5.0 Site Parameters

Table 5.0-1 identifies the key site parameters that are specified for the design of safety-related aspects of structures, systems, and components for the AP1000. An actual site is acceptable if its site characteristics fall within the AP1000 plant site design parameters in Table 5.0-1.

Structures, systems, and components for the AP1000 are evaluated for generic envelope response spectra with high frequency seismic input. The spectra shown in Figure 5.0-3 and Figure 5.0-4 provide hard rock high frequency (HRHF) envelope response spectra at the foundation level for both the horizontal and vertical directions for 5% damping. An actual site is acceptable if its site-specific GMRS falls within the AP1000 HRHF parameters in Figures 5.0-3 and 5.0-4. No additional design or analyses are required for the structures, systems, and components for sites that fall within the AP1000 HRHF parameters.

Table 5.0-1
Site Parameters

Maximum Ground Water Level	Plant elevation 98 ft
Maximum Flood Level	Plant elevation 100 ft (design grade elevation)
Precipitation	
Rain	20.7 in/hr [1-hr 1-mi^2 PMP]
Snow/Ice	Ground snow load of 75 lb/ft^2 with exposure factor of 1.0 and importance factor of 1.2
Air Temperature	Limits based on historical data excluding peaks of less than 2 hours duration Maximum temperature of 115° dry bulb/86.1°F coincident wet bulb Maximum wet bulb 86.1°F (noncoincident) Minimum temperature of -40°F
Tornado	
Wind Speed	Maximum wind speed of 300 mph
Maximum Pressure Differential	Maximum pressure differential of 2.0 lb/in^2
Tornado Missile Spectra	4000-lb automobile at 105 mph horizontal, 74 mph vertical 275-lb, 8-in. shell at 105 mph horizontal, 74 mph vertical 1-in.-diameter steel ball at 105 mph in the most damaging direction
Soil	
Average Allowable Static Soil Bearing Capacity	The allowable bearing capacity, including a factor of safety appropriate for the design load combination, shall be greater than or equal to the average bearing demand of 8,900 lb/ft^2 over the footprint of the nuclear island at its excavation depth.
Minimum Soil Angle of Internal Friction	The minimum soil angle of internal friction is greater than or equal to 35 degrees below the footprint of the nuclear island at its excavation depth. If the minimum soil angle of internal friction is below 35 degrees, a site-specific analysis shall be performed using the site-specific soil properties to demonstrate stability.
Dynamic Bearing Capacity for Normal Plus Safe Shutdown Earthquake (SSE)	The allowable bearing capacity, including a factor of safety appropriate for the design load combination, shall be greater than or equal to the maximum bearing demand of 35,000 lb/ft^2 at the edge of the nuclear island at its excavation depth, or site-specific analyses demonstrate factor of safety appropriate for normal plus safe shutdown earthquake loads.

Table 5.0-1 (cont.)
Site Parameters

Soil (cont.)		
Limits of Acceptable Settlement Without Additional Evaluation[1]	Differential across nuclear island foundation mat	1/2 inch in 50 feet
	Total for nuclear island foundation mat	6 inches
	Differential between nuclear island and turbine building[2]	3 inches
	Differential between nuclear island and other buildings[2]	3 inches
Lateral Variability	Soils supporting the nuclear island should not have extreme variations in subgrade stiffness. This may be demonstrated by one of the following: 1. Soils supporting the nuclear island are uniform in accordance with Regulatory Guide 1.132 if the geologic and stratigraphic features at depths less than 120 feet below grade can be correlated from one boring or sounding location to the next with relatively smooth variations in thicknesses or properties of the geologic units, or 2. Site-specific assessment of subsurface conditions demonstrates that the bearing pressures below the footprint of the nuclear island do not exceed 120% of those from the generic analyses of the nuclear island at a uniform site, or 3. Site-specific analysis of the nuclear island basemat demonstrates that the site specific demand is within the capacity of the basemat.	

Notes:

1. Additional evaluation may include evaluation of the impact of the elevated estimated settlement values on the critical components of the AP1000, determining a construction sequence to control the predicted settlement behavior, or developing an active settlement monitoring system throughout the entire construction sequence as well as a long-term (plant operation) plan.
2. Differential settlement is measured at the center of the nuclear island and the center of adjacent structures.

