5. SITE PARAMETERS

5.1 SCOPE AND PURPOSE

The intent of this section is to provide Tier 1 material that complies with the 10 CFR Part 52 requirements to define the site parameters postulated for the ESBWR certified design.

Assuming the certified design will be referenced for a wide range of sites, it is necessary to specify a set of site parameters enveloping the conditions that could occur at most potential power plant sites in the United States. These parameters are provided in Table 5.1-1. It is intended that any facility that references the certified design will utilize a site where the actual site-specific conditions are within the defined envelope.

In the case of seismic design and soil parameters not meeting the defined conditions, site-specific soil-structure interaction analyses may be performed. The results may be used to confirm the seismic design adequacy of the certified design using approved methods and acceptance criteria.

Table 5.1-1 Envelope of ESBWR Standard Plant Site Parameters (1)

Maximum Ground Water Level:	0.61 m (2 ft) below plant grade
Extreme Wind: (8)	**Seismic Category I, II and Radwaste Building Structures** - 100-year Wind Speed (3-sec gust): 67.1 m/s (150 mph) - Exposure Category: D **Other Seismic Category NS Standard Plant Structures** - 50-year Wind Speed (3-sec gust): 58.1 m/s (130 mph)
Maximum Flood (or Tsunami) Level:	0.3 m (1 ft) below plant grade
Tornado:	- Maximum Tornado Wind Speed: 147.5 m/s (330 mph) - Maximum Rotational Speed: 116.2 m/s (260 mph) - Translational Speed: 31.3 m/s (70 mph) - Radius: 45.7 m (150 ft) - Pressure Drop: 16.6 kPa (2.4 psi) - Rate of Pressure Drop: 11.7 kPa/s (1.7 psi/s) - Missile Spectrum(7): Spectrum I of SRP 3.5.1.4, Rev 2 applied to full building height.
Precipitation (for Roof Design):	- Maximum Rainfall Rate: 49.3 cm/hr (19.4 in/hr) - Maximum Short Term Rate: 15.7 cm (6.2 in) in 5 minutes - Maximum Ground Snow Load for normal winter precipitation event: 2394 Pa (50 lbf/ft^2) - Maximum Ground Snow Load for extreme winter precipitation event: 7757 Pa (162 lbf/ft^2)
Ambient Design Temperature:	**2% Annual Exceedance Values** - Maximum: 35.6°C (96°F) dry bulb 26.1°C (79°F) wet bulb (mean coincident) 27.2°C (81°F) wet bulb (non-coincident) - Minimum: -23.3°C (-10°F) **1% Annual Exceedance Values** - Maximum: 37.8°C (100°F) dry bulb 26.1°C (79°F) wet bulb (mean coincident) 27.8°C (82°F) wet bulb (non-coincident) - Minimum: -23.3°C (-10°F) **0% Exceedance Values** - Maximum: 47.2°C (117°F) dry bulb 26.7°C (80°F) wet bulb (mean coincident) 31.1°C (88°F) wet bulb (non-coincident) - Minimum: -40°C (-40°F)

Table 5.1-1 Envelope of ESBWR Standard Plant Site Parameters (continued)

Soil Properties: [6]	- Minimum Static Bearing Capacity [2]: Greater than or equal to the maximum static bearing demand. Maximum Static Bearing Demand: Reactor/Fuel Building: 699 kPa (14,600 lbf/ft^2) Control Building: 292 kPa (6,100 lbf/ft^2) Fire Water Service Complex: 165 kPa (3,450 lbf/ft^2) - Minimum Dynamic Bearing Capacity [2]: Greater than or equal to the maximum dynamic bearing demand. Maximum Dynamic Bearing Demand (SSE + Static): **Reactor/Fuel Building:** Soft: 1100 kPa (23,000 lbf/ft^2) Medium: 2700 kPa (56,400 lbf/ft^2) Hard: 1100 kPa (23,000 lbf/ft^2) **Control Building:** Soft: 500 kPa (10,500 lbf/ft^2) Medium: 2200 kPa (46,000 lbf/ft^2) Hard: 420 kPa (8,800 lbf/ft^2) **Firewater Service Complex (FWSC):** Soft: 460 kPa (9,600 lbf/ft^2) Medium: 690 kPa (14,400 lbf/ft^2) Hard: 1200 kPa (25,100 lbf/ft^2) - Minimum Shear Wave Velocity: [3] 300 m/s (1000 ft/s) - Liquefaction Potential: Seismic Category I Structures: None under footprint of Seismic Category I structures resulting from site-specific SSE. - Angle of Internal Friction (in-situ and backfill): ≥ 35 degrees - Backfill on sides of and underneath Seismic Category I structures Product of peak ground acceleration α (in g), Poisson's ratio ν and density γ: $\alpha(0.95\nu+0.65)\gamma$: 1220 kg/m^3 (76 lbf/ft^3) maximum Product of at-rest pressure coefficient k_0 and density: $k_0\gamma$: 750 kg/m^3 (47 lbf/ft^3) minimum Soil density: γ: 2000 kg/m^3 (125 lbf/ft^3) minimum
Seismology:	- SSE Horizontal Ground Response Spectra: [4] See Figure 5.1-1 - SSE Vertical Ground Response Spectra: [4] See Figure 5.1-2

