December 3, 2022 Docket No. 99902078

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

SUBJECT: NuScale Power, LLC Submittal of the NuScale Standard Design Approval Application Part 2 – Final Safety Analysis Report, Chapter 2, “Site Characteristics and Site Parameters,” Revision 0

REFERENCES:

1. NuScale letter to NRC, “NuScale Power, LLC Submittal of Planned Standard Design Approval Application Content,” dated February 24, 2020 (ML20055E565)
2. NuScale letter to NRC, “NuScale Power, LLC Requests the NRC staff to conduct a pre-application readiness assessment of the draft, ‘NuScale Standard Design Approval Application (SDAA),’” dated May 25, 2022 (ML22145A460)
3. NRC letter to NuScale, “Preapplication Readiness Assessment Report of the NuScale Power, LLC Standard Design Approval Draft Application,” Office of Nuclear Reactor Regulation dated November 15, 2022 (ML22305A518)
4. NuScale letter to NRC, “NuScale Power, LLC Staged Submittal of Planned Standard Design Approval Application,” dated November 21, 2022 (ML22325A349)

NuScale Power, LLC (NuScale) is pleased to submit Chapter 2 of the Standard Design Approval Application, “Site Characteristics and Site Parameters,” Revision 0. This chapter supports Part 2, “Final Safety Analysis Report,” of the NuScale Standard Design Approval Application (SDAA) (Reference 1). NuScale submits the chapter in accordance with requirements of 10 CFR 52 Subpart E, Standard Design Approvals. As described in Reference 4, the enclosure is part of a staged SDAA submittal. NuScale requests NRC review, approval, and granting of standard design approval for the US460 standard plant design.

From July 25, 2022 to October 26, 2022, the NRC performed a pre-application readiness assessment of available portions of the draft NuScale Final Safety Analysis Report (FSAR) to determine the FSAR’s readiness for submittal and for subsequent review by NRC staff (References 2 and 3). The NRC staff reviewed draft Chapter 2. The NRC did not identify readiness issues with the chapter.

Enclosure 1 contains SDAA Part 2 Chapter 2, “Site Characteristics and Site Parameters,” Revision 0.

This letter makes no regulatory commitments and no revisions to any existing regulatory commitments.

If you have any questions, please contact Mark Shaver at 541-360-0630 or at mshaver@nuscalepower.com.

I declare under penalty of perjury that the foregoing is true and correct. Executed on December 3, 2022.

Sincerely,

Carrie Fosaaen
Senior Director, Regulatory Affairs
NuScale Power, LLC

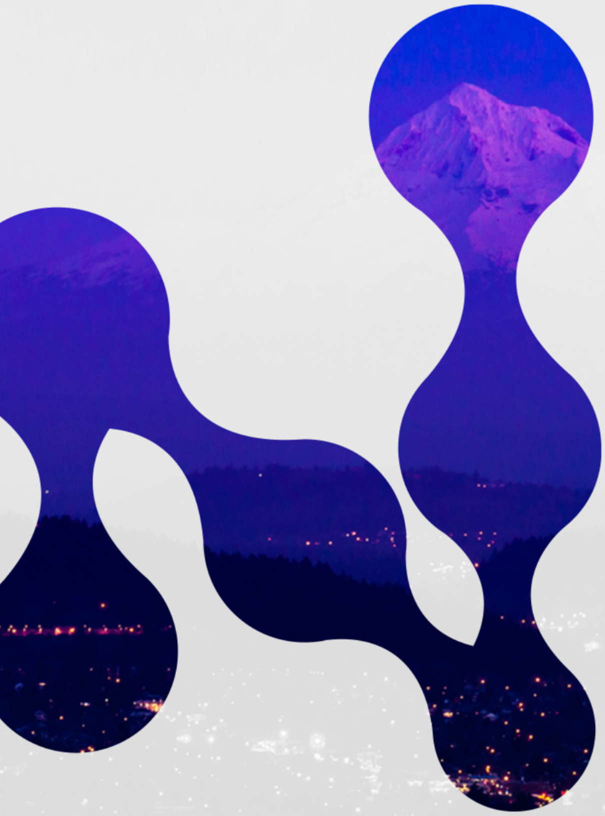
Distribution: Brian Smith, NRC
Michael Dudek, NRC
Getachew Tesfaye, NRC
Bruce Bavol, NRC

