RAIO-1217-57509

December 07, 2017

Docket No. 52-048

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

SUBJECT: NuScale Power, LLC Supplemental Response to NRC Request for Additional Information No. 164 (eRAI No. 8935) on the NuScale Design Certification Application

REFERENCES:
1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 164 (eRAI No. 8935)," dated August 11, 2017
2. NuScale Power, LLC Response to NRC "Request for Additional Information No. 164 (eRAI No.8935)," dated October 06, 2017

The purpose of this letter is to provide the NuScale Power, LLC (NuScale) supplemental response to the referenced NRC Request for Additional Information (RAI).

The Enclosure to this letter contains NuScale's supplemental response to the following RAI Question from NRC eRAI No. 8935:

- 03.07.02-24

This letter and the enclosed response make no new regulatory commitments and no revisions to any existing regulatory commitments.

If you have any questions on this response, please contact Marty Bryan at 541-452-7172 or at mbryan@nuscalepower.com.

Sincerely,

Zackary W. Rad
Director, Regulatory Affairs
NuScale Power, LLC

Distribution: Gregory Cranston, NRC, OWFN-8G9A
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Enclosure 1: NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 8935

Enclosure 1:

NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 8935

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Response to Request for Additional Information
Docket No. 52-048

eRAI No.: 8935
Date of RAI Issue: 08/11/2017

NRC Question No.: 03.07.02-24

10 CFR 50 Appendix S requires that the safety functions of structures, systems, and components (SSCs) must be assured during and after the vibratory ground motion associated with the Safe Shutdown Earthquake (SSE) through design, testing, or qualification methods.

On Page 3.7-37 of the FSAR, Rev 0, the staff notes that there are 540 SSI analysis cases with five CSDRS compatible time history inputs and 72 SSI analysis cases with one CSDRS-HF compatible time history input. Staff is not able to discern which of these analysis cases correspond with
which SSCs.
Please update the FSAR to include a table to summarize the above-mentioned analysis cases with the following breakdown based on these SSCs:

a. Analysis cases used to establish the seismic demands (loads and ISRS) for each of the seismic Category I buildings, RXB and CRB.
b. Analysis cases used to establish the seismic demands (loads and ISRS) for the NuScale Power Module, Bioshield, Reactor Building Crane, Fuel Handling Crane, Fuel Storage Rack, Reactor Flange Tool, and Containment Flange Tool.

NuScale Response:

As discussed, during a public meeting with the staff on November 7, 2017, the following information is provided to supplement NuScale's original response to RAI 8935 03.07.02-24.

FSAR Tier 1, Table 5.0-1 and Tier 2, Table 2.0-1 have been updated to clarify that the RXB and CRB are designed for both the CSDRS and CSDRS-HF and that other Category I SSCs are designed only for the CSDRS.

The definition of the term, "safe shutdown earthquake (SSE)," is added to FSAR Tier 1, Section 1.1. Safe shutdown earthquake is also defined in FSAR Tier 2, Section 3.7, Seismic Design.

Notes have been added to FSAR Tier 1, Figures 5.0-3 and 5.0-4, and Tier 2 Figures 3.7.1-3 and

3.7.1-4 to clarify the basis of the “design basis seismic loads” for applicable SSCs.

Impact on DCA:

FSAR Tier 1, Section 1.1, Table 5.0-1, Figures 5.0-3 and 5.0-4, and Tier 2 Table 2.0-1, Figures 3.7.1-3 and 3.7.1-4 have been revised as described in the response above and as shown in the markup provided in this response.

assurance that the facility has been constructed and will be operated in conformity with the license, the provisions of the Atomic Energy Act, as amended, and the Commission's rules and regulations.

NuScale Power Module (NPM) is a collection of systems, sub-systems, and components that together constitute a modularized, movable, nuclear steam supply system. The NPM is composed of a reactor core, a pressurizer, and two steam generators integrated within a reactor pressure vessel and housed in a compact steel containment vessel.