Table 5.1-1 Envelope of ESBWR Standard Plant Site Parameters (continued)

Hazards in Site Vicinity:	- Site Proximity Missiles and Aircraft: - Volcanic Activity: - Toxic Gases:	< about 10^{-7} per year None None *
*Maximum toxic gas concentrations at the MCR HVAC intakes:	< toxicity limits	
Required Stability of Slopes:	- Factor of safety for static (non-seismic) loading - Factor of safety for dynamic (seismic) loading due to site-specific SSE	1.5 1.1
Maximum Settlement Values for Seismic Category I Buildings (5)		
Maximum Settlement at any corner of basemat	- Under Reactor/Fuel Building - Under Control Building - Under FWSC Structure	103 mm (4.0 inches) 18 mm (0.7 inches) 17 mm (0.7 inches)
Average Settlement at four corners of basemat	- Under Reactor/Fuel Building - Under Control Building - Under FWSC Structure	65 mm (2.6 inches) 12 mm (0.5 inches) 10 mm (0.4 inches)
Maximum Differential Settlement along the longest mat foundation dimension	- within Reactor/Fuel Building - within Control Building - within FWSC Structure	77 mm (3.0 inches) 14 mm (0.6 inches) 12 mm (0.5 inches)
Maximum Differential Displacement between Reactor/Fuel Buildings and Control Building		85 mm (3.3 inches)

Table 5.1-1 Envelope of ESBWR Standard Plant Site Parameters (continued)

Meteorological Dispersion (X/Q):	EAB X/Q:		
	0-2 hours:	2.00E-03 s/m^3	
	LPZ X/Q:		
	0-8 hours:	1.90E-04 s/m^3	
	8-24 hours:	1.40E-04 s/m^3	
	1-4 days:	7.50E-05 s/m^3	
	4-30 days:	3.00E-05 s/m^3	
	Control Room X/Q: *		
* First value is for unfiltered inleakage. Second value is for air intakes (emergency and normal)	Reactor Building		
	0-2 hours:	1.90E-03 s/m^3	1.50E-03 s/m^3
	2-8 hours:	1.30E-03 s/m^3	1.10E-03 s/m^3
	8-24 hours:	5.90E-04 s/m^3	5.00E-04 s/m^3
	1-4 days:	5.00E-04 s/m^3	4.20E-04 s/m^3
	4-30 days:	4.40E-04 s/m^3	3.80E-04 s/m^3
	Passive Containment Cooling System / Reactor Building Roof		
	0-2 hours:	3.40E-03 s/m^3	3.00E-03 s/m^3
	2-8 hours:	2.70E-03 s/m^3	2.50E-03 s/m^3
	8-24 hours:	1.40E-03 s/m^3	1.20E-03 s/m^3
	1-4 days:	1.10E-03 s/m^3	9.00E-04 s/m^3
	4-30 days:	7.90E-04 s/m^3	7.00E-04 s/m^3
	HELB Blowout Panels/Reactor Building		
	0-2 hours:	7.00E-03 s/m^3	5.90E-03 s/m^3
	2-8 hours:	5.00E-03 s/m^3	4.70E-03 s/m^3
	8-24 hours:	2.10E-03 s/m^3	1.50E-03 s/m^3
	1-4 days:	1.70E-03 s/m^3	1.10E-03 s/m^3
	4-30 days:	1.50E-03 s/m^3	1.00E-03 s/m^3
	Turbine Building		
	0-2 hours:	1.20E-03 s/m^3	1.20E-03 s/m^3
	2-8 hours:	9.80E-04 s/m^3	9.80E-04 s/m^3
	8-24 hours:	3.90E-04 s/m^3	3.90E-04 s/m^3
	1-4 days:	3.80E-04 s/m^3	3.80E-04 s/m^3
	4-30 days:	3.20E-04 s/m^3	3.20E-04 s/m^3
	Fuel Building		
	0-2 hours:	2.80E-03 s/m^3	2.80E-03 s/m^3
	2-8 hours:	2.50E-03 s/m^3	2.50E-03 s/m^3
	8-24 hours:	1.25E-03 s/m^3	1.25E-03 s/m^3
	1-4 days:	1.10E-03 s/m^3	1.10E-03 s/m^3
	4-30 days:	1.00E-03 s/m^3	1.00E-03 s/m^3

