



May 25, 2018

Docket No. 52-048

U.S. Nuclear Regulatory Commission  
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**SUBJECT:** NuScale Power, LLC Submittal of Changes to Tier 1 and Tier 2 of the NuScale Final Safety Analysis Report

**REFERENCES:**

1. Memorandum from Chowdhury to Lee, "Summary of the January 24, 2018, and January 31, 2018, U.S. Nuclear Regulatory Commission Category 1 Public Teleconference with NuScale Power, LLC to Discuss Staff Feedback on Request for Additional Information Nos. 9179, 9182, and 9185" (ML18044A070)
2. Letter from NuScale Power, LLC to U.S. Nuclear Regulatory Commission, "NuScale Power, LLC Submittal of the NuScale Standard Plant Design Certification Application, Revision 1", dated March 15, 2018 (ML18086A090)

NuScale Power, LLC (NuScale) participated in several teleconferences with the U.S. Nuclear Regulatory Commission (NRC) staff between January 24, 2018 (Reference 1) and May 7, 2018 related to meteorological topics. As a result of these discussions, NuScale is making changes to the final safety analysis report (FSAR) associated with the NuScale design certification application (DCA) (Reference 2). The enclosure to this letter provides a mark-up of the FSAR pages incorporating revisions in the FSAR, in redline/strikeout format. NuScale will include these changes as a part of a future revision to the NuScale DCA.

NuScale requests that the security-related information in Enclosure 1 be withheld from public disclosure in accordance with the requirements of 10 CFR § 2.390. Enclosure 2 contains a public version of the changes to Tier 1 and Tier 2 of the FSAR.

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

If you have any questions, please contact Marty Bryan at 541-452-7172 or at [mbryan@nuscalepower.com](mailto:mbryan@nuscalepower.com).

Sincerely,

A handwritten signature in black ink, appearing to read "Zackary W. Rad".

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

Distribution: Greg Cranston, NRC, OWFN-8G9A  
Samuel Lee, NRC, OWFN-8G9A  
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Enclosure 1: "Changes to NuScale Final Safety Analysis Report," nonpublic  
Enclosure 2: "Changes to NuScale Final Safety Analysis Report," public



LO-0518-60103

**Enclosure 1:**

“Changes to NuScale Final Safety Analysis Report,” nonpublic  
Security-Related Information - Withhold Under 10 CFR § 2.390

**Enclosure 2:**

“Changes to NuScale Final Safety Analysis Report,” public

RAI 02.03.01-6, 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	
<b>Nearby Industrial, Transportation, and Military Facilities</b>		
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 <u>design basis</u> aircraft hazards	
<b>Meteorology</b>		
Maximum precipitation rate	19.4 <del>inches</del> per hour 6.3 <del>inches</del> 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 wind speed translational speed maximum rotational speed radius of maximum rotational speed pressure drop 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.	
Zero percent exceedance value (historical limit excluding peaks <2 hours)		
<del>Maximum outdoor design dry bulb temperature</del> <del>Minimum outdoor design dry bulb temperature</del>	115°F <del>-40°F</del>	
<del>Zero percent exceedance value (historical limit excluding peaks &lt;2 hours) minimum outdoor design dry bulb temperature</del>	<del>-40°F</del>	
Accident release $\chi/Q$ values at <del>security owner controlled area fence exclusion area boundary and outer boundary of low population zone</del> 0-2 hr 2-8 hr 8-24 hr 24-96 hr 96-720 hr	6.22E-04 s/m <sup>3</sup> 5.27E-04 s/m <sup>3</sup> 2.41E-04 s/m <sup>3</sup> 2.51E-04 s/m <sup>3</sup> 2.46E-04 s/m <sup>3</sup>	
Accident release $\chi/Q$ values at main control room/ technical support center door and heating ventilation and air conditioning intake <del>(approximately 112 feet from source)</del> 0-2 hr 2-8 hr 8-24 hr 1-4 day 4-30 day	<u>Door</u> 6.50E-03 s/m <sup>3</sup> 5.34E-03 s/m <sup>3</sup> 2.32E-03 s/m <sup>3</sup> 2.37E-03 s/m <sup>3</sup> 2.14E-03 s/m <sup>3</sup>	<u>Heating Ventilation and Air Conditioning Intake</u> 6.50E-03 s/m <sup>3</sup> 5.34E-03 s/m <sup>3</sup> 2.32E-03 s/m <sup>3</sup> 2.37E-03 s/m <sup>3</sup> 2.14E-03 s/m <sup>3</sup>

**Table 5.0-1: Site Design Parameters (Continued)**

Site Characteristic/Parameter	NuScale Design Parameter
<b>Hydrologic Engineering</b>	
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
<b>Geology, Seismology, and Geotechnical Engineering</b>	
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 (CSDRS) 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 (CSDRS-HF) 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)
Minimum soil angle of internal friction	30 degrees
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)	4 inches Maximum of 0.5 inch per 50 feet of building length or 1 inch total in any direction at any point in these structures 0.5 inch
Slope failure potential	No slope failure potential

RAI 02.03.01-2, RAI 02.03.05-1

**Table 1.1-1: Acronyms and Abbreviations**

<b>Acronym or Abbreviation</b>	<b>Description</b>
AAC	alternate AC power
AAPS	auxiliary AC power source
ABS	auxiliary boiler system
ABVS	Annex Building HVAC system
ABWR	Advanced Boiling Water Reactor
AC	alternating current
ACI	American Concrete Institute
ACM	Availability Controls Manual
ACRS	Advisory Committee on Reactor Safeguards
AEA	Atomic Energy Act
AFU	air filtration unit
AFWS	auxiliary feedwater system
AHJ	authority having jurisdiction
AHU	air handling unit
AIA	Authorized Inspection Agency
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ALARA	as low as reasonably achievable
ALU	actuation logic unit
ALWR	advanced light water reactor
AMCA	Air Movement and Control Association International, Inc.
ANB	Annex Building
ANS	American Nuclear Society
ANSI	American National Standards Institute
AO	axial offset
AOA	axial offset anomaly
AOO	anticipated operational occurrence
AOV	air-operated valve
API	American Petroleum Institute
APWR	Advanced Pressurized Water Reactor
AQ	augmented quality
ARM	area radiation monitor
ARO	all rods out
ARS	acceleration response spectra
ASCE	American Society of Civil Engineers
ASD	adjustable speed drive
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASM	American Society for Metals International
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATB	Administration and Training Building
ATWS	anticipated transient without scram
AVT	all-volatile treatment
AWS	American Welding Society
AWWA	American Water Works Association
BAS	boron addition system
BAST	boric acid storage tank
BDBE	beyond design basis event

Table 1.1-1: Acronyms and Abbreviations (Continued)

Acronym or Abbreviation	Description
RCS	reactor coolant system
RDT	reactor drain tank
REA	rod ejection accident
RETS	Radiological Effluent Technical Specifications
RFI	radio frequency interference
RFP	refueling pool
RFT	reactor flange tool
RG	Regulatory Guide
RHR	residual heat removal
RHX	regenerative heat exchanger
RIS	regulatory issue summary
RM	radiation monitoring
RMS	fixed area radiation monitoring system
RMTS	risk-managed technical specifications
RO	reverse osmosis
<b>ROCA</b>	<b>restricted-owner-controlled-area</b>
ROP	Reactor Oversight Process
RPCS	reactor pool cooling system
RPI	rod position indication
RPS	reactor protection system
RPV	reactor pressure vessel
RRS	required response spectrum
RRV	reactor recirculation valve
RSA	remote shutdown area
RSR	results summary report
RSS	remote shutdown station
RSV	reactor safety valve
RTB	reactor trip breaker
RTD	resistance temperature detector
RTM	requirements traceability matrix
RT <sub>NDT</sub>	reference temperature for nil-ductility transition
RTNSS	regulatory treatment of nonsafety systems
RTP	rated thermal power
RTPTS	reference temperature, pressurized thermal shock
RTS	reactor trip system
RVI	reactor vessel internals
RVV	reactor vent valve
RWB	Radioactive Waste Building
RWBCR	Radioactive Waste Building control room
RWBVS	Radioactive Waste Building HVAC system
RWDS	radioactive waste drain system
RWMS	radioactive waste management system
RWSS	raw water supply system
RXB	Reactor Building
RXC	reactor core
S&Q	staffing and qualifications
SAFDL	specified acceptable fuel design limit
SAM	seismic anchor motion
SAMDA	severe accident mitigation design alternative
SAMG	severe accident management guideline



**Figure 1.2-4: Layout of a Multi-Module NuScale Power Plant**

{{ Withheld - See Part 9 }}

RAI 02.03.01-2, RAI 02.03.05-1

Tier 2

1.2-25

Draft Revision 2

**Table 1.8-1: Summary of NuScale Certified Design Interfaces with Remainder of Plant**

System, Structure, or Component	Interface Type	FSAR Section
Turbine Generator Buildings	CDI	1.2.2
Annex Building	CDI	1.2.2
Cooling towers, pump houses, and associated structures, systems, and components (e.g., cooling tower basin, circulating water pumps, cooling tower fans, chemical treatment building, etc.)	CDI	1.2.2, 10.4.5
Security Buildings	CDI	1.2.2
Central Utility Building	CDI	1.2.2
Diesel Generator Buildings	CDI	1.2.2
Offsite power transmission system, main switchyard, and transformer area	CDI	8.2
Auxiliary AC power system	CDI	8.3.1
Site cooling water system	CDI	9.2.7
Circulating water system	CDI	10.4.5
Grounding and lightning protection system	CDI	8.3.1
<a href="#">Plant exhaust stack</a>	<a href="#">CDI</a>	<a href="#">9.4.2</a>
Potable and sanitary water systems	COL	9.2.4
Resin tanks for the condensate polishing system	COL	10.4
Site drainage system	COL	N/A
Raw water system	COL	9.2.9
Site-specific design parameters, geographic and demographic characteristics, meteorological characteristics, nearby industrial, transportation, and military facilities, hydrologic characteristics, geology, seismology, and geotechnical characteristics, weather conditions and site topography, flooding	COL	Table 2.0-1, 2.1, 2.2, 2.3, 2.4, 2.5, 3.3, 3.4
Site-specific communications	COL	9.5.2
Turbine generators	COL	3.5-1
Diesel generators	COL	3.5-1
Operational Support Center	COL	13.3