Reconciliation or **Reconciled** means the identification, assessment, and disposition of differences between an approved design feature and an as-built plant design feature. For ASME Code piping systems, it is the reconciliation of differences between the approved design and the as-built piping system. For structural features, it is the reconciliation of differences between the approved design and the as-built structural feature.

Report, as used in the ITAAC table Acceptance Criteria column, means a document that verifies that the acceptance criteria of the subject ITAAC have been met and references the supporting documentation. The report may be a simple form that consolidates all of the necessary information related to the closure package for supporting successful completion of the ITAAC.

Common or Shared ITAAC means ITAAC that are associated with common or shared SSC and activities that support multiple NPMs. This includes (1) SSC that are common or shared by multiple NPMs, and for which the interface and functional performance requirements between the common or shared SSC and each NPM are identical, or (2) analyses or other generic design and qualification activities that are identical for each NPM (e.g., environmental qualification of equipment). For a multi-module plant, satisfactory completion of a common or shared ITAAC for the lead NPM shall constitute satisfactory completion of the common or shared ITAAC for associated NPMs.

RAI 03.07.02-24S1

Safe Shutdown Earthquake (SSE) Ground Motion is the site-specific vibratory ground motion for which safety-related SSC are designed to remain functional. The SSE for a site is a smoothed spectra developed to envelop the GMRS. The SSE is characterized at the free ground surface. A combined license (COL) applicant may use the SSE for design of site specific SSC.

System Description (Tier 1) includes

- a concise description of the system's or structure's safety-related functions, nonsafety-related functions that support safety-related functions, and certain nonsafety risk-significant functions.
- a listing of components required to perform those functions.
- identification of the system safety classification.
- the system components' general locations.

The system description may include system description tables and figures.

Test means actuation or operation, or establishment of specified conditions, to evaluate the performance or integrity of as-built SSC, unless explicitly stated otherwise, to determine whether ITAAC are met.

