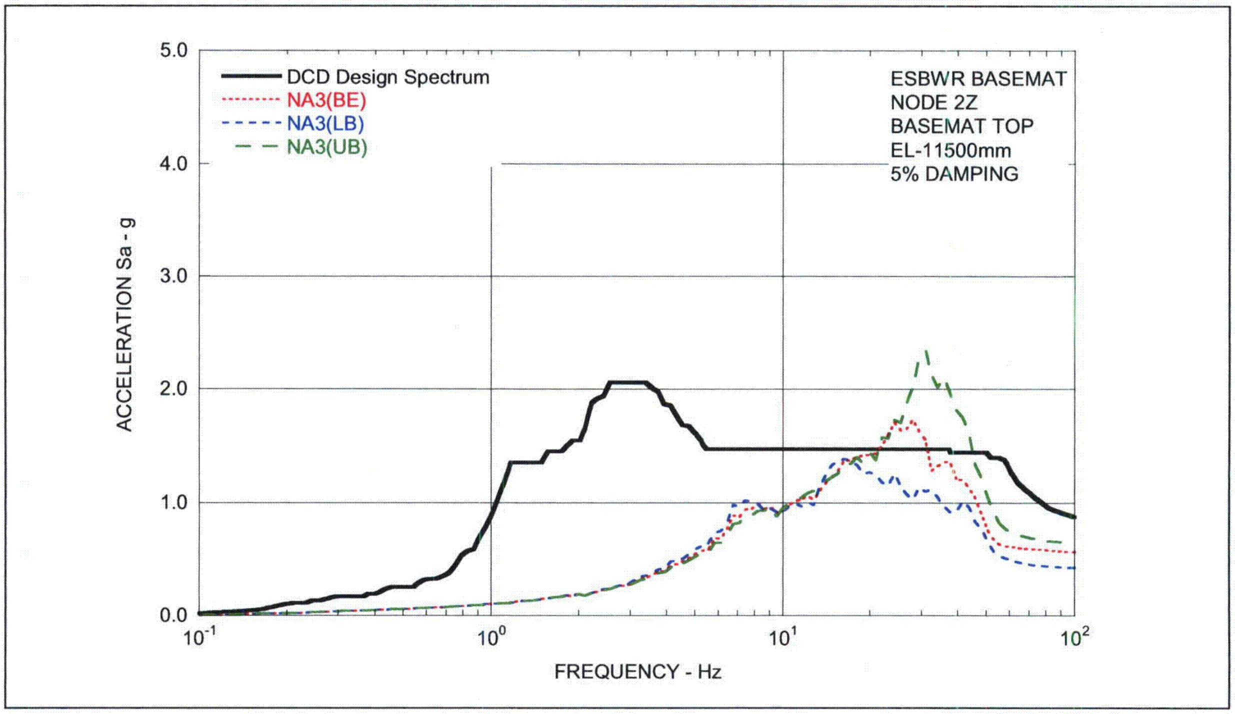


**Figure 3.7.2-229 Unit 3 Site-Specific SSE ISRS - RB/FB Refueling Floor in X-Direction**

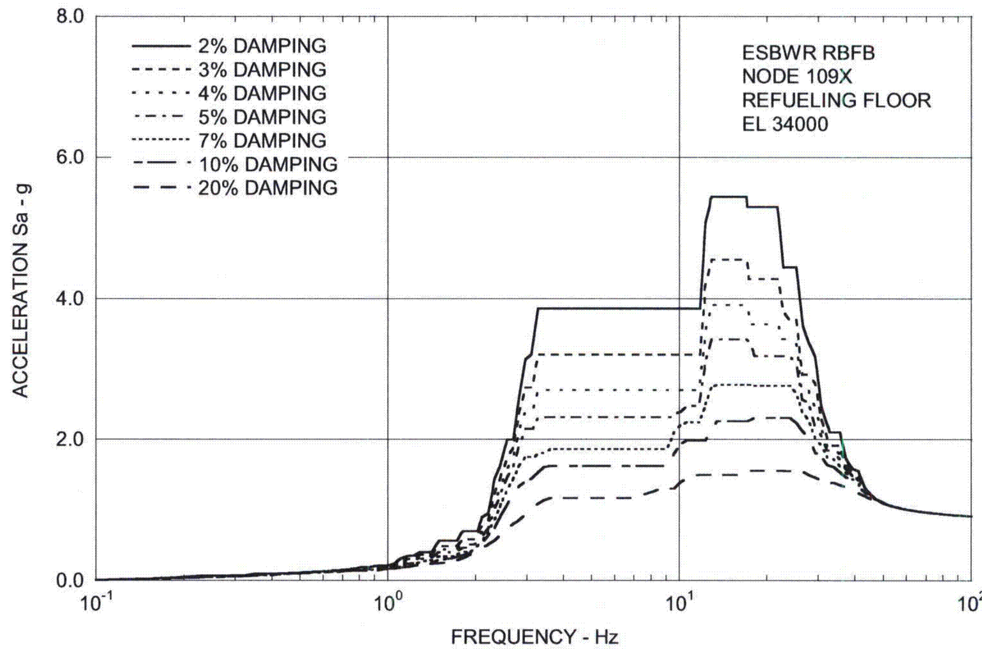


**Figure 3.7.2-230 Unit 3 Site-Specific SSE ISRS - RCCV Top Slab in X-Direction**

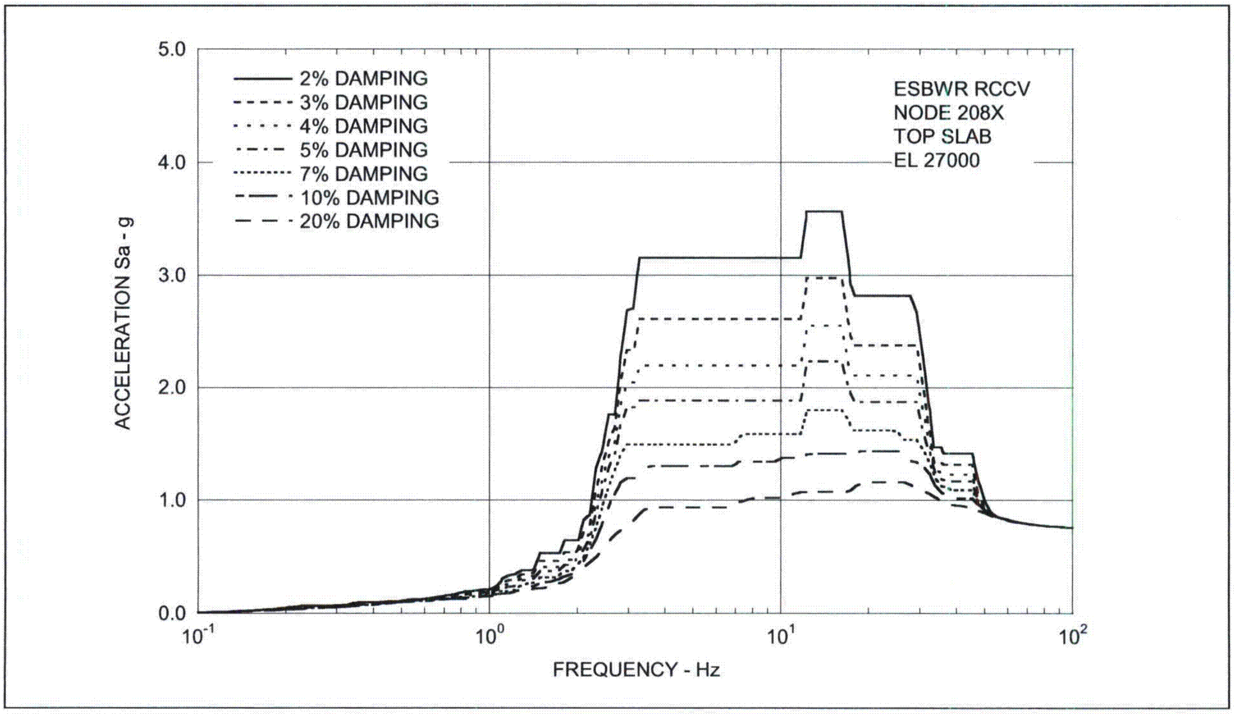


**Figure 3.7.2-231 Unit 3 Site-Specific SSE ISRS - Vent Wall Top in X-Direction**

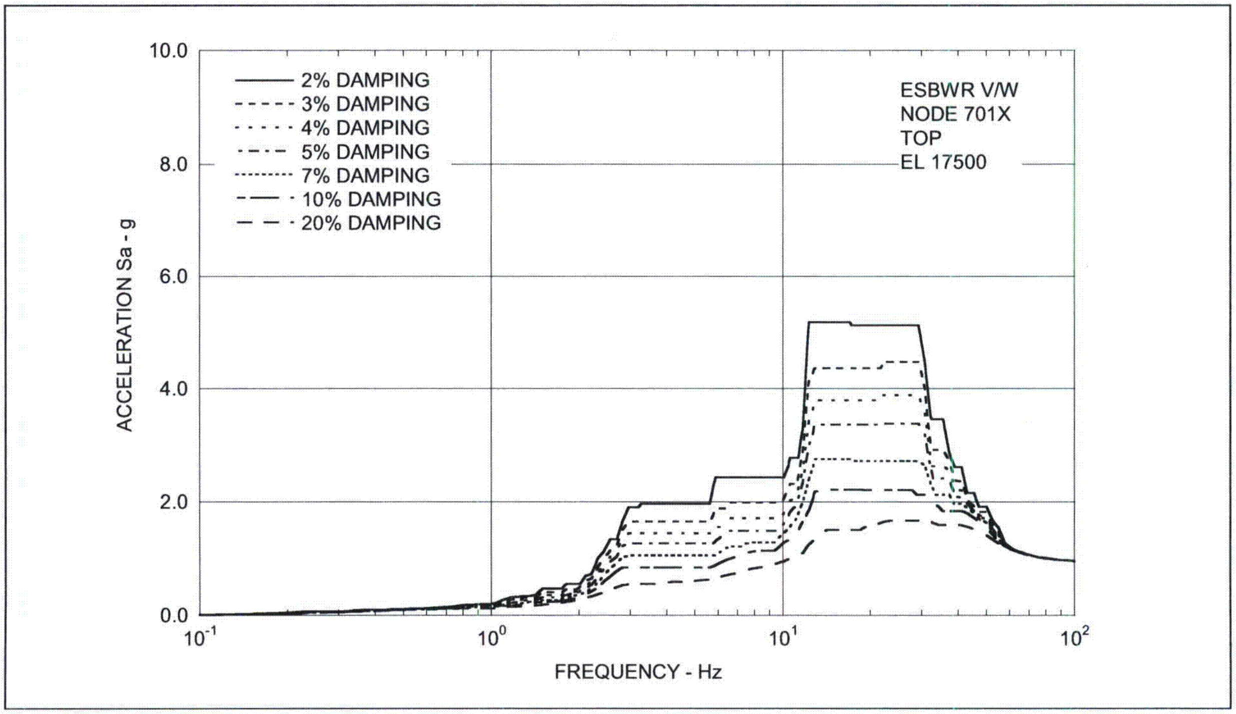


**Figure 3.7.2-232 Unit 3 Site-Specific SSE ISRS - RSW Top in X-Direction**

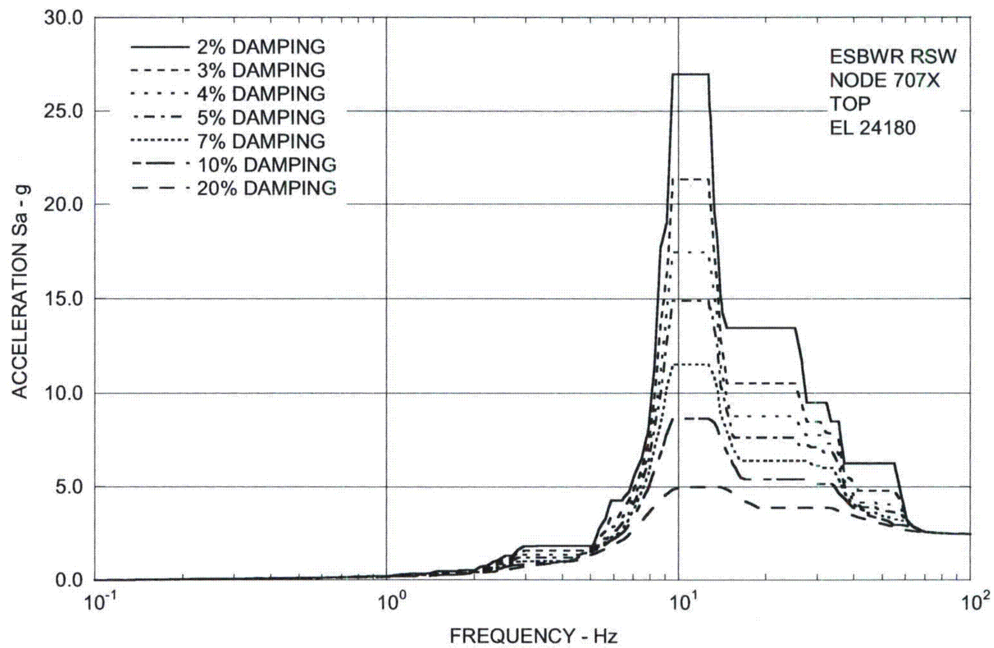


**Figure 3.7.2-233 Unit 3 Site-Specific SSE ISRS - RPV Top in X-Direction**

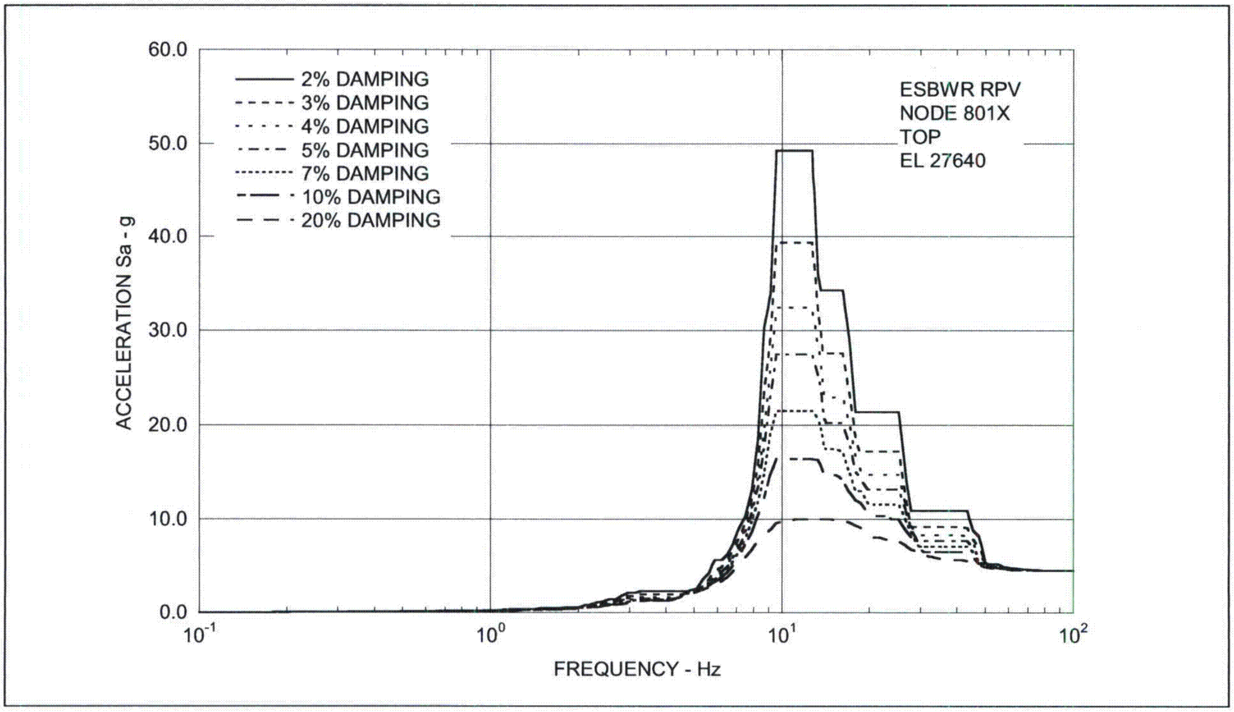


**Figure 3.7.2-234 Unit 3 Site-Specific SSE ISRS - RB/FB Basemat in X-Direction**

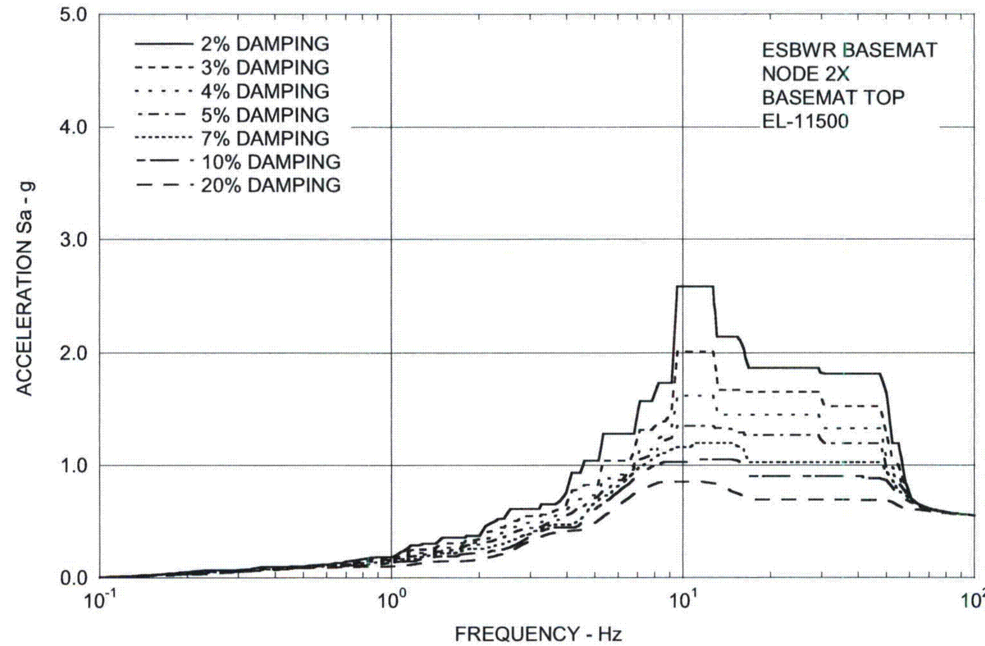


**Figure 3.7.2-235 Unit 3 Site-Specific SSE ISRS - RB/FB Refueling Floor in Y-Direction**

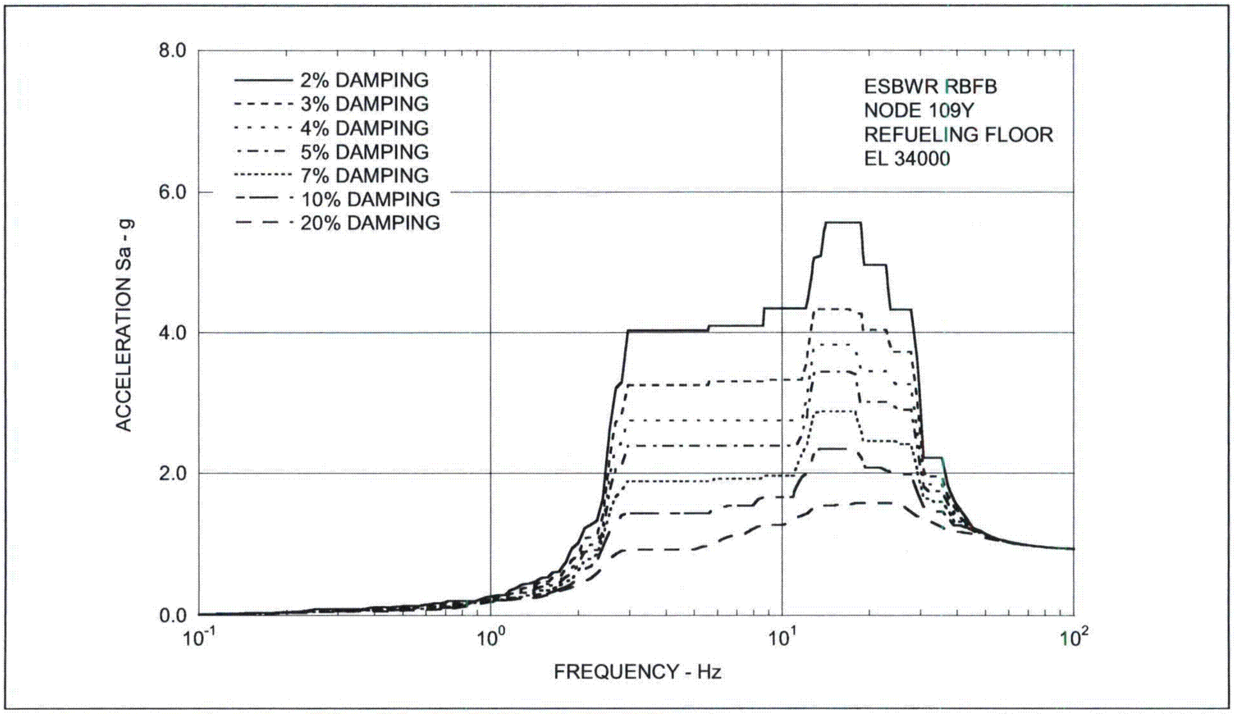


**Figure 3.7.2-236 Unit 3 Site-Specific SSE ISRS - RCCV Top Slab in Y-Direction**

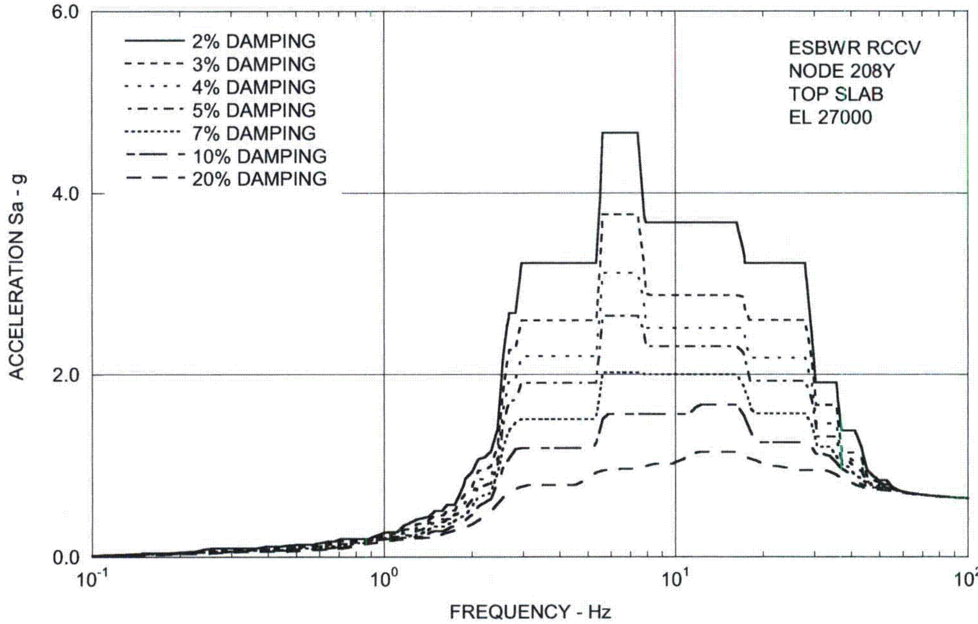


**Figure 3.7.2-237 Unit 3 Site-Specific SSE ISRS - Vent Wall Top in Y-Direction**

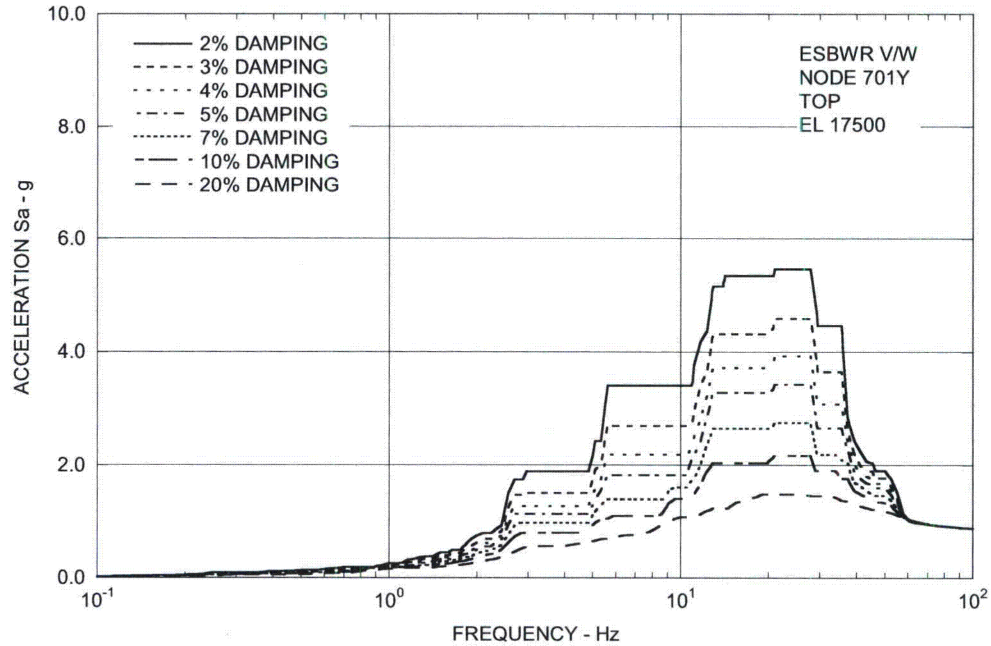


**Figure 3.7.2-238 Unit 3 Site-Specific SSE ISRS - RSW Top in Y-Direction**

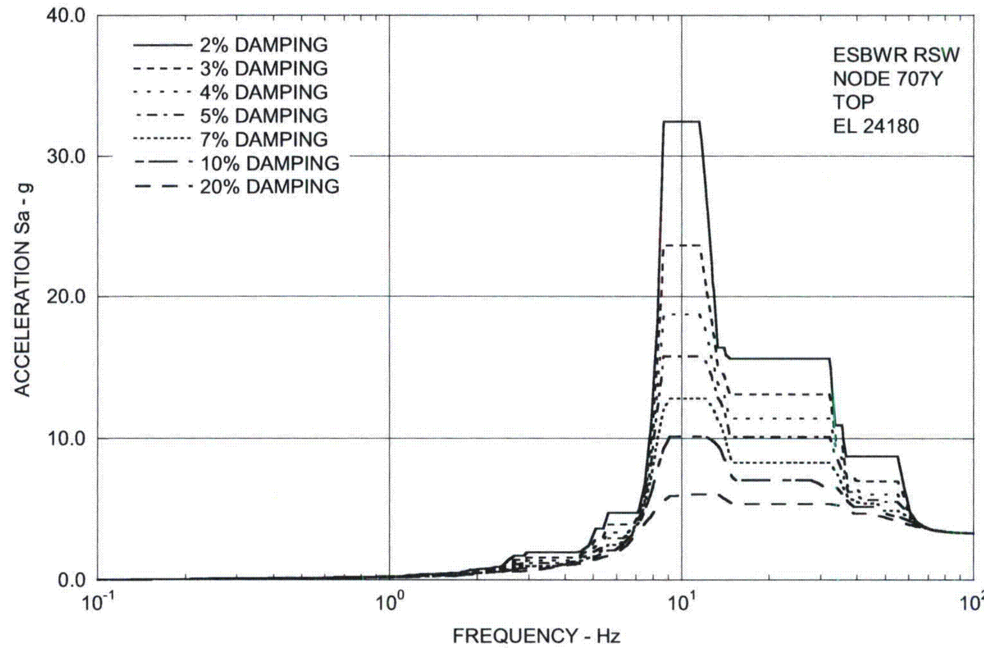


**Figure 3.7.2-239 Unit 3 Site-Specific SSE ISRS - RPV Top in Y-Direction**

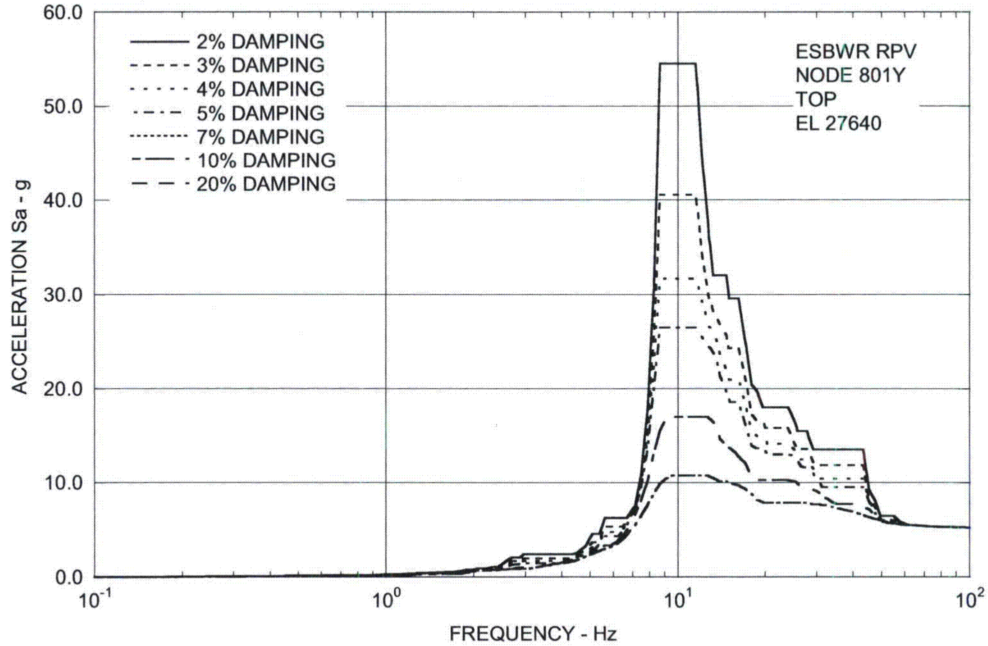


**Figure 3.7.2-240 Unit 3 Site-Specific SSE ISRS - RB/FB Basemat in Y-Direction**

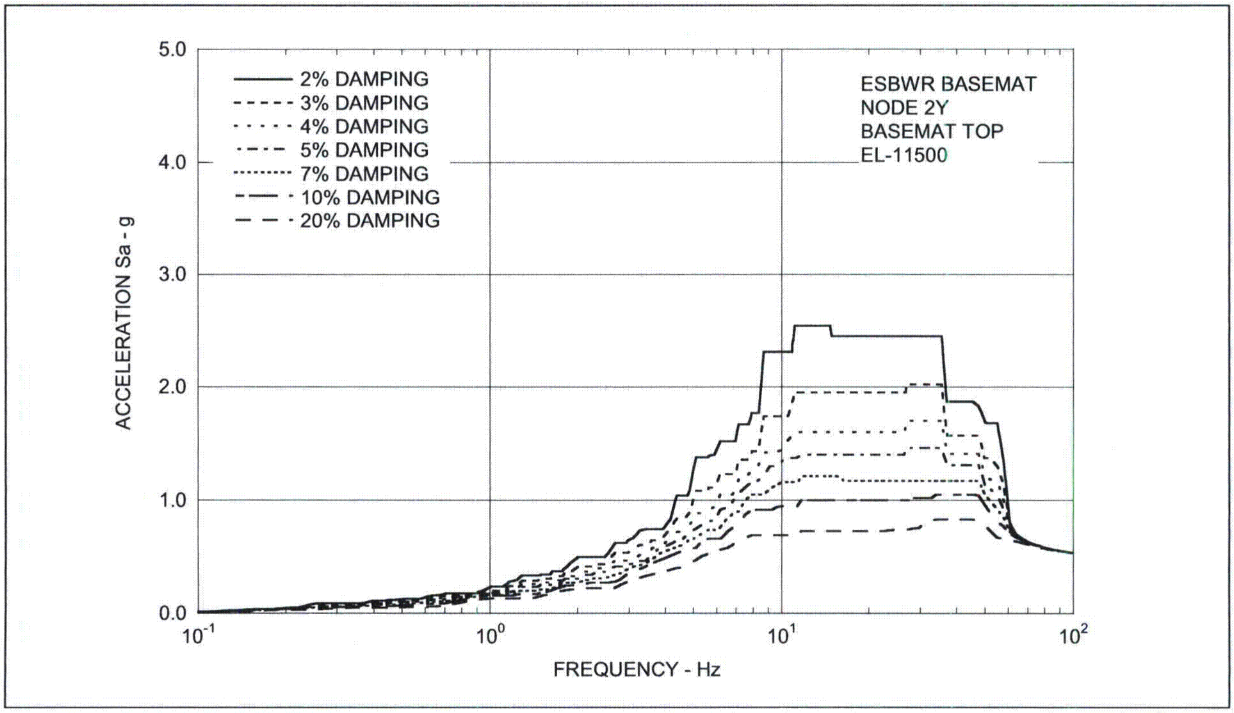


**Figure 3.7.2-241 Unit 3 Site-Specific SSE ISRS - RB/FB Refueling Floor in Z-Direction**

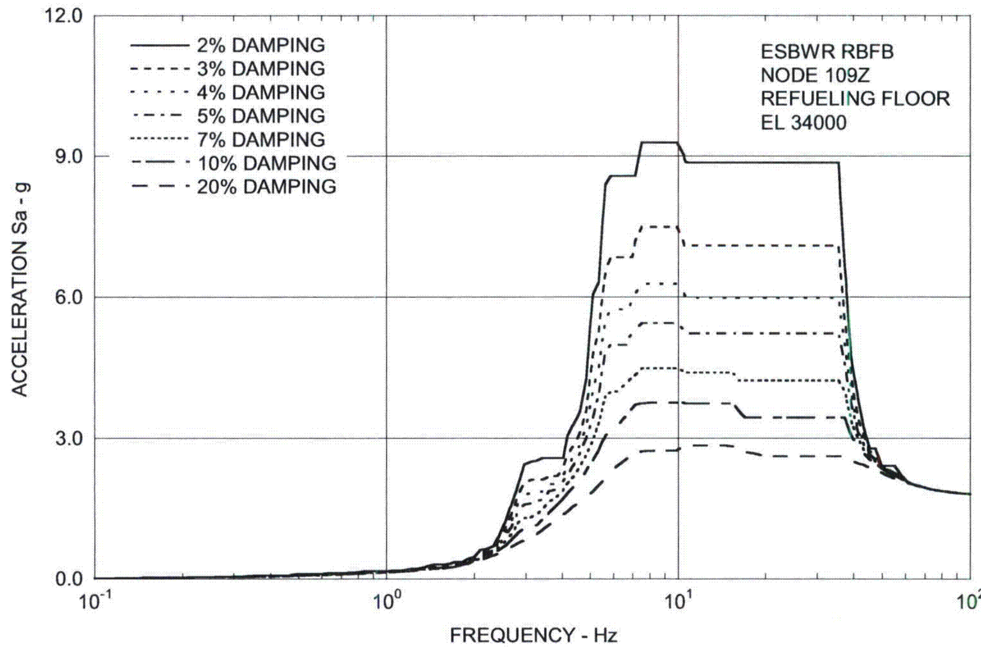


**Figure 3.7.2-242 Unit 3 Site-Specific SSE ISRS - RCCV Top Slab in Z-Direction**

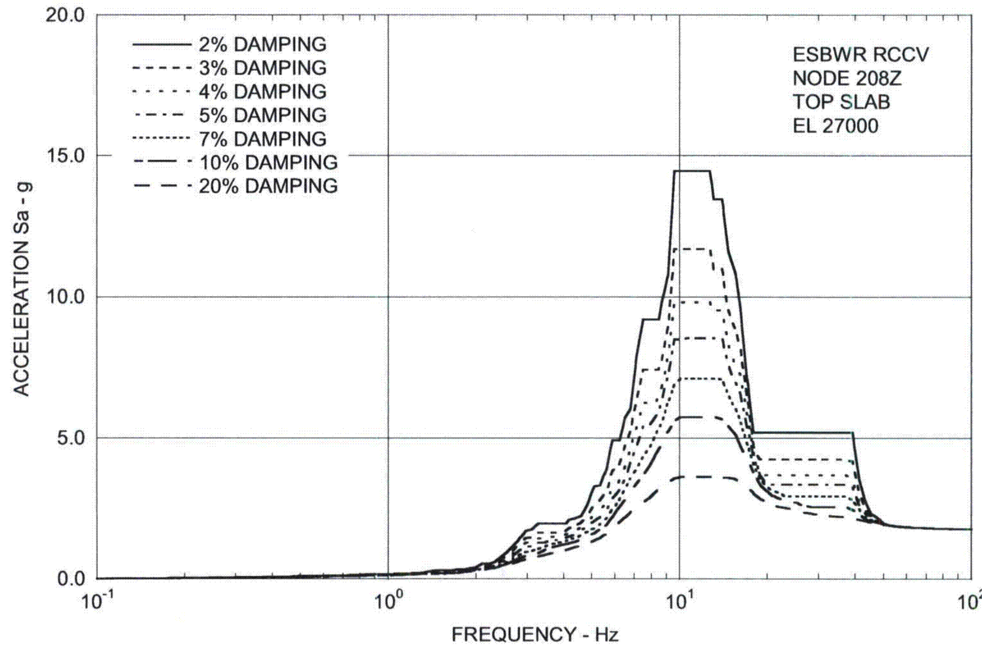


**Figure 3.7.2-243 Unit 3 Site-Specific SSE ISRS - Vent Wall Top in Z-Direction**

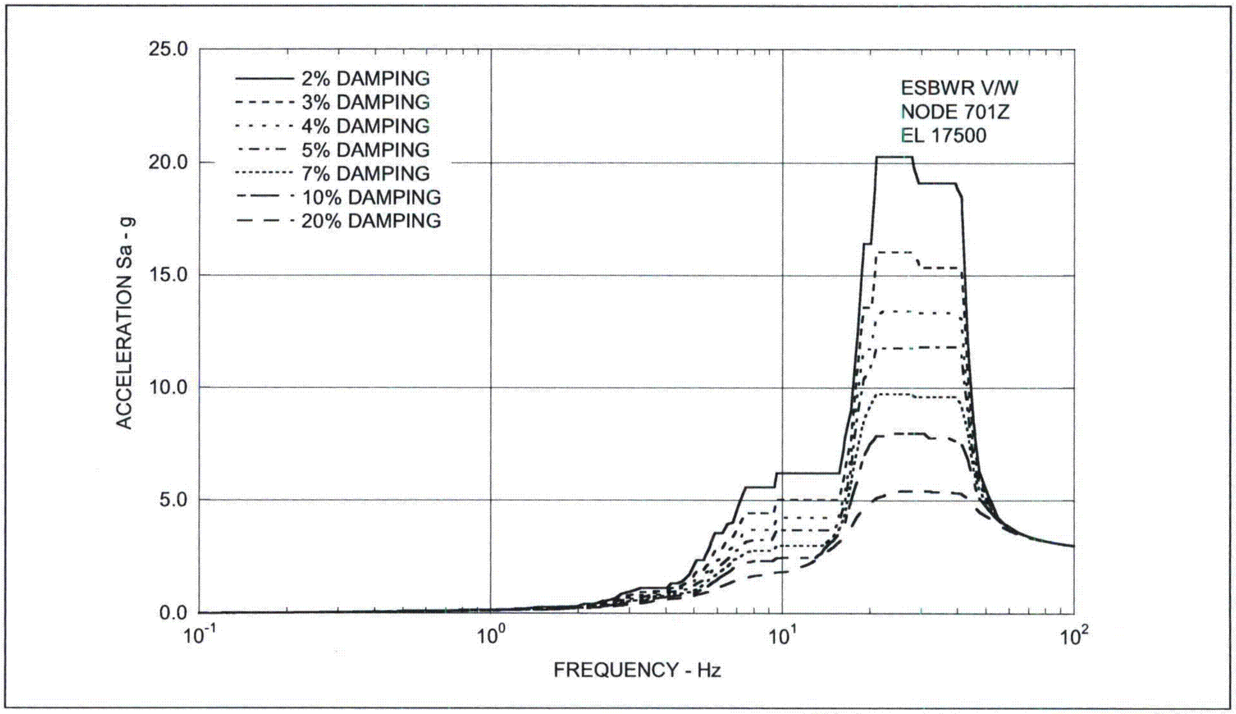


**Figure 3.7.2-244 Unit 3 Site-Specific SSE ISRS - RSW Top in Z-Direction**

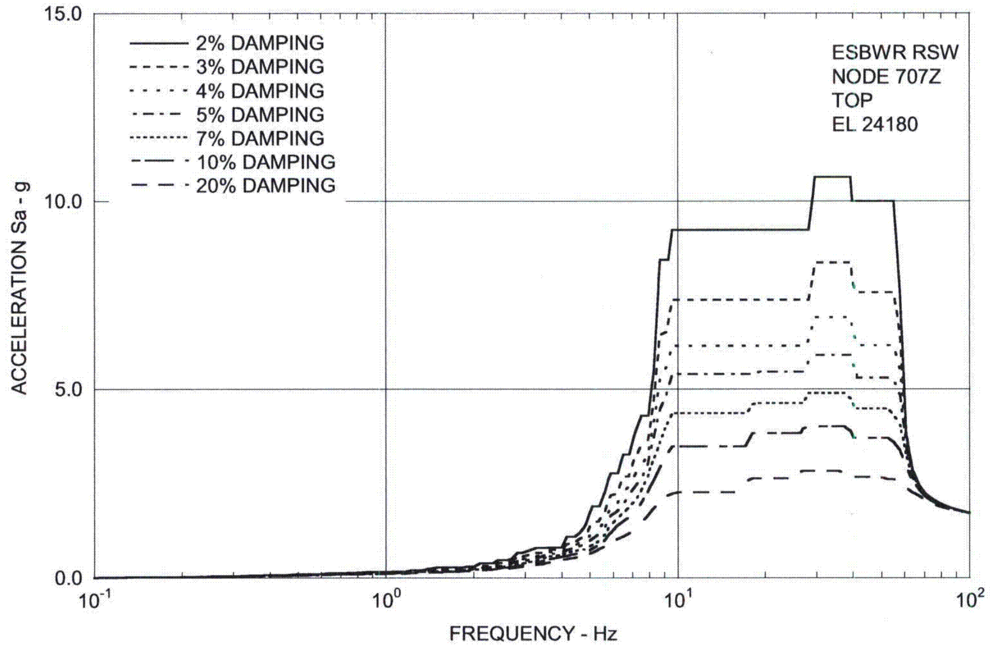


**Figure 3.7.2-245 Unit 3 Site-Specific SSE ISRS - RPV Top in Z-Direction**

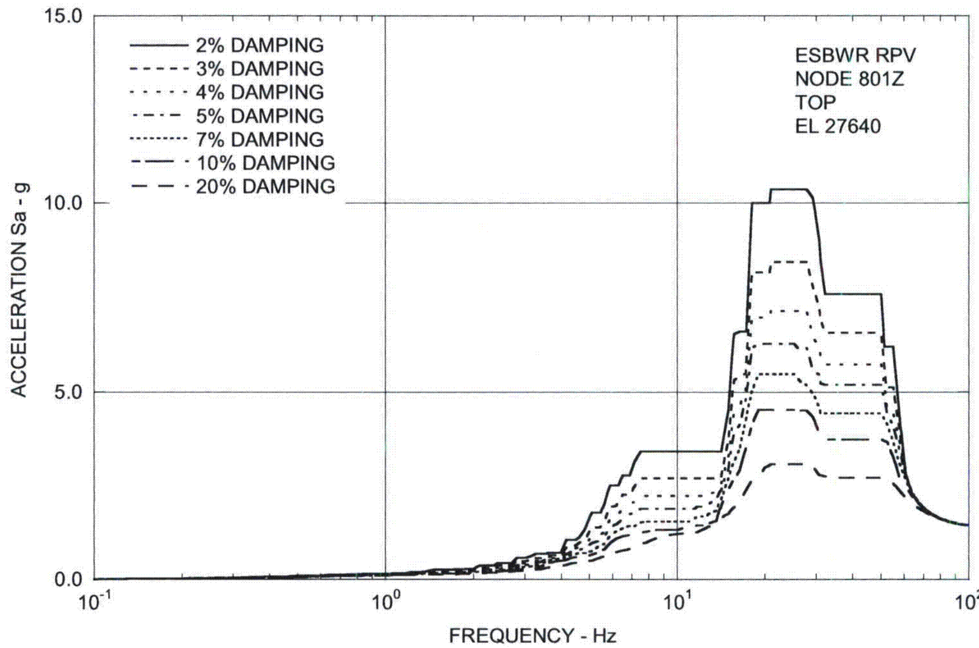


**Figure 3.7.2-246 Unit 3 Site-Specific SSE ISRS - RB/FB Basemat ~~Top~~ in Z-Direction**

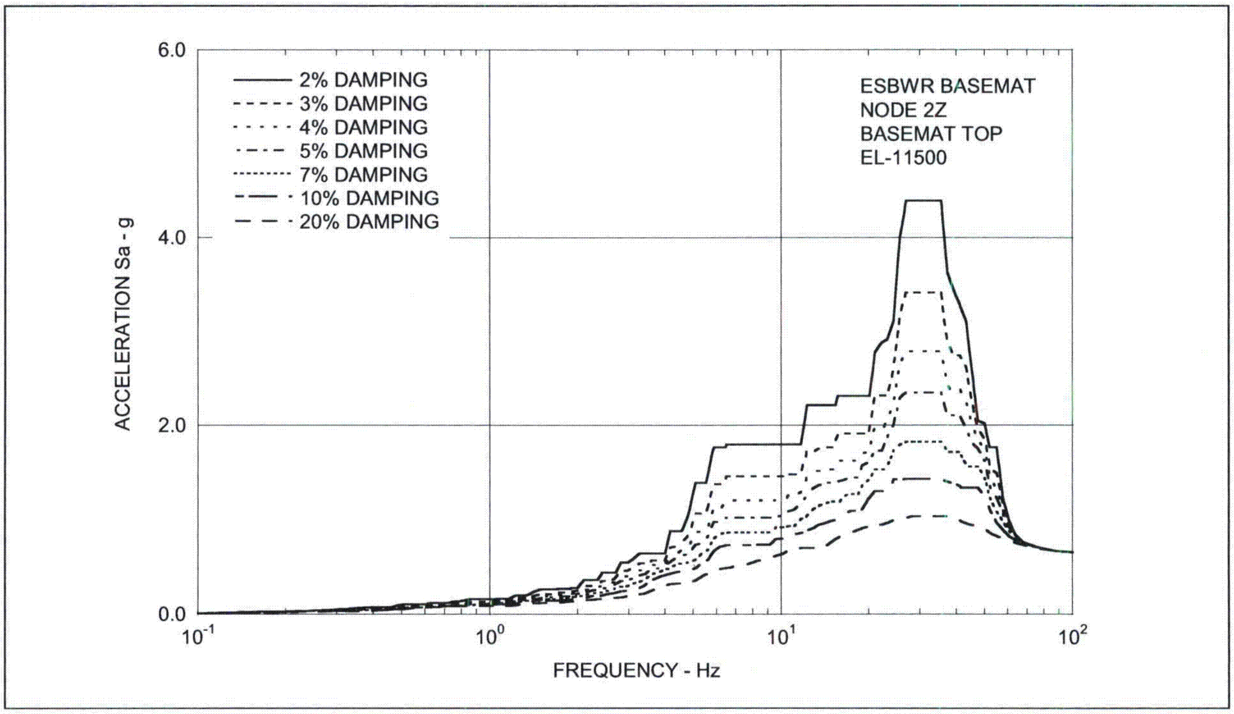


**Figure 3.7.2-247 Comparison of ISRS - CB Top in X-Direction**

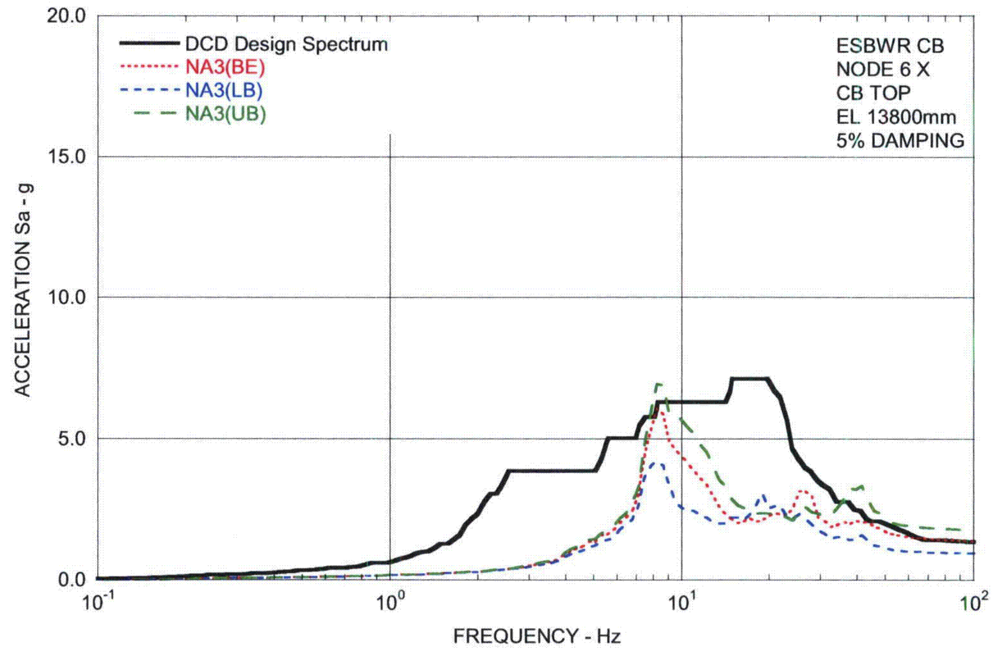



**Figure 3.7.2-248 Comparison of ISRS - CB Basemat in X-Direction**

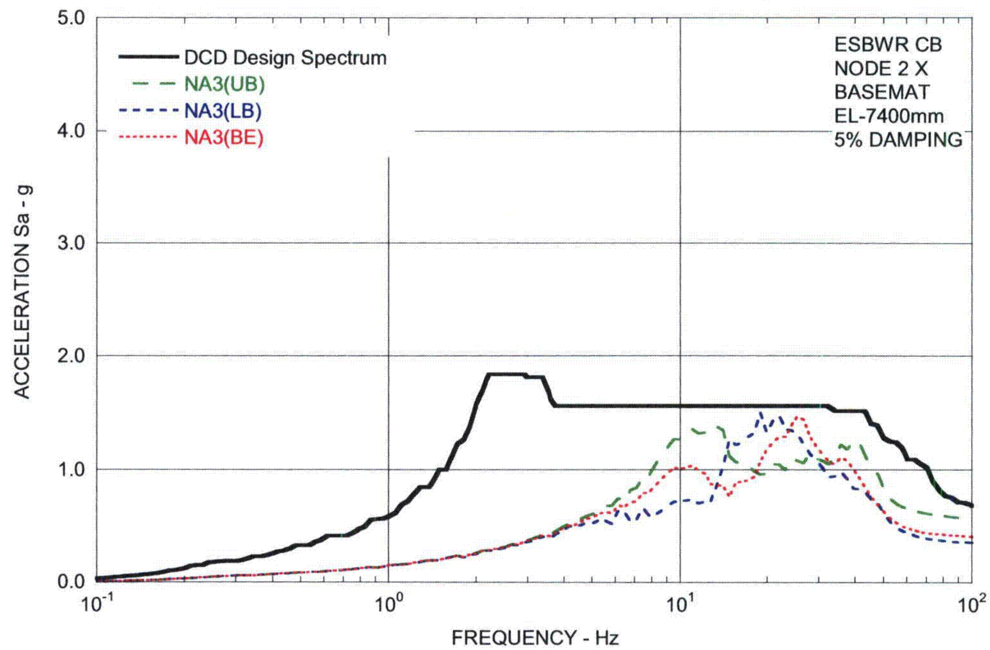


**Figure 3.7.2-249 Comparison of ISRS - CB Top in Y-Direction**

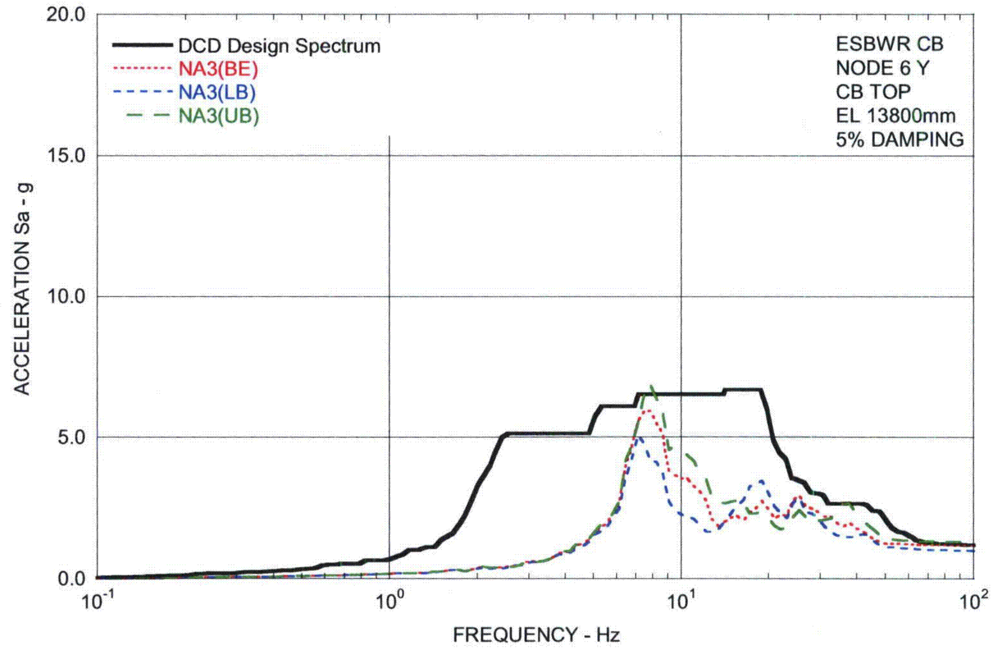



**Figure 3.7.2-250 Comparison of ISRS - CB Basemat in Y-Direction**

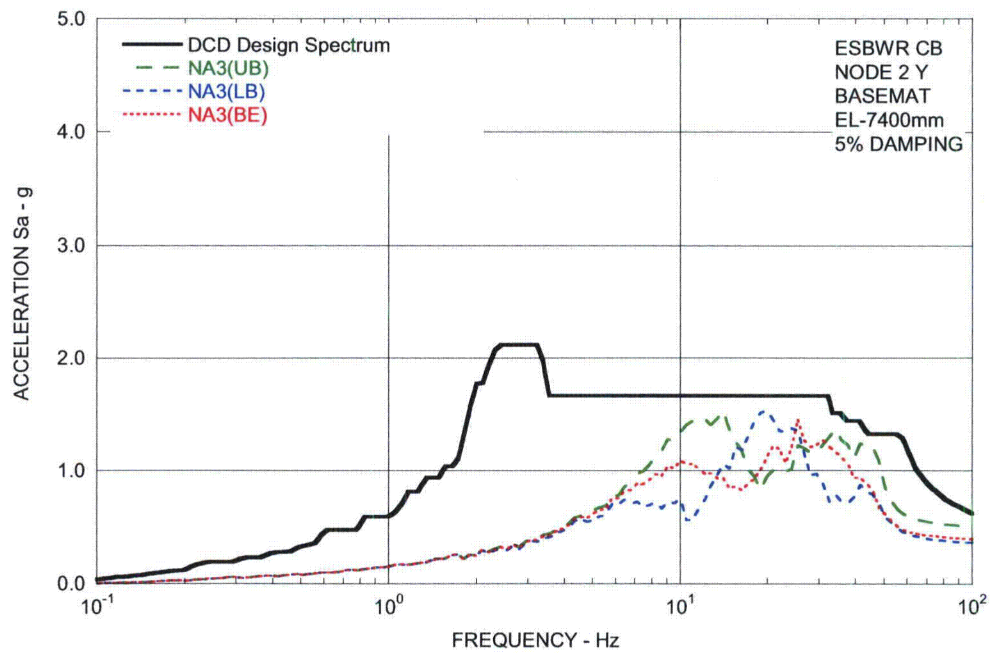


**Figure 3.7.2-251 Comparison of ISRS - CB Top in Z-Direction**

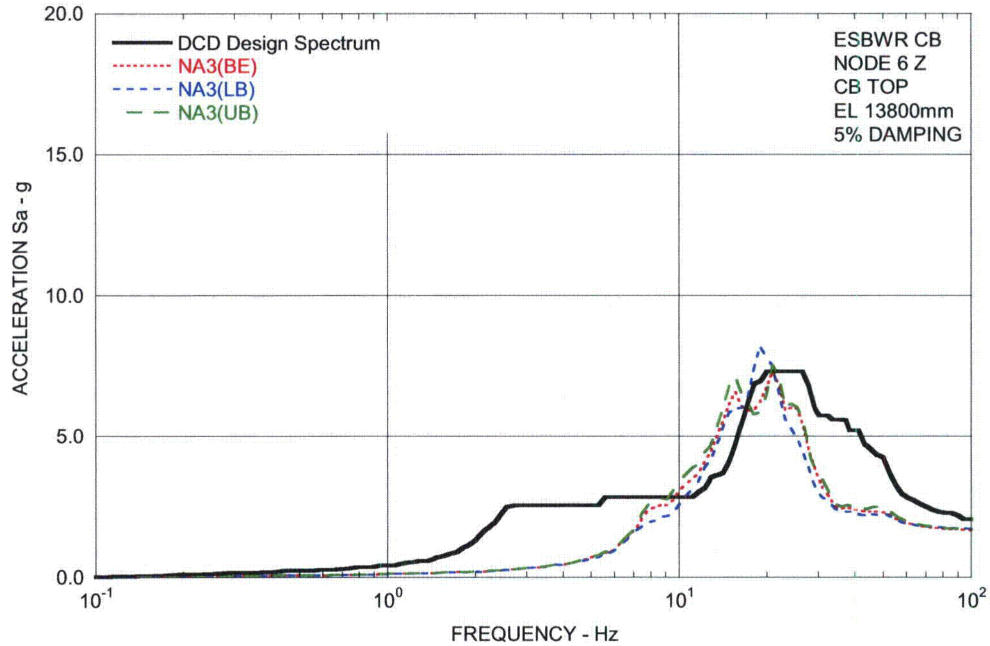



**Figure 3.7.2-252 Comparison of ISRS - CB Basemat in Z-Direction**

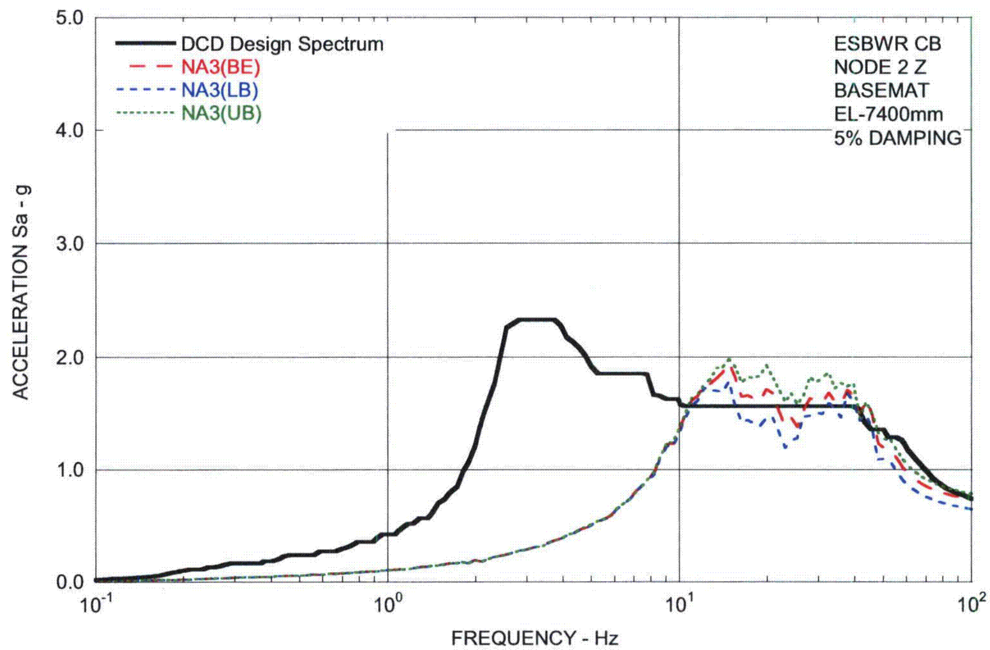