Table 5.0-1 (cont.)
Site Parameters

Soil (cont.)	
Lateral Variability (cont.)	As an example of sites that are considered uniform, the variation of shear wave velocity in the material below the foundation to a depth of 120 feet below finished grade within the nuclear island footprint and 40 feet beyond the boundaries of the nuclear island footprint meets the criteria in the case outlined below. Case 1: For a layer with a low strain shear wave velocity greater than or equal to 2500 feet per second, the layer should have approximately uniform thickness, should have a dip not greater than 20 degrees, and should have less than 20 percent variation in the shear wave velocity from the average velocity in any layer.
Shear Wave Velocity	Greater than or equal to 1000 ft/sec based on minimum low-strain soil properties over the footprint of the nuclear island at its excavation depth
Liquefaction Potential	No liquefaction considered beneath the seismic Category I and seismic Category II structures and immediate surrounding area. The immediate surrounding area includes the effective soil supporting media associated with the seismic Category I and seismic Category II structures.
Seismic	
CSDRS	CSDRS free field peak ground acceleration of 0.30g with modified Regulatory Guide 1.60 response spectra (See Figures 5.0-1 and 5.0-2). The SSE is now referred to as CSDRS. Seismic input is defined at finished grade except for sites where the nuclear island is founded on hard rock. If the site-specific spectra exceed the response spectra in Figures 5.0-1 and 5.0-2 at any frequency, or if soil conditions are outside the range evaluated for AP1000 design certification, a site-specific evaluation can be performed. This evaluation will consist of a site-specific dynamic analysis and generation of in-structure response spectra at key locations to be compared with the floor response spectra of the certified design at 5-percent damping. The site is acceptable if the floor response spectra from the site-specific evaluation do not exceed the AP1000 spectra for each of the locations or the exceedances are justified.

Table 5.0-1 (cont.) Site Parameters	
Seismic (cont.) CSDRS (cont.)	The hard rock high frequency (HRHF) envelope response spectra are shown in Figure 5.0-3 and Figure 5.0-4 defined at the foundation level for 5% damping. The HRHF envelope response spectra provide an alternative set of spectra for evaluation of site-specific GMRS. A site is acceptable if its site-specific GMRS falls within the AP1000 HRHF envelope response spectra. Evaluation of a site for application of the HRHF envelope response spectra includes consideration of the limitation on shear wave velocity identified for use of the HRHF envelope response spectra. This limitation is defined by a shear wave velocity at the bottom of the basemat equal to or higher than 7,500 fps, while maintaining a shear wave velocity equal to or above 8,000 fps at the lower depths.
Fault Displacement Potential	No potential fault displacement considered beneath the seismic Category I and seismic Category II structures and immediate surrounding area. The immediate surrounding area includes the effective soil supporting media associated with the seismic Category I and seismic Category II structures.
Atmospheric Dispersion Factors (χ/Q)	
Site Boundary (0-2 hr)	$\leq 5.1 \times 10^{-4}$ sec/m^3
Site Boundary (annual average)	$\leq 2.0 \times 10^{-5}$ sec/m^3
Low Population Zone Boundary	
0 - 8 hr	$\leq 2.2 \times 10^{-4}$ sec/m^3
8 - 24 hr	$\leq 1.6 \times 10^{-4}$ sec/m^3
24 - 96 hr	$\leq 1.0 \times 10^{-4}$ sec/m^3
96 - 720 hr	$\leq 8.0 \times 10^{-5}$ sec/m^3

Table 5.0-1 (cont.)
Site Parameters

Control Room Atmospheric Dispersion Factors (χ /Q) for Accident Dose Analysis						
χ/Q (s/m^3) at HVAC Intake for the Identified Release Points(3)						
	Plant Vent or PCS Air Diffuser(5)	**Ground Level Containment Release Points(6)**	**PORV and Safety Valve Releases(7)**	**Steam Line Break Releases**	**Fuel Handling Area(8)**	**Condenser Air Removal Stack(9)**
0 - 2 hours	3.0E-3	6.0E-3	2.0E-2	2.4E-2	6.0E-3	6.0E-3
2 - 8 hours	2.5E-3	3.6E-3	1.8E-2	2.0E-2	4.0E-3	4.0E-3
8 - 24 hours	1.0E-3	1.4E-3	7.0E-3	7.5E-3	2.0E-3	2.0E-3
1 - 4 days	8.0E-4	1.8E-3	5.0E-3	5.5E-3	1.5E-3	1.5E-3
4 - 30 days	6.0E-4	1.5E-3	4.5E-3	5.0E-3	1.0E-3	1.0E-3
χ/Q (s/m^3) at Annex Building Door for the Identified Release Points(4)						
0 - 2 hours	1.0E-3	1.0E-3	4.0E-3	4.0E-3	6.0E-3	2.0E-2
2 - 8 hours	7.5E-4	7.5E-4	3.2E-3	3.2E-3	4.0E-3	1.8E-2
8 - 24 hours	3.5E-4	3.5E-4	1.2E-3	1.2E-3	2.0E-3	7.0E-3
1 - 4 days	2.8E-4	2.8E-4	1.0E-3	1.0E-3	1.5E-3	5.0E-3
4 - 30 days	2.5E-4	2.5E-4	8.0E-4	8.0E-4	1.0E-3	4.5E-3