RAI 01-61, RAI 02.04.13-1, RAI 03.04.02-1, RAI 03.04.02-2, RAI 03.04.02-3, RAI 03.05.01.04-1, RAI 03.05.02-2, RAI 03.06.02-15, RAI 03.06.03-11, RAI 03.07.01-2, RAI 03.07.01-3, RAI 03.07.02-8, RAI 03.07.02-12, RAI 03.08.04-23S1, RAI 03.08.05-14S1, RAI 03.09.02-15, RAI 03.09.02-48, RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-6, RAI 03.09.06-16, RAI 03.09.06-16S1, RAI 03.09.06-27, RAI 03.11-8, RAI 03.11-14, RAI 03.11-14S1, RAI 03.11-18, RAI 03.13-3, RAI 05.02.05-8, RAI 05.04.02.01-13, RAI 05.04.02.01-14, RAI 06.04-1, RAI 09.01.02-4, RAI 09.01.05-3, RAI 09.01.05-6, RAI 09.03.02-3, RAI 09.03.02-4, RAI 09.03.02-5, RAI 09.03.02-6, RAI 09.03.02-8, RAI 10.02-1, RAI 10.02-2, RAI 10.03.06-1, RAI 10.03.06-5, RAI 10.04.06-1, RAI 10.04.06-2, RAI 10.04.06-3, RAI 10.04.10-2, RAI 13.01.01-1, RAI 13.01.01-1S1, RAI 13.02.02-1, RAI 13.03-4, RAI 13.05.02.01-2, RAI 13.05.02.01-2S1, RAI 13.05.02.01-3, RAI 13.05.02.01-3S1, RAI 13.05.02.01-4, RAI 13.05.02.01-4S1, RAI 14.02-7, RAI 19-31, RAI 19-31S1, RAI 19-38

**Table 1.8-2: Combined License Information Items**

Item No.	Description of COL Information Item	Section
COL Item 1.1-1:	A COL applicant that references the NuScale Power Plant design certification will identify the site-specific plant location.	1.1
COL Item 1.1-2:	A COL applicant that references the NuScale Power Plant design certification will provide the schedules for completion of construction and commercial operation of each power module.	1.1
COL Item 1.4-1:	A COL applicant that references the NuScale Power Plant design certification will identify the prime agents or contractors for the construction and operation of the nuclear power plant.	1.4
COL Item 1.7-1:	A COL applicant that references the NuScale Power Plant design certification will provide site-specific diagrams and legends, as applicable.	1.7
COL Item 1.7-2:	A COL applicant that references the NuScale Power Plant design certification will list additional site-specific piping and instrumentation diagrams and legends as applicable.	1.7
COL Item 1.8-1:	A COL applicant that references the NuScale Power Plant design certification will provide a list of departures from the certified design.	1.8
COL Item 1.9-1:	A COL applicant that references the NuScale Power Plant design certification will review and address the conformance with regulatory criteria in effect six months before the docket date of the COL application for the site-specific portions and operational aspects of the facility design.	1.9
COL Item 1.10-1:	A COL applicant that references the NuScale Power Plant design certification will evaluate the potential hazards resulting from construction activities of the new NuScale facility to the safety-related and risk significant structures, systems, and components of existing operating unit(s) and newly constructed operating unit(s) at the co-located site per 10 CFR 52.79(a)(31). The evaluation will include identification of management and administrative controls necessary to eliminate or mitigate the consequences of potential hazards and demonstration that the limiting conditions for operation of an operating unit would not be exceeded. This COL item is not applicable for construction activities (build-out of the facility) at an individual NuScale Power Plant with operating NuScale Power Modules.	1.10
COL Item 2.0-1:	A COL applicant that references the NuScale Power Plant design certification will demonstrate that site-specific characteristics are bounded by the design parameters specified in Table 2.0-1. If site-specific values are not bounded by the values in Table 2.0-1, the COL applicant will demonstrate the acceptability of the site-specific values in the appropriate sections of its combined license application.	2.0
COL Item 2.1-1:	A COL applicant that references the NuScale Power Plant design certification will describe the site geographic and demographic characteristics.	2.1
COL Item 2.2-1:	A COL applicant that references the NuScale Power Plant design certification will describe nearby industrial, transportation, and military facilities. The COL applicant will demonstrate that the design is acceptable for each potential accident, or provide site-specific design alternatives.	2.2
COL Item 2.3-1:	A COL applicant that references the NuScale Power Plant design certification will describe the site-specific meteorological characteristics for Section 2.3.1 through Section 2.3.5, as applicable.	2.3
COL Item 2.4-1:	A COL applicant that references the NuScale Power Plant design certification will investigate and describe the site-specific hydrologic characteristics for Section 2.4.1 through Section 2.4.14, <del>as applicable</del> except Section 2.4.8 and Section 2.4.10.	2.4
COL Item 2.5-1:	A COL applicant that references the NuScale Power Plant design certification will describe the site-specific geology, seismology, and geotechnical characteristics for Section 2.5.1 through Section 2.5.5, below.	2.5
COL Item 3.2-1:	A COL applicant that references the NuScale Power Plant design certification will update Table 3.2-1 to identify the classification of site-specific structures, systems, and components.	3.2

**Table 1.9-8: Conformance with SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor Designs" (Continued)**

Issue	Description	Conformance Status	Comments	Section
I.J	Containment Performance: Position on acceptable conditional containment failure probabilities or other analyses to ensure a high degree of protection from the containment.	Conforms	None.	19.1 19.2
I.K	Dedicated Containment Vent Penetration: Position for a dedicated vent penetration to preclude containment failure resulting from a containment over-pressurization event.	Conforms	None.	19.2.4
I.L	Equipment Survivability: Position on the applicability of environmental qualification and quality assurance requirements related to plant features provided only for severe-accident protection.	Conforms	None.	19.2.3
I.M	Elimination of Operating-Basis Earthquake: Position on the applicability of the OBE in design and the possibility of decoupling the OBE and SSE in the design of safety systems.	Conforms	By setting the OBE to 1/3 of the SSE it is decoupled from the design evaluation process.	3.7
I.N	In-Service Testing of Pumps and Valves: Position on periodic testing to confirm operability of safety-related pumps and valves.	Conforms	None.	3.9.6
II.A	Industry Codes and Standards: Position on use of recently developed or modified design codes and industry standards in ALWR designs that have not been reviewed for acceptability by the NRC.	Conforms	NuScale use the latest endorsed codes and standards or others on case by case basis.	all
II.B	Electrical Distribution: Positions originally addressed by SECY-91-078 that specified that an evolutionary ALWR provide: (1) an alternate power source to nonsafety-related loads, and (2) at least one offsite circuit connected directly to each redundant safety division with no intervening nonsafety-related buses.	Not Applicable	The NuScale electrical system design conforms to the passive plant guidance of SECY-94-084, Section G.	Not Applicable
II.C	Seismic Hazard Curves and Design Parameters: Position on use of proposed generic bounding seismic hazard curves and performance of seismic PRA.	Conforms	None.	19.1.5
II.D	Leak-Before-Break: Position on use of leak-before-break concept.	Conforms	LBB is applied to the MS and FW lines inside containment.	3.6.3
II.E	Classification of Main Steam Lines in BWRs: Position on the staffs defined approach for seismic classification of the main steam line in both evolutionary and passive BWRs.	Not Applicable	Applicable to BWRs.	Not Applicable
II.F	Tornado Design Basis: Position on the maximum tornado wind speed to be used for a design basis tornado.	Partially Conforms	The FSAR uses the maximum tornado wind speed of 230 mph found in RG 1.76 Revision 1 rather than the outdated 300 mph guidance found in SECY-93-087.	3.3

RAI 02.03.01-2, RAI 02.03.01-6, RAI 02.03.01-8, RAI 02.03.05-1S1, 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	References to Parameter
<b>Geography and Demography (Section 2.1)</b>		
Minimum exclusion area boundary	400 feet from the closest release point	Sections 2.1 and 2.3.4
Minimum outer boundary of low population zone	400 feet from the closest release point	Sections 2.1 and 2.3.4
<b>Nearby Industrial, Transportation, and Military Facilities (Section 2.2)</b>		
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	Section 2.2
Aircraft hazards on plant SSC	No design basis aircraft hazards	Sections 2.2 and 3.5.1.6
<b>Meteorology (Section 2.3)</b>		
Maximum precipitation rate	19.4 inches per hour 6.3 inches for a 5 minute period	Sections 3.4.2.2 and <a href="#">3.8.4.3.10</a>
Normal roof snow load	50 psf	Sections 3.4.2.2, <a href="#">3.8.4.3.10</a> , 3.8.4.3.11, and <del>3.8.4.8</del> <a href="#">3.8.4.3.16</a> , <a href="#">3.8.4.4.1</a> , <a href="#">3.8.4.4.2</a> , <a href="#">3.8.4.8</a> , and <a href="#">3.8.5.5.5</a>
Extreme roof snow load	75 psf	Sections 3.4.2.2, <a href="#">3.8.4.3.10</a> , 3.8.4.3.12, and <del>3.8.4.8</del> <a href="#">3.8.4.3.16</a> , <a href="#">3.8.4.4.1</a> , <a href="#">3.8.4.4.2</a> , <a href="#">3.8.4.8</a> , and <a href="#">3.8.5.5.5</a>
100-year return period 3-second wind gust speed	145 mph (eExposure Category C) with an importance factor of 1.15 for Reactor Building, Control Building, and Radioactive Waste Building	Sections 3.3.1.1, 3.8.4.3.13, and 3.8.4.8
Design basis tornado maximum wind speed translational speed maximum rotational speed radius of maximum rotational speed pressure drop rate of pressure drop	230 mph 46 mph 184 mph 150 ft 1.2 psi 0.5 psi/sec	Sections 3.1.1.2, 3.3.2.1, <a href="#">3.3.2.2</a> , <a href="#">3.3.2.3</a> , 3.8.4.3.14, and 3.8.4.8
Tornado missile spectra	Table 2 of Regulatory Guide 1.76, Revision 1, Region 1	Sections <a href="#">3.3.2.3</a> , 3.5.1.4, <a href="#">3.5.2</a> , <a href="#">3.5.3.1</a> , and <a href="#">3.5.3.2</a>
Maximum wind speed design basis hurricane	290 mph	Sections <a href="#">3.1.1.2</a> , 3.3.2.1, <a href="#">3.3.2.2</a> , <a href="#">3.3.2.3</a> , 3.8.4.3.14, and 3.8.4.8
Hurricane missile spectra	Tables 1 and 2 of Regulatory Guide 1.221, Revision 0	Section 3.5.1.4, <a href="#">3.3.2.3</a> , <a href="#">3.5.2</a> , <a href="#">3.5.3.1</a> , and <a href="#">3.5.3.2</a>