RAI 03.07.02-24S1, RAI 03.08.05-1, RAI 03.08.05-8

Table 5.0-1: Site Design Parameters

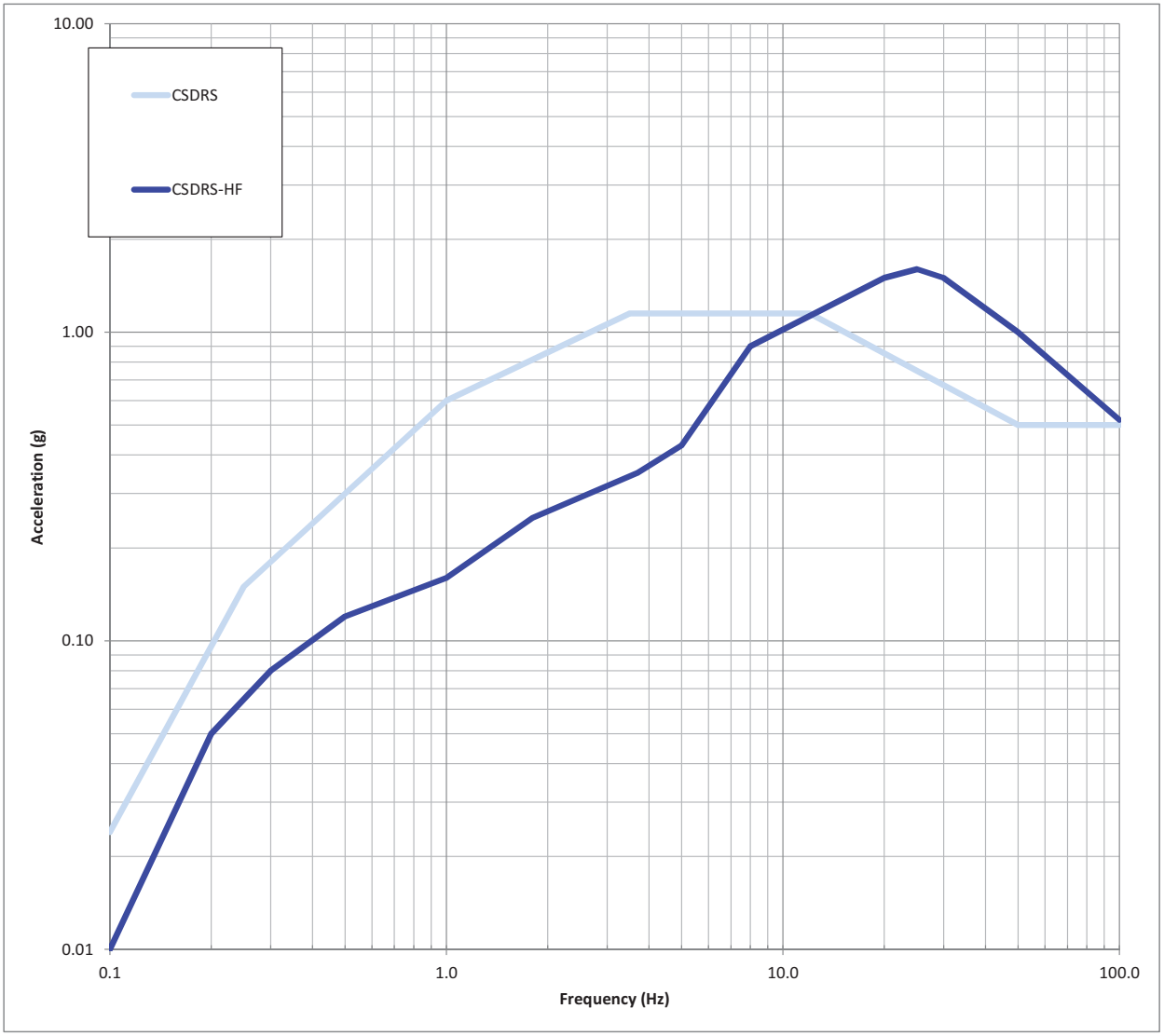
Site Characteristic/Parameter	NuScale Design Parameter
Nearby Industrial, Transportation, and Military Facilities	
External hazards on plant structures, systems, and components (SSC) (e.g., explosions, fires, release of toxic chemicals and flammable clouds, pressure effects) on plant SSC	No external hazards
Aircraft hazards on plant SSC	No aircraft hazards
Meteorology	
Maximum precipitation rate	19.4 in. per hour 6.3 in. for a 5-minute period
Normal roof snow load	50 psf
Extreme roof snow load	75 psf
100-year return period 3-second wind gust speed	145 mph (Exposure Category C) with an importance factor of 1.15 for Reactor Building, Control Building, and Radioactive Waste Building
Design Basis Tornado • maximum horizontal wind speed • maximum translational speed • maximum rotational speed • maximum radius of rotational speed • maximum pressure differential • maximum rate of pressure drop	 230 mph 46 mph 184 mph 150 ft 1.2 psi 0.5 psi/sec
Tornado missile spectra	Table 2 of Regulatory Guide 1.76, Revision 1, Region 1.
Maximum wind speed design basis hurricane	290 mph
Hurricane missile spectra	Tables 1 and 2 of Regulatory Guide1.221, Revision 0.
Summer outdoor design dry bulb temperature	115°F
Winter outdoor design dry-bulb temperature	-40°F
Summer outdoor wet bulb temperature coincident non-coincident	 80°F 81°F
Accident release χ/Q values at security owner controlled area fence 0-2 hr 2-8 hr 8-24 hr 24-96 hr 96-720 hr	 ~~5.72~~6.22E-04 s/m^3 ~~4.85~~5.27E-04 s/m^3 ~~2.14~~2.41E-04 s/m^3 ~~2.15~~2.51E-04 s/m^3 ~~1.95~~2.46E-04 s/m^3
Accident release χ/Q values at main control room/ technical support center door and heating ventilation and air conditioning intake (approximately 112 feet from source)	Door / Heating Ventilation and Air Conditioning Intake
0-2 hr	6.50E-03 s/m^3 / 6.50E-03 s/m^3
2-8 hr	5.34E-03 s/m^3 / 5.34E-03 s/m^3
8-24 hr	2.32E-03 s/m^3 / 2.32E-03 s/m^3
1-4 day	2.37E-03 s/m^3 / 2.37E-03 s/m^3
4-30 day	2.14E-03 s/m^3 / 2.14E-03 s/m^3
Hydrologic Engineering	
Maximum flood elevation Probable maximum flood and coincident wind wave and other effects on maximum flood level	 1 foot below the baseline plant elevation
Maximum elevation of groundwater	2 feet below the baseline plant elevation