Enclosure 1: SDAA Part 2 Chapter 2, “Site Characteristics and Site Parameters,” Revision 0

Enclosure 1:

SDAA Part 2 Chapter 2, “Site Characteristics and Site Parameters,” Revision 0

NuScale Power, LLC
1100 NE Circle Blvd., Suite 200 Corvallis, Oregon 97330 Office 541.360-0500 Fax 541.207.3928
www.nuscalepower.com



NuScale US460 Plant
Standard Design Approval Application

Chapter Two
Site Characteristics and Site Parameters

Final Safety Analysis Report

Revision 0

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CHAPTER 2 SITE CHARACTERISTICS AND SITE PARAMETERS

2.0 Site Characteristics and Site Parameters

The NuScale Power Plant US460 standard design uses site parameters that are representative of a reasonable number of potential plant site locations in the United States. Table 2.0-1 summarizes these parameters.

COL Item 2.0-1: An applicant that references the NuScale Power Plant US460 standard design will demonstrate that site-specific characteristics are bounded by the site parameters specified in Table 2.0-1. If site-specific values are not bounded by the values in Table 2.0-1, the applicant will demonstrate the acceptability of the site-specific values in the appropriate sections of its license application.

Table 2.0-1: Site Parameters

Parameter Description	Site Parameter	References to Parameter
Geography and Demography (Section 2.1)		
Minimum exclusion area boundary	369 feet from the closest release point	Section 2.1 and Section 2.3.4
Minimum outer boundary of low population zone	369 feet from the closest release point	Section 2.1 and Section 2.3.4
Nearby Industrial, Transportation, and Military Facilities (Section 2.2)		
External hazards (e.g., explosions, fires, release of toxic chemicals and flammable clouds, pressure effects) on plant structures, systems, and components (SSC)	No external hazards	Section 2.2
Aircraft hazards on plant SSC	No design basis aircraft hazards	Section 2.2 and Section 3.5.1
Meteorology (Section 2.3)		
Maximum precipitation rate	19.4 inches per hour 6.3 inches for a 5 minute period	Section 3.4.2
Normal roof snow load	50 psf	Section 3.4.2 and Section 3.8.4
Extreme roof snow load	75 psf	Section 3.4.2 and Section 3.8.4
100-year return period 3-second wind gust speed	190 mph (Exposure Category C) with an importance factor of 1.15 for Reactor Building (RXB), Control Building (CRB), and Radioactive Waste Building (RWB)	Section 3.3.1 and Section 3.8.4
Design basis tornado maximum wind speed translational speed maximum rotational speed radius of maximum rotational speed pressure drop rate of pressure drop	 270 mph 55 mph 215 mph 150 ft 1.6 psi 0.9 psi/sec	Section 3.3 and Section 3.8.4
Tornado missile spectra	Table 2 of Regulatory Guide 1.76, Revision 1, Region I	Section 3.3, Section 3.5.1, Section 3.5.2, and Section 3.5.3
Maximum wind speed design basis hurricane	290 mph	Section 3.3 and Section 3.8.4
Hurricane missile spectra	Tables 1 and 2 of Regulatory Guide 1.221, Revision 0	Section 3.5.1, Section 3.3, Section 3.5.2, and Section 3.5.3
Accident release χ/Q values at exclusion area boundary and outer boundary of low population zone[(1)]		
0-2 hr	8.96E-04 s/m^3	Section 15.0.3 and Section 11.3.3
2-8 hr	7.41E-04 s/m^3	
8-24 hr	3.32E-04 s/m^3	
24-96 hr	3.63E-04 s/m^3	
96-720 hr	3.51E-04 s/m^3	