**Table 2.0-1: Site Design Parameters (Continued)**

Site Characteristic / Parameter	NuScale Design Parameter		References to Parameter
Accident release $\chi/Q$ values at <del>security owner controlled area fence</del> <u>exclusion area boundary and outer boundary of low population zone</u>			
0-2 hr	6.22E-04 s/m <sup>3</sup>		Sections 15.0.3.2 and 15.0.3.3.11; Table 15.0-13
2-8 hr	5.27E-04 s/m <sup>3</sup>		
8-24 hr	2.41E-04 s/m <sup>3</sup>		
24-96 hr	2.51E-04 s/m <sup>3</sup>		
96-720 hr	2.46E-04 s/m <sup>3</sup>		
Accident release $\chi/Q$ values at main control room/technical support center door and HVAC intake <del>(approximately 112 feet from source)</del>	<u>Door</u>	<u>HVAC Intake</u>	
0-2 hr	6.50E-03 s/m <sup>3</sup>	6.50E-03 s/m <sup>3</sup>	Section 15.0.3.3.11; Table 15.0-13
2-8 hr	5.34E-03 s/m <sup>3</sup>	5.34E-03 s/m <sup>3</sup>	
8-24 hr	2.32E-03 s/m <sup>3</sup>	2.32E-03 s/m <sup>3</sup>	
1-4 day	2.37E-03 s/m <sup>3</sup>	2.37E-03 s/m <sup>3</sup>	
4-30 day	2.14E-03 s/m <sup>3</sup>	2.14E-03 s/m <sup>3</sup>	
Routine release $\chi/Q$ and D/Q values <del>associated with the bounding offsite dose location</del> <u>at restricted area boundary</u>			
undepleted/no decay	5.43E-05 s/m <sup>3</sup>		Table 11.3-6
undepleted/2.26-day decay	5.43E-05 s/m <sup>3</sup>		
depleted/8.00-day decay	5.43E-05 s/m <sup>3</sup>		
D/Q	5.43E-07 1/m <sup>2</sup>		
Zero percent exceedance values (historical limit excluding peaks <2 hours)			Sections 3.8.4.3.8, 3.8.4.8, <u>9.4.1.1</u> , 20.1.1.4, and 20.1.1.5; Table 9.4.1-1
Maximum outdoor design dry bulb temperature	115°F		
Minimum outdoor design dry bulb temperature	-40°F		
Maximum coincident wet bulb temperature	80°F		
Maximum non-coincident wet bulb temperature	81°F		
One percent <u>annual</u> exceedance values			Section 9.2.7.2.1; Tables 9.2.7-1, 9.4.2-1, 9.4.3-1, and 10.4-9
Maximum outdoor design dry bulb temperature	100°F		
Minimum outdoor design dry bulb temperature	-10°F		
Maximum coincident wet bulb temperature	77°F		
Maximum non-coincident wet bulb temperature	80°F		

**Table 2.0-1: Site Design Parameters (Continued)**

Site Characteristic / Parameter	NuScale Design Parameter	References to Parameter
Five percent <b>annual</b> exceedance values		Table 9.4.4-1
Maximum outdoor design dry bulb temperature	95°F	
Minimum outdoor design dry bulb temperature	-5°F	
Maximum coincident wet bulb temperature	77°F	
<b>Hydrologic Engineering (Section 2.4)</b>		
Maximum flood elevation	1 foot below the baseline plant elevation	Sections 2.4.2 and 3.4.2.1; Table 3.8.5-9
<b>p</b> Probable maximum flood and coincident wind wave and other effects on max flood level		
Maximum elevation of groundwater	2 feet below the baseline plant elevation	Sections 2.4.12, 3.4.2.1, 3.8.4.3.22.1, and 3.8.4.8; Table 3.8.5-9
<b>Geology, Seismology, and Geotechnical Engineering (Section 2.5)</b>		
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 (CSDRS) 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 (CSDRS-HF) for Reactor Building and Control Building.	Sections 3.7.1.1, 3.8.4.3.16, and 3.8.4.8
Fault displacement potential	No fault displacement potential	Section 2.5.3
Minimum soil bearing capacity ( $Q_{ult}$ ) beneath safety-related structures	75 ksf	Sections 2.5.4, 3.8.5.6.3, and 3.8.5.6.7
Lateral soil variability	Uniform site (< 20 degree dip)	Section 2.5.4
Minimum soil angle of internal friction	30 degrees	Sections 2.5.4 and 3.8.5.3.1; Table 3.8.5-1
Minimum shear wave velocity	≥ 1000 fps at bottom of foundation	Section 2.5.4
Liquefaction potential	No liquefaction potential	Section 2.5.4
Maximum settlement for the Reactor Building, Control Building, and Radioactive Waste Building;		
• total settlement	4 inches	Sections 3.8.5.6.1 and 3.8.5.6.2
• tilt settlement	Maximum of 0.5 inch per 50 feet of building length or 1 inch total in any direction at any point in these structures	Sections 2.5.4, 3.8.5.6.1, 3.8.5.6.2, and 3.8.5.6.4
• differential settlement (between Reactor Building and Control Building, and between Reactor Building and Radioactive Waste Building)	0.5 inch	Section 3.8.5.6.4
Slope failure potential	No slope failure potential	Section 2.5.5

## 2.3 Meteorology

RAI 02.03.01-7

The NuScale Power Plant is designed using 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: A COL applicant that references the NuScale Power Plant design certification 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, a value of 150 percent of the normal roof snow load, or 75 psf was selected.

The design basis severe wind is a 3-second gust at 33 ft above ground for exposure category C. The wind speed (*W*) is 145 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 upon ASCE/SEI 7-05 (Reference 2.3-4).

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 ~~continental~~contiguous United States as identified in RG 1.76, Rev. 1. Similarly, the parameters for the design basis hurricane and hurricane missiles are the most severe parameters postulated in RG 1.221, Rev 0.

RAI 02.03.01-6, RAI 02.03.01-8

The design basis dry-bulb and wet bulb temperatures are based on the EPRI Utility Requirements Document (Reference 2.3-2). Pertinent zero-, one-, and five-percent exceedance values assumed in the design are provided in Table 2.0-1. The coincident wet-bulb temperature value represents the mean of the collected wet bulb temperatures that occurred coincident with the indicated dry-bulb temperature.

Regional climatology is site-specific and is addressed by the COL applicant as part of the response to COL Item 2.3-1.

### 2.3.2 Local Meteorology

Local meteorology is site-specific and is addressed by the COL applicant as part of the response to COL Item 2.3-1.



## 2.3.4 Short-Term Atmospheric Dispersion Estimates for Accident Releases

### Accidental Radioactive Releases

Topical Report TR-0915-17565, Revision 2, (Reference 2.3-3) describes the methodology used for establishing source terms and calculating the atmospheric dispersion factors used to determine accident radiological consequences at the technical support center (TSC), main control room (MCR) and offsite locations for the NuScale Power Plant certified design.

RAI 02.03.01-2

Atmospheric dispersion factors ( $\chi/Q$  values) are determined at ~~the site owner controlled area boundary. This fence is as close as 400 feet from the closest release point and may be used as both~~ the exclusion area boundary (EAB) and ~~as~~ the low population zone (LPZ) outer boundary, which may be as close as 400 feet from the closest release point. These  $\chi/Q$  values as well as the  $\chi/Q$  values for the MCR were determined for various sites in the United States using a meteorological database that included multiple years of data across all regions of the United States. This approach determined that the meteorological dataset for Sacramento, California, between 1984-1986, is representative of the bounding 80th to 90th percentile of potential NuScale Power Plant construction sites in the United States. This meteorological data set was used to calculate the  $\chi/Q$  values for the certified design.

The  $\chi/Q$  values at the ~~site owner controlled area fence~~ EAB and the LPZ outer boundary are listed in Table 2.0-1. These  $\chi/Q$  values are based on the source location and path shown in Figure 2.3-1.

RAI 02.03.04-1

The  $\chi/Q$  values used for evaluation of doses in the MCR and TSC are determined at the Control Building doors and HVAC inlet and are listed in Table 2.0-1. Figure 2.3-2 and Figure 2.3-3 show the path and distances from the Reactor Building release point to MCR door and HVAC inlet. The two source locations shown in Figure 2.3-2 and Figure 2.3-3 are the limiting source locations because they are the closest source locations to the main control room personnel doors and main control room HVAC intake. Assumptions for release point characteristics used for the  $\chi/Q$  calculations are listed in Table 15.0-20.

The  $\chi/Q$  values for the TSC are the same as the MCR because the TSC is located directly above the MCR and shares the same HVAC inlet and outside doors.

The COL applicant will determine site specific  $\chi/Q$  values for the EAB, LPZ outer boundary, MCR and present that information as part of the response to COL item 2.3-1.

### Hazardous Material Releases

As stated in Section 2.2, the NuScale Power Plant certified design does not postulate any hazards from on-site sources or nearby industrial, transportation, or military facilities.

The COL applicant will provide discussion of site specific hazardous material releases as part of the response to COL item 2.3-1.

The COL applicant will provide discussion of site specific hazardous material releases as part of the response to COL item 2.3-1.

### 2.3.5 Long-Term Atmospheric Dispersion Estimates for Routine Releases

RAI 02.03.01-2, RAI 02.03.05-1

~~Site boundary annual average~~ Routine release atmospheric dispersion factors ( $\chi/Q$  values) and relative deposition factor (D/Q) values at the restricted area boundary provided in Table 2.0-1 are ~~used to calculate the site boundary~~ conservatively estimated and used to calculate release concentrations for comparison to the activity release limits in 10 CFR 20, as discussed in Section 11.3.