Table 5.0-1: Site Design Parameters (Continued)

Site Characteristic/Parameter	NuScale Design Parameter
Geology, Seismology, and Geotechnical Engineering	
Ground motion response spectra/safe shutdown earthquake	See Figure 5.0-1 and Figure 5.0-2 for horizontal and vertical certified seismic design response spectra for all Seismic Category I SSC. and See Figure 5.0-3 and Figure 5.0-4 for horizontal and vertical high frequency certified seismic design response spectra for Reactor Building and Control Building.
Fault displacement potential	No fault displacement potential
Minimum soil bearing capacity (Q_{ult}) beneath safety-related structures	75 ksf
Lateral soil variability	Uniform site (± 20 degree dip)
Soil angle of internal friction	30 degrees
Coefficient of Friction (COF) Between Concrete Foundation and Soil (RXB and CRB Static Analysis):~~Minimum coefficient of static friction (all interfaces between basemat and soil)~~ Coefficient of Friction (COF) Between Concrete Foundation and Soil (CRB Nonlinear Analysis):	0.58 ~~0.58~~0.55
Coefficient of Friction (COF) Between Concrete Walls and Soil	0.5
Minimum shear wave velocity	≥ 1000 fps at bottom of foundation
Maximum settlement for the Reactor Building, Control Building, and Radioactive Waste Building: • total settlement • tilt settlement • differential settlement (between Reactor Building and Control Building, and Reactor Building and Radioactive Waste Building)	 ~~No limit~~4 inches ~~1 inch per 50 feet in any direction~~Maximum of 0.5 inch per 50 feet of building length or 1 inch total in any direction at any point in these structures ~~No limit~~0.5 inch
Slope failure potential	No slope failure potential