Table 5.1-1 Envelope of ESBWR Standard Plant Site Parameters (continued)

Meteorological Dispersion (X/Q):	Technical Support Center X/Q:*		
(continued)	Reactor Building		
	0-2 hours:	1.00E-03 s/m^3	1.00E-03 s/m^3
	2-8 hours:	6.00E-04 s/m^3	6.00E-04 s/m^3
	8-24 hours:	3.00E-04 s/m^3	3.00E-04 s/m^3
	1-4 days:	2.00E-04 s/m^3	2.00E-04 s/m^3
	4-30 days:	1.00E-04 s/m^3	1.00E-04 s/m^3
	Turbine Building		
	0-2 hours:	2.00E-03 s/m^3	2.00E-03 s/m^3
	2-8 hours:	1.50E-03 s/m^3	1.50E-03 s/m^3
	8-24 hours:	8.00E-04 s/m^3	8.00E-04 s/m^3
	1-4 days:	6.00E-04 s/m^3	6.00E-04 s/m^3
	4-30 days:	5.00E-04 s/m^3	5.00E-04 s/m^3
	Passive Containment Cooling System / Reactor Building Roof		
	0-2 hours:	2.00E-03 s/m^3	2.00E-03 s/m^3
	2-8 hours:	1.10E-03 s/m^3	1.10E-03 s/m^3
	8-24 hours:	5.00E-04 s/m^3	5.00E-04 s/m^3
	1-4 days:	4.00E-04 s/m^3	4.00E-04 s/m^3
	4-30 days:	3.00E-04 s/m^3	3.00E-04 s/m^3

Notes:

(1) The site parameters defined in this table are applicable to Seismic Category I, II, and Radwaste Building structures, unless noted otherwise.

(2) At the foundation level of Seismic Category I structures. The dynamic bearing pressure is the toe pressure. The maximum static bearing demand is compared with the site-specific allowable static bearing pressure, which is obtained by dividing the ultimate soil bearing capacity by a factor of safety appropriate for the design load combination. The maximum dynamic bearing demand is compared with the site-specific allowable dynamic bearing pressure, which is obtained by dividing the ultimate soil bearing capacity by a factor of safety appropriate for the design load combination. When a site-specific shear wave velocity is between soft soil and medium soil the larger of the soft or medium maximum dynamic bearing demand will be used. When a site-specific shear wave velocity is between medium soil and hard soil the larger of the medium or hard maximum dynamic bearing demand will be used. Alternatively, for soils with a site-specific shear wave velocity a linearly interpolated dynamic bearing demand between soft and medium soil or between medium and hard soil can be used. The shear wave velocities of soft, medium and hard soils are 300 m/sec (1000 ft/sec), 800 m/sec (2600 ft/sec) and greater than or equal to 1700 m/sec (5600 ft/sec), respectively.

(3) This is the minimum shear wave velocity of the supporting foundation material and material surrounding the embedded walls associated with seismic strains for lower bound soil properties at minus one sigma from the mean. The ratio of the largest to the smallest shear wave velocity over the mat foundation width of the supporting foundation material does not exceed 1.7.

Table 5.1-1 Envelope of ESBWR Standard Plant Site Parameters (continued)

(4) Safe Shutdown Earthquake (SSE) design ground response spectra of 5% damping, also termed Certified Seismic Design Response Spectra (CSDRS), are defined as free-field outcrop spectra at the foundation level (bottom of the base slab) of the Reactor/Fuel and Control Building structures. For the Firewater Service Complex, which is essentially a surface founded structure, the CSDRS is 1.35 times the values shown in Figures 5.1-1 and 5.1-2 and is defined as free-field outcrop spectra at the foundation level (bottom of the base slab) of the Firewater Service Complex structure.

(5) Settlement values are long-term (post-construction) values except for differential settlement within the foundation mat. The design of the foundation mat accommodates immediate and long-term (post construction) differential settlements after the installation of the basemat.