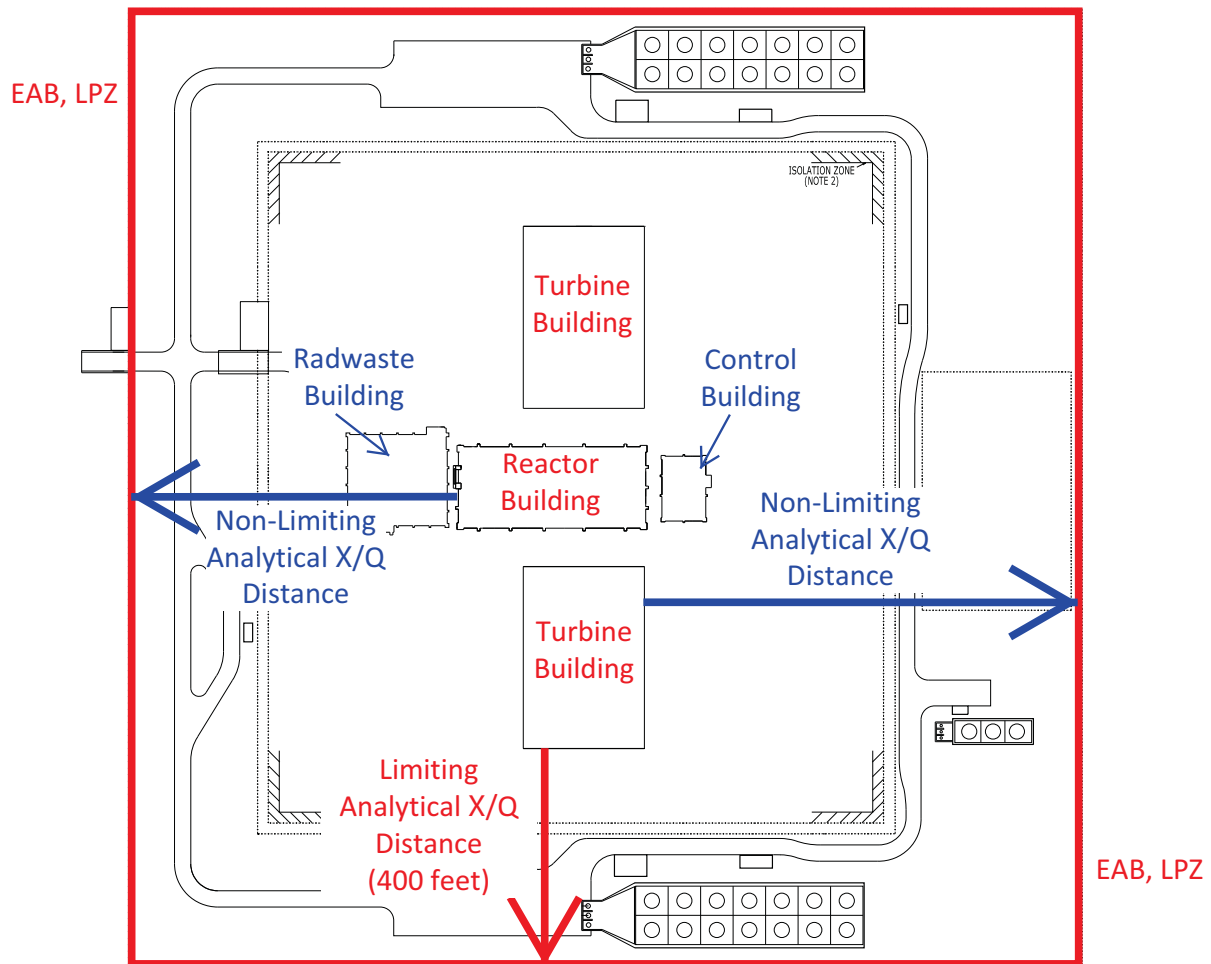
RAI 02.03.01-2, RAI 02.03.05-1

~~Annual average~~ Routine release atmospheric dispersion factors ( $\chi/Q$  values) and deposition factor (D/Q) values in at the site boundary unrestricted areas and at locations of interest are site-specific and are developed by the COL applicant as part of the response to COL Item 2.3-1.

### 2.3.6 References

- 2.3-1 National Oceanic and Atmospheric Administration Hydrometeorological Report Number 52, "Application of Probable Maximum Precipitation Estimates- United States East of the 105th Meridian," Washington DC, August 1982.
- 2.3-2 Electrical Power Research Institute, "Advanced Nuclear Technology: Advanced Light Water Reactor Utility Requirements Document," Revision 13, 2014.
- 2.3-3 NuScale Power LLC, Licensing Topical Report TR-0915-17565-P "Accident Source Term Methodology," Rev. 2, September 2017
- 2.3-4 American Society of Civil Engineers/Structural Engineering Institute, "Minimum Design Loads for Buildings and Other Structures," ASCE/SEI 7-05, Reston, VA, 2005.

Figure 2.3-1: Limiting Analytical Distance to **Site-Owner-Controlled Area Fence** **EAB and LPZ** **Outer Boundary**



## 2.4 Hydrologic Engineering

The NuScale Power Plant design does not rely upon 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. Design parameters selected to represent site conditions are presented in Table 2.0-1.

COL Item 2.4-1: A COL applicant that references the NuScale Power Plant design certification will investigate and describe the site-specific hydrologic characteristics for Section 2.4.1 through Section 2.4.14, ~~as applicable~~ except Section 2.4.8 and Section 2.4.10.

### 2.4.1 Hydrologic Description

The local hydrology is site-specific and is addressed by the COL applicant as part of the response to COL Item 2.4-1.

### 2.4.2 Floods

The design assumes that 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 Reactor Building. ~~A second, related, design assumption is that the site is properly graded and has adequate drainage to prevent localized flooding from the maximum precipitation event. These are~~ This maximum flood elevation is a key design parameters.

The potential for flooding is site-specific and is addressed by the COL applicant as part of part of the response to COL Item 2.4-1.

### 2.4.3 Probable Maximum Flood (PMF) on Streams and Rivers

The probable maximum flood (PMF) is site-specific and is addressed by the COL as part of the response to COL Item 2.4-1.

### 2.4.4 Potential Dam Failures

The presence of dams is site-specific and is addressed by the COL applicant as part of the response to COL Item 2.4-1.

### 2.4.5 Probable Maximum Surge and Seiche Flooding

The potential for surge or seiche flooding is site-specific and is addressed by the COL applicant as part of the response to COL Item 2.4-1.

### 2.4.6 Probable Maximum Tsunami Hazards

The potential for tsunamis is site-specific and is addressed by the COL applicant as part of the response to COL Item 2.4-1.

#### 2.4.7 Ice Effects

The design does not rely upon 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. The potential for ice effects to contribute to flooding is site-specific and is addressed by the COL applicant as part of the response to COL Item 2.4-1.

#### 2.4.8 Cooling Water Canals and Reservoirs

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

#### 2.4.9 Channel Diversions

The design does not rely upon a safety-related makeup water source. Therefore, upstream channel diversions would not adversely affect safety-related cooling. The potential for channel diversions to contribute to flooding is site-specific and is addressed by the COL applicant as part of the response to COL Item 2.4-1.

#### 2.4.10 Flood Protection Requirements

The design assumes that 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.

The potential effects of low water levels on nonsafety-related water supplies is site-specific and is addressed by the COL applicant as part of the response to COL Item 2.4-1.

#### 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. This is a key design parameter.

Groundwater is site-specific and is addressed by the COL applicant as part of the response to COL Item 2.4-1.

#### 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

$$q_z = 0.00256 K_z K_{zt} K_d V_w^2 I \text{ (lb/ft}^2\text{)}$$

where,

RAI 03.03.01-1

$K_z$  = velocity pressure exposure coefficient evaluated at height "z", as defined in ASCE/SEI 7-05, Table 6-3, but not less than 0.87. For simplicity and conservatism, z is assumed to be the building height,

$K_{zt}$  = topographic factor equal to 1.0,

$K_d$  = wind directionality factor equal to 1.0,

$V_w$  = maximum wind speed equal to 145 mph, and

$I$  = importance factor equal to 1.15 for the RXB, CRB, and RWB.

Design wind loads on the RXB, CRB, and RWB are determined in conformance with ASCE/SEI 7-05 (Reference 3.3-1), Equation 6-17:

$$p = qGC_p - q_i(GC_{pi}) \text{ (lb/ft}^2\text{)}$$

where,

RAI 03.03.01-1S1

$G$  = gust factor equal to 0.85,

$C_p$  = external pressure coefficient equal to 1.0,

$GC_{pi}$  = internal pressure coefficient equal to 0.18,

$q$  = velocity pressure, and

$q_i$  = internal velocity pressure.

### 3.3.2 Extreme Wind Loads (Tornado and Hurricane Loads)

#### 3.3.2.1 Design Parameters for Extreme Winds

Tornado wind loads include loads caused by the tornado wind pressure, tornado atmospheric pressure change effect, and tornado-generated missile impact. Hurricane wind loads include loads due to the hurricane wind pressure and hurricane-generated missiles.

The parameters for the design basis tornado are the most severe tornado parameters postulated for the ~~continental~~contiguous United States as identified in RG 1.76, Rev. 1.

RAI 02.03.01-2

supporting the walkways at EL. 62'-0" and a live load of 200 psf for the portions of the EL. 75'-0" floor supporting walkways at EL 86'-0". The floor live loads are not applied on areas occupied by equipment, whose weight is specifically included as a uniform equipment load or a significant concentrated equipment load.

Floor beams, girders and slabs in the RXB are designed to withstand a 5000 lb concentrated load in locations that maximize moment and shear. Any location where permanent equipment is installed is not designed for this concentrated load. The concentrated loads will not be combined with load combinations that include seismic loads.

The CRB uses a base live load of 100 psf. The offices at EL. 76'-6" and EL. 100'-0" have a 50 psf live load. The floor live load is not applied on areas occupied by equipment, that weight is specifically included as a dead load.

#### **3.8.4.3.5 Roof Live Loads ( $L_r$ )**

A load of 50 psf is used for the roof live load of both structures.

#### **3.8.4.3.6 Pipe and Equipment Reactions ( $R_o$ )**

Pipe reactions during normal operation or shutdown conditions are based on the most critical transient or steady state condition.

The CRB does not have any high energy piping.  $R_o$  is not a load for the CRB.

#### **3.8.4.3.7 Accident Pipe and Equipment Reactions ( $R_a$ )**

Pipe and equipment reactions under thermal conditions are generated by the postulated pipe break, including ( $R_o$ ). This includes their dead load, live load, thermal load, seismic load, thrust load, and transient unbalanced internal pressure loads under abnormal or extreme environmental conditions.

The CRB does not have any high energy or high temperature piping.  $R_a$  is not a load for the CRB.