RAI 03.07.02-24S1

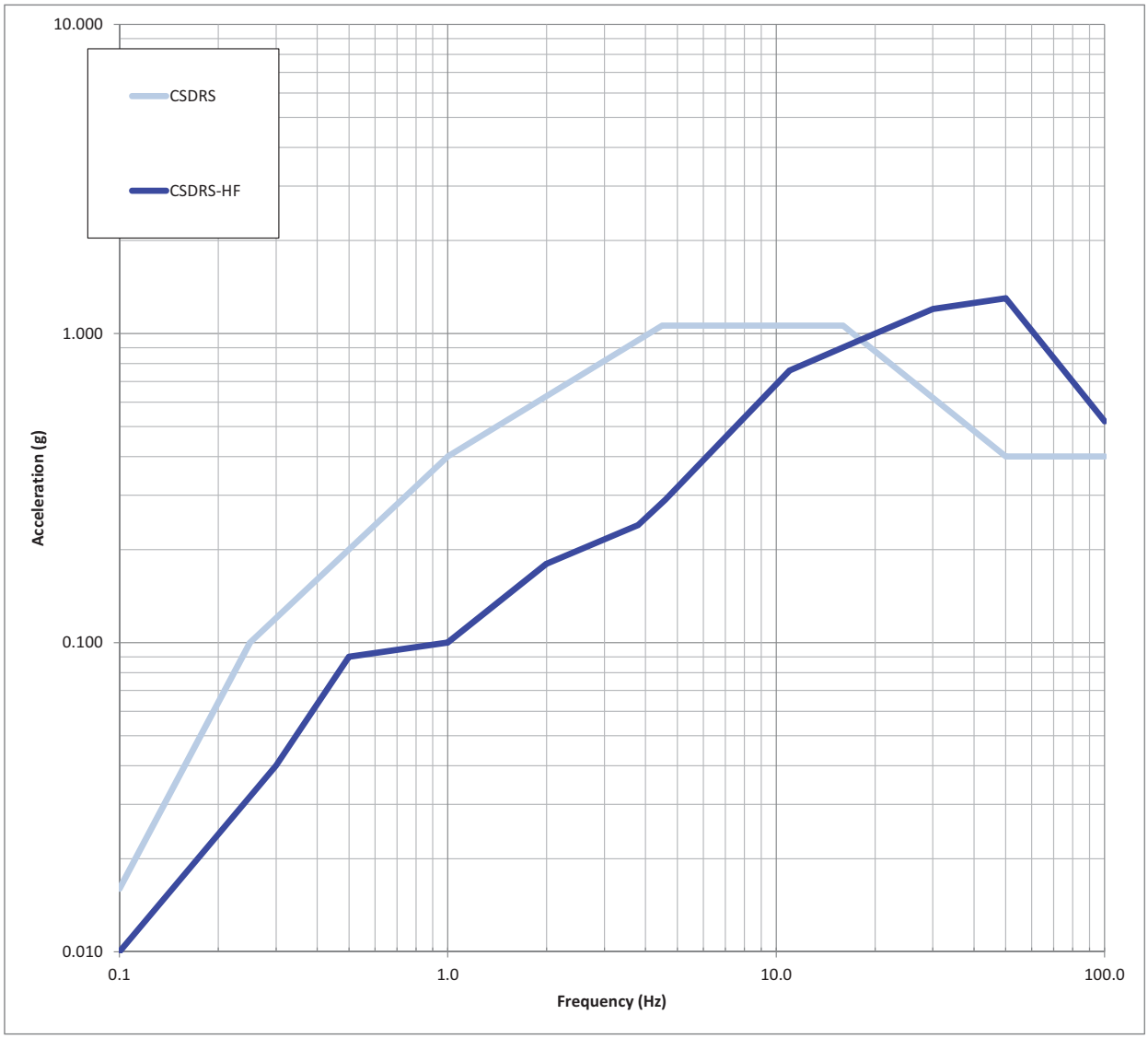
Figure 5.0-3: NuScale Horizontal Certified Seismic Design Response Spectra - High Frequency 5% Damping



Note: CSDRS-HF is evaluated for the RXB and CRB only

RAI 03.07.02-24S1

Figure 5.0-4: NuScale Vertical Certified Seismic Design Response Spectra - High Frequency 5% Damping