Notes:

3. These dispersion factors are to be used 1) for the time period preceding the isolation of the main control room and actuation of the emergency habitability system, 2) for the time after 72 hours when the compressed air supply in the emergency habitability system would be exhausted and outside air would be drawn into the main control room, and 3) for the determination of control room doses when the nonsafety ventilation system is assumed to remain operable such that the emergency habitability system is not actuated.
4. These dispersion factors are to be used when the emergency habitability system is in operation and the only path for outside air to enter the main control room is that due to ingress/egress.
5. These dispersion factors are used for analysis of the doses due to a postulated small line break outside of containment. The plant vent and PCS air diffuser are potential release paths for other postulated events (loss-of-coolant accident, rod ejection accident, and fuel handling accident inside the containment); however, the values are bounded by the dispersion factors for ground level releases.
6. The listed values represent modeling the containment shell as a diffuse area source, and are used for evaluating the doses in the main control room for a loss-of-coolant accident, for the containment leakage of activity following a rod ejection accident, and for a fuel handling accident occurring inside the containment.

7. The listed values bound the dispersion factors for releases from the steam line safety and power-operated relief valves. These dispersion factors would be used for evaluating the doses in the main control room for a steam generator tube rupture, a main steam line break, a locked reactor coolant pump rotor, and the secondary side release from a rod ejection accident.
8. The listed values bound the dispersion factors for releases from the fuel storage and handling area. The listed values also bound the dispersion factors for releases from the fuel storage area in the event that spent fuel boiling occurs and the fuel building relief panel opens on high temperature. These dispersion factors are used for the fuel handling accident occurring outside containment and for evaluating the impact of releases associated with spent fuel pool boiling.
9. This release point is included for information only as a potential activity release point. None of the design basis accident radiological consequences analyses model release from this point.