#### **3.8.4.3.8 Operating Thermal Loads ( $T_o$ )**

Thermal loads are caused by a temperature variation through the concrete wall between the interior temperature and the external environmental temperature. In addition, in the RXB, a thermal gradient could occur in the five foot thick walls surrounding the reactor pool. Section 1.3 of ACI 349.1R (Reference 3.8.4-7) states that thermal gradients should be considered in the design of reinforcement for normal conditions to control concrete cracking. However, a thermal gradient less than approximately 100° F need not be analyzed because such gradients will not cause significant stress in the reinforcement or strength deterioration.

As shown in Table 2.0-1, the external temperature design parameters for the NuScale standard structures are zero percent exceedance dry bulb values of -40°F and +115°F. The external soil temperature is assumed to be 21°F in the winter and 40°F in the summer.

The RXB has a design internal air temperature range of 70°F to 130°F, and a design pool temperature range of 40°F to 120°F. These temperatures are used to determine the stresses and displacements.

The CRB has a maximum temperature differential of 110°F, based on an external temperature of -40°F and an internal temperature of 70°F. This gradient has been determined not to affect the design stresses in the building.  $T_0$  is not a load for the CRB.

#### 3.8.4.3.9 Accident Thermal Loads ( $T_a$ )

The maximum post accident temperature in the RXB is assumed to be 212°F. This temperature is used in conjunction with the external temperature to determine the stresses and displacements.

The CRB does not have any high energy or high temperature piping.  $T_a$  is not a load for the CRB.

#### 3.8.4.3.10 Rain Load (R)

RAI 02.03.01-3

The flat portion of the roof of the RXB does not have a parapet or any means to retain water. The CRB roof is sloped and the parapet has scuppers to disperse rainwater. An additional drainage pipe limits the average water depth on the CRB roof to a maximum of 4 inches. Therefore a rain load is assumed bounded by the snow load and extreme snow load.

#### 3.8.4.3.11 Snow Loads (S)

RAI 02.03.01-2, RAI 02.03.01-3

As shown in Table 2.0-1, a roof snow load of 50 psf is assumed for normal load combinations. Equation 3.8-1 (taken from Equation 7-1 of Reference 3.8.4-8) is used to convert from ground-level snow loads to roof snow loads. An exposure factor of 1.0 is used. A thermal factor of 1.0 is used. An importance factor of 1.2 is used for buildings listed as Seismic Category I in Table 3.2-1 and an importance factor of 1.0 is used for the other buildings.

$$p_f = 0.7C_e C_t I_p g \quad \text{Equation 3.8-1}$$

where,

$p_f$  is the roof snow load,



RAI 02.03.01-8, RAI 09.02.07-6

**Table 9.2.7-1: Site Cooling Water System Equipment Design Data**

Description	Technical Data
<b>Site Cooling Water Pumps</b>	
Quantity	3
Type	Vertical wet pit type
Flow rate (max).	24,000 GPM each (50% capacity)
Motor brake horsepower	1500 HP
<b>Cooling Tower - Three Cells (Two Cell Tower plus Spare Cell)</b>	
Type	Mechanical draft, induced
Flow maximum (GPM) over 2 cells	48,000 (design flow plus margin)
Number of cells	3 (2 active)
Fan motor (horsepower)	300 each, three fans required.
One percent <u>annual</u> exceedance non-coincident wet bulb temperature	80 °F
Cold water temperature	90 °F
<b>Travelling Screens with Motors with Trash Rakes</b>	
Flow (GPM)	24,000 each maximum (design flow plus margin)

prior to distribution is predicated upon the chemical composition of the source as well as plant water chemistry requirements.

- COL Item 9.2-5: A COL applicant that references the NuScale Power Plant design certification will identify the site-specific water source and provide a water treatment system that is capable of producing water that meets the plant water chemistry requirements.

Above ground UWS piping is lined or coated, or both, carbon steel and designed to ASME B31.1 (Reference 9.2.9-1). Valve material(s) are chosen based upon system service and design conditions. The UWS underground piping is reinforced or pre-stressed, or both, concrete pressure piping and designed to the American Water Works Association standards.

RAI 12.03-3

During normal operations, the raw water pumps supply water to the circulating water and site cooling water cooling towers. The utility water transfer pumps operate automatically to keep the utility water storage tank filled. The firewater transfer pump is operated as necessary to provide makeup water to the fire protection system water storage tank. The three utility water supply pumps are used to supply various users. Water from the UWS is used for maintenance activities such as general wash downs in areas including the Reactor Building, the Radioactive Waste Building, and the Turbine Generator Buildings.

~~The utility water supply pumps are loaded on the backup diesel generator of the backup power supply system. Electric power to the raw water pumps is considered a permanent non-safety load. The raw water pumps also receive power from the backup power supply system in order to maintain the water level in the cooling tower basins.~~ In the event of loss of normal AC power, one of the two available raw water pumps can be powered by the auxiliary AC power source in order to maintain the water level in the cooling tower basins.

RAI 02.03.01-2, RAI 02.03.05-1

The UWS is the single point liquid effluent release path to the environment and it is sampled and monitored for radiation. An off-line radiation monitor provides continuous indication of effluent parameters. An alarm is provided in the main control room and the waste management control room via the plant control system when predetermined system thresholds are exceeded. The alarms and indications ensure that operators are alerted to abnormal conditions to allow appropriate mitigating actions. In addition, dilution flow is monitored to ensure sufficient in-plant effluent dilution factors and dilution factors beyond the point of discharge ~~to the site boundary and nearest offsite dose receptors~~. A flow transmitter provides dilution flow information to the liquid radioactive waste system. The liquid radioactive waste system is isolated when there is inadequate dilution flow to meet necessary dilution factors. Refer to Section 11.5 for a discussion pertaining to radiation monitoring of the UWS discharge and Section 11.2 for a discussion pertaining to liquid effluent release evaluation and characteristics.

RAI 02.03.01-6

**Table 9.4.1-1: CRVS Outdoor Air Design Conditions**

<b>Parameter</b>	<b>Temperature*</b>
Maximum outdoor design dry bulb temperature	115°F
Maximum coincident <u>design</u> wet bulb temperature	80°F
Maximum non-coincident wet bulb temperature	81°F
Minimum outdoor design dry bulb temperature	-40°F
*Table 9.4.1-1 temperatures are zero percent exceedance values ( <u>historical limits excluding peaks &lt;2 hours</u> )	

RAI 02.03.01-8

**Table 9.4.2-1: Outside Air Temperature Range for Reactor Building Ventilation System**

<b>Parameter</b>	<b>Temperature*</b>
Maximum outdoor design dry bulb temperature	100°F
Maximum coincident design wet bulb temperature	77°F
Minimum outdoor design dry bulb temperature	-10°F

\*Table 9.4.2-1 temperatures are one percent annual exceedance values

RAI 02.03.01-8

**Table 9.4.3-1: Outside Air Design Temperature for the Radioactive Waste Building HVAC System**

<b>Parameter</b>	<b>Temperature*</b>
Maximum outdoor design dry bulb temperature	100°F
Maximum coincident design wet bulb temperature	77°F
Minimum outdoor design dry bulb temperature	-10°F

\*Table 9.4.3-1 temperatures are one percent annual exceedance values

RAI 02.03.01-8

**Table 9.4.4-1: Turbine Building HVAC System Outdoor Air Design Conditions**

<b>Parameter</b>	<b>Temperature*</b>
Maximum Outdoor Design Dry Bulb Temperature	95°F
Maximum coincident Design Wet Bulb Temperature	77°F
Minimum Design Dry Bulb Temperature	-5°F

\*Table 9.4.4-1 temperatures are five percent annual exceedance values

RAI 02.03.01-7

**Table 10.4-9: Circulating Water System Design Parameters**

<b>Circulating Water Pumps, per six NPMs</b>	
Number	3 pumps per loop
Capacity	[[76353 gpm]] / 33% capacity
Type	Vertical, wet pit
Motor horsepower (nameplate)	[[1750 hp]]
Limitations	3 pumps are sufficient when assuming loss of a single pump
<b>Traveling Screens</b>	
Type	Continuously moving
Number	1 per pump
<b>Cooling Tower</b>	
Cells per tower	[[14]]
Type	Mechanical draft, induced
One percent annual exceedance <del>value maximum</del> non-coincident wet bulb temperature	[[80°F]]
Range	[[20°F]]
Approach	[[10°F]]
Flow, each CWS loop	[[228,000 gpm]]
Construction code	ACI 318 standards
Testing standard	Cooling tower performance standard ASME PTC 23
<b>Cooling Tower Makeup and Blowdown</b>	
Rate	[[5320 gpm per loop]]
Cycles of concentration	[[5]]
<b>Chemical Treatment</b>	
Materials	[[biocide (typically sodium hypochlorite), algaecide, pH adjuster, corrosion inhibitor, scale inhibitor, and dispersant.]]
<b>Piping, including the expansion joints, butterfly valves, condenser water boxes, and tube bundles.</b>	
Size	[[9-foot diameter]]
Material	Prestressed concrete lined pipe (underground); carbon steel pipe (above ground).
Code	ASME B31.1 (above ground)

### 11.2.3.3 Dilution Factors

The liquid effluent from LRWS is discharged through the discharge header and ties into the UWS as shown in Figure 11.2-1g. The UWS receives discharge water from multiple sources that provides dilution for the LRWS discharge in the discharge basin (Section 9.2.9). The UWS also provides a signal to LRWS in the event that dilution flow reduces to an unacceptable level to automatically close the LRWS discharge header isolation valves (Section 11.5.2.1).

RAI 02.03.01-2, RAI 02.03.05-1

A dilution factor of 5.56 cfs of the LRWS discharge is assumed in the calculation of the ~~site boundary~~ (Section 2.3.4 and Figure 1.2-4) ~~discharge~~ concentrations, as shown in Table 11.2-4. This ensures that the discharge ~~site boundary~~ concentrations are within 10 CFR 20 Appendix B, Table 2, limits. The ~~offsite unrestricted area~~ doses are calculated using an additional dilution factor of 740 cfs, which results in the ~~offsite unrestricted area~~ doses being within 10 CFR 50, Appendix I, limits.

COL Item 11.2-4: A COL applicant that references the NuScale Power Plant design certification will perform a site-specific evaluation using the site-specific dilution flow.