Note: CSDRS-HF is evaluated for the RXB and CRB only

RAI 02.03.01-2, RAI 03.07.02-24S1, RAI 03.08.05-1, RAI 03.08.05-8

Table 2.0-1: Site Design Parameters

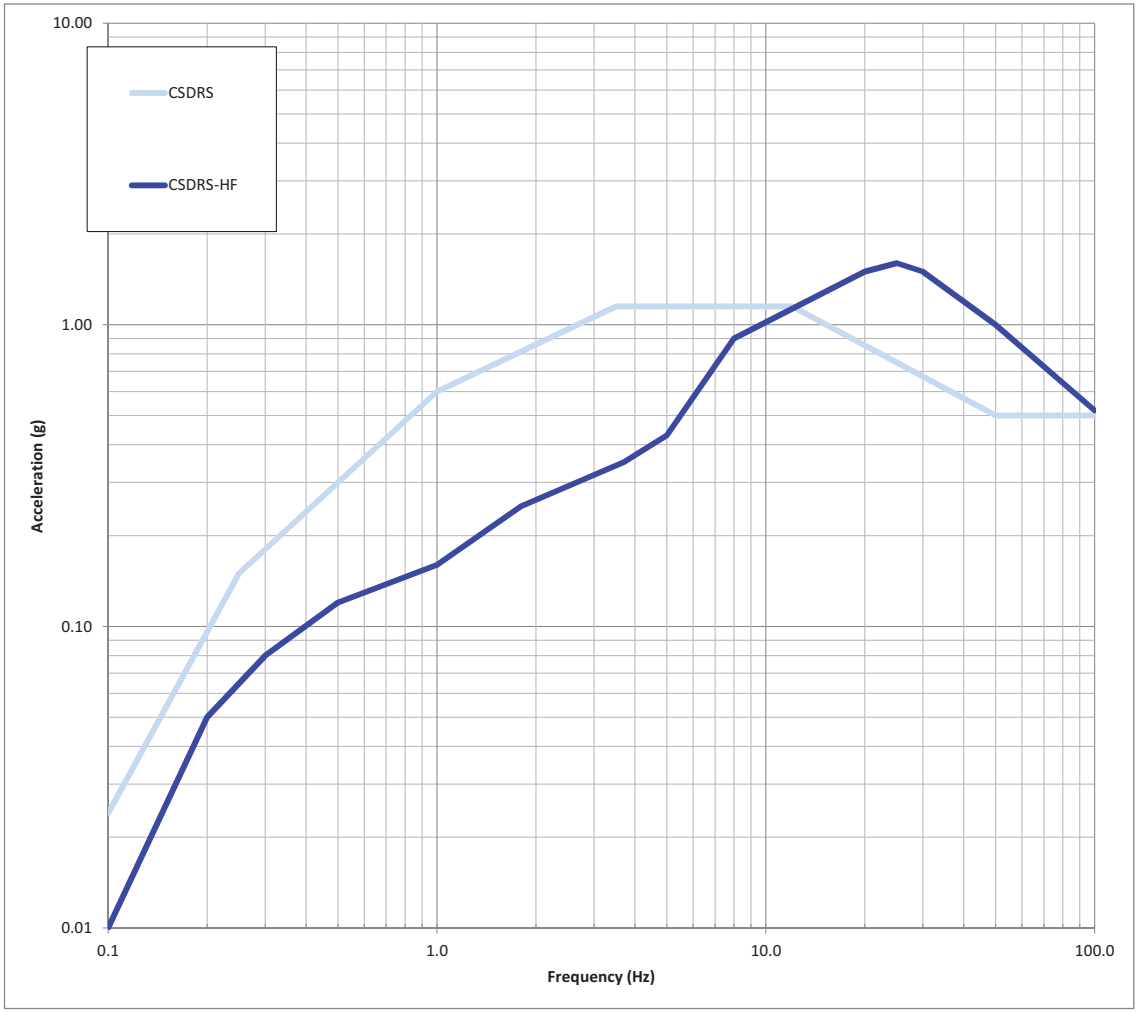
Site Characteristic / Parameter	NuScale Design Parameter
Geography and Demography (Section 2.1)	
Minimum exclusion area boundary	Security owner controlled area fence
Minimum outer boundary of low population zone	Security owner controlled area fence
Nearby Industrial, Transportation, and Military Facilities (Section 2.2)	
External hazards on plant systems, structures, and components (SSC) (e.g., explosions, fires, release of toxic chemicals and flammable clouds, pressure effects) on plant SSC	No external hazards
Aircraft hazards on plant SSC	No design basis aircraft hazards
Meteorology (Section 2.3)	
Maximum precipitation rate	19.4 inches per hour 6.3 inches for a 5 minute period
Normal roof snow load	50 psf
Extreme roof snow load	75 psf
100-year return period 3-second wind gust speed	145 mph (exposure Category C) with an importance factor of 1.15 for Reactor Building, Control Building and Radioactive Waste Building
Design basis tornado maximum horizontal wind speed maximum translational speed maximum rotational speed maximum radius of rotational speed maximum pressure differential maximum rate of pressure drop	 230 mph 46 mph 184 mph 150 ft 1.2 psi 0.5 psi/sec
Tornado missile spectra	Table 2 of Regulatory Guide 1.76, Revision 1, Region 1
Maximum wind speed design basis hurricane	290 mph
Hurricane missile spectra	Tables 1 and 2 of Regulatory Guide 1.221, Revision 0
Summer outdoor design dry bulb temperature	115°F
Winter outdoor design dry-bulb temperature	-40°F
Summer outdoor wet bulb temperature coincident non-coincident	 80°F 81°F
~~Accident airborne effluent release point characteristics for offsite receptors~~ ~~release height~~ ~~adjacent building height~~ ~~adjacent building cross-sectional area~~	 ~~ground level (0 meters)~~ ~~negligible~~ ~~negligible (0.1 square meters)~~
Accident release χ/Q values at security owner controlled area fence 0-2 hr 2-8 hr 8-24 hr 24-96 hr 96-720 hr	 ~~5.72~~6.22E-04 s/m^3 ~~4.85~~5.27E-04 s/m^3 ~~2.14~~2.41E-04 s/m^3 ~~2.15~~2.51E-04 s/m^3 ~~1.95~~2.46E-04 s/m^3
Accident release χ/Q values at main control room/technical support center door and HVAC intake (approximately 112 feet from source) 0-2 hr 2-8 hr	Door / HVAC Intake 6.50E-03 s/m^3 / 6.50E-03 s/m^3 5.34E-03 s/m^3 / 5.34E-03 s/m^3