(6) For sites not meeting the soil property requirements, a site-specific analysis is required to demonstrate the adequacy of the standard plant design.

(7) Tornado missiles do not apply to Seismic Category NS and Seismic Category II buildings. For the Radwaste Building, the tornado missiles defined in Regulatory Guide 1.143, Table 2, Class RW-IIa apply. The hurricane missile spectrum for Seismic Category NS and Seismic Category II structures that house RTNSS equipment is consistent with the tornado missile spectrum identified in this table.

(8) Values were selected to comply with expected requirements of southeastern coastal locations, which include the consideration of hurricanes as described in ASCE 7-02. Wind speeds are considered to be at 10 m (33 ft) above ground per ASCE 7-02. Seismic Category NS buildings that house RTNSS equipment are designed to withstand hurricane Category 5 wind velocity at 87.2 m/s (195 mph), 3-second gust, and missiles generated by that wind velocity.

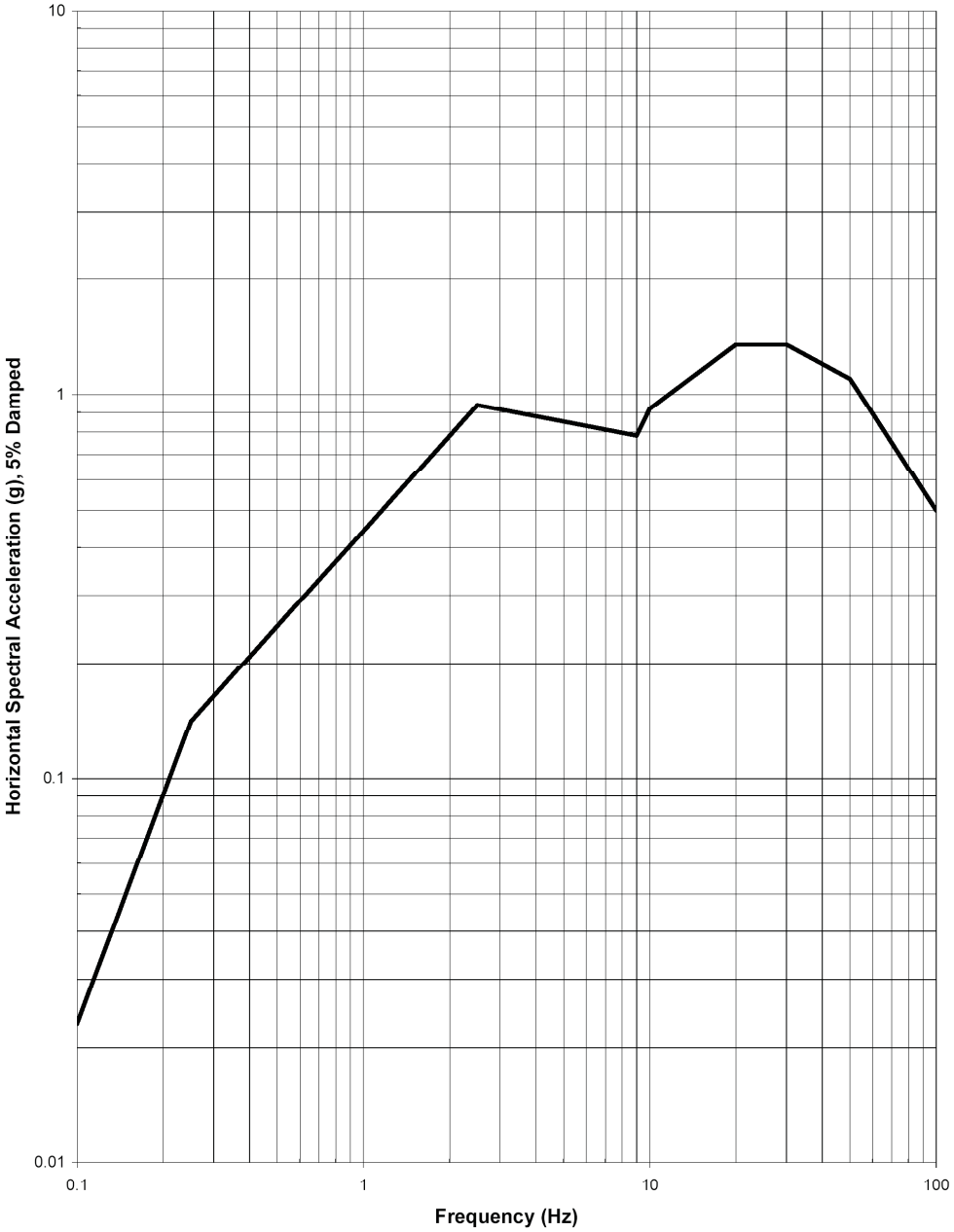

Figure 5.1-1. ESBWR Horizontal SSE Design Ground Spectra at Foundation Level

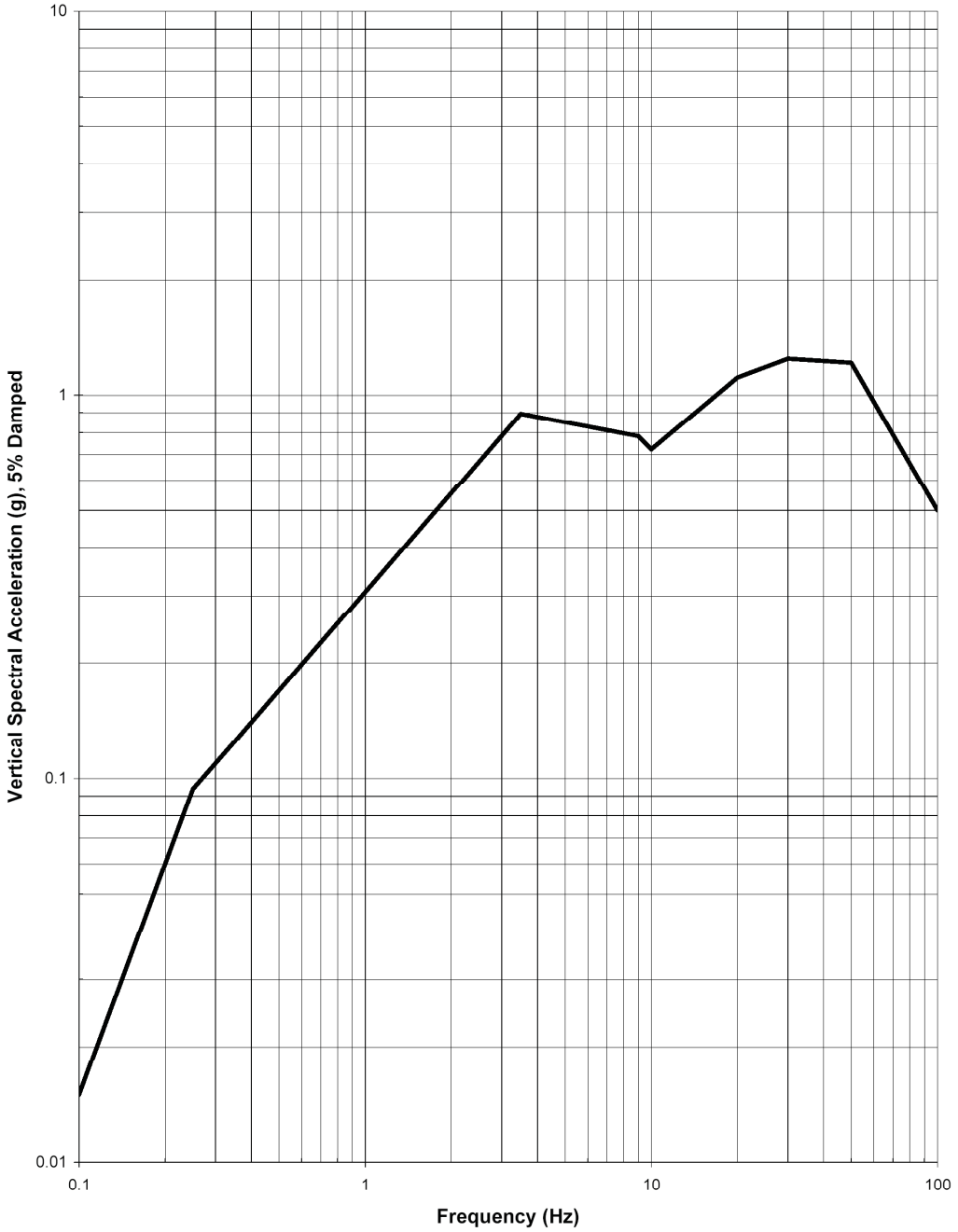

Figure 5.1-2. ESBWR Vertical SSE Design Ground Response Spectra at Foundation Level