Table 2.0-1: Site Parameters (Continued)

Parameter Description	Site Parameter		References to Parameter
Accident release χ/Q values at main control room personnel access doors and HVAC intake	Door	HVAC Intake	
0-2 hr	3.50E-03 s/m^3	3.50E-03 s/m^3	Section 15.0.3
2-8 hr	2.83E-03 s/m^3	2.83E-03 s/m^3	
8-24 hr	1.26E-03 s/m^3	1.26E-03 s/m^3	
1-4 day	1.26E-03 s/m^3	1.26E-03 s/m^3	
4-30 day	1.14E-03 s/m^3	1.14E-03 s/m^3	
Routine release χ/Q and D/Q values at restricted area boundary			Section 11.3.3
χ/Q	9.98E-06 s/m^3		
D/Q	9.98E-08 1/m^2		
Zero percent exceedance values (historical limit excluding peaks <2 hours)			Section 3.8.4
Maximum outdoor design dry bulb temperature	115°F		
Maximum coincident wet bulb temperature	80°F		
Maximum non-coincident wet bulb temperature	81°F		
Minimum outdoor design dry bulb temperature	-40°F		
One percent annual exceedance values			
Maximum outdoor design dry bulb temperature	100°F		
Maximum coincident wet bulb temperature	77°F		
Maximum non-coincident wet bulb temperature	80°F		
Minimum outdoor design dry bulb temperature	-10°F		
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		Section 2.4.2, Section 3.4.2, and Section 3.8.5
Maximum elevation of groundwater	2 feet below the baseline plant elevation		Section 2.4.12, Section 3.4.2, Section 3.8.4, and Section 3.8.5
Geology, Seismology, and Geotechnical Engineering (Section 2.5)			
Ground motion response spectra/safe shutdown earthquake	Figure 3.7.1-1 and Figure 3.7.1-2 show horizontal and vertical certified seismic design response spectra for Seismic Category I SSC. Figure 3.7.1-3 and Figure 3.7.1-4 show horizontal and vertical high frequency certified seismic design response spectra - high frequency, for RXB and CRB.		Section 3.7.1.1 and Section 3.8.4
Fault displacement potential	No fault displacement potential		Section 2.5.3

Table 2.0-1: Site Parameters (Continued)

Parameter Description	Site Parameter	References to Parameter
Minimum allowable soil bearing capacities(2)(3) • RXB static bearing capacity • RXB dynamic bearing capacity • CRB static bearing capacity • CRB dynamic bearing capacity	 16 ksf 34 ksf 6 ksf 25 ksf	Section 2.5.4 and Section 3.8.5
Minimum soil angle of internal friction φ	30 degrees	Section 2.5.4 and Section 3.8.5
Minimum shear wave velocity	≥ 1000 fps at bottom of foundation	Section 2.5.4
Liquefaction potential	No liquefaction potential	Section 2.5.4
Coefficient of friction (CoF)	≥ 0.58 where CoF = tan (φ)	Section 2.5.4 and Section 3.8.5
Maximum settlement for the RXB, CRB, and RWB • Maximum tilt • Maximum total settlement • Maximum differential settlement	RXB / CRB / RWB 0.1 inches per 50 feet / 0.2 inches per 50 feet(4) / 0.3 inches per 50 feet 1.5 inches / 1.0 inches / 1.3 inches(5) 0.2 inches / 0.3 inches / 0.7 inches	Section 2.5.4 and Section 3.8.5
Slope failure potential	No slope failure potential	Section 2.5.5

Note 1: The χ/Q values provided are conservatively calculated based on approximately 90 percent of the exclusion area boundary distance.

Note 2: Minimum allowable soil bearing capacity is equivalent to the maximum soil bearing demand.

Note 3: Maximum static and dynamic bearing demands are obtained at the building base edges.

Note 4: For the Seismic Category I portion of the building.