Table 2.0-1: Site Design Parameters (Continued)

Site Characteristic / Parameter	NuScale Design Parameter
8-24 hr	2.32E-03 s/m^3 2.32E-03 s/m^3
1-4 day	2.37E-03 s/m^3 2.37E-03 s/m^3
4-30 day	2.14E-03 s/m^3 2.14E-03 s/m^3
~~Routine airborne effluent release point characteristics for offsite receptors~~	
~~release location~~	~~Any point on Reactor Building or Turbine Building wall~~
~~release height~~	~~37.0 meters~~
~~vent/stack exit velocity~~	~~0.0 meters/second~~
~~vent/stack inside diameter~~	~~0.0 meters~~
~~vent/stack exhaust orientation (vertical, horizontal, or other)~~	~~not applicable~~
~~restrictions to exhaust Air flow (e.g., rain caps)~~	~~not applicable~~
~~adjacent building height~~	~~0.0 meters~~
~~adjacent building cross-sectional area~~	~~0.01 square meters~~
~~Annual average routine release χ/Q values at the security owner controlled area fence~~	~~3.64E-04 s/m^3~~
Routine release χ/Q and D/Q values at site boundary and locations of interest	
undepleted/no decay	5.43E-05 ~~m/s^3~~ s/m^3
undepleted/2.26-day decay	5.43E-05 ~~m/s^3~~ s/m^3
depleted/8.00-day decay	5.43E-05 ~~m/s^3~~ s/m^3
D/Q	5.43E-07 1/m^2
Hydrologic Engineering (Section 2.4)	
Maximum flood elevation probable maximum flood and coincident wind wave and other effects on max flood level	1 foot below the baseline plant elevation
Maximum elevation of groundwater	2 feet below the baseline plant elevation
Site grading	~~Site is properly graded and has adequate drainage to prevent localized flooding~~The yard is graded with a minimum slope of 1.5% away from building structures.
Geology, Seismology, and Geotechnical Engineering (Section 2.5)	
Ground motion response spectra /safe shutdown earthquake	See Figures 3.7.1-1 and 3.7.1-2 for horizontal and vertical certified seismic design response spectra for all Seismic Category I SSC. See Figures 3.7.1-3 and 3.7.1-4 for horizontal and vertical high frequency certified seismic design response spectra for Reactor Building and Control Building.
Fault displacement potential	No fault displacement potential
Minimum soil bearing capacity (Q_{ult}) beneath safety-related structures	75 ksf
Lateral soil variability	Uniform site (+/- 20 degree dip)
Soil angle of internal friction	30 degrees
~~Minimum coefficient of static friction (all interfaces between basemat and soil)~~Coefficient of Friction (COF) Between Concrete Foundation and Soil (RXB and CRB Static Analysis):	0.58~~0.58~~
Coefficient of Friction (COF) Between Concrete Foundation and Soil (CRB Nonlinear Analysis):	0.55
Coefficient of Friction (COF) Between Concrete Walls and Soil	0.5
Minimum shear wave velocity	≥ 1000 fps at bottom of foundation
Liquefaction potential	No liquefaction potential