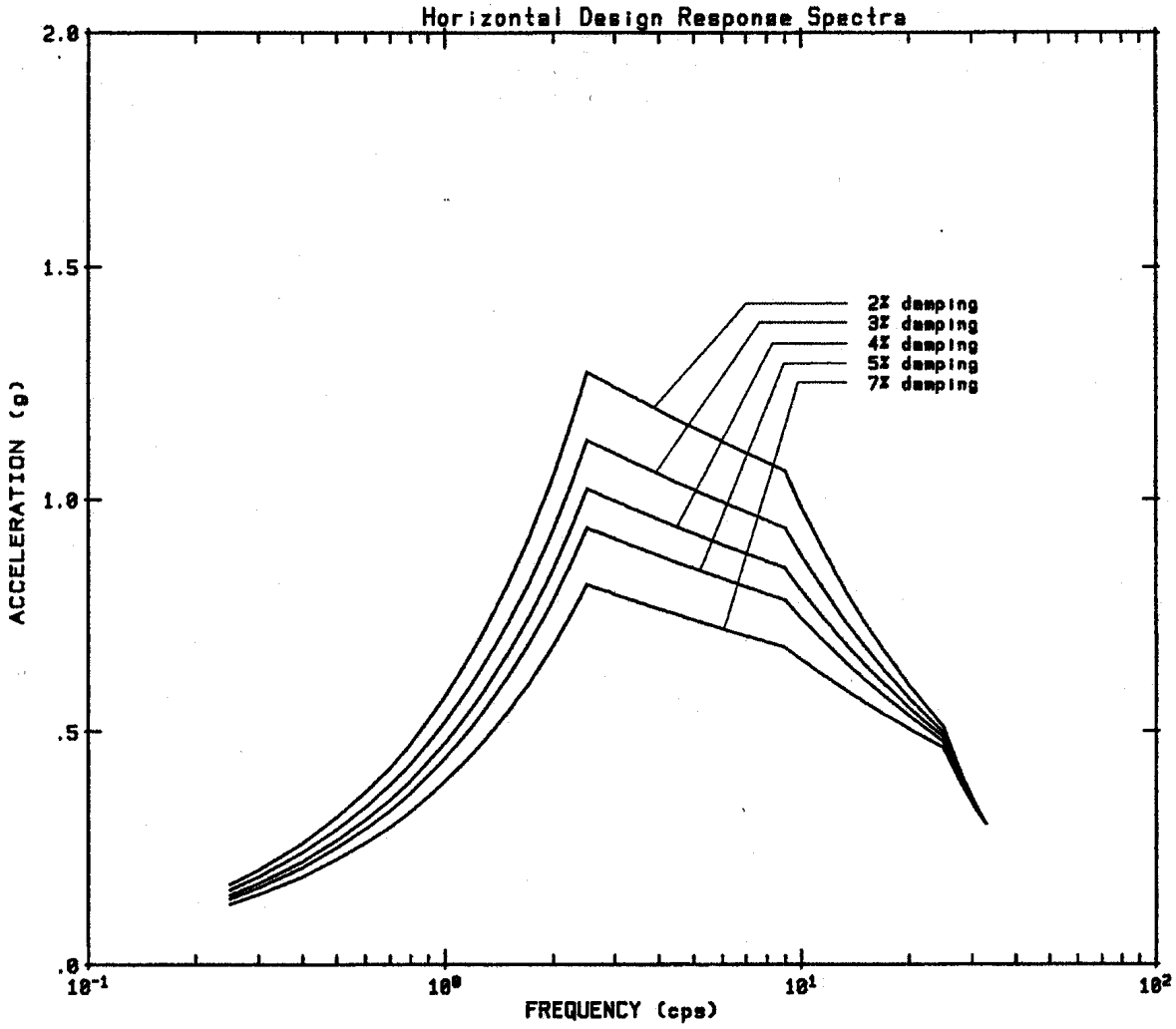

Figure 5.0-1
Horizontal Design Response Spectra
Safe Shutdown Earthquake

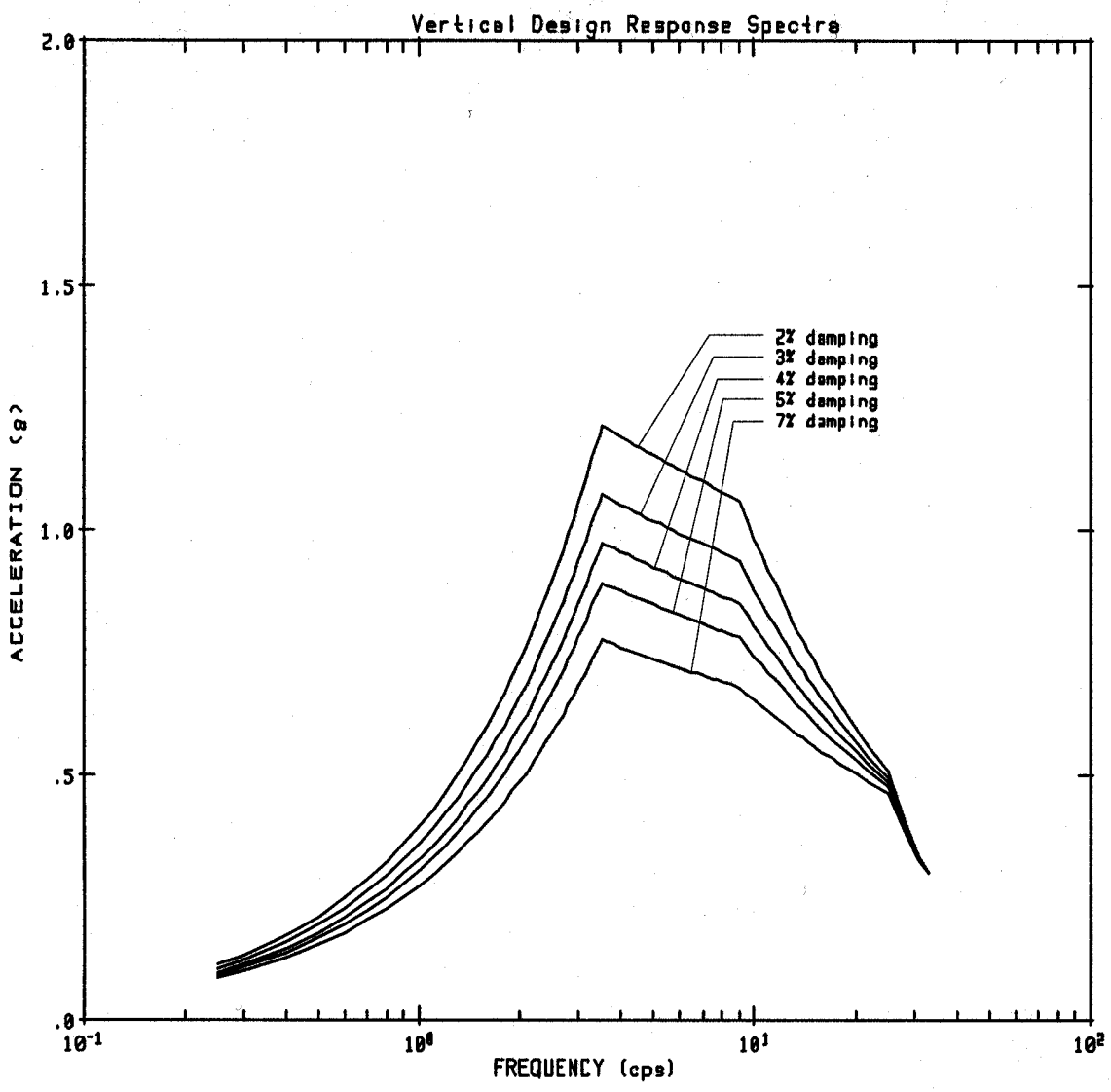