Note 5: At the edge of the tunnels that extend towards the RXB.

2.1 Geography and Demography

The NuScale Power Plant US460 standard design considers that the exclusion area boundary and low population zone outer boundary are as close as 369 feet from the nearest release point. The minimum distance to the exclusion area boundary and low population zone boundary is a key site parameter and included in Table 2.0-1.

COL Item 2.1-1: An applicant that references the NuScale Power Plant US460 standard design will describe the site geographic and demographic characteristics.

2.2 Nearby Industrial, Transportation, and Military Facilities

The NuScale Power Plant US460 standard design does not postulate hazards from nearby industrial, transportation, or military facilities.

COL Item 2.2-1: An applicant that references the NuScale Power Plant US460 standard design will describe nearby industrial, transportation, and military facilities. The applicant will demonstrate that the design is acceptable for each of these potential hazards, or provide site-specific design alternatives.

2.3 Meteorology

The NuScale Power Plant US460 standard design uses meteorological parameters that are representative of a reasonable number of potential plant site locations in the United States. These parameters are discussed below and presented in Table 2.0-1.

COL Item 2.3-1: An applicant that references the NuScale Power Plant US460 standard design will describe the site-specific meteorological characteristics for Section 2.3.1 through Section 2.3.5, as applicable.

2.3.1 Regional Climatology

The design maximum precipitation rate is 19.4 inches per hour and 6.3 inches for a 5-minute period. These values come from NWS HMR #52 (Reference 2.3-1) and address the majority of locations in the contiguous United States.

The design normal roof snow load is 50 psf. For the extreme roof snow load, NuScale selected a value of 150 percent of the normal roof snow load, or 75 psf.

The design basis severe wind is a 3-second gust at 33 ft above ground for exposure category C. The wind speed is 190 mph. The wind speed is increased by an importance factor of 1.15 for the design of the site independent structures. These design parameters are based on ASCE/SEI 7-05 (Reference 2.3-2).

The parameters provided in Table 2.0-1 for the design-basis tornado and tornado missiles are the most severe tornado parameters postulated for the contiguous United States as identified in Regulatory Guide (RG) 1.76, “Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants,” Revision 1. The parameters for the design-basis hurricane and hurricane missiles are the most severe parameters postulated in RG 1.221, “Design-Basis Hurricane and Hurricane Missiles for Nuclear Power Plants,” Revision 0.

The design-basis dry-bulb and wet-bulb temperatures are based on the EPRI Utility Requirements Document (Reference 2.3-3). Pertinent zero percent and one percent annual exceedance values assumed in the design are provided in Table 2.0-1. The coincident wet-bulb temperature value represents the overall maximum wet-bulb temperature that is coincident with the indicated dry-bulb temperature.

2.3.2 Local Meteorology

Local meteorology is site-specific.

2.3.3 Onsite Meteorological Measurements Programs

Onsite meteorological measurement programs are site-specific.

2.3.4 Short-Term Atmospheric Dispersion Estimates for Accident Releases

Accidental Radioactive Releases

Topical Report TR-0915-17565-P-A, Revision 4 (Reference 2.3-4) describes the methodology for establishing source terms and calculating the atmospheric dispersion factors to determine accident radiological consequences at the Technical Support Center (TSC), main control room (MCR), and off-site locations for the design.

Atmospheric dispersion factors (χ/Q values) are determined at the exclusion area boundary and the low population zone outer boundary, which can be as close as 369 feet from the closest release point. These χ/Q values as well as the χ/Q values for the MCR are determined for various sites in the United States using a meteorological database with multiple years of data across regions of the United States. This approach determines that the meteorological dataset for Sacramento, California, between 1984-1986, is representative of the bounding 80th to 90th percentile of potential construction sites in the United States. NuScale uses this meteorological data set to calculate the χ/Q values for the design.

The χ/Q values at the exclusion area boundary and the low population zone outer boundary are listed in Table 2.0-1.

