

## 2 SITE CHARACTERISTICS AND SITE PARAMETERS

This chapter of the final safety evaluation report (FSER) documents the U.S. Nuclear Regulatory Commission (NRC) staff's review of Chapter 2, "Site Characteristics and Site Parameters," of the NuScale Power, LLC (hereinafter referred to as "the applicant"), Design Certification Application (DCA), Part 2, "Final Safety Analysis Report (FSAR)." The staff's regulatory findings documented in this report are based on Revision 5 of the DCA, dated July 29, 2020 (Agencywide Document Access and Management System (ADAMS), Accession No. ML20225A071). The precise parameter values, as reviewed by the staff in this safety evaluation, are provided by the applicant in the DCA using the English system of measure. Where appropriate, the NRC staff converted these values for presentation in this safety evaluation to the International System (SI) units of measure based on the NRC's standard convention. In these cases, the SI converted value is approximate and is presented first, followed by the applicant-provided parameter value in English units within parentheses. If only one value appears in either SI or English units, it is directly quoted from the DCA and not converted.

The following evaluation focuses on the postulated site parameters on which the staff needs to be able to reach a conclusion about safety matters related to siting.

### 2.0 Site Characteristics

#### 2.0.1 Introduction

This chapter discusses the assumed site envelope for the NuScale Power Plant design and focuses on the geography, demography, nearby facilities, and postulated site parameters for the design, including meteorology, hydrology, geology, seismology, and geotechnical parameters.

An applicant for a combined license (COL) (referred to as the "COL applicant") referencing the NuScale Power Plant design certification (DC) will demonstrate that the characteristics of the site fall within the postulated site parameters of the certified design identified in DCA Part 2, Tier 1, Table 5.0-1, "Site Parameters," and DCA Part 2 Tier 2, Table 2.0-1, "Site Parameters." If the actual site characteristics do not fall within the certified standard design site parameters, the COL applicant is to provide sufficient justification (e.g., by request for exemption or departure from the DC) that the proposed facility is acceptable at the proposed site.

#### 2.0.2 Summary of Application

**DCA Part 2 Tier 1:** The Tier 1 information associated with this section is found in DCA Part 2 Tier 1, Section 5.0, "Site Parameters." DCA Part 2 Tier 1, Table 5.0-1, lists the key site parameters for the NuScale design basis. DCA Part 2, Tier 1, Figure 5.0-1, "NuScale Horizontal Certified Seismic Design Response Spectra 5% Damping," and Figure 5.0-3, "NuScale Horizontal Certified Seismic Design Response Spectra—High Frequency 5% Damping," provide the horizontal NuScale certified seismic design response spectra (CSDRS). DCA Part 2 Tier 1, Figure 5.0-2, "NuScale Vertical Certified Seismic Design Response Spectra 5% Damping," and Figure 5.0-4, "NuScale Vertical Certified Seismic Design Response Spectra—High Frequency 5% Damping," provide the vertical NuScale CSDRS.

**DCA Part 2 Tier 2:** The applicant provided in DCA Part 2 Tier 2, a description and summary table identifying design-basis parameters for the NuScale design in Section 2.0, “Site Characteristics and Site Parameters,” summarized here, in part, as follows.

DCA Part 2 Tier 2, Table 2.0-1, contains the same key site parameter descriptions and parameter values as those in DCA Part 2, Tier 1, Table 5.0-1.

**ITAAC:** There are no inspections, tests, analyses, and acceptance criteria (ITAAC) for this area of review.

**Technical Specifications:** There are no technical specifications (TS) for this area of review.

**Technical Reports:** There are no technical reports associated with this area of review.

**Topical Reports:** NuScale Power, LLC, Licensing Topical Report TR-0915-17565-NP-A, “Accident Source Term Methodology,” Revision 4, issued February 2020 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML20057G132, nonproprietary version).

### **2.0.3 Regulatory Basis**

Section 2.0, “Site Characteristics and Site Parameters,” of NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition” (hereafter referred to as the “SRP”), provides the relevant NRC staff requirements for these areas of review and the associated acceptance criteria, as summarized below:

- Title 10 of the *Code of Federal Regulations* (10 CFR) 52.47(a)(1) requires a DC applicant, among other things, to provide site parameters postulated for the design.
- The requirements in 10 CFR Part 100, “Reactor Site Criteria,” give the siting factors and criteria that apply to determining an acceptable site.

Review interfaces with other sections of the SRP can be found in SRP Section 2.0. The following provides the acceptance criteria that are adequate to meet the above requirements:

- The related SRP Chapter 2, “Site Characteristics and Site Parameters,” or other referenced sections of the SRP provide acceptance criteria associated with site characteristics and design parameters.

DC applications do not contain general descriptions of site characteristics because this information is site specific and is addressed by the COL applicant referencing the NuScale Power Plant DC in the COL FSAR.