**Figure 3.7.2-253 Unit 3 Site-Specific SSE ISRS - CB Top in X-Direction**

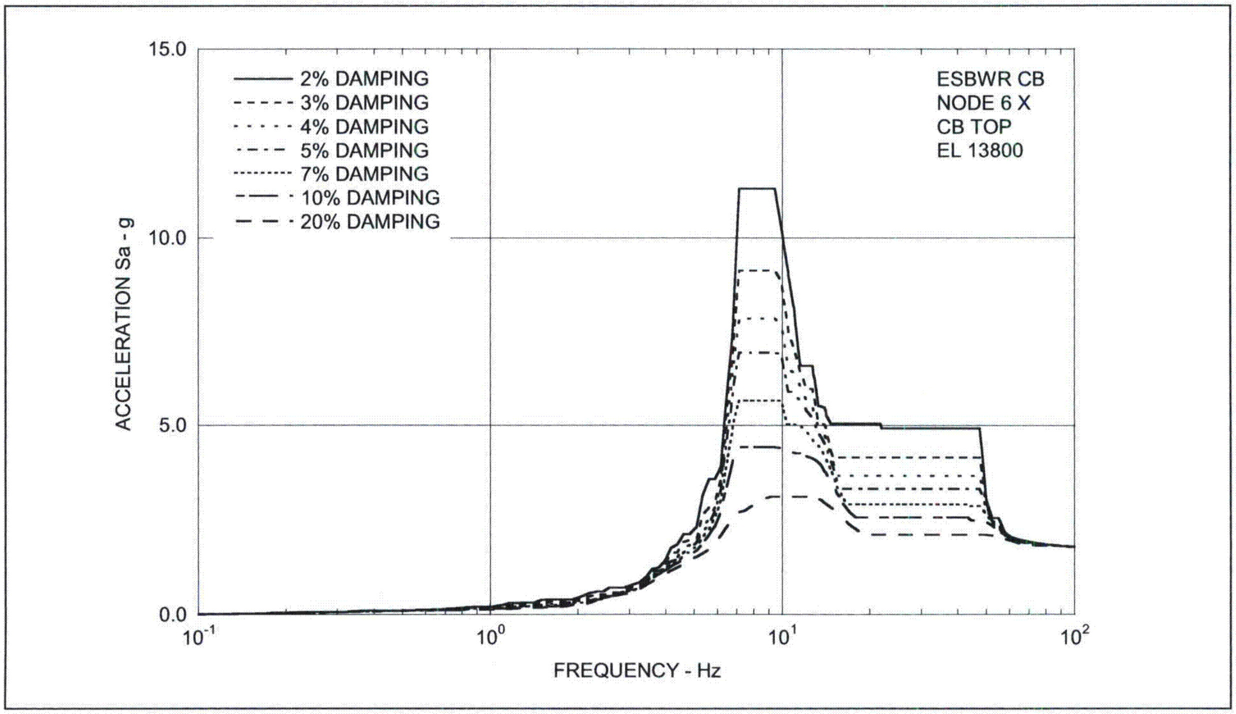



**Figure 3.7.2-254 Unit 3 Site-Specific SSE ISRS - CB Basemat in X-Direction**

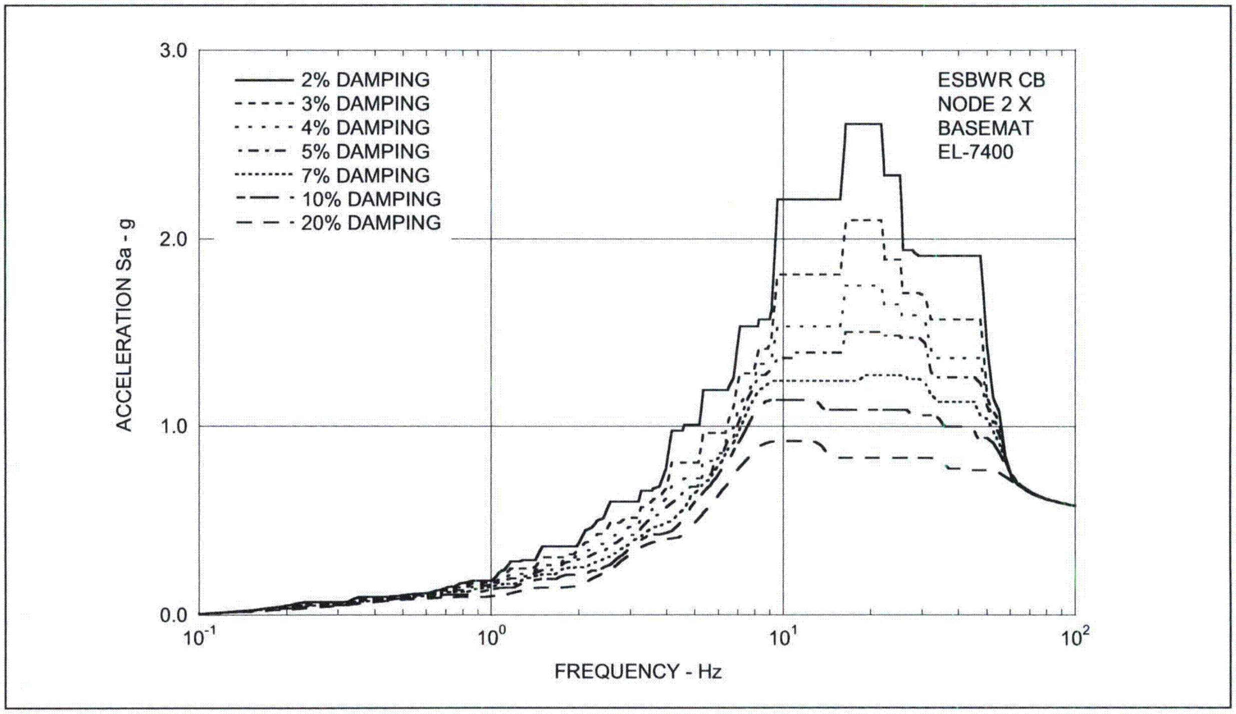


**Figure 3.7.2-255 Unit 3 Site-Specific SSE ISRS - CB Top in Y-Direction**

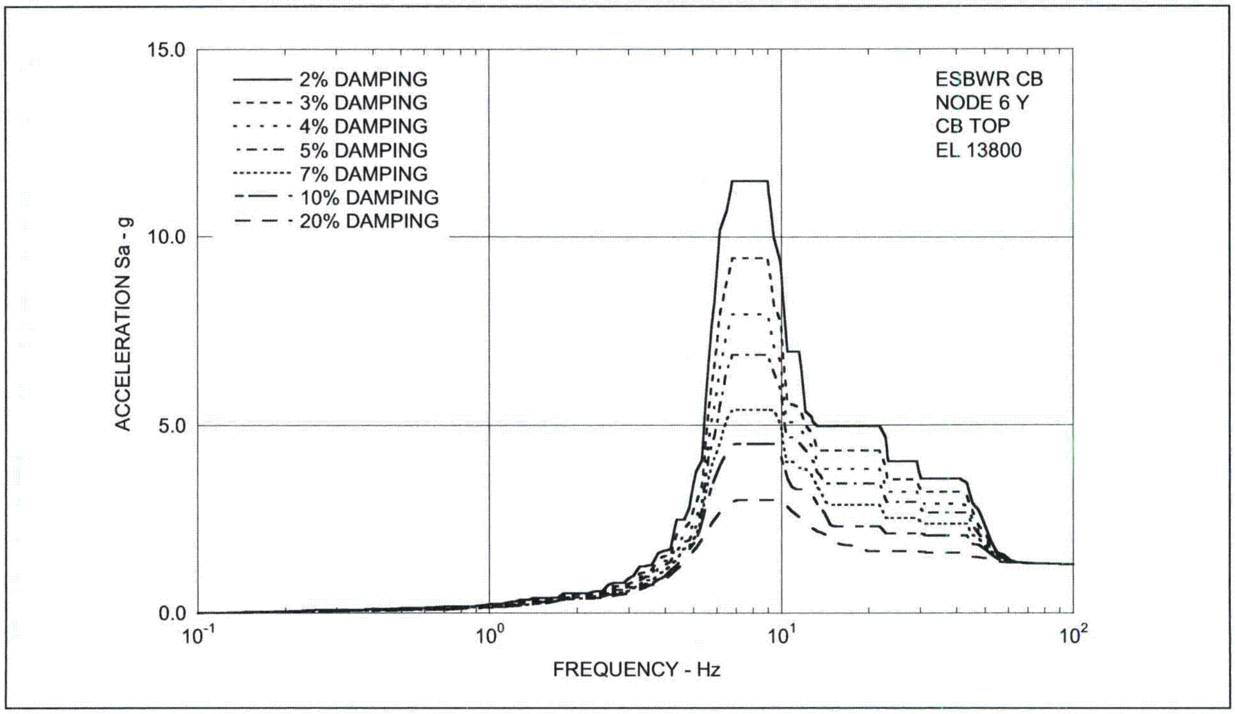



**Figure 3.7.2-256 Unit 3 Site-Specific SSE ISRS - CB Basemat in Y-Direction**

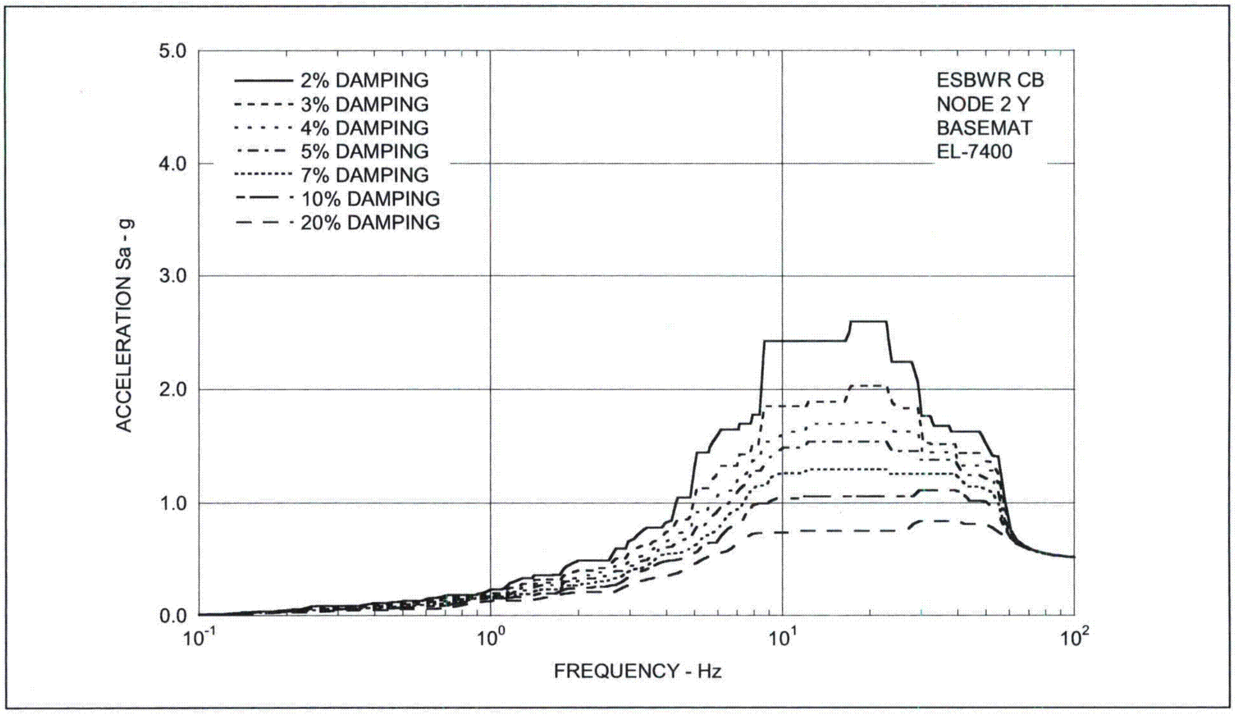


**Figure 3.7.2-257 Unit 3 Site-Specific SSE ISRS - CB Top in Z-Direction**

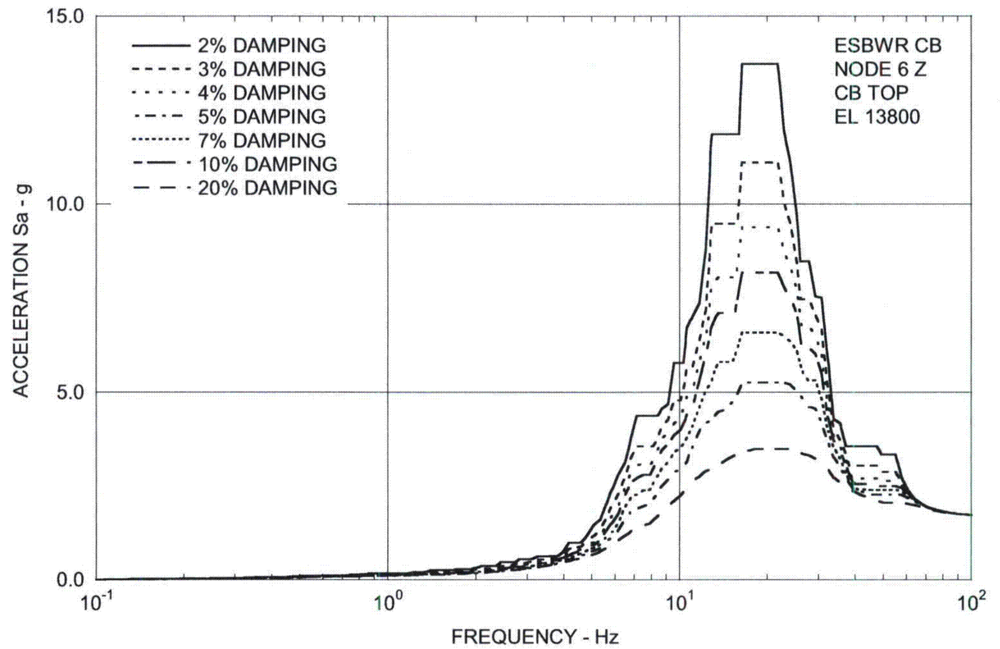



**Figure 3.7.2-258 Unit 3 Site-Specific SSE ISRS - CB Basemat in Z-Direction**

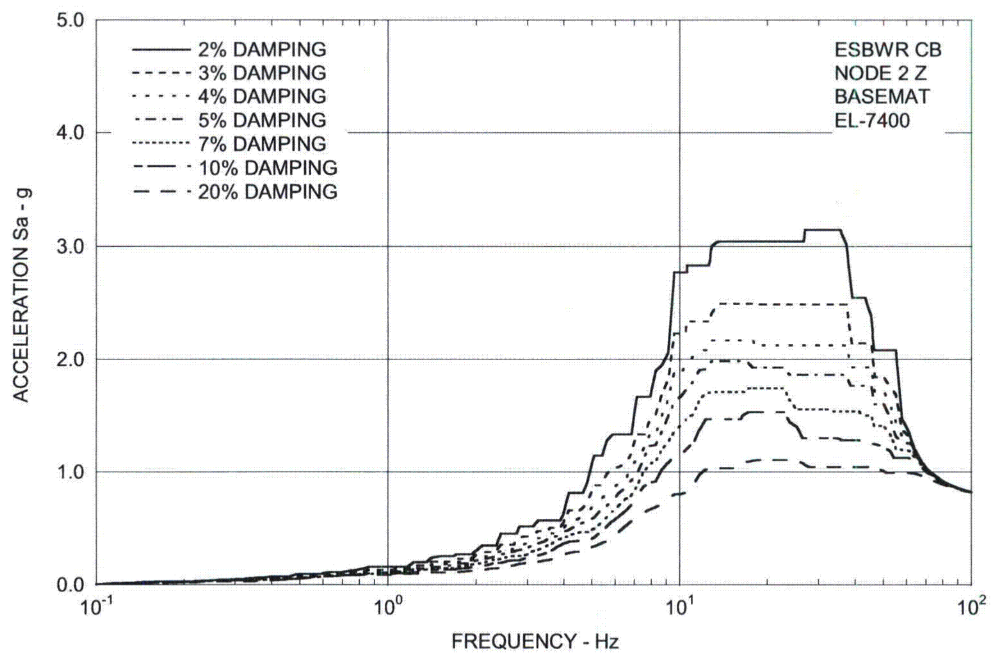


**Figure 3.7.2-259 Comparison of ISRS - FWS Wall Top in X-Direction**

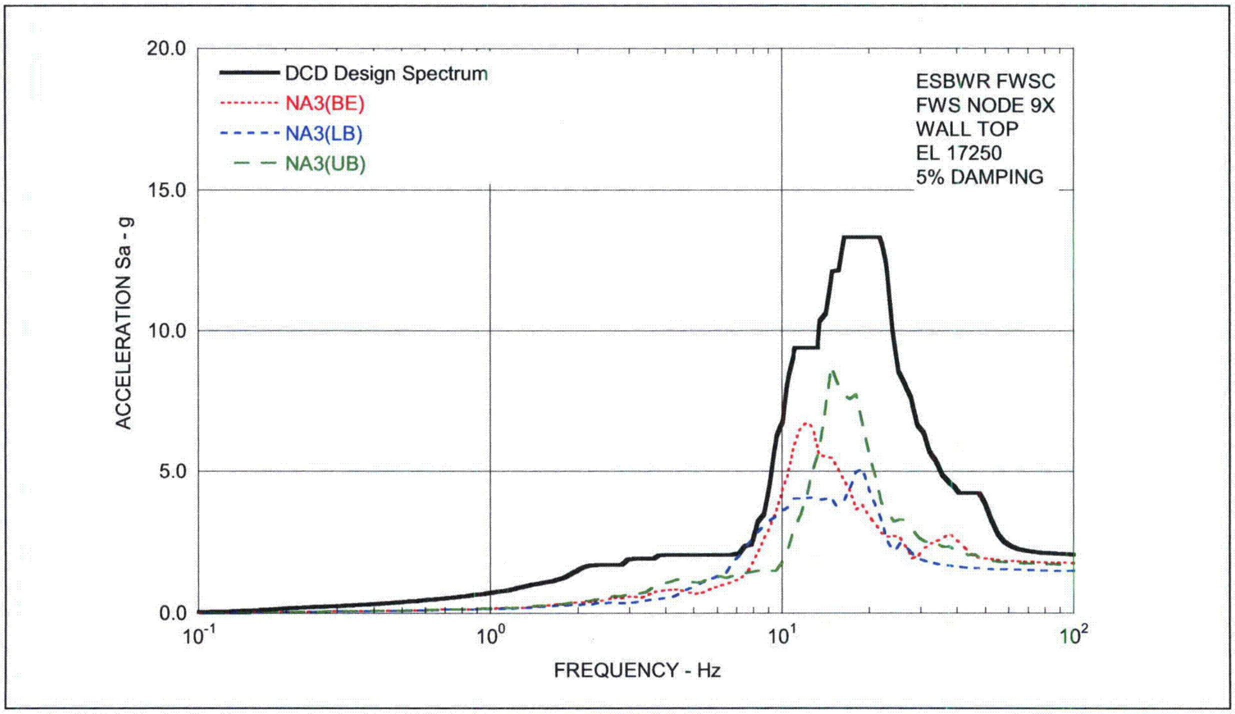



**Figure 3.7.2-260 Comparison of ISRS - FWS Basemat in X-Direction**

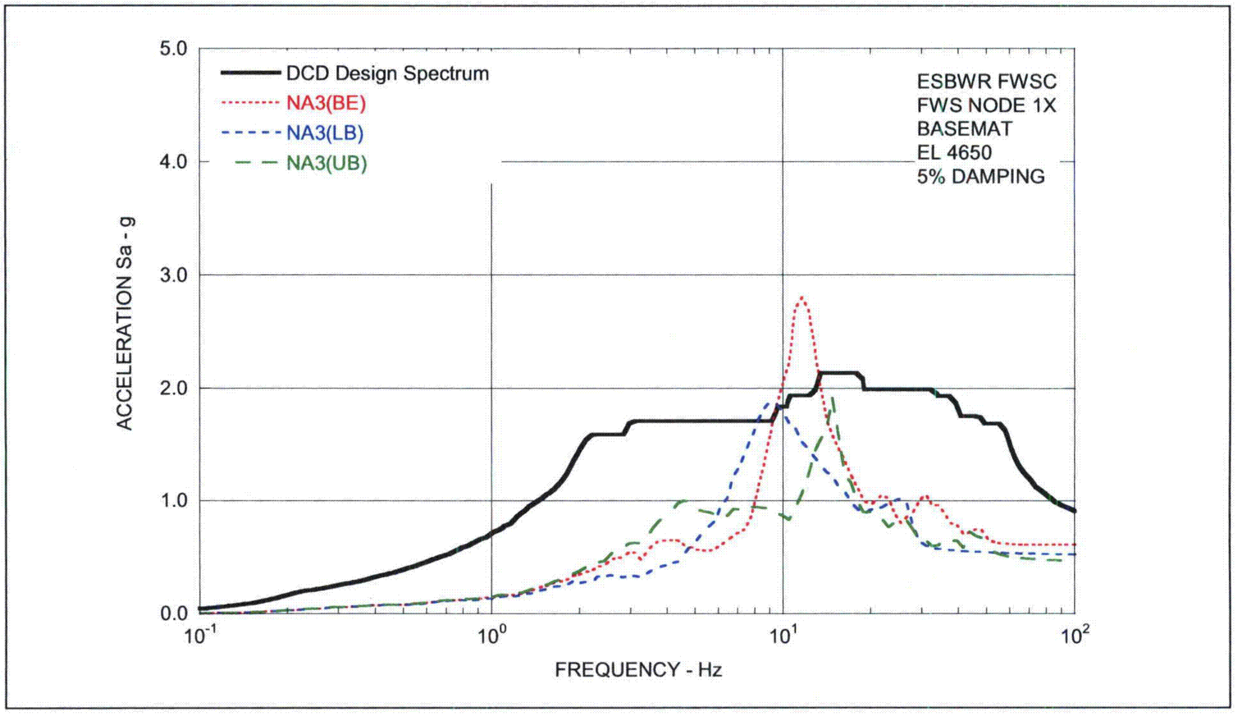


**Figure 3.7.2-261 Comparison of ISRS - FPE Top in X-Direction**

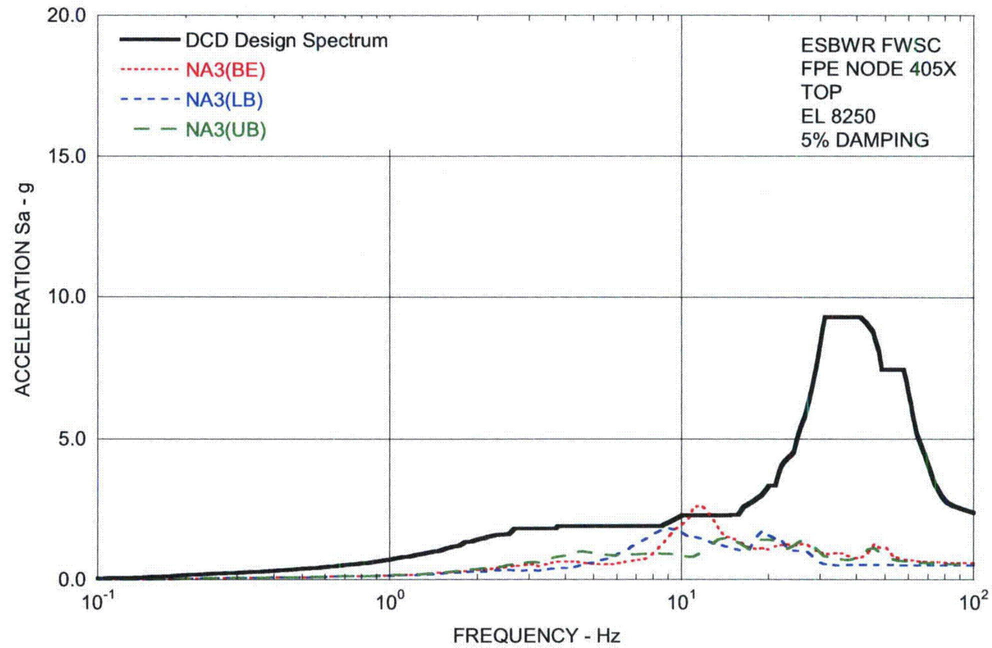



**Figure 3.7.2-262 Comparison of ISRS - FPE Basemat in X-Direction**

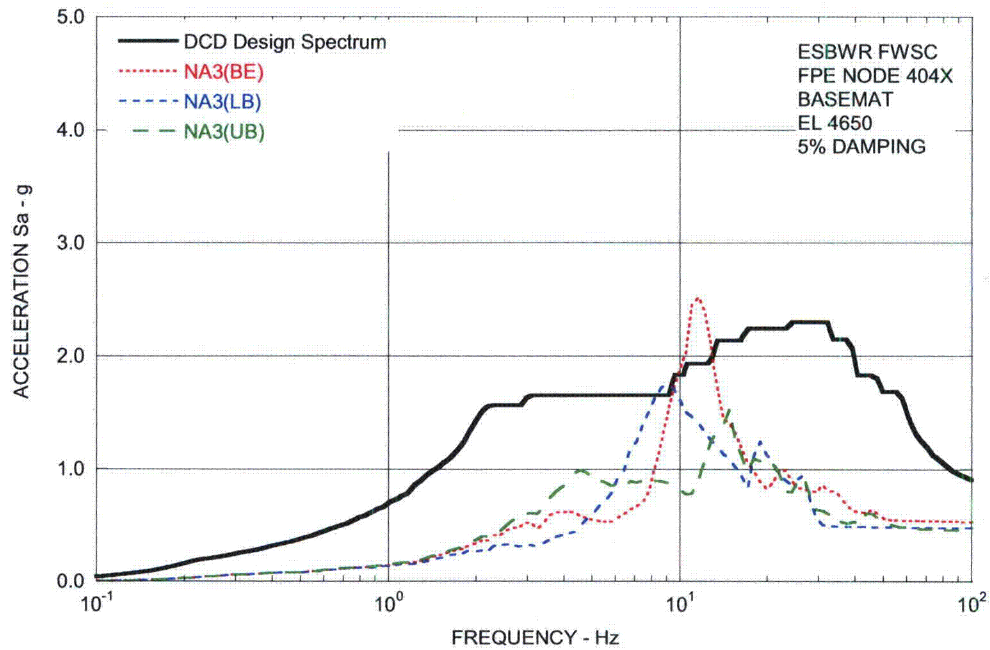


**Figure 3.7.2-263 Comparison of ISRS - FWS Wall Top in Y-Direction**

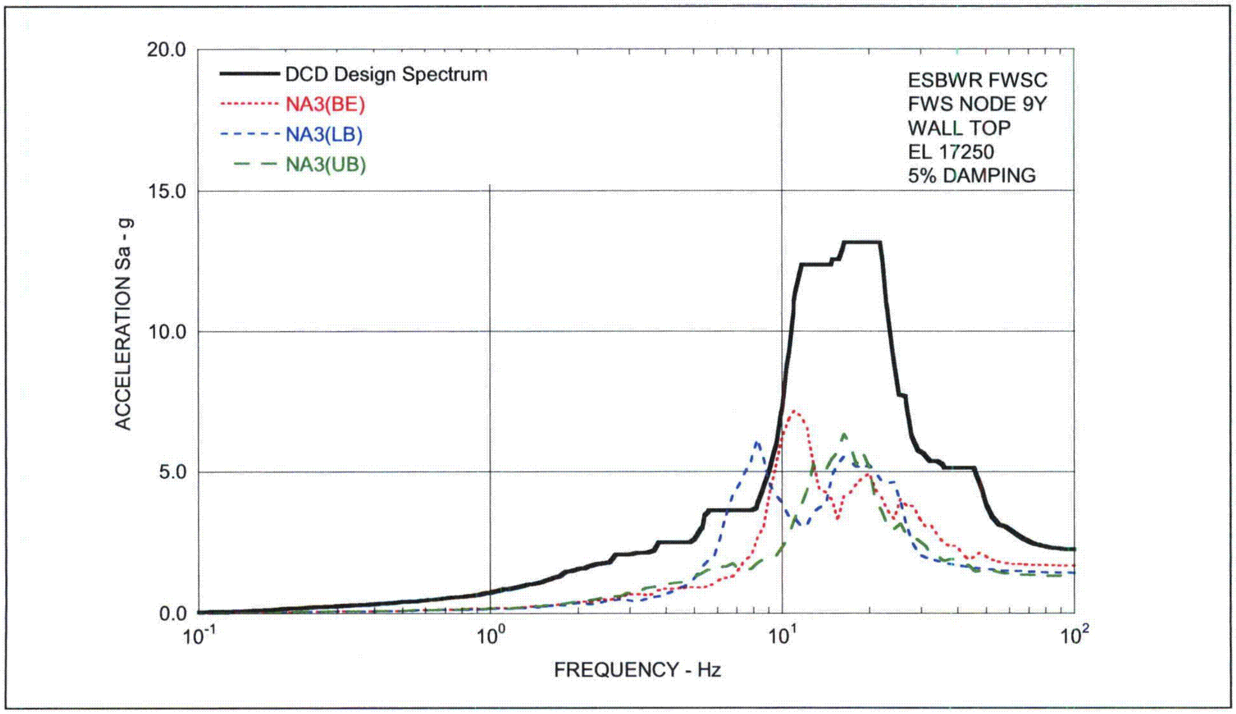



**Figure 3.7.2-264 Comparison of ISRS - FWS Basemat in Y -Direction**

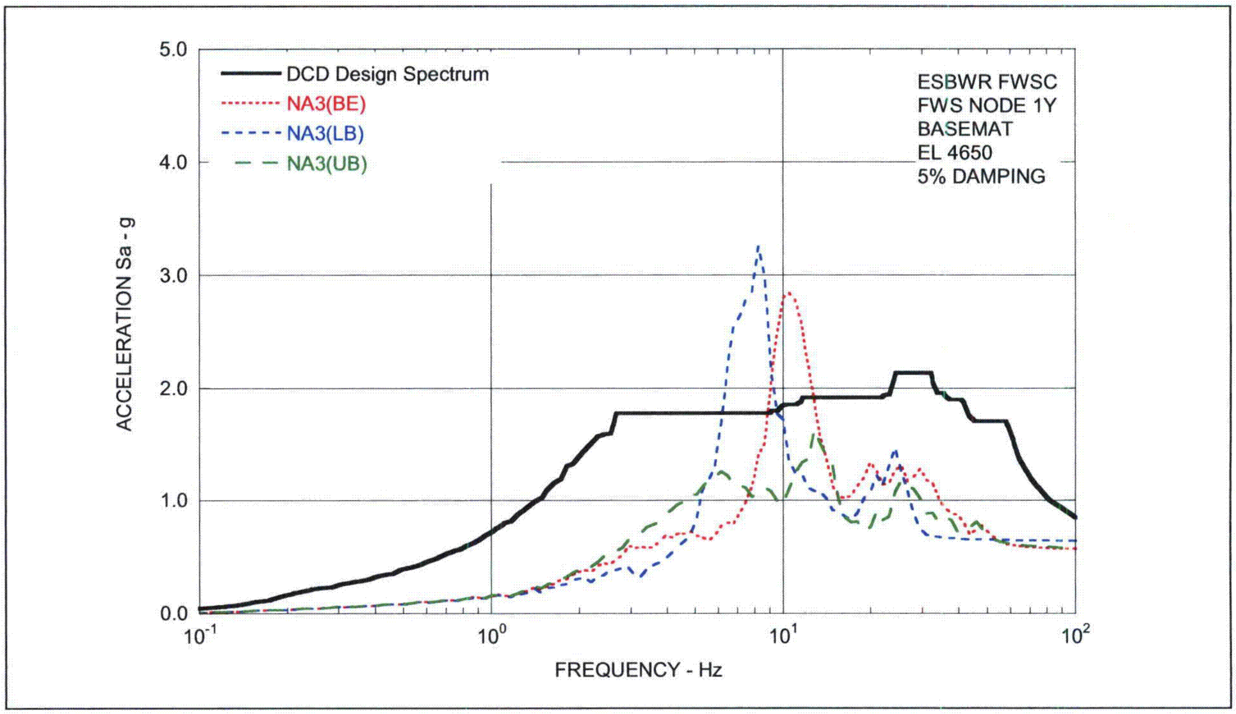


**Figure 3.7.2-265 Comparison of ISRS - FPE Top in Y -Direction**

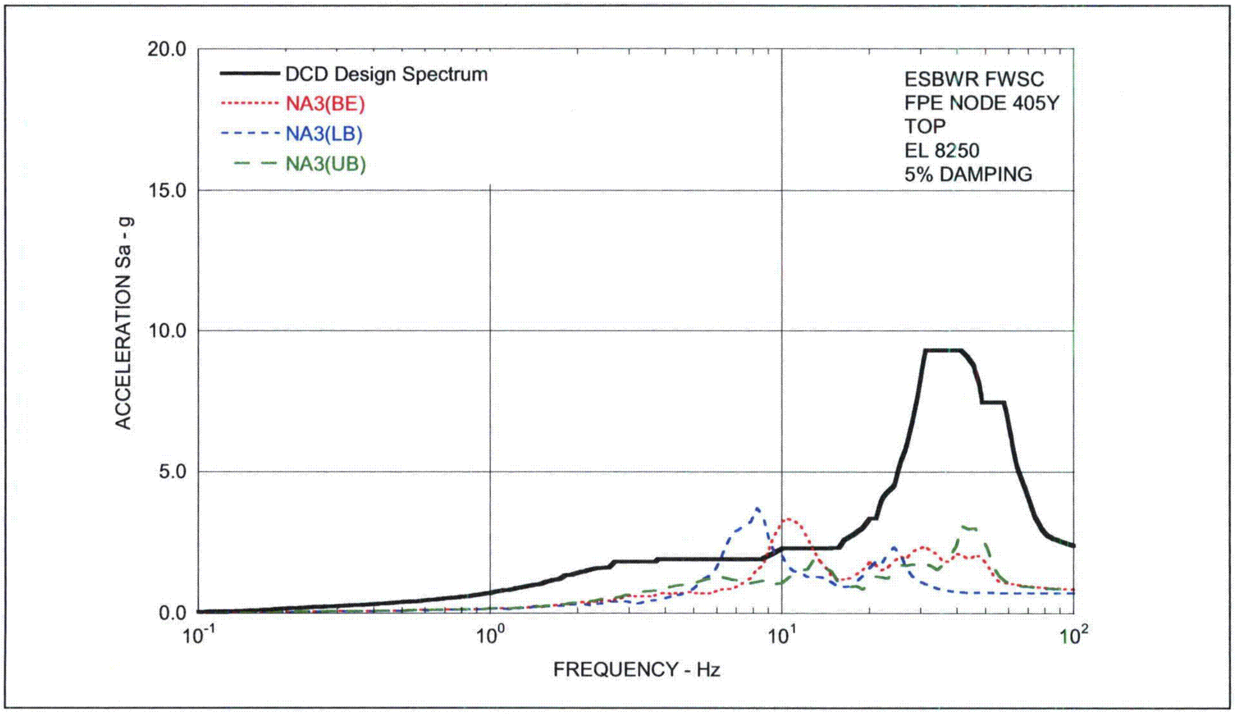



**Figure 3.7.2-266 Comparison of ISRS - FPE Basemat in Y -Direction**

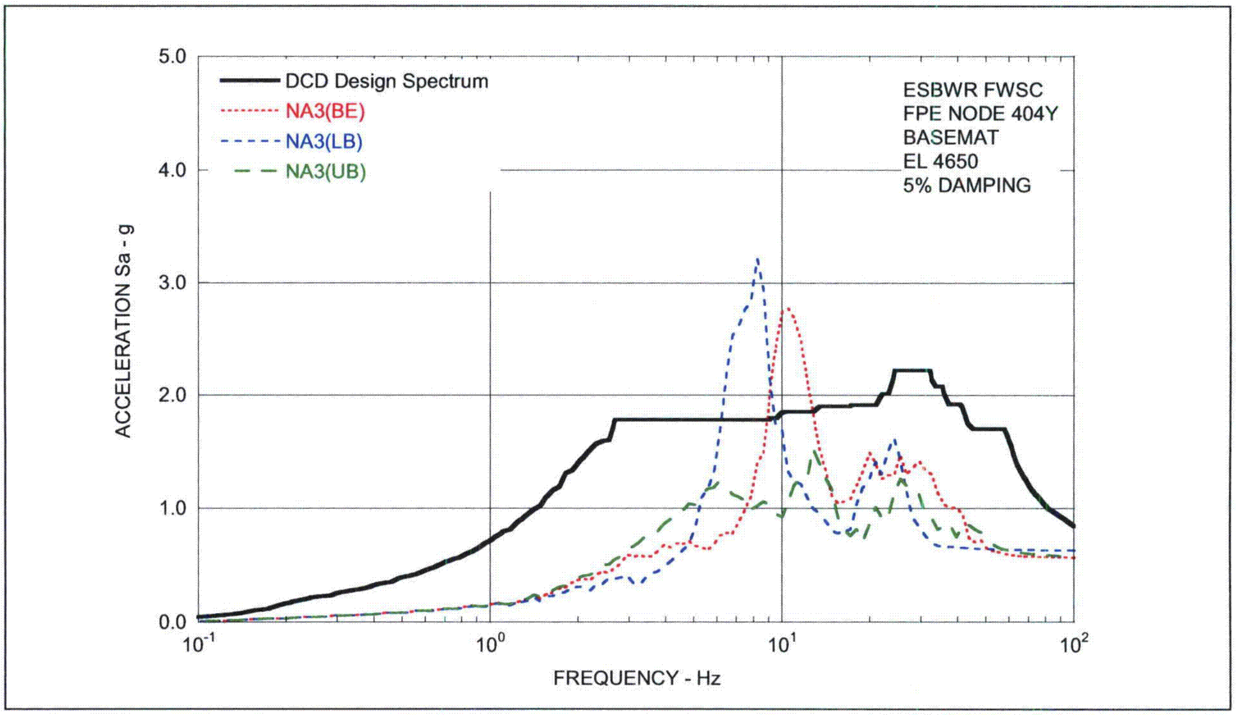


**Figure 3.7.2-267 Comparison of ISRS - FWS Wall Top in Z-Direction**

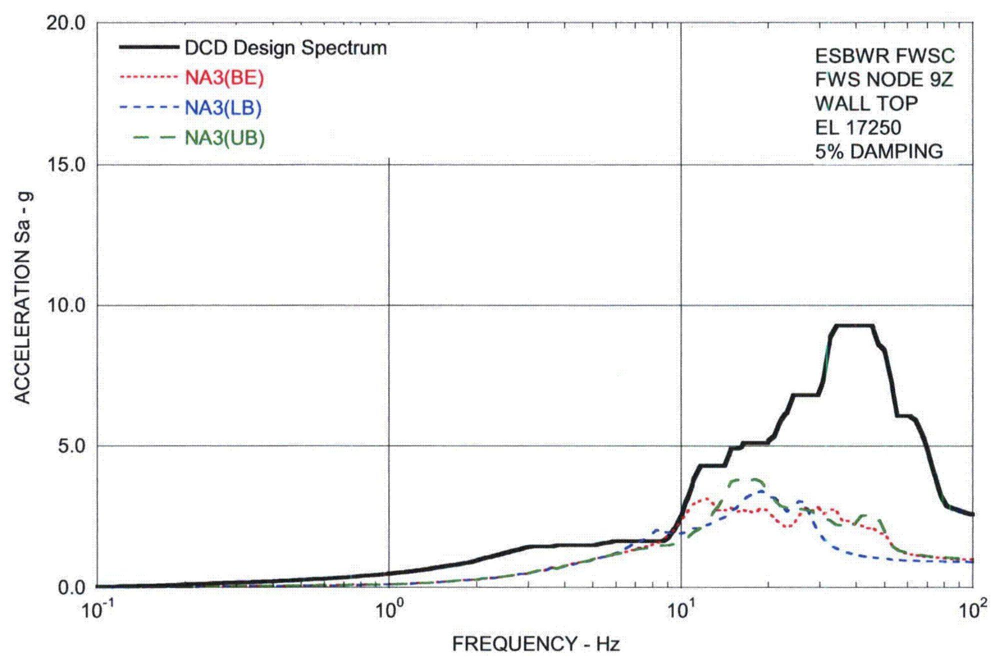



**Figure 3.7.2-268 Comparison of ISRS - FWS Basemat in Z-Direction**

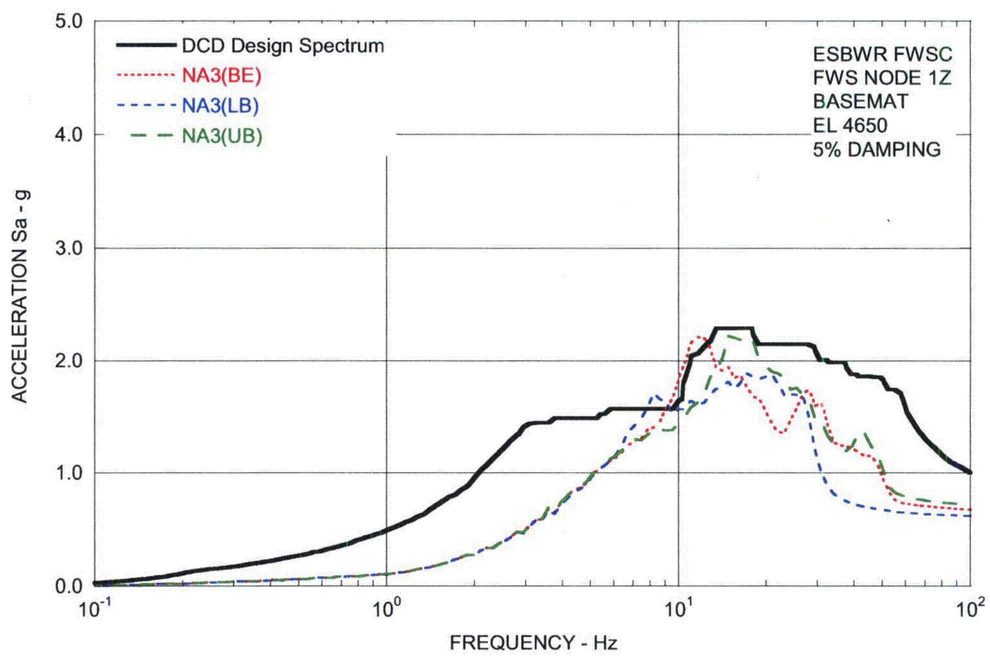


**Figure 3.7.2-269 Comparison of ISRS - FPE Top in Z-Direction**

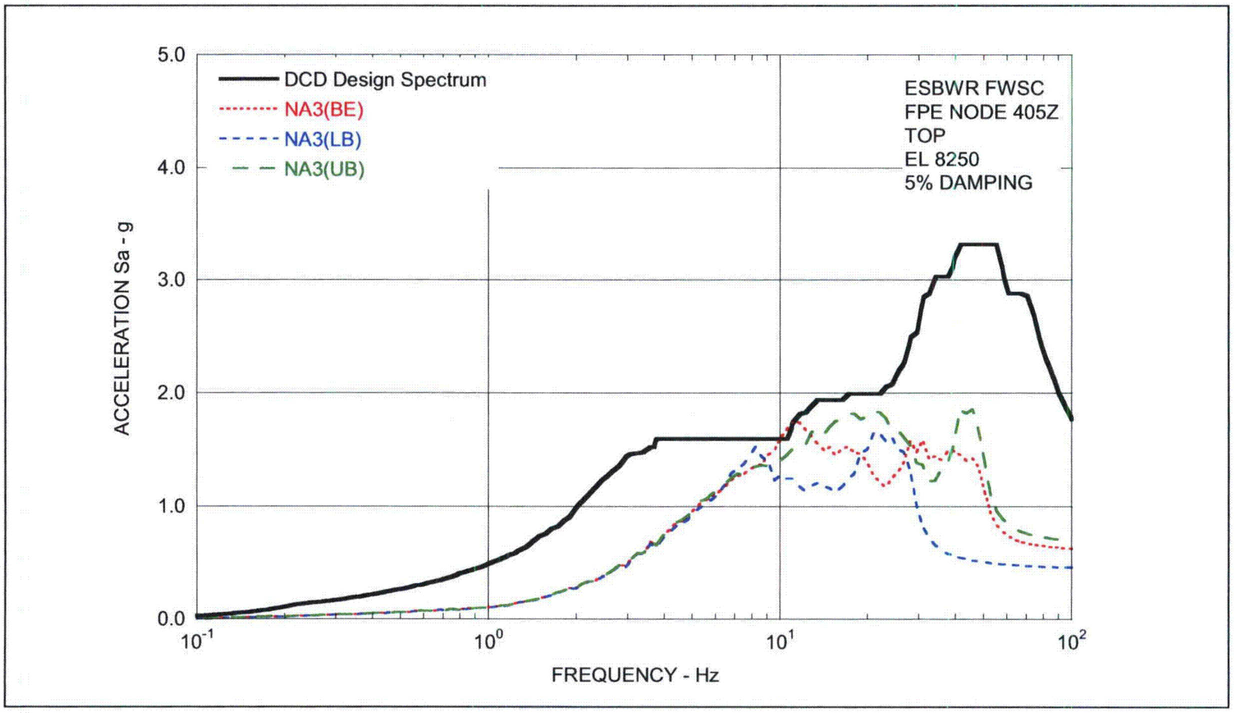



**Figure 3.7.2-270 Comparison of ISRS - FPE Basemat in Z-Direction**

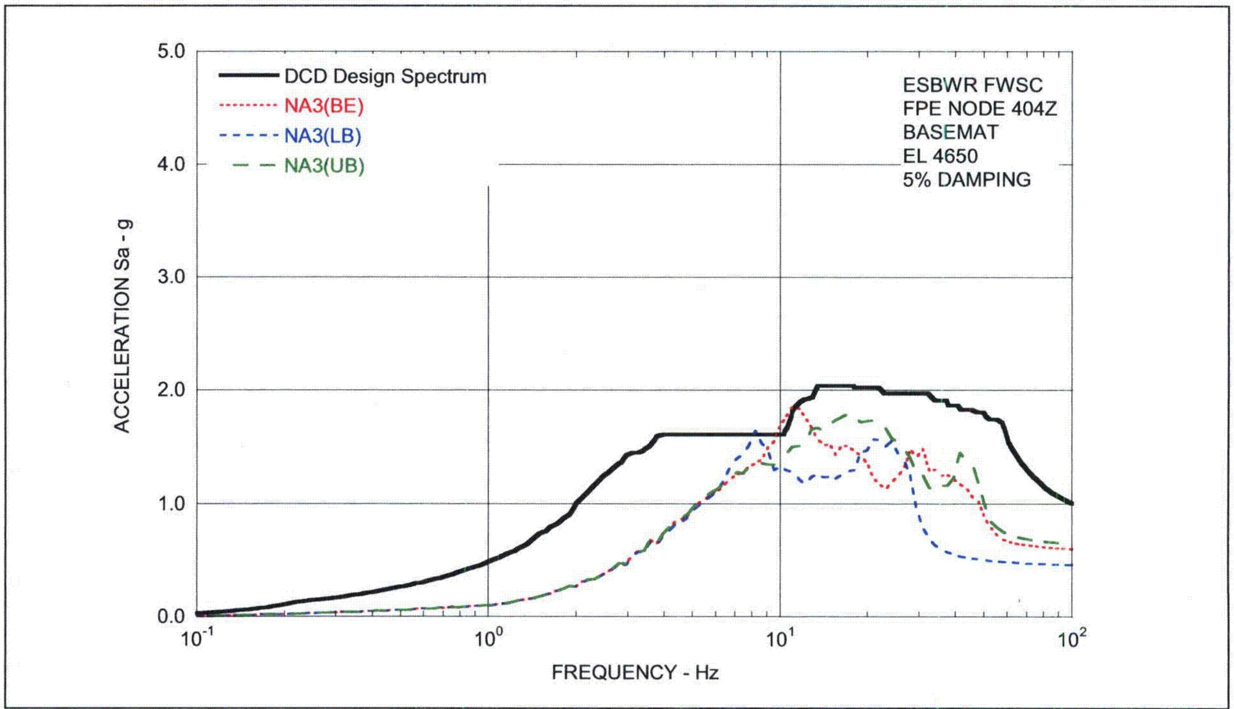


**Figure 3.7.2-271 Unit 3 Site-Specific SSE ISRS - FWS Wall Top in X-Direction**

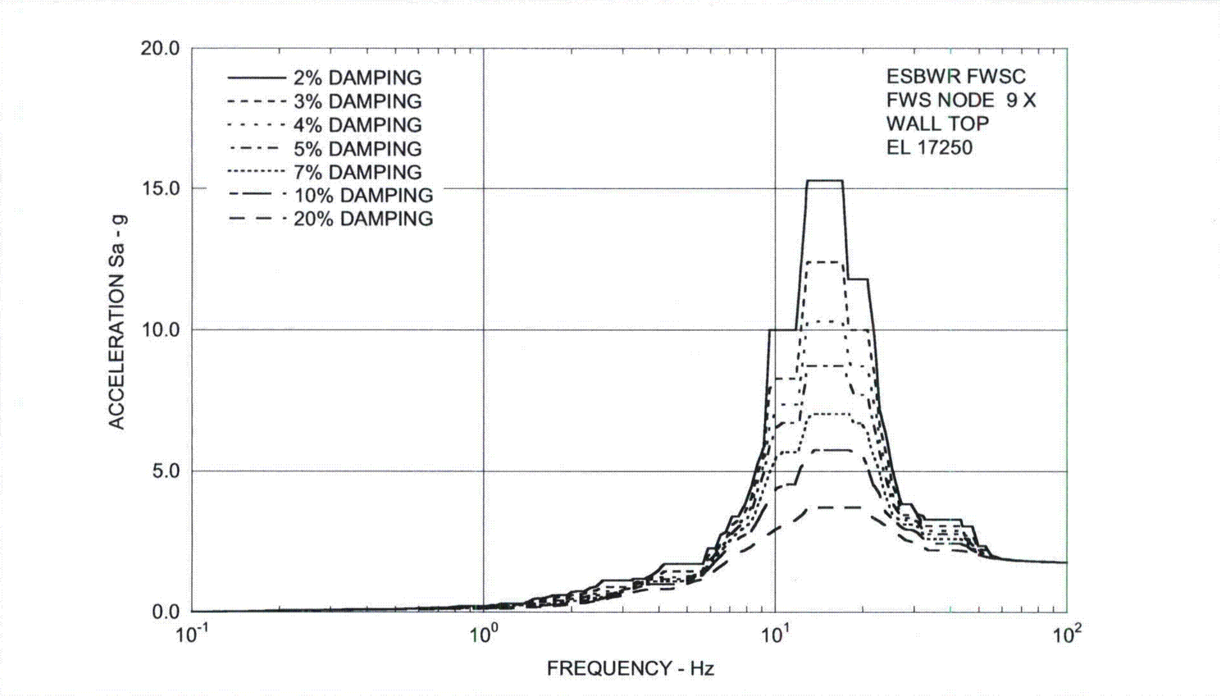


**Figure 3.7.2-272 Unit 3 Site-Specific SSE ISRS - FWS Basemat in X-Direction**

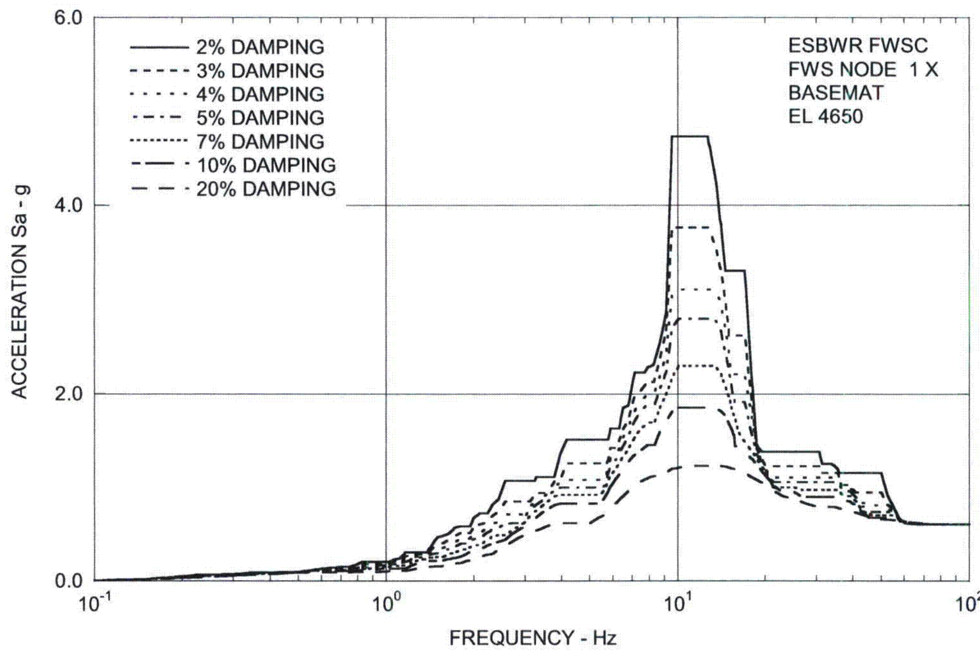


**Figure 3.7.2-273 Unit 3 Site-Specific SSE ISRS - FPE Top in X-Direction**

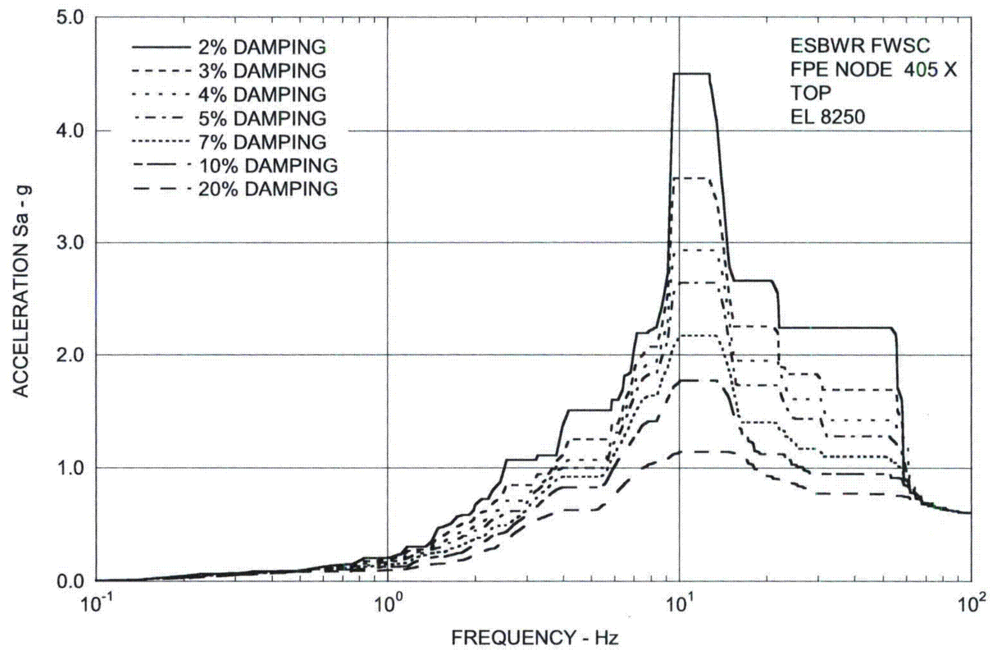


**Figure 3.7.2-274 Unit 3 Site-Specific SSE ISRS - FPE Basemat in X-Direction**

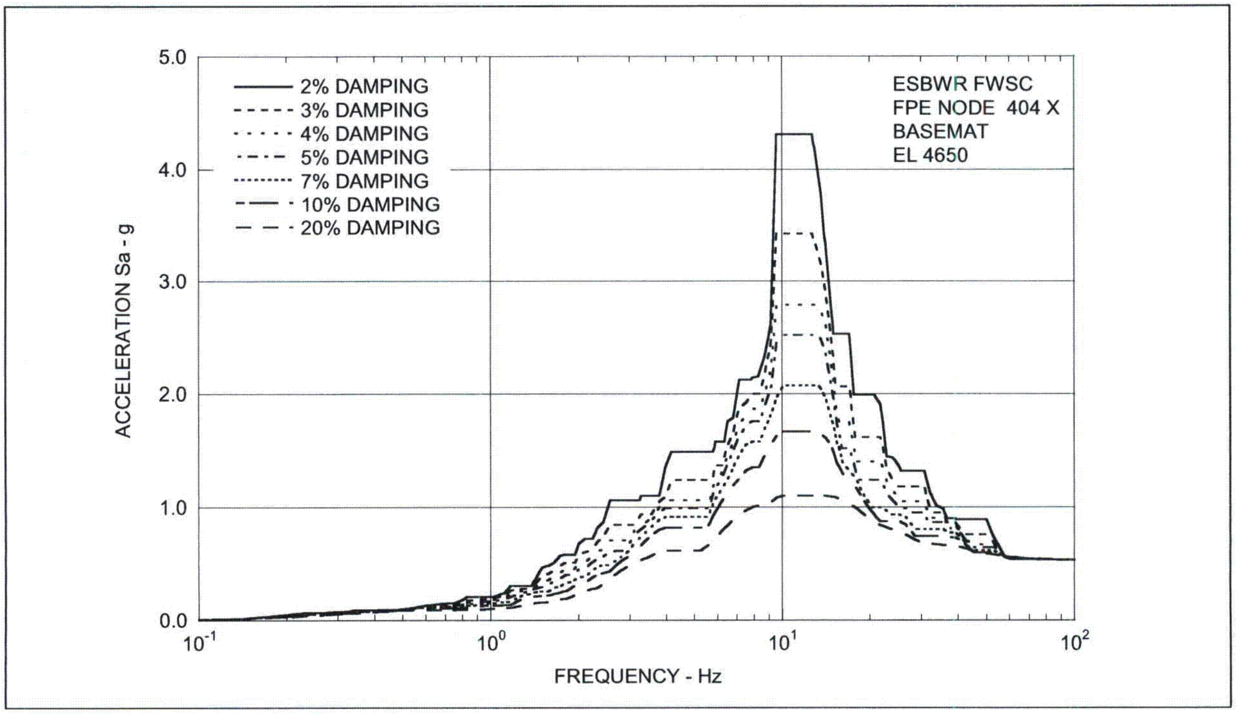


**Figure 3.7.2-275 Unit 3 Site-Specific SSE ISRS - FWS Wall Top in Y-Direction**

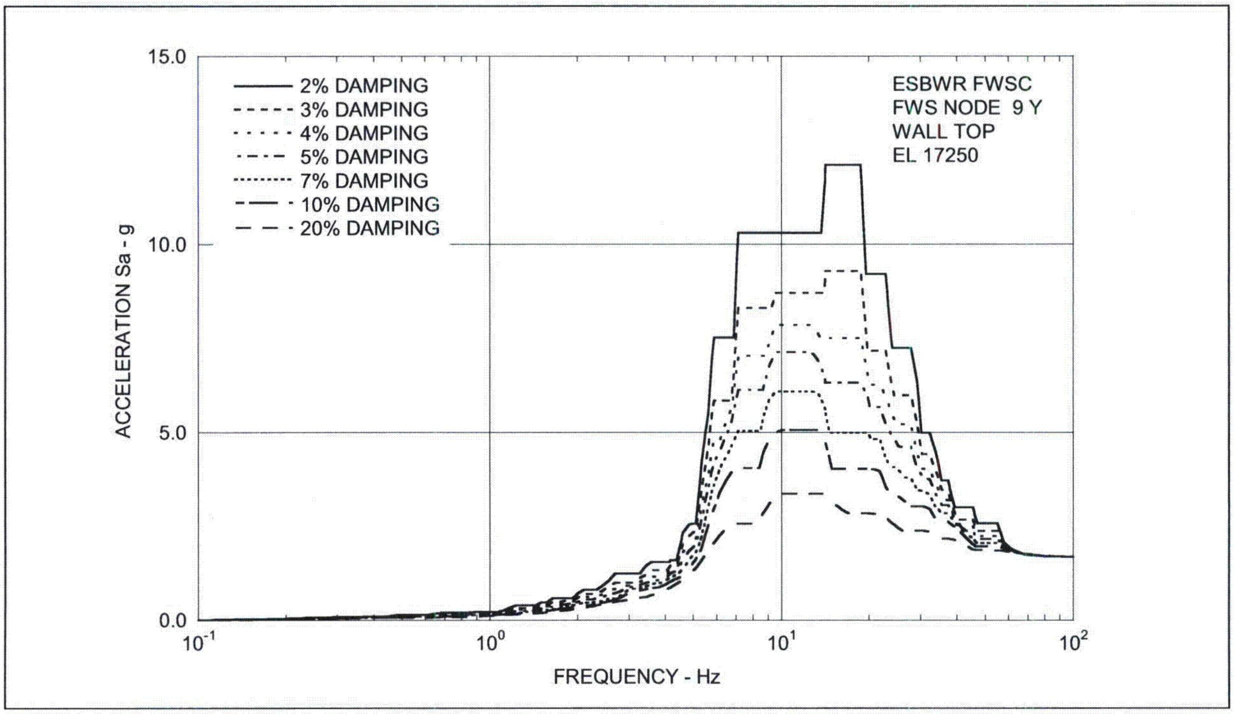


**Figure 3.7.2-276 Unit 3 Site-Specific SSE ISRS - FWS Basemat in Y-Direction**

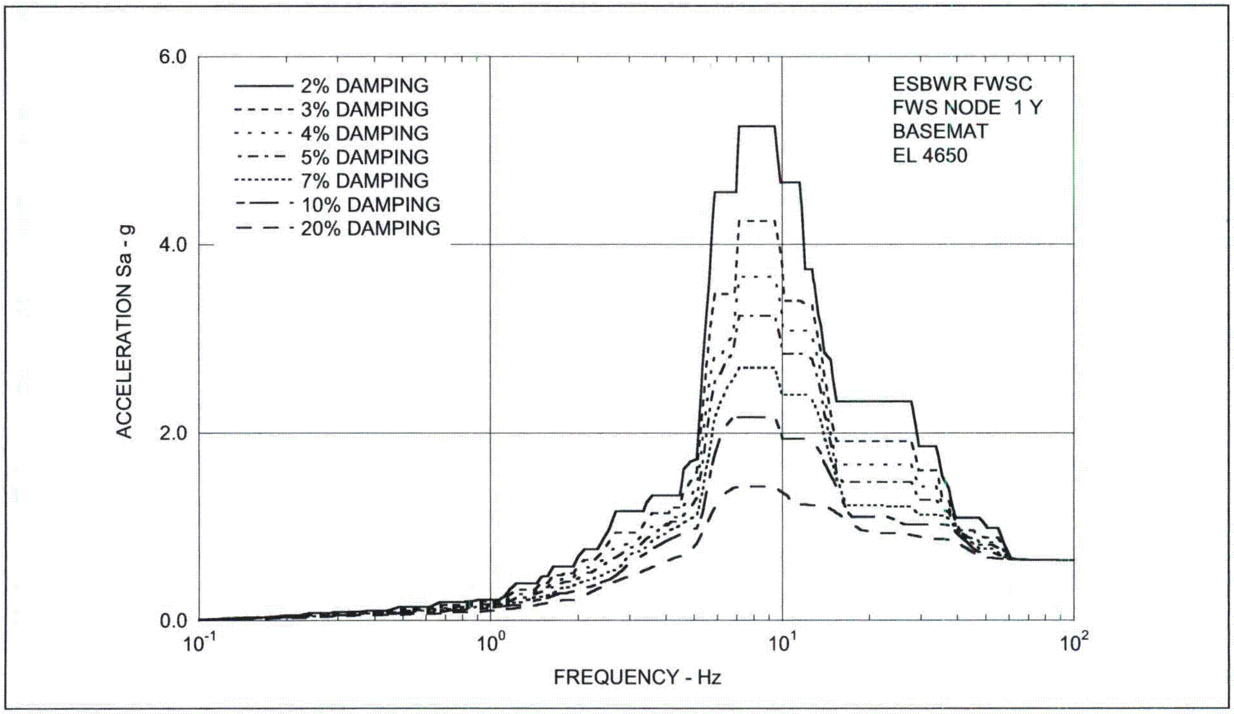


**Figure 3.7.2-277 Unit 3 Site-Specific SSE ISRS - FPE Top in Y-Direction**

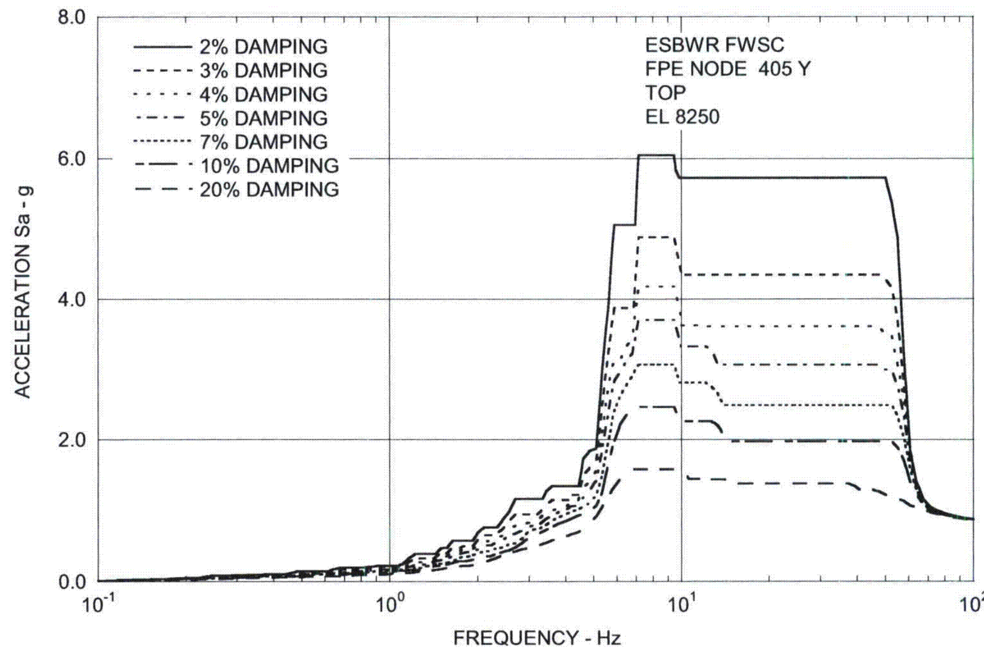