### 11.2.3.4 Site-Specific Cost-Benefit Analysis

COL Item 11.2-5: A COL applicant that references the NuScale Power Plant design certification will perform a cost-benefit analysis as required by 10 CFR 50.34a and 10 CFR 50, Appendix I, to demonstrate conformance with regulatory requirements. This cost-benefit analysis is to be performed using the guidance of Regulatory Guide 1.110.

## 11.2.4 Testing and Inspection Requirements

The LRWS preoperational tests are described in Section 14.2 and include the applicable testing and inspection requirements from RG 1.143.

Inspection and testing provisions are incorporated to enable periodic evaluation of the operability and required functional performance of active components of the system.

## 11.2.5 Instrumentation and Controls

The LRWS waste collection is operated in the automatic mode and LRWS processing is operated in a batch-type mode. For normal operation, automated and manual valves are aligned to collect the waste from other systems, hold it until processed, and discharge or recycle treated waste.

The LRWS processing functions that use mobile radioactive waste processing equipment and interfacing-permanent-plant LRWS equipment are controlled and monitored from the WMCR by an operator. Mobile radioactive waste processing equipment skids are controlled from local control panels.

The permanent plant controls and indications for filling waste collection tanks are automatic and are controlled by the plant control system with indication in the WMCR. The



The RBVS and RWBVS are also designed to comply with RG 1.140 as it pertains to the design, testing, and maintenance of normal ventilation exhaust system air filtration and adsorption units (see Section 9.4.2 and Section 9.4.3, respectively).

#### 11.3.2.4 Method of Treatment

The GRWS utilizes ambient temperature charcoal beds to delay the release of radioactive gases generated from plant operations. The delay characteristics are provided in Table 11.3-1 for normal operating conditions.

The vapor condenser package reduces the moisture level of the waste gas stream prior to entering the charcoal beds. A charcoal guard bed provides another means of removing moisture from the waste gas stream to ensure proper performance of the charcoal decay beds.

The gaseous radioactive waste inlet stream is monitored for hydrogen and oxygen content to ensure a flammable mixture does not accumulate. An explosive hydrogen and oxygen mixture is prevented by maintaining hydrogen and oxygen gas concentrations below 4 percent by volume. This is accomplished by allowing only non-aerated gaseous inputs, maintaining a positive pressure with respect to the surroundings, using nitrogen as a carrier gas, and monitoring the gas stream for the presence of oxygen and hydrogen.

Once the waste gas stream exits the charcoal decay beds, the stream is conveyed to the RWBVS, where it is mixed and diluted with the normal RWBVS ventilation flow. The RWBVS outlet flow is monitored and sent to the RBVS. Releases to the environment through the plant exhaust stack are monitored.

RAI 02.03.01-2, RAI 02.03.05-1

The annual average airborne releases of radionuclides from the plant exhaust stack are determined using the methodology described in RG 1.112, as modified by TR-1116-52065 (Reference 11.3-1). The expected annual quantities of radioactive material released and expected doses to members of the public ~~at or near the site boundary (Section 2.3.4 and Figure 1.2-4)~~ in unrestricted areas are calculated and provided in Table 11.3-5 and Table 11.3-8, respectively.

The GRWS equipment is designed to accommodate gases using the design basis source term (Section 11.1) and operating conditions that include normal operation and anticipated operational occurrences (AOOs). The system equipment is contained within the Radioactive Waste Building (RWB) with sufficient shielding to protect workers in accordance with RG 8.8. Charcoal decay beds remove radioactive iodine in the effluent stream and hold up noble gases to sufficiently reduce the activity level in the effluent stream prior to release to comply with regulatory limits.

The gaseous radioactive waste structures, systems, and components are designed in accordance with the codes and standards provided in RG 1.143, Table 1 through 4 (see Table 11.3-10). The applicable design criteria from RG 1.143, Table 2, Table 3 and Table 4 are used in the design analysis of the GRWS components. The safety classification for the GRWS components applies to components, up to and including the nearest

isolation device. Design parameters of major components, including safety classification and operating conditions, are provided in Table 11.3-2.

#### 11.3.2.5 Site-Specific Cost-Benefit Analysis

Regulatory Guide 1.110 provides guidance for complying with 10 CFR 50, Appendix I, Section II, Paragraph D, to demonstrate that the addition of items of reasonably demonstrated technology is not favorable or cost-beneficial.

COL Item 11.3-1: A COL applicant that references the NuScale Power Plant design certification will perform a site-specific cost-benefit analysis.

#### 11.3.2.6 Mobile or Temporary Equipment

The GRWS does not employ the use of mobile or temporary equipment in the design.

#### 11.3.2.7 Seismic Design

The gaseous radioactive waste equipment and piping are classified in accordance with RG 1.143. The RWB seismic design is described in Section 3.7.2. The structures, systems, and component classifications for the GRWS components are listed in Table 3.2-1 and Table 11.3-2. The component activity contents are shown in Section 12.2.1.

### 11.3.3 Radioactive Effluent Releases

The GRWS processes and releases waste gas from normal reactor operations and AOOs to the RWBVS, and the waste gas is monitored and released to the environment through the RBVS exhaust stack. Section 9.4.2 provides additional information on the plant exhaust stack. Other normal gaseous discharge pathways include the condenser air removal system and secondary system steam leaks as illustrated in Figure 11.5-1. The discharge of gaseous effluents is tabulated by isotope, pathway, and annual released activity in Table 11.3-5.

RAI 02.03.04-1, RAI 02.03.05-1S1

As described in Section 11.2.3, an alternate methodology to replace PWR-GALE was developed that uses first principles based calculations, combined with more recent nuclear industry experience. The calculation of gaseous effluent offsite dose consequences is consistent with methodologies presented in RG 1.112 and RG 1.109. A description of the methodology used to develop the primary and secondary coolant source terms is provided in Section 11.1. For normal effluents, the realistic coolant source terms are used and propagated through the plant systems. The major assumptions and inputs for the gaseous release methodology are listed in Table 11.3-4. From the component and airborne source terms, the normal gaseous effluent source term is determined and presented in Table 11.3-5. From the gaseous effluent source term, the offsite consequences are calculated using GASPAR II from the input values presented in Table 11.3-6. ~~The atmospheric dispersion and deposition values presented in Table 11.3-6 were derived using NARCON and the assumptions presented in Table 11.3-12.~~ The released gaseous radioactive effluent meets the concentration limits of 10 CFR 20.1302 and the dose limits of 10 CFR 50 Appendix I. A more thorough description of this PWR-GALE replacement methodology is presented in Reference 11.3-1.

RAI 02.03.01-2, RAI 02.03.05-1

**Table 11.3-5: Gaseous Estimated Discharge for Normal Effluents**

Nuclide	GRWS (Ci/yr)	Pool Evaporation (Ci/yr)	AOO Gas Leakage (Ci/yr)	Primary Coolant Leaks (Ci/yr)	Plant Exhaust Stack Total (Ci/yr)	Secondary Steam Leaks (Ci/yr)	Condenser Air Removal System (Ci/yr)	Total TGB Releases (Ci/yr)	Total Plant Gaseous Releases (Ci/yr)	Total Gaseous Effluent Concentration in Unrestricted Area at Site Boundary (µCi/ml)	10 CFR 20 Appendix B Limits (µCi/ml)	Fraction of Limit
Kr83m	4.60E-09	5.93E-11	2.46E-05	2.76E-03	2.79E-03	1.93E-07	1.29E-03	1.30E-03	4.08E-03	7.02E-15	5.00E-05	1.40E-10
Kr85m	5.97E-04	7.35E-10	1.02E-04	1.15E-02	1.22E-02	8.06E-07	5.40E-03	5.40E-03	1.76E-02	3.03E-14	1.00E-07	3.03E-07
Kr85	2.50E+02	3.01E+00	3.19E-02	3.59E+00	2.57E+02	2.51E-04	1.68E+00	1.68E+00	2.58E+02	4.44E-10	7.00E-07	6.35E-04
Kr87	4.17E-12	-	5.59E-05	6.29E-03	6.34E-03	4.40E-07	2.95E-03	2.95E-03	9.29E-03	1.60E-14	2.00E-08	7.99E-07
Kr88	1.48E-05	1.03E-12	1.63E-04	1.83E-02	1.85E-02	1.28E-06	8.58E-03	8.59E-03	2.71E-02	4.66E-14	9.00E-09	5.18E-06
Kr89	-	0.00E+00	3.72E-06	4.18E-04	4.22E-04	2.93E-08	1.96E-04	1.96E-04	6.18E-04	1.06E-15	1.00E-09	1.06E-06
Xe131m	2.18E-01	1.31E-02	3.95E-04	4.44E-02	2.76E-01	3.11E-06	2.08E-02	2.08E-02	2.97E-01	5.11E-13	2.00E-06	2.55E-07
Xe133m	1.69E-06	1.49E-03	3.62E-04	4.07E-02	4.26E-02	2.85E-06	1.91E-02	1.91E-02	6.17E-02	1.06E-13	6.00E-07	1.77E-07
Xe133	5.40E-01	3.32E-01	2.70E-02	3.03E+00	3.93E+00	2.12E-04	1.42E+00	1.42E+00	5.35E+00	9.20E-12	5.00E-07	1.84E-05
Xe135m	0.00E+00	1.28E-09	3.75E-05	4.21E-03	4.25E-03	2.95E-07	1.97E-03	1.97E-03	6.22E-03	1.07E-14	4.00E-08	2.68E-07
Xe135	4.17E-15	6.80E-06	9.26E-04	1.04E-01	1.05E-01	7.28E-06	4.88E-02	4.88E-02	1.54E-01	2.65E-13	7.00E-08	3.78E-06
Xe137	0.00E+00	0.00E+00	1.20E-05	1.34E-03	1.35E-03	9.40E-08	6.30E-04	6.30E-04	1.98E-03	3.41E-15	1.00E-09	3.41E-06
Xe138	0.00E+00	0.00E+00	4.09E-05	4.60E-03	4.64E-03	3.22E-07	2.16E-03	2.16E-03	6.79E-03	1.17E-14	2.00E-08	5.84E-07
Br82	3.27E-09	1.72E-09	-	3.76E-07	3.81E-07	6.62E-09	1.67E-09	8.29E-09	3.89E-07	6.70E-19	5.00E-09	1.34E-10
Br83	1.61E-08	1.43E-18	-	1.85E-06	1.86E-06	3.14E-08	7.91E-09	3.93E-08	1.90E-06	3.27E-18	9.00E-08	3.64E-11
Br84	7.15E-09	-	-	8.21E-07	8.28E-07	1.23E-08	3.10E-09	1.54E-08	8.44E-07	1.45E-18	8.00E-08	1.81E-11
Br85	8.51E-10	0.00E+00	-	9.77E-08	9.86E-08	5.88E-10	1.48E-10	7.36E-10	9.93E-08	1.71E-19	1.00E-09	1.71E-10
I129	8.45E-14	1.78E-13	-	9.70E-12	9.96E-12	1.71E-13	4.31E-14	2.15E-13	1.02E-11	1.75E-23	4.00E-11	4.38E-13
I130	2.52E-08	1.60E-11	-	2.89E-06	2.92E-06	5.07E-08	1.28E-08	6.35E-08	2.98E-06	5.13E-18	3.00E-09	1.71E-09
I131	7.03E-07	3.09E-05	-	8.07E-05	1.12E-04	1.43E-06	3.59E-07	1.78E-06	1.14E-04	1.96E-16	2.00E-10	9.81E-07
I132	2.80E-07	2.74E-08	-	3.21E-05	3.24E-05	5.45E-07	1.37E-07	6.82E-07	3.31E-05	5.69E-17	2.00E-08	2.84E-09
I133	1.00E-06	3.41E-07	-	1.15E-04	1.16E-04	2.02E-06	5.08E-07	2.53E-06	1.19E-04	2.04E-16	1.00E-09	2.04E-07
I134	1.53E-07	-	-	1.75E-05	1.77E-05	2.80E-07	7.04E-08	3.50E-07	1.80E-05	3.10E-17	6.00E-08	5.17E-10
I135	5.87E-07	5.19E-12	-	6.74E-05	6.80E-05	1.17E-06	2.95E-07	1.47E-06	6.94E-05	1.19E-16	6.00E-09	1.99E-08