Acceptance is based on the COL applicant’s demonstration that the characteristics of the site fall within the postulated site parameters of the certified design. If the actual site characteristics do not fall within the certified standard design site parameters, the COL applicant is to provide sufficient justification (e.g., by request for exemption or departure from the DC) that the proposed facility is acceptable at the proposed site.

#### 2.0.4 Technical Evaluation

The staff reviewed DCA Part 2 using the review guidance described in SRP Section 2.0. The staff based its evaluation of the NuScale site parameters on a review of DCA Part 2 Tier 2, Chapter 2, "Site Characteristics and Site Parameters." The application addressed each of the pertinent site parameters described in 10 CFR 52.47(a)(1)(iii). The applicant described the adequacy of each site parameter in the individual safety analysis sections. As described in more depth below, the staff finds that, within the scope of applicable COL items as discussed in individual sections below, the postulated site parameters of the NuScale design, as set forth in DCA Part 2 Tier 1, Table 5.0-1, and DCA Part 2 Tier 2, Table 2.0-1, are consistent with the applicable regulations and acceptance criteria cited in SRP Chapter 2 in that (1) pertinent parameters were selected as key site parameters, (2) the key site parameters are representative of a reasonable number of sites that have been or may be considered for a COL application, and (3) a technical basis was provided for each site parameter.

#### 2.0.5 Combined License Information Items

As part of its review of this portion of the application, the staff considered the adequacy of the COL information items presented in DCA Part 2 Tier 2, Table 1.8-2, "Combined License Information Items." The following table summarizes the COL information item related to DCA Part 2 Tier 2, Section 2.0, "Site Characteristics and Site Parameters."

**Table 2.0-1 NuScale COL Information Item for DCA Part 2 Tier 2, Section 2.0**

Item No.	Description	DCA Part 2 Tier 2 Section
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 site 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

#### 2.0.6 Conclusion

As set forth above, the staff reviewed the application to ensure that sufficient information was presented with respect to the postulated site parameters in the DC. Accordingly, as described in more depth below, the staff concludes that the applicant has addressed DC site parameters and thus meets the requirements in 10 CFR 52.47(a)(1).

## **2.1 Geography and Demography**

### **2.1.1 Site Location and Description**

#### **2.1.1.1 *Introduction***

The staff uses the descriptions of the site area and reactor location to assess the acceptability of the reactor site. For applications submitted under 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," the staff's review generally covers the following specific areas: (1) specification of reactor location with respect to latitude and longitude, political subdivisions, and prominent natural and manmade features of the area, (2) a site area map to determine the distance from the reactor to the boundary lines of the exclusion area, including consideration of the location, distance, and orientation of plant structures with respect to highways, railroads, and waterways that traverse or lie adjacent to the exclusion area, and (3) any additional information requirements prescribed by the "Contents of Application" sections of the applicable subparts to 10 CFR Part 52. The purpose of the review is to ascertain the accuracy of the applicant's description for use in independent evaluations of the exclusion area authority and control, surrounding population, and nearby manmade hazards.

#### **2.1.1.2 *Summary of Application***

**DCA Part 2 Tier 2:** DCA Part 2 Tier 2, Section 2.1, "Geography and Demography," addresses the need for a site location and description with a statement that a COL applicant referencing the NuScale Power Plant DC will provide site-specific information related to the site location and description, exclusion area authority and control, and population distribution in accordance with COL Item 2.1-1.

#### **2.1.1.3 *Regulatory Basis***

As specified in SRP Section 2.1.1, "Site Location and Description," the following regulations contain the relevant requirements generally applicable to site location and description:

- 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," and 10 CFR Part 52, as they relate to the inclusion, in the safety analysis report (SAR), of a detailed description and safety assessment of the site on which the facility will be located, with appropriate attention to features that affect the facility design (10 CFR 50.34(a)(1), 10 CFR 52.47(a)(1), and 10 CFR 52.79(a)(1))
- 10 CFR Part 100, as it relates to (1) defining an exclusion area and setting forth requirements for activities in that area (10 CFR 100.3, "Definitions"), (2) addressing and evaluating factors that are used to determine the acceptability of the site as identified in 10 CFR 100.20(a) and (b), (3) determining an exclusion area such that certain dose guidelines would not be exceeded in the event of a postulated fission product release as described in 10 CFR 50.34(a)(1), as it relates to the site evaluation factors identified in 10 CFR Part 100, and (4) requiring that the site location and the engineered features included as safeguards against the hazardous consequences of an accident, should one occur, should ensure a low risk of public exposure

SRP Section 2.1.1 lists acceptance criteria adequate to meet the above requirements, as well as review interfaces with other SRP sections. In addition, the following guidance provides acceptance criteria that confirm that the above requirements have been adequately addressed:

- **Specification of Location:** The information submitted by the applicant is adequate and meets the requirements if it describes highways, railroads, and waterways that traverse the exclusion area in sufficient detail to allow the reviewer to determine that the applicant has met the requirements in 10 CFR 100.3.
- **Site Area Map:** The information submitted by the applicant is adequate and meets the requirements if it describes the site location, including the exclusion area and the location of the plant within the area, in sufficient detail to enable the reviewer to evaluate the applicant's analysis of a postulated fission product release, thereby allowing the reviewer to determine (based on SRP Section 2.1.2, "Exclusion Area Authority and Control," and Section 2.1.3, "Population Distribution") that the applicant has met the requirements in 10 CFR 50.34(a)(1) and 10 CFR Part 100.