**Figure 3.7.2-278 Unit 3 Site-Specific SSE ISRS - FPE Basemat in Y-Direction**

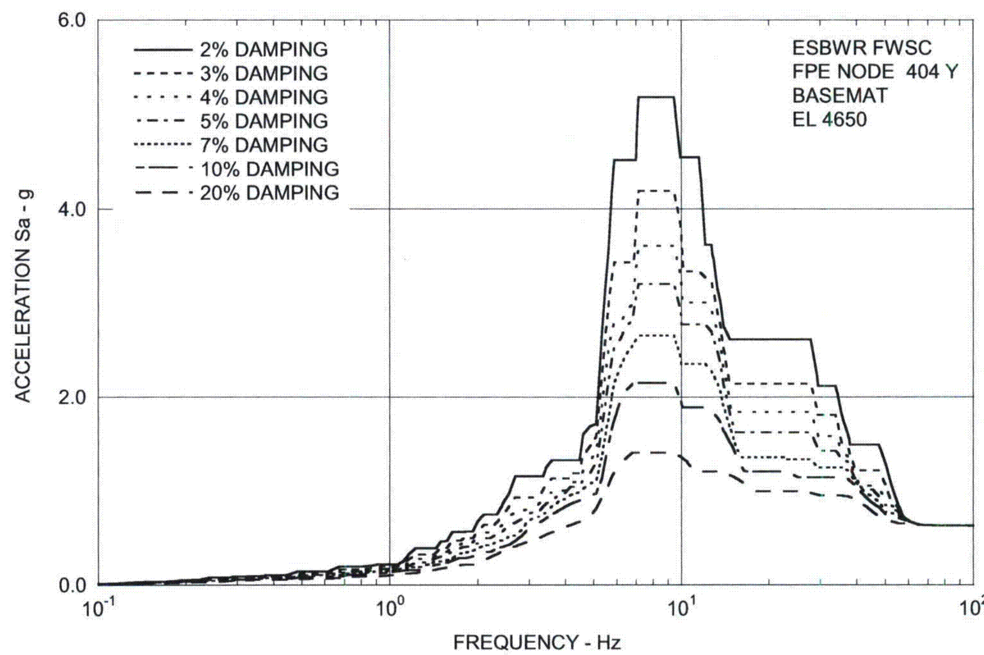


**Figure 3.7.2-279 Unit 3 Site-Specific SSE ISRS - FWS Wall Top in Z-Direction**

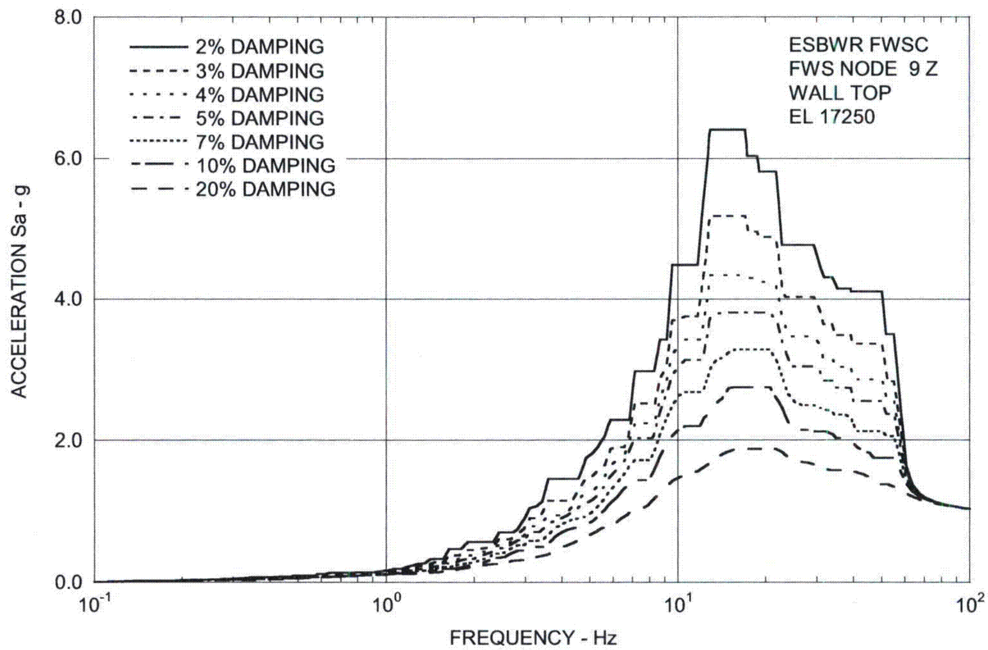


**Figure 3.7.2-280 Unit 3 Site-Specific SSE ISRS - FWS Basemat in Z-Direction**

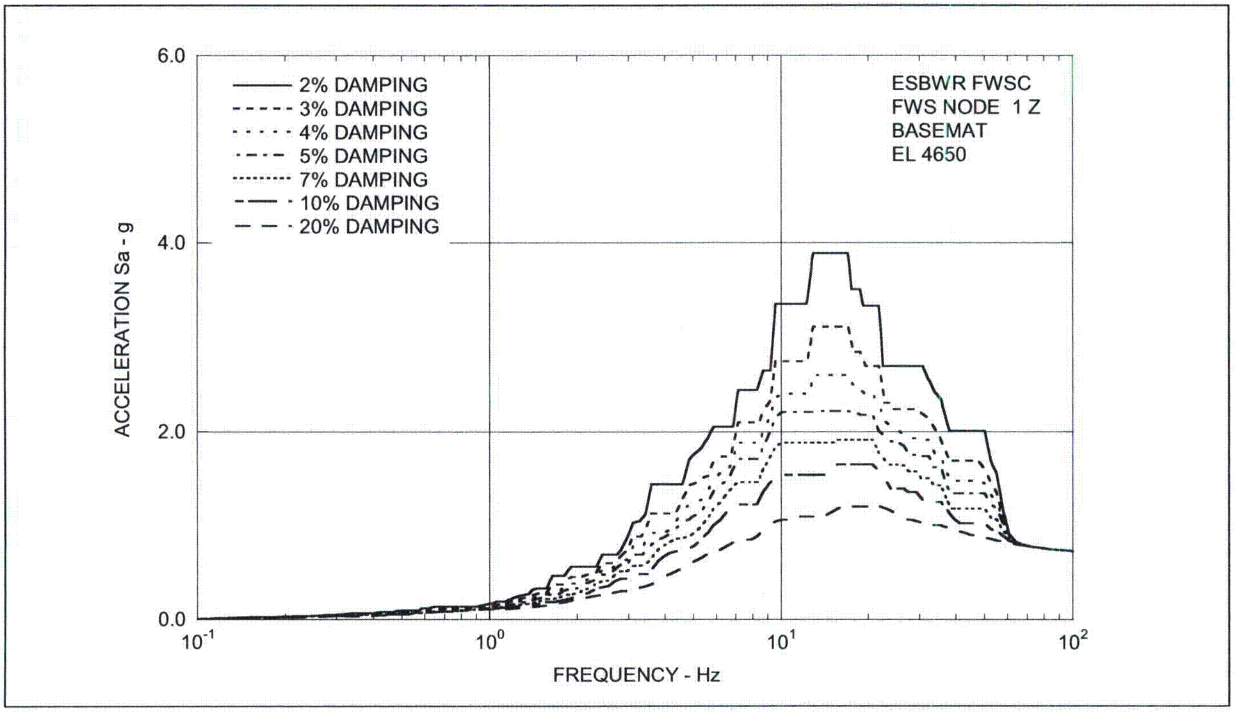


**Figure 3.7.2-281 Unit 3 Site-Specific SSE ISRS - FPE Top in Z-Direction**

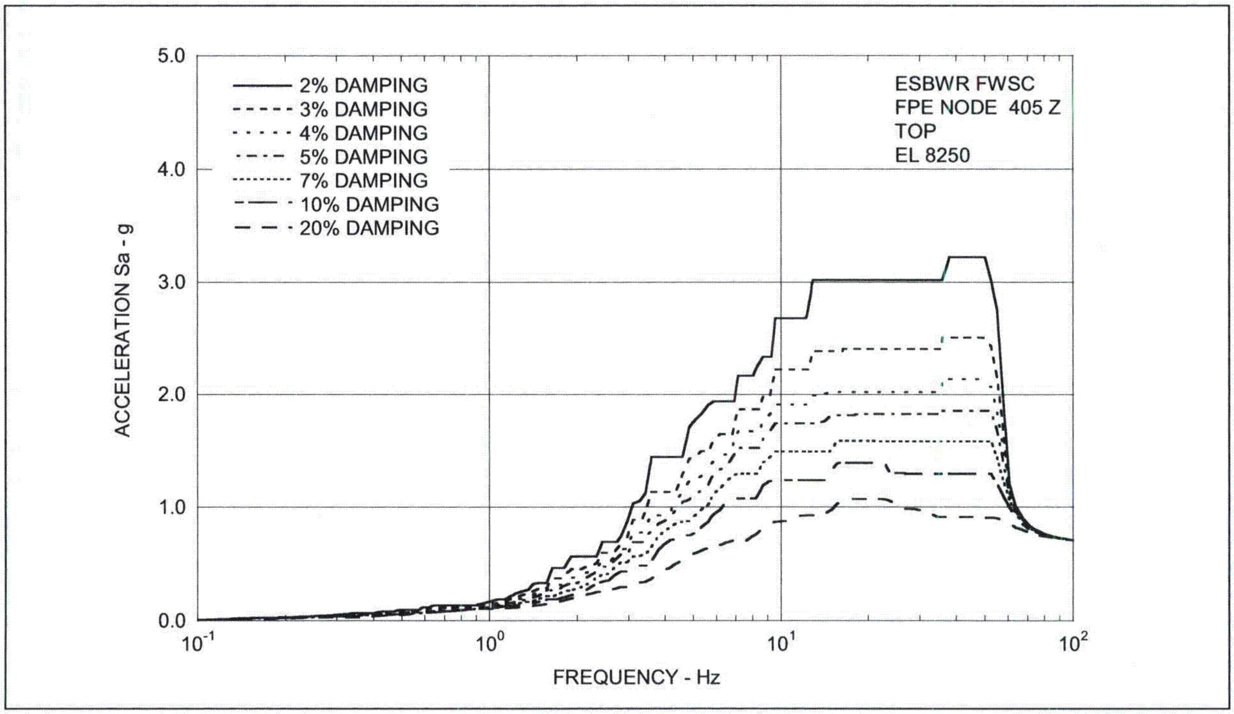
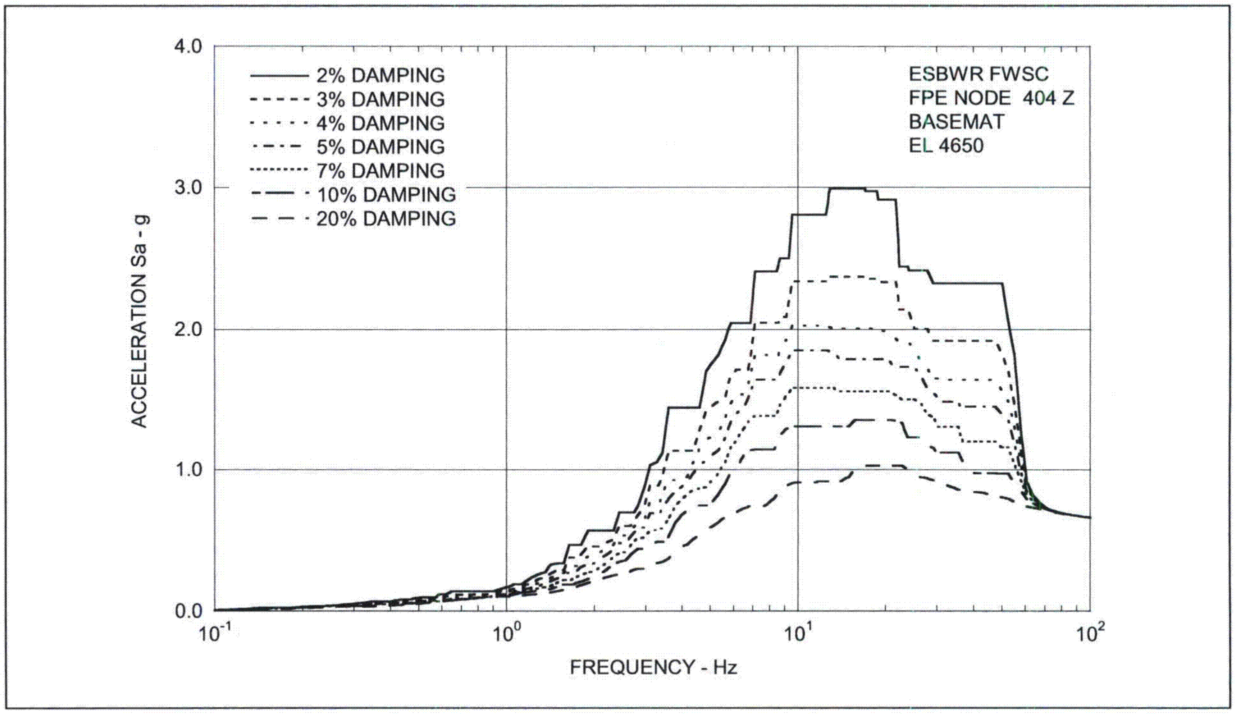



**Figure 3.7.2-282 Unit 3 Site-Specific SSE ISRS - FPE Basemat in Z-Direction**



### 3.7.3.13 Seismic Category I Buried Piping, Conduits and Tunnels

Replace the sixth paragraph sixth bullet as follows.

NAPS DEP 3.7-1

- [*Seismic input motions are based on the single envelope design response spectra as defined in DCD Table 3.7-2, using the applicable scale factor, and site-specific SSE FIRS.*]*

Replace the seventh paragraph as follows.

[*Seismic Category I utilities and Safety Class RW-IIa radwaste piping installed in trenches or tunnels are analyzed in accordance with the standard requirements of DCD Section 3.7.3. Seismic input motions for the portions located below ground are based on the single envelope design response spectra as defined in DCD Table 3.7-2, using applicable scale factors, and site-specific SSE FIRS.*]*

* Text sections that are bracketed and italicized with an asterisk following the brackets are designated as Tier 2*. Prior NRC approval is required to change.

### 3.7.4 Seismic Instrumentation

Add the following at the end of the first paragraph.

NAPS SUP 3.7-6

The seismic monitoring program described in this subsection, including the necessary test and operating procedures, will be implemented prior to receipt of fuel on site.

### 3.7.4.4 Comparison of Measured and Predicted Responses

Add the following after the first paragraph.

NAPS DEP 3.7-1

Based on the definition of the SSE for Unit 3 in Section 3.7.1 using two spectra for seismic design, analysis, and qualification of SSCs, the OBE for purposes of plant shutdown (referred to herein as the "plant-shutdown OBE") is similarly based on two spectra defining the OBE design ground motion at grade. The first plant-shutdown OBE spectrum is 1/3 of the CSDRS, and the second plant-shutdown OBE spectrum is the site-dependent OBE described in Section 3.7.1.1.6. The two sets of horizontal and vertical OBE response spectra derived from the SSE spectra at grade serve as the reference against which OBE exceedance

## 3.8 Seismic Category I Structures

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

Add the following at the end of this section.