The χ/Q values for evaluation of doses in the MCR and TSC are determined at the Control Building (CRB) doors and heating, ventilation, and air conditioning inlet and are listed in Table 2.0-1. The limiting distance between Reactor Building (RXB) release points and CRB openings is that from the door in the RXB west wall to the door in the CRB south wall. Assumptions for release point characteristics for χ/Q calculations and MCR χ/Q calculations are listed in tables in Section 15.0.

The χ/Q values for the TSC are the same as the MCR because both are located on the same floor of the CRB and share the same heating, ventilation, and air conditioning inlet and outside doors.

2.3.5 Long-Term Atmospheric Dispersion Estimates for Routine Releases

NuScale uses the routine release χ/Q values and relative deposition factor (D/Q) values at the restricted area boundary provided in Table 2.0-1 to calculate release concentrations for comparison to the activity release limits in 10 CFR 20, as discussed in Section 11.3.

2.3.6 References

2.3-1 National Oceanic and Atmospheric Administration, “Application of Probable Maximum Precipitation Estimates - United States East of the 105th Meridian,” Hydrometeorological Report Number 52, Washington DC, August 1982.

2.3-2 American Society of Civil Engineers/Structural Engineering Institute, "Minimum Design Loads for Buildings and Other Structures," ASCE/SEI 7-05, Reston, VA.

2.3-3 Electrical Power Research Institute, "Advanced Nuclear Technology: Advanced Light Water Reactor Utility Requirements Document," Revision 13, EPRI, Palo Alto, CA, 2014.

2.3-4 NuScale Power, LLC, "Accident Source Term Methodology," TR-0915-17565-P-A Revision 4.

2.4 Hydrologic Engineering

The NuScale Power Plant US460 standard design does not rely on an external water supply for the ultimate heat sink or safety-related makeup water. This design reduces the influence local hydrologic features have on plant safety. Table 2.0-1 presents parameters selected to represent site conditions.

COL Item 2.4-1: An applicant that references the NuScale Power Plant US460 standard design will investigate and describe the site-specific hydrologic characteristics for Section 2.4.1 through Section 2.4.14, except Section 2.4.8, Section 2.4.10, and Section 2.4.11.

2.4.1 Hydrologic Description

The local hydrology is site-specific.

2.4.2 Floods

The design assumes the maximum flood elevation (including wind-induced wave run-up) is one foot below baseline plant elevation. The baseline plant elevation is the top of concrete of the ground floor of the RXB. This maximum flood elevation is a key design parameter.

2.4.3 Probable Maximum Flood on Streams and Rivers

The probable maximum flood is site-specific.

2.4.4 Potential Dam Failures

The presence of on-site, upstream, and downstream water control structures is site-specific.

2.4.5 Probable Maximum Surge and Seiche Flooding

The potential for surge or seiche flooding is site-specific.

2.4.6 Probable Maximum Tsunami Hazards

The potential for tsunamis is site-specific.

2.4.7 Ice Effects

The design does not rely on a safety-related intake structure as a makeup source for the reactor pool, which acts as the ultimate heat sink. Therefore, ice effects do not affect safety-related cooling.

2.4.8 Cooling Water Canals and Reservoirs

The design does not rely on safety-related cooling water canals or reservoirs as a makeup source for the reactor pool, which acts as the ultimate heat sink. Therefore, cooling water canals or reservoirs do not affect safety-related cooling.

2.4.9 Channel Diversions

The design does not rely on a safety-related makeup water source. Therefore, upstream channel diversions would not adversely affect safety-related cooling.

2.4.10 Flood Protection Requirements

The design assumes the baseline plant elevation is one foot above the maximum flood level. Therefore, there are no flood protection requirements.

2.4.11 Low Water Considerations

The design does not rely upon a safety-related source of makeup water. Low flow from surges, seiches, tsunamis, downstream dam failures, future water controls, ice effects, upstream channel diversions, or other sources of low water would not adversely affect safety-related cooling.