Tier 2

11.3-16

Draft Revision 2

**Table 11.3-5: Gaseous Estimated Discharge for Normal Effluents (Continued)**

Nuclide	GRWS (Ci/yr)	Pool Evaporation (Ci/yr)	AOO Gas Leakage (Ci/yr)	Primary Coolant Leaks (Ci/yr)	Plant Exhaust Stack Total (Ci/yr)	Secondary Steam Leaks (Ci/yr)	Condenser Air Removal System (Ci/yr)	Total TGB Releases (Ci/yr)	Total Plant Gaseous Releases (Ci/yr)	Total Gaseous Effluent Concentration in Unrestricted Area at Site Boundary (µCi/ml)	10 CFR 20 Appendix B Limits (µCi/ml)	Fraction of Limit
La140	-	7.61E-11	-	1.68E-10	2.44E-10	5.91E-10	-	5.91E-10	8.35E-10	1.437E-21	2.00E-09	7.18E-13
La141	-	1.82E-19	-	3.60E-11	3.60E-11	1.24E-10	-	1.24E-10	1.60E-10	2.754E-22	1.00E-08	2.75E-14
La142	-	-	-	1.89E-11	1.89E-11	6.29E-11	-	6.29E-11	8.18E-11	1.408E-22	3.00E-08	4.69E-15
Ce141	-	1.86E-11	-	7.86E-11	9.72E-11	2.78E-10	-	2.78E-10	3.75E-10	6.450E-22	8.00E-10	8.06E-13
Ce143	-	2.26E-13	-	5.72E-11	5.74E-11	2.01E-10	-	2.01E-10	2.59E-10	4.453E-22	2.00E-09	2.23E-13
Ce144	-	2.33E-11	-	6.61E-11	8.94E-11	2.33E-10	-	2.33E-10	3.23E-10	5.555E-22	2.00E-11	2.78E-11
Pr143	-	1.02E-11	-	6.99E-11	8.01E-11	2.47E-10	-	2.47E-10	3.27E-10	5.624E-22	9.00E-10	6.25E-13
Pr144	-	2.31E-11	-	6.61E-11	8.92E-11	1.76E-10	-	1.76E-10	2.65E-10	4.567E-22	2.00E-07	2.28E-15
Np239	-	1.55E-11	-	1.22E-09	1.24E-09	4.31E-09	-	4.31E-09	5.54E-09	9.538E-21	3.00E-09	3.18E-12
Na24	-	1.28E-06	-	4.58E-06	5.86E-06	1.61E-05	-	1.61E-05	2.19E-05	3.774E-17	7.00E-09	5.39E-09
Cr51	-	3.92E-05	-	1.79E-07	3.94E-05	6.33E-07	-	6.33E-07	4.00E-05	6.881E-17	3.00E-08	2.29E-09
Mn54	-	3.24E-05	-	9.13E-08	3.25E-05	3.22E-07	-	3.22E-07	3.28E-05	5.645E-17	1.00E-09	5.64E-08
Fe55	-	2.51E-05	-	6.82E-08	2.51E-05	2.41E-07	-	2.41E-07	2.54E-05	4.365E-17	3.00E-09	1.46E-08
Fe59	-	4.58E-06	-	1.72E-08	4.59E-06	6.09E-08	-	6.09E-08	4.65E-06	8.007E-18	5.00E-10	1.60E-08
Co58	-	7.91E-04	-	2.63E-07	7.91E-04	9.30E-07	-	9.30E-07	7.92E-04	1.363E-15	1.00E-09	1.36E-06
Co60	-	1.12E-05	-	3.02E-08	1.12E-05	1.07E-07	-	1.07E-07	1.13E-05	1.948E-17	5.00E-11	3.90E-07
W187	-	3.19E-07	-	2.06E-07	5.25E-07	7.24E-07	-	7.24E-07	1.25E-06	2.148E-18	1.00E-08	2.15E-10
Zn65	-	1.02E-05	-	2.91E-08	1.02E-05	1.03E-07	-	1.03E-07	1.03E-05	1.775E-17	4.00E-10	4.44E-08
H3	-	7.25E+02	-	5.80E+00	7.31E+02	6.76E+00	-	6.76E+00	7.37E+02	1.269E-09	1.00E-07	1.27E-02
C14	-	5.16E-07	-	1.38E-06	1.90E-06	4.88E-08	-	4.88E-08	1.95E-06	3.350E-18	3.00E-09	1.12E-09
N16	-	0.00E+00	-	0.00E+00	0.00E+00	0.00E+00	-	0.00E+00	0.00E+00	0.000E+00	1.00E-15	0.00E+00
Ar41	1.01E+01	0.00E+00	4.29E-17	1.99E+00	1.21E+01	2.74E-03	9.34E-01	9.36E-01	1.30E+01	2.238E-11	1.00E-08	2.24E-03
<b>Total</b>	<b>2.61E+02</b>	<b>7.28E+02</b>	<b>6.10E-02</b>	<b>1.47E+01</b>	<b>1.00E+03</b>	<b>6.77E+00</b>	<b>4.15E+00</b>	<b>1.09E+01</b>	<b>1.01E+03</b>	<b>1.75E-09</b>	<b>5.84E-05</b>	<b>1.56E-02</b>

Note: The X/Q that was used to calculate the site boundary unrestricted area concentrations is provided in Table 11.3-6. The restricted area boundary is conservatively assumed to be the SOCA fence, which can be as close as 400 feet from the nearest release point, in this design certification analysis.

RAI 02.03.05-1S1

Table 11.3-6: GASPAR Code Input Parameter Values

Parameter	Value
<del><math>\chi/Q</math> associated with the bounding off site dose location</del>	5.43E-05 s/m <sup>3</sup>
<del>D/Q associated with the bounding off site dose location</del>	5.43E-07 m <sup>-2</sup>
<del>Distance from plant exhaust stack to bounding off site dose location<sup>1</sup></del>	<del>820 meters</del>
Milk animal	Goat
Midpoint of plant life	20 yrs
Fraction of year that leafy vegetables are grown	1.0
Fraction of year that milk cows are in pasture	1.0
Fraction of the maximum individual's vegetable intake that is from his own garden	0.76
Fraction of milk-cow feed intake that is from pasture while on pasture	1.0
Average absolute humidity over the growing season	8.0 gram/m <sup>3</sup>
Fraction of year that beef cattle are in pasture	1.0
Fraction of beef cattle feed intake that is from pasture while the cattle are on pasture	1.0
Source term	Table 11.3-5

~~Note 1: The elevated release from the plant exhaust stack causes the bounding offsite dose location to occur farther than the site owner controlled area fence.~~

RAI 02.03.04-1, RAI 02.03.05-1S1

**Table 11.3-12: ~~Not Used~~ Assumptions for Routine Airborne Effluent Release Point Characteristics for Offsite Receptors**

<b>Parameter</b>	<b>Value</b>
Release location	Plant exhaust stack
Release height	37.0 meters
Intake height	0.0 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

- Provisions for sampling are described in Table 11.5-2 and Table 11.5-3 for gaseous and liquid process streams, respectively.
- Estimated dynamic detection range, principle radionuclides measured, and basis for dynamic range are provided in Table 11.5-4.
- Figure 11.5-1 presents an integrated plant radiological monitoring drawing.
- Figure 11.5-2 provides a logic block diagram for radiation monitoring.
- Figure 11.5-3 provides an off-line radiation detection drawing.
- Figure 11.5-4 provides a process radiation adjacent-to-line detection drawing.
- Figure 11.5-5 provides a process radiation in-line detection drawing.
- Figure 11.5-6 provides a plant exhaust stack effluent radiation detection drawing.

COL Item 11.5-1: A COL applicant that references the NuScale Power Plant design certification will describe site-specific process and effluent monitoring and sampling system components and address the guidance provided in ANSI N13.1-2011, ANSI N42.18-2004 and Regulatory Guides 1.21, 1.33 and 4.15.

### 11.5.2.1 Effluent Radiation Monitoring

A description of effluent radiation monitoring and sampling equipment is provided below for systems with a potentially radioactive gaseous or liquid effluent stream. The applicable regulatory requirements are also addressed for each system.