The evaluations in Section 3.7.2.4.1.6.1 demonstrate the adequacy of the standard plant design of RB/FB, CB and FWSC structural members for Unit 3 site-specific seismic load demands. The evaluations are based on comparison of ~~stress~~ results from site-specific SSI analysis with the standard design seismic loads and structural member capacities. Section 3.8.4.5.6 demonstrates that the Unit 3 site-specific lateral pressure loads on below grade exterior walls are also enveloped by the standard design.

### 3.8.4 Other Seismic Category I Structures

#### 3.8.4.5 Structural Acceptance Criteria

Add the following at the end of this section.

NAPS DEP 3.7-1

##### 3.8.4.5.6 Below Grade Exterior Wall Design

Unit 3 exterior below grade wall designs for the RB/FB and CB are evaluated through comparison of site-specific lateral pressure demands with the lateral loads used for standard design. The results of the Unit 3 site-specific SSI analyses for the RB/FB and CB presented in Section 3.7.2.4.1 provide the Unit 3 site-specific seismic lateral pressure loads applied ~~from the rock and concrete fill~~ to the below grade exterior walls of RB/FB and CB. ~~Section 2.5.4.10.3 provides the site specific static earth pressure and hydrostatic loads that are calculated using the properties of the Unit 3 structural fill and in situ materials and the Unit 3 site specific nominal maximum ground water level for RB/FB, CB, and FWSC.~~ The applicability of the standard design of below grade exterior walls is demonstrated by showing that the lateral loads used for standard design envelope the site-specific lateral load demands.

Figures 3.8.4-201 through 3.8.4-204 show the Unit 3 site-specific lateral soil pressure demands on each of the four exterior walls of the RB/FB. The distributions of the site-specific total lateral pressures that include the site-specific hydrostatic pressure, the static lateral pressure and the dynamic lateral pressure obtained from Unit 3 site-specific SSI analyses are presented. The figures also present the distribution of the site-specific passive resistance pressures on the walls that are required for the sliding stability of the Unit 3 RB/FB as discussed in Section 3.8.5.5. These site-specific lateral pressure demands are compared with the corresponding standard design lateral pressure loads, the standard design total soil pressure load and the passive pressure load considered for the standard design wall capacity check. The RB/FB wall capacity check for the standard design is performed conservatively considering the maximum passive resistance pressures required to meet the sliding stability of the building for the different generic soil conditions in conjunction with the static lateral pressure loads.

As shown in Figures 3.8.4-201 through 3.8.4-204, the Unit 3 lateral pressure demands on the walls of the RB/FB are bounded by the ~~Referenced~~ DCD design soil pressures and DCD wall capacity passive pressures except at the top of the Zone III rock. These sharp exceedances of the site-specific lateral pressures are due to SASSI calculations of the site-specific seismic lateral pressures at the top of the concrete fill model. Their effects on the out-of-plane bending moments and shear forces in the walls are small and are bounded by the standard design.