RAI 03.07.02-24S1

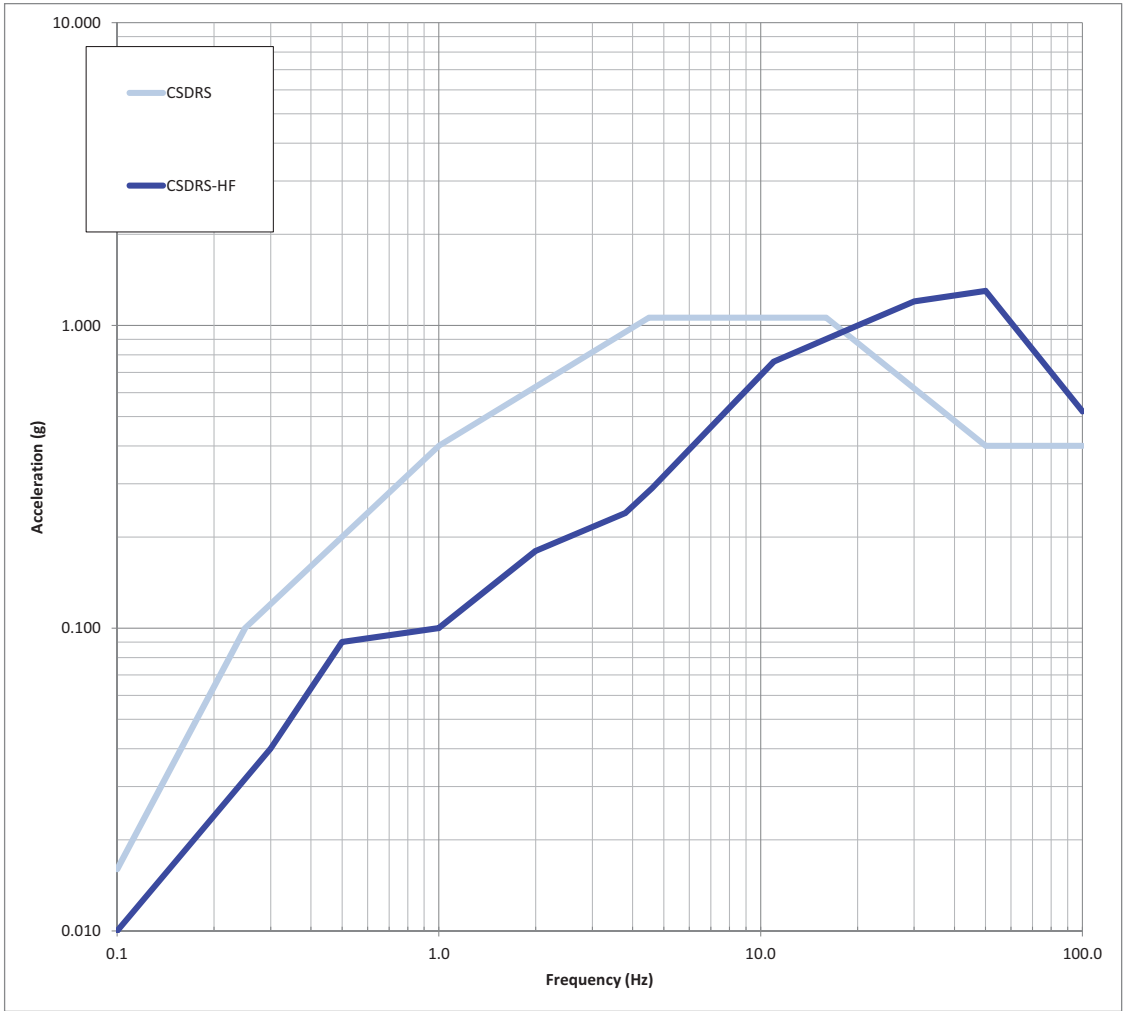
Figure 3.7.1-3: NuScale Horizontal CSDRS-HF at 5 Percent Damping



Note: CSDRS-HF is evaluated for the RXB and CRB only

RAI 03.07.02-24S1

Figure 3.7.1-4: NuScale Vertical CSDRS-HF at 5 Percent Damping



Note: CSDRS-HF is evaluated for the RXB and CRB only