Figure 5.0-2
Vertical Design Response Spectra
Safe Shutdown Earthquake

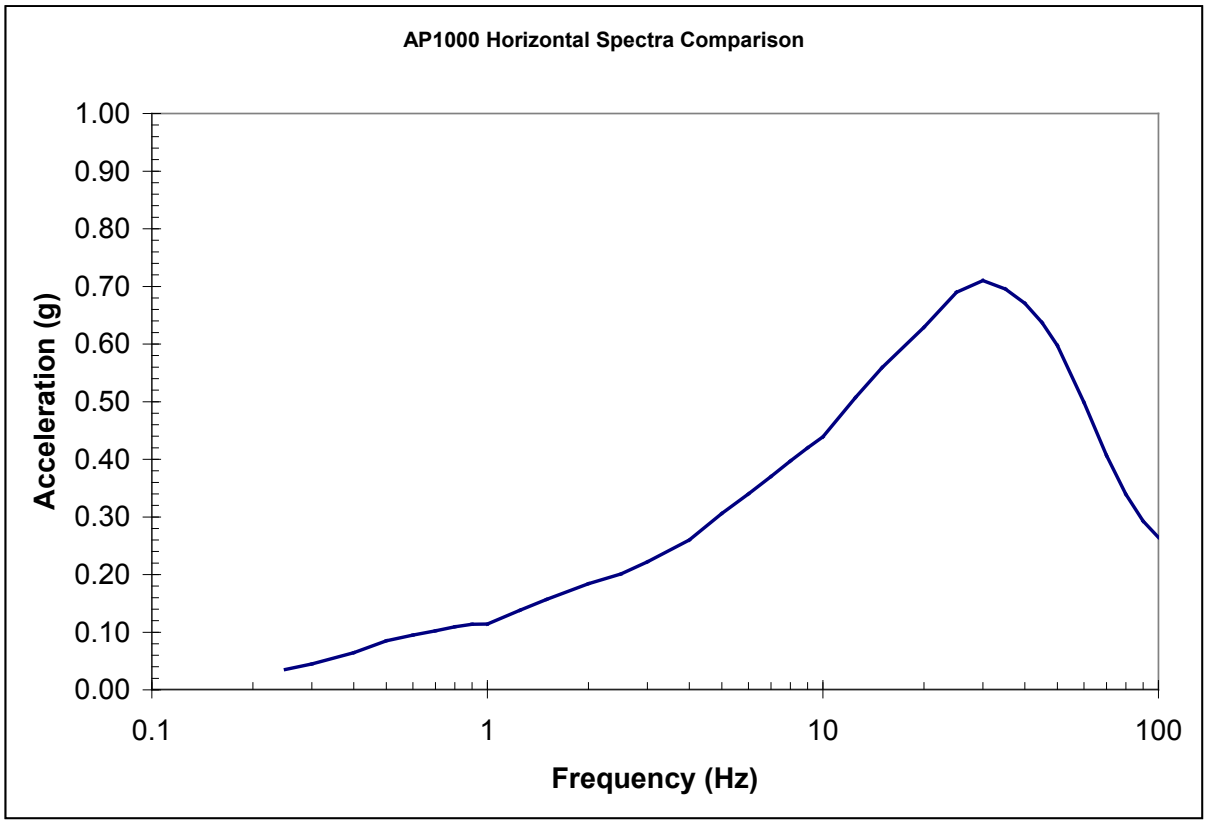

Figure 5.0-3
Horizontal HRHF Envelope Response Spectra