Figures 3.8.4-205 through 3.8.4-208 show the site-specific lateral soil pressure demands on ~~the~~ each of the four exterior walls of the CB. The total lateral pressure demands include the site-specific hydrostatic pressure, the static lateral pressure and the dynamic lateral pressure obtained from site-specific SSI analyses of CB. The site-specific passive resistance pressures on the exterior walls are required for the sliding stability of the Unit 3 CB as discussed in Section 3.8.5.5. These site-specific lateral pressure demands are compared with the corresponding standard design lateral pressure loads, the standard design total soil pressure load and the passive pressure load considered for the standard design wall capacity check. The CB wall capacity check for the standard design is performed conservatively considering the maximum passive resistance pressures required to meet the sliding stability of the building for the different generic soil conditions in conjunction with the static lateral pressure loads.

As shown in Figures 3.8.4-205 through 3.8.4-208, the Unit 3 lateral pressure demands on the CB exterior walls are bounded by the lateral pressure loads considered for the standard design of the CB structure except at the top of the Zone III rock. These sharp exceedances of the site-specific lateral pressures are due to SASSI calculations of the site-specific seismic lateral pressures at the top of the concrete fill model. Their effects on the out-of-plane bending moments and shear forces in the CB walls are small and are bounded by the standard design.

## 3.8.5 Foundations

### 3.8.5.5 Structural Acceptance Criteria

Add the following at the end of this section.

**NAPS DEP 3.7-1**

#### 3.8.5.5.1 Foundation Stability

Unit 3 site-specific foundation stability for the RB/FB, CB, and FWSC are evaluated against overturning and sliding based on the results from the Unit 3 site-specific SSI analyses for the RB/FB, CB, and FWSC presented in Section 3.7.2.4.1. The stability evaluation for overturning and sliding follow the methodology in DCD Section 3.8.5.5.

The sliding stability of the building is evaluated on time step basis by calculating safety factor for different instances of time. The minimum value obtained during the duration of the site-specific ground motion is adopted as the safety factor for sliding stability of the building. A 0.03 second moving average window is applied on these time histories to obtain the lateral resistance force demands for the RB/FB, CB, and FWSC foundation. The applied moving average window helps to filter out the spurious peak in the vertical reaction time history when the magnitude of the upward seismic force is near or exceeds the effective weight of the building.