2.4.12 Groundwater

The design does not employ a permanent dewatering system. Groundwater is assumed to be a minimum of two feet below site grade. High groundwater has an adverse effect on stability. Maximum elevation of groundwater is a key design parameter.

2.4.13 Accidental Releases of Radioactive Liquid Effluents in Groundwater and Surface Waters

Dilution factors, dispersion coefficients, flow velocities, travel times, adsorption, and pathways of liquid contaminants for radioactive liquid effluents from accidental releases into groundwater or surface water are site-specific. The source term provided in Table 12.2-10 associated with the pool surge control system storage tank is assumed to be contained by the passive and durable mitigative design feature (a metal-lined concrete catch basin) in an analysis to evaluate the effects of an accidental release of radioactive liquid demonstrating the adequacy of the site's hydrogeologic properties.

2.4.14 Technical Specifications and Emergency Operation Requirements

The design does not require emergency protective measures nor technical specifications to minimize the impact of adverse hydrology-related events on safety-related facilities.

2.5 Geology, Seismology, and Geotechnical Engineering

The NuScale Power Plant US460 standard design uses geologic, seismologic, and geotechnical engineering parameters that are representative of a reasonable number of potential plant site locations in the United States. These parameters are presented in Table 2.0-1.

COL Item 2.5-1: An applicant that references the NuScale Power Plant US460 standard design will describe the site-specific geology, seismology, and geotechnical characteristics for Section 2.5.1 through Section 2.5.5.

2.5.1 Basic Geologic and Seismic Information

Basic regional and site geologic and seismic information is site-specific.

2.5.2 Vibratory Ground Motion

Two design-basis earthquakes for the evaluation of structures are included in the design: the certified seismic design response spectra (CSDRS) and the certified seismic design response spectra - high frequency (CSDRS-HF). These spectra are developed by reviewing earthquake design data from the United States nuclear industry and are intended to bound most of the central and eastern United States as well as sites in less seismically-active portions of the western United States.

The CSDRS and CSDRS-HF are discussed in Section 3.7.1. The CSDRS is shown in Figure 3.7.1-1 and Figure 3.7.1-2. The CSDRS-HF is shown in Figure 3.7.1-3 and Figure 3.7.1-4. The CSDRS and CSDRS-HF are key design parameters.

2.5.3 Surface Deformation

The design analysis assumes there is no fault displacement potential under the plant structures. This assumption is a key design parameter.

2.5.4 Stability of Subsurface Materials and Foundations

The design analysis assumes the following parameters:

- The minimum shear wave velocity is 1000 fps. Competent material is considered to be in situ material having a minimum shear wave velocity of 1000 fps.
- Allowable soil bearing capacities for the Reactor Building and Control Building are provided in Table 2.0-1 and Section 3.8.5.
- There is no potential for soil liquefaction. This analysis can be performed with the site-specific safe shutdown earthquake.
- The minimum coefficient of static friction at the interfaces between the basemat and the soil is 0.58. The friction is defined between concrete and clean gravel, gravel-sand mixture, or coarse sand with a friction angle of 30 degrees (Reference 2.5-1).
- The minimum soil angle of internal friction is 30 degrees.

There are no rigid safety-related connections between the structures and no safety-related connections to other site structures. The maximum allowable total settlement, maximum total settlement, maximum tilt, and maximum differential settlement values are provided in Table 2.0-1. For sites not meeting these parameters, site-specific analyses demonstrate the adequacy of the standard plant design.

The following are key design parameters:

- minimum shear wave velocity
- minimum allowable soil bearing capacity
- uniformity of soil layers
- potential for soil liquefaction
- minimum coefficient of static friction
- minimum soil angle of internal friction
- tilt

2.5.5 Stability of Slopes

The standard plant layout assumes a uniform, graded site. Therefore, no slope failure potential is a key design parameter.

2.5.6 References

2.5-1 Department of the Navy, “Design Manual 7.2 - Foundation and Earth Structures,” NAVFAC DM-7.2, Alexandria, VA, May 1982.