#### 11.5.2.1.1 Reactor Building HVAC System

RAI 02.03.01-2, RAI 02.03.05-1

The Reactor Building HVAC system (RBVS) exhaust fans remove air from the Reactor Building general area, Radioactive Waste Building, and Annex Building. The RBVS also conveys the process flow from the containment evacuation system (CES) to the plant exhaust stack, and gaseous radioactive waste system (GRWS) process flow via the Radioactive Waste Building HVAC system (RWBVS) to the plant exhaust stack. The RBVS plant exhaust stack is a continuously monitored gaseous radioactive effluent flow path that uses an off-line radiation monitor and integrated sampling system that measures and records exhaust stack flow, particulate, iodine and noble gases in three ranges. Stack flow is also continuously monitored to calculate and record radiological release rates. These design features ensure compliance with RG 1.21, 10 CFR 20.1301, and 10 CFR 20.1302. Stack flow measurement capability supports the consideration of atmospheric dispersion ( $\chi/Q$ ) and deposition (D/Q) factors ~~to the site boundary and offsite dose receptors~~ when developing alarm setpoints.

The RBVS plant exhaust stack gaseous effluent radiation monitor provides continuous indication for effluent parameters and an alarm function via the plant control system (PCS) to the main control room when predetermined plant exhaust stack thresholds are exceeded. The alarms and indications alert operators to abnormal conditions to allow appropriate mitigating action. System monitoring

RAI 02.03.01-2, RAI 02.03.05-1

- During normal plant operations, the dose from airborne radioactive material exposure in unrestricted areas ~~beyond the site boundary~~ is maintained ALARA and within the limits specified in 10 CFR 20.1301 and 10 CFR 50, Appendix I.
- The dose to the control room personnel does not exceed the limits specified in 10 CFR 50, Appendix A, GDC 19 following the design basis accidents described in Chapter 15.

### 12.3.3.2 Design Features to Minimize Personnel Exposure from Heating Ventilation and Air Conditioning Equipment

The building ventilation systems are designed to maintain a negative pressure with respect to the outside environs and create air flow inside the building from areas of low airborne potential to areas of higher airborne potential.

Other design features that are incorporated to minimize radiation exposures to personnel are listed below.

- The design of the plant ventilation systems incorporates the guidance of RG 8.8.
- Ventilation fans and filters are provided with adequate access space to permit servicing with minimum personnel radiation exposure. The heating ventilation and air conditioning system is designed to allow rapid replacement of components. Filter-adsorber unit conformance complies with the recommendations of RG 1.140.
- Ventilation ducts are designed to minimize the buildup of radioactive contamination within the ducts.
- Access to ventilation systems in potentially radioactive areas can result in personnel exposure during maintenance, inspection, and testing. Equipment is located in low dose areas as much as practicable, with most equipment being located outside of rooms that contain significant radiation sources. The outside air supply units and building exhaust system components have adequate work space provided around each unit for anticipated maintenance, testing, and inspection.

### 12.3.3.3 Reactor Building Heating Ventilation and Air Conditioning System

During normal operation, the RBVS services the areas inside the RXB by providing conditioned and filtered outside air. The exhaust from the RXB is normally filtered by a high-efficiency particulate air (HEPA) filter. If the spent fuel pool exhaust radiation monitors detect radioactivity above their setpoints, the exhaust flow from the spent fuel pool area is diverted to go through HEPA filters and charcoal adsorbers. See Section 9.4.2 for additional details.

The dry dock area is provided with exhaust flow to entrain airborne contamination that may result from NPM components being exposed to air during maintenance activities.

Heating ventilation and air conditioning equipment drains are routed to the RWDS.

In response to a high-radiation signal from the spent fuel exhaust ductwork, the RBVS will change into its high-radiological mode. In this mode, the spent fuel pool exhaust



**12.4.1.9 Construction Activities**

For the construction of an additional NuScale Power Plant adjacent to an existing NuScale Power Plant, the estimated annual radiation exposure to a construction worker is estimated based upon a construction staffing plan over the estimated construction period. It is estimated that the annual dose for a construction worker is 1.64 mrem/year.

COL Item 12.4-1: A COL applicant that references the NuScale Power Plant design certification will estimate doses to construction personnel from a co-located existing operating nuclear power plant that is not a NuScale Power Plant.

RAI 02.03.01-2, RAI 02.03.05-1

**12.4.2 Radiation Exposure at the Site Restricted Area Boundary**

RAI 02.03.01-2, RAI 02.03.05-1

The direct radiation to the site restricted area boundary from on-site sources, such as buildings, is negligible.

**15.0.3.3.11 Atmospheric Dispersion Factors ( $\chi/Q$ ), Breathing Rates, and Occupancy Factors**

RAI 02.03.04-1

Atmospheric dispersion factor ( $\chi/Q$ ) inputs to RADTRAD are derived as described in Reference 15.0-4 with assumptions shown in Table 15.0-20 [and Table 15.0-21](#). Table 2.0-1 provides the accident release  $\chi/Q$  values.

Control room and offsite breathing rate and control room occupancy factor inputs to RADTRAD, consistent with RG 1.183, are listed in Table 15.0-13.

**15.0.3.3.12 Dose Conversion Factors**

Consistent with RG 1.183, dose conversion factors from Environmental Protection Agency Federal Guidance Report No. 11 (Reference 15.0-8) and Report No. 12 (Reference 15.0-9) are used for dose analysis.

RAI 15.00.03-1

**15.0.3.4 Containment Leakage**

Containment leakage is described in Reference 15.0-4, is consistent with the recommendations of RG 1.183, and is listed in Table 12.2-28.

**15.0.3.5 Secondary-Side Decontamination**

The helical coil steam generators of the NuScale Power Plant design are different than that of a large PWR because the primary coolant is on the outside of the tubes. As a result, there is no bulk water volume in which decontamination can easily occur. Reference 15.0-4 provides the details about the decontamination factor used in the helical coil steam generators as well as the treatment of iodine deposition in the main steam piping and the condenser.

**15.0.3.6 Reactor Building Decontamination Factors**

Reactor Building RXB decontamination factors are described in Reference 15.0-4.

**15.0.3.7 Receptor Location Considerations**

RAI 15.00.03-2

Potential on-site radiological receptor locations considered in this evaluation are the control room and TSC; potential off-site locations are the EAB and LPZ. Figure 15.0-3 shows the schematic of the RADTRAD code nodalization used to model these locations for leakage paths from the containment or RXB. Figure 15.0-4 shows the RADTRAD code nodalization for the SGTF and MSLB events in which the principal release path is through the steam generator.

RAI 15.00.03-7

**Table 15.0-21: Assumptions for Control Room  $\chi/Q$** 

<b>Parameter</b>	<b>Value</b>
Release height	Ground level (0.0 meters)
Intake height	0.0 meters
Adjacent building cross-sectional area	Negligible (0.01 square meters)
Distance from source to receptor	34.1 meters

## 20.1.1 Determining Applicable Extreme External Hazards

FLEX equipment credited in the mitigation strategies is required to be available following a BDBEE. The extreme external hazards required to be considered for a BDBEE are seismic, flooding, high winds (including applicable missiles), snow, ice, and extreme (cold and high) temperatures. Descriptions of the external hazards design criteria are provided in the following sections.

### 20.1.1.1 Seismic

The seismic design criteria are identified in Section 3.7.1.

COL Item 20.1-1: A COL applicant that references the NuScale Power Plant design certification will ensure equipment and structures credited for diverse and flexible coping strategies are designed to be available following a site-specific seismic hazard.

### 20.1.1.2 External Flooding

The external flood design criteria are identified in Section 3.4.2.

COL Item 20.1-2: A COL applicant that references the NuScale Power Plant design certification will determine if a flood hazard is applicable at the site location. If a flood hazard is applicable, then the COL applicant will ensure equipment and structures credited for diverse and flexible coping strategies are designed to be available following a site-specific flood (including wave action) hazard.

### 20.1.1.3 High Winds / Missile Protection

The high winds (hurricane and tornado) and applicable missile design criteria are identified in Section 3.3 and Section 3.5.

COL Item 20.1-3: A COL applicant that references the NuScale Power Plant design certification will determine if high wind and applicable missile hazards are applicable at the site location. If high wind and applicable missile hazards are applicable, then the COL applicant will ensure equipment and structures credited for diverse and flexible coping strategies are designed to be available following a site-specific high wind and applicable missile hazards.

### 20.1.1.4 Snow, Ice, and Extreme Cold

The snow and ice design criteria are identified in Section 3.8.4. The zero percent exceedance minimum outdoor design dry bulb temperature (i.e., extreme cold) is identified in Table 2.0-1.

COL Item 20.1-4: A COL applicant that references the NuScale Power Plant design certification will determine if snow, ice and extreme cold temperature hazards are applicable at the site location. If snow, ice and extreme cold hazards are applicable, the COL applicant will ensure equipment and structures credited for diverse and flexible

coping strategies are designed to be available following a site-specific snow, ice or extreme cold temperature hazard.

#### 20.1.1.5 High Temperatures

RAI 02.03.01-6

The zero percent exceedance maximum outdoor design dry bulb temperature (i.e. high temperature) is identified in Table 2.0-1.

COL Item 20.1-5: A COL applicant that references the NuScale Power Plant design certification will determine if extreme high temperature hazard is applicable at the site location. If extreme high temperature hazard is applicable, the COL applicant will ensure equipment and structures credited for diverse and flexible coping strategies are designed to be available following a site-specific extreme high temperature hazard.

#### 20.1.2 Extended Loss of AC Power and Loss of Ultimate Heat Sink Design Assessment

This section discusses the inherent coping capability of the NuScale Power Plant design to maintain the key safety functions following an ELAP and an LUHS event. The key safety functions are maintaining core cooling, containment and spent fuel pool cooling.

##### 20.1.2.1 Definitions

An ELAP event is defined as a loss of all alternating current (AC) electric power to the essential and nonessential switchgear buses except for those fed by qualified DC batteries through inverters.

NEI 12-06 (Reference 20.1-6) defines an LUHS as the loss of motive force for UHS flow, i.e., service water or circulating water pumps, with no prospect for recovery. The LUHS event assumes the water inventory in the UHS remains available following the event, and the piping connecting the UHS to plant systems, which are qualified to survive the applicable external hazards, remains intact.

NEI 12-06 defines the following three phases for developing FLEX strategies (Reference 20.1-6):

- Phase 1 (initial): cope relying on plant equipment
- Phase 2 (transition): augment or transition from plant equipment to on-site FLEX equipment and consumables to maintain or restore key functions
- Phase 3 (final): obtain additional capability and redundancy from off-site equipment until power, water, and coolant injection systems are restored or commissioned

##### 20.1.2.2 Applicable Systems, Structures, and Components

The UHS is a large pool of water consisting of the combined water volumes of the reactor pool (RP), refueling pool (RFP) and spent fuel pool (SFP), as described in