The factor of safety against overturning due to earthquake loading is determined by the energy approach method for both NS and EW direction as described in DCD Section 3.7.2.14. The calculated site-specific factors of safety against overturning based on Unit 3 site-specific SSI for the RB/FB, CB, and FWSC are shown in Tables 3.8.5-201, 3.8.5-202, and 3.8.5-203, respectively. The Unit 3 site-specific factors of safety against overturning for the RB/FB, CB, and FWSC ~~are 529, 559, and 902, respectively, and~~ are larger than the required minimum factor of safety of 1.1.

Unit 3 site-specific sliding evaluation is performed using driving forces calculated from the results of the site-specific SSI analyses, which neglects the effect of the structural fill placed above the top of the Zone III rock. The sliding shear resistance forces ($F_{ub}$) are calculated using the Unit 3 site-specific value for static sliding coefficient of friction of 0.60 for the critical sliding planes located at interface of the RB/FB, CB, and FWSC foundations with the underlying concrete fill and/or Zone III-IV rock. The base shear resistance values are calculated considering the effect of vertical component of the input earthquake motion and the ground water buoyancy forces that are calculated based on the Unit 3 nominal maximum ground water level for RB/FB, CB, and FWSC. The site-specific sliding evaluations for the Unit 3 RB/FB and CB also consider the lateral resistance provided by the concrete fill and Zone III rock. The stability evaluations neglect ~~to consider~~ the resistance provided by the following skin friction resistance forces:

1. $F_{us}$ = Skin friction resistance force provided by basemat side parallel to the direction of motion (i.e., $F_{us}$ = 0)

2. $F_{us}'$ = Skin friction resistance force provided by shear key side parallel to the direction of motion (when shear keys are used (i.e., $F_{us}'$ = 0).

The lateral resistance provided by the RB/FB shear key ($F_r'$) is also neglected so no credit is taken for the shear key in the RB/FB stability evaluations. The calculated Unit 3 site-specific factors of safety against sliding for the RB/FB and CB are shown in Tables 3.8.5-201 and 3.8.5-202, respectively. The table lists the maximum values of the lateral resistance forces and pressures along the RB/FB and CB embedded exterior walls and basemat opposite to the direction of motion that are needed to achieve a minimum factor of safety of 1.1 against sliding. The corresponding maximum required lateral passive resistance pressures are 0.20 MPa for RB/FB and 0.50 MPa for CB. These site-specific passive resistance pressures are well within the allowable bearing pressure of the concrete fill, Zone III rock and the lateral pressure capacity of the buildings below grade walls as shown in ~~Figure 3.8.4-205~~ Figures 3.8.4-201 through ~~3.7.2-208~~ 3.8.4-208. These lateral passive resistance forces are associated with very small deformation of the concrete fill that will not result in motion of the foundation relative to the supporting subgrade. Therefore, the use of static coefficient of friction to calculate the base shear resistance against sliding is adequate.