Safe Shutdown Earthquake

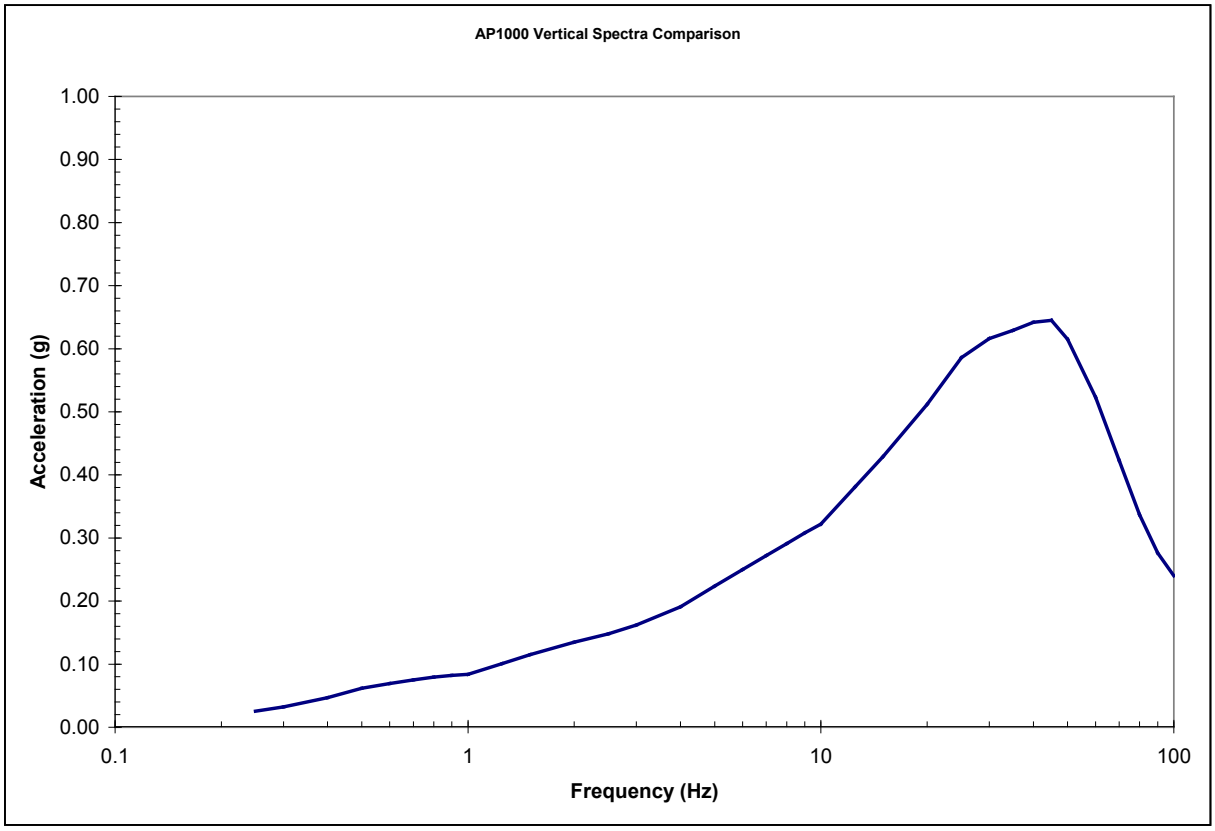

Figure 5.0-4
Vertical HRHF Envelope Response Spectra
Safe Shutdown Earthquake