The sliding of the FWSC is evaluated using driving seismic forces obtained from the Unit 3 site-specific SSI analyses. The site-specific sliding evaluations for the Unit 3 FWSC also consider the lateral resistance provided by the shear keys embedded in concrete fill below the FWSC foundation. The calculated Unit 3 site-specific factors of safety against sliding for the FWSC are shown in Table 3.8.5-203. The table lists the maximum values of the lateral resistance forces and pressures along the FWSC ~~embedded basemat and~~ shear key opposite to the direction of motion that are needed to achieve a minimum factor of safety of 1.1 against sliding. The corresponding maximum required lateral passive resistance pressure is ~~0.54~~ 0.50 MPa. This site-specific passive resistance pressure is well within the allowable bearing pressure of ~~structural fill, Zone II rock~~ concrete fill and the lateral pressure capacity of the shear key.

#### 3.8.5.5.2 Foundation Dynamic Bearing Pressures

The maximum soil dynamic bearing pressure demands for the RB/FB, CB and FWSC foundation basemats at Unit 3 site are calculated using the Energy Balance Method/Modified Energy Balance Method described in DCD ~~Section 3G.1.5.5~~ Reference 3G.1-2. The results of the Unit 3 site-specific SSI analyses for BE, UB, and LB subsurface profiles presented in Section 3.7.2.4.1, provide time histories of the vertical seismic force and overturning seismic moment base reactions for each one of the three Seismic Category I foundations. A 0.03 second moving average window is applied on these time histories to obtain the bearing pressure demands under the CB foundation. The applied moving average window helps to filter out the spurious peak in the vertical reaction time history when the magnitude of the upward seismic force is near or exceeds the effective weight of the building. At this instance of time, the corresponding ~~rotation~~ angle of rotation of the basemat predicted by the soil-structure interaction model is extremely small. The same moving average window approach is used to calculate the contact ratio of the CB foundation directly from the results of SSI analysis as described in Section 3.7.2.4.1.6. The maximum values of the dynamic pressures calculated for the whole duration of the site-specific ground motion are selected to represent the maximum site-specific bearing pressure demands under the RB/FB, CB, and FWSC basemats.

The Unit 3 site-specific maximum dynamic soil bearing pressure demands for the RB/FB, CB, and FWSC foundations are shown in Tables 3.8.5-204, 3.8.5-205 and 3.8.5-206, respectively.

**Table 3.8.5-201 Factors of safety for RB/FB Foundation Stability**

| | Overturning | | Sliding | |
|---|---|---|---|---|
| Load Combination | SRP 3.8.5 Required FS | Calculated FS | SRP 3.8.5 Required FS | Calculated FS |
| D + H + E' | 1.1 | 533 | 1.1 | ~~>~~ ≥1.1 |

Where,
D = Dead Load
H = Lateral soil pressure
E' = Safe Shutdown Earthquake
Note: The maximum required lateral resistance force is ~~104~~ 110 MN.
The maximum required lateral pressure is ~~0.20 MPa~~ 200 kPa

**Table 3.8.5-202 Factors of safety for CB Foundation Stability**

| | Overturning | | Sliding | |
|---|---|---|---|---|
| Load Combination | SRP 3.8.5 Required FS | Calculated FS | SRP 3.8.5 Required FS | Calculated FS |
| D + H + E' | 1.1 | 559 | 1.1 | ~~>~~ ≥1.1 |

Where,
D = Dead Load
H = Lateral soil pressure
E' = Safe Shutdown Earthquake
Note: The maximum required lateral resistance force is 53 MN.
The maximum required lateral pressure is ~~0.50 MPa~~ 500 kPa

**Table 3.8.5-203 Factors of safety for FWSC Foundation Stability**

| | Overturning | | Sliding | |
|---|---|---|---|---|
| Load Combination | SRP 3.8.5 Required FS | Calculated FS | SRP 3.8.5 Required FS | Calculated FS |
| D + H + E' | 1.1 | 902 | 1.1 | ~~>~~ ≥1.1 |

Where,
D = Dead Load
H = Lateral soil pressure
E' = Safe Shutdown Earthquake
Note: The maximum required lateral resistance force is 43 MN.
CCR NA3-14-6003
The maximum required lateral pressure is ~~0.54 MPa~~ 500 kPa

**Table 3.8.5-204 Maximum Soil Dynamic Bearing Pressure Demand for RB/FB (Unit: ~~KPa~~ kPa)**

| Site Conditions | Lower Bound Subsurface Profile | Best Estimate Subsurface Profile | Upper Bound Subsurface Profile |
|---|---|---|---|
| Dynamic (Static + Seismic) | 1150 | 1170 | 1150 |

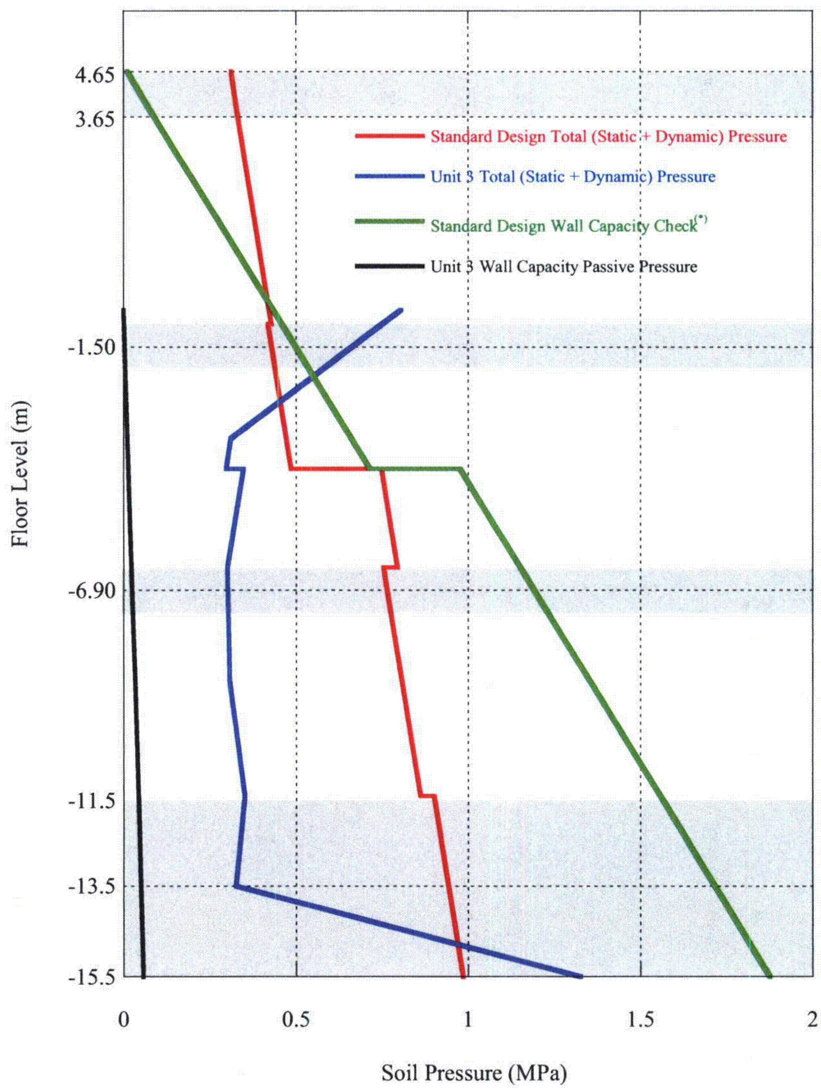
**Table 3.8.5-205 Maximum Soil Dynamic Bearing Pressure Demand for CB (Unit: ~~KPa~~ kPa)**

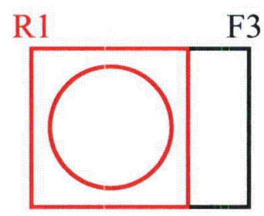
| Site Conditions | Lower Bound Subsurface Profile | Best Estimate Subsurface Profile | Upper Bound Subsurface Profile |
|---|---|---|---|
| Dynamic (Static + Seismic) | 490 | 510 | 520 |

**Table 3.8.5-206 Maximum Soil Dynamic Bearing Pressure Demand for FWSC (Unit: ~~KPa~~ kPa)**

| Site Conditions | Lower Bound Subsurface Profile | Best Estimate Subsurface Profile | Upper Bound Subsurface Profile |
|---|---|---|---|
| Dynamic (Static + Seismic) | 420 | 420 | 400 |

**Figure 3.8.4-201 Lateral Soil Pressure - RB/FB R1 Wall**

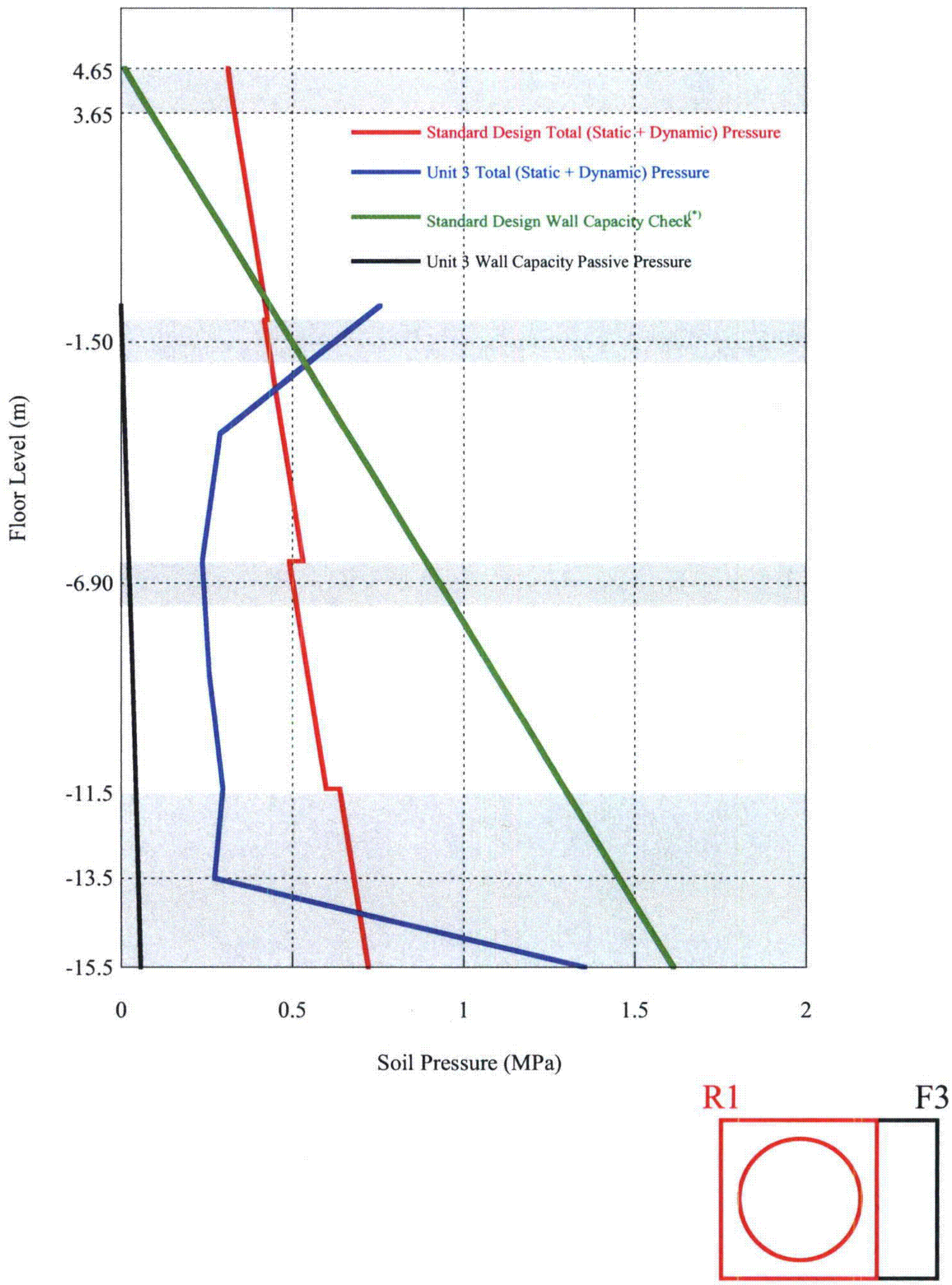



Note: (*) Wall capacity check for the standard design is performed conservatively considering passive pressures required to meet the sliding stability of the building + static lateral pressure loads.

The shaded area shows thickness of the floor slabs and basemat.

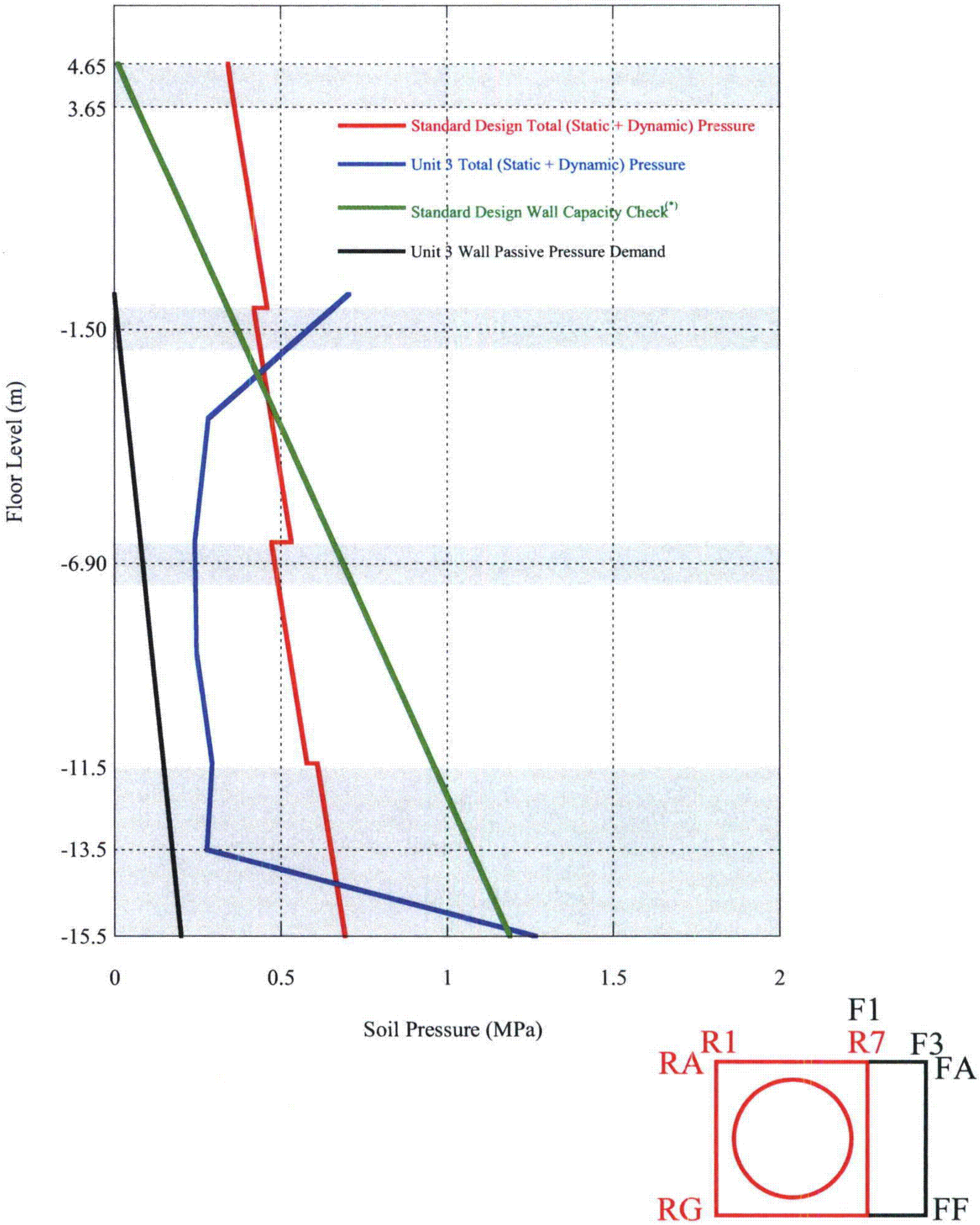
**Figure 3.8.4-202 Lateral Soil Pressure - RB/FB F3 Wall**




Note: (*) Wall capacity check for the standard design is performed conservatively considering passive pressures required to meet the sliding stability of the building + static lateral pressure loads.

The shaded area shows thickness of the floor slabs and basemat.

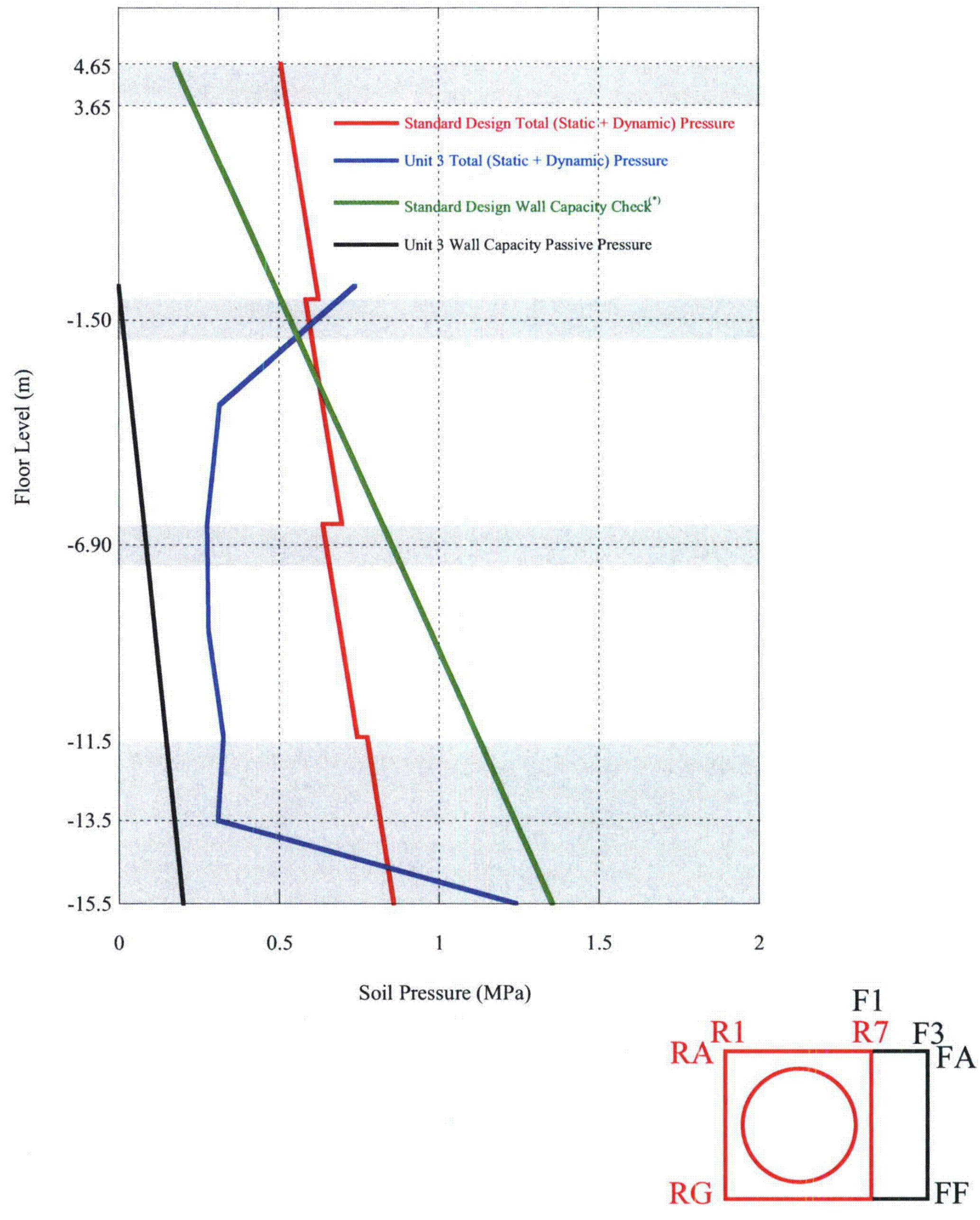
**Figure 3.8.4-203 Lateral Soil Pressure - RB/FB RA/RG/~~FG~~ FF Wall**




Note: (*) Wall capacity check for the standard design is performed conservatively considering passive pressures required to meet the sliding stability of the building + static lateral pressure loads.

The shaded area shows thickness of the floor slabs and basemat.

**Figure 3.8.4-204 Lateral Soil Pressure - RB/FB FA Wall**




Note: (*) Wall capacity check for the standard design is performed conservatively considering passive pressures required to meet the sliding stability of the building + static lateral pressure loads.

(**) The soil pressure at rest of FA wall includes a surcharge from the Service Building.

The shaded area shows thickness of the floor slabs and basemat.

## REVISION SUMMARY

| Section | Changes | Reason for Change |
|---|---|---|
| 1.1.1 | Deleted "NAPS DEP 3.7-1" from action statement. Corrected DCD Tier 1 Reference figures for CSDRS | Editorial and typographical |
| Table 5.1-1, Footnote (4) | Tier 1 Departures- SSE design ground response spectra of 5% damping is defined as the higher of a combination of the CSDRS free-field outcrop spectra at the foundation level (bottom of the base slab) of the Reactor/Fuel and Control Building structures and the Unit 3 site-dependent SSE at grade. | DEP 3.7-1 |

# TIER 1 INFORMATION
# INSPECTIONS, TESTS, ANALYSES, AND ACCEPTANCE CRITERIA, AND PROPOSED LICENSE CONDITIONS

## 1. Tier 1 Information

DCD Tier 1 is incorporated by reference with the following departures and/or supplements.

### 1.1.1 Definitions

Add the following at the end of this section ~~NAPS DEP 3.7-1~~:

Unit 3 Seismic Design Response Spectra, for purposes of seismic requirements for Seismic Category I SSCs as specified in Tier 1, means the seismic design response spectra based on the results of the Unit 3 site-specific SSI analyses described in FSAR Section 3.7.2. Specifically, Safe Shutdown Earthquake (SSE) design ground motion for purposes of seismic design, analysis, and qualification of Unit 3 plant structures, systems, and equipment, is defined by two sets of ground motion acceleration response spectra:

- the single envelope design ground motion response spectra or Certified Seismic Design Response Spectra (CSDRS) described in FSAR Section 3.7.1.1.3 that defines the SSE design motion for seismic design of ESBWR Standard Plant, and the site-specific Foundation Input Response Spectra (FIRS) described in FSAR Section 3.7.1.1.4.2, representative of the Unit 3 site specific seismological and geological conditions.

FSAR Figures 2.0-201 through 2.0-204 present these 5% damped acceleration response spectra that define the design ground motion as a free-field outcrop motion at the foundation bottom of each Seismic Category I structure. DCD Tier 1 Figures 5.1-1 and 5.1-2 present the standard design CSDRS.

For each structure and each equipment location within the buildings, in-structure response spectra (ISRS) are developed. The site-specific ISRS that exceed the standard design ISRS, are used in conjunction with the standard design ISRS for seismic design and qualification of equipment and components.

This approach applies to SSCs that are required to withstand SSE loads. Similarly, other SSCs that are specifically required to meet SSE seismic demands are designed, analyzed, and qualified using the process in FSAR Sections 3.7.1 and 3.7.2 for applying the CSDRS and site-specific FIRS. The same approach is applied for the Seismic Category II and Radwaste Building structures.

Table 5.1-1 **Envelope of ESBWR Standard Plant Site Parameters**

Replace footnote (4) with the following:

(4) Safe Shutdown Earthquake (SSE) design ground motion for purposes of seismic design, analysis, and qualification of Unit 3 Reactor Building/Fuel Building (RB/FB) and Control Building (CB) structures, systems, and components, is defined by two sets of ground motion acceleration response spectra: the standard design Certified Seismic Design Response Spectra (CSDRS), and the site-specific Foundation Input Response Spectra (FIRS) for these two buildings. For Firewater Service Complex (FWSC), which is essentially a surface founded structure, the SSE design ground motion is defined as 1.35 times the spectra of the CSDRS and the FWSC site specific FIRS. FSAR Figures 2.0-201 through 2.0-204 present these spectra that define the free-field outcrop motion at the foundation bottom of each structure. DCD Tier 1 Figures 5.1-1 and 5.1-2 present the standard design CSDRS. The same process will be followed for the Seismic Category II and Radwaste Building structures.

# 2. COLA ITAAC

The Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) for the COLA are provided in tabular form, consistent with the format shown in RG 1.206 Table C.II.1-1.

The COLA-ITAAC consist of the following four parts:

1. Design Certification ITAAC
2. Emergency Planning ITAAC
3. Physical Security ITAAC
4. Site-Specific ITAAC

This set of COLA-ITAAC is included herein. Completion of the ITAAC is a proposed condition of the combined license to be satisfied prior to fuel load.

## 2.1 Design Certification ITAAC

The Design Certification ITAAC are contained in DCD Tier 1, which is incorporated by reference with the following departures and/or supplements.

### 2.1.1 Liquid Radwaste Effluent Discharge Piping Flow Path

There is a departure from DCD Tier 1, Section 2.10.1, as described in COLA Part 7. The Unit 3 piping used for the flow path from the Liquid Waste Management System (LWMS) in the Radwaste Building to the environment will not include piping in the circulating water system. The last sentence of the fourth paragraph of this section is replaced with the following: "The LWMS either returns processed water to the condensate system or discharges to the environment using the liquid radwaste effluent discharge pipeline."