SRP Section 2.1.1 identifies the following DCA-specific guidance:

- **Standard DC Reviews:** DCAs do not contain general descriptions of site characteristics because this information is site specific and will be addressed by the COL applicant. Under 10 CFR 52.47(a)(1), a DC applicant must provide site parameters postulated for the design. However, the identification of site location and description are not applicable for this area of standard DC review.

There are no postulated site parameters for a DC related to this SRP section. The site location and description are site specific and will be addressed by the COL applicant.

#### *2.1.1.4 Technical Evaluation*

In DCA Part 2, Tier 2, the applicant stated that a COL applicant referencing the NuScale power plant DC will address the site-specific information on the site location and description to include the boundaries of the site; the proposed general location of each facility on the site; the location and description of any industrial, military, or transportation facilities and routes; and prominent natural and manmade features in the site area. The detailed information included the following:

- The reactor location is described with respect to (1) latitude and longitude and the universal transverse Mercator coordinate system, (2) political subdivisions, and (3) prominent natural and manmade features of the area for use in conducting independent evaluations of the exclusion area authority and control (SRP Section 2.1.2), the surrounding population (SRP Section 2.1.3), and nearby manmade hazards (SRP Section 2.2.3, "Evaluation of Potential Accidents").
- The site area map contains the reactor and associated principal plant structures to determine (1) the distance from the reactor to the boundary lines of the exclusion area, including the direction and distance from the reactor to the nearest exclusion area boundary (EAB) line, and (2) the location, distance, and orientation of plant structures with respect to highways, railroads, and waterways that traverse or lie adjacent to the exclusion area to ensure that they are adequately described to permit analyses of the possible effects of plant accidents on these transportation routes (SRP Section 2.1.1).
- Because the information related to site location and description is site specific and to be provided by a COL applicant referencing the NuScale Power Plant DC, the NuScale DCA does not contain this information.

#### 2.1.1.5 Combined License Information Items

Table 2.1-1 lists the COL information item related to DCA Part 2 Tier 2, Section 2.1.1, from DCA Part 2 Tier 2, Table 1.8-2.

**Table 2.1-1 NuScale COL Information Items for DCA Part 2 Tier 2, Section 2.1.1**

Item No.	Description	DCA Part 2 Tier 2 Section
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

#### 2.1.1.6 Conclusion

As set forth above, the applicant stated in DCA Part 2 Tier 2, that the COL applicant will provide the site-specific information in accordance with COL Item 2.1-1. Because this information is site specific, the staff considers the applicant's statement in DCA Part 2 Tier 2, that the COL applicant will provide this site-specific information in accordance with COL Item 2.1-1 to be acceptable. Based on the foregoing regulatory basis, corresponding SRP guidance, and review of the DCA, the staff concludes that, because this information is site specific, it will be addressed by the COL applicant and, therefore, would be reviewed at the COL stage. The COL applicant should include information sufficient to demonstrate that the site characteristics, including those related to site location, fall within the site parameters.

### 2.1.2 Exclusion Area Authority and Control

#### 2.1.2.1 Introduction

The staff uses the descriptions of exclusion area authority and control, as provided in the application, to verify the applicant's legal authority to determine and control activities within the designated exclusion area. For applications submitted under 10 CFR Part 52, the staff's review generally covers (1) the establishment of the applicant's legal authority to determine all activities within the designated exclusion area, (2) the applicant's authority and control in excluding or removing personnel and property from the exclusion area in the event of an emergency, (3) the establishment that proposed or permitted activities in the exclusion area unrelated to operation of the reactor do not result in a significant hazard to public health and safety, and (4) any additional information requirements prescribed in 10 CFR Part 52.

#### 2.1.2.2 Summary of Application

The applicant addressed the need for exclusion area authority and control with a statement that a COL applicant referencing the NuScale Power Plant DC will provide site-specific information related to exclusion area authority and control in accordance with COL Item 2.1-1.

#### 2.1.2.3 Regulatory Basis

As specified in SRP Section 2.1.2, the following NRC regulations contain the relevant requirements generally applicable to exclusion area authority and control:

- 10 CFR Part 50 and 10 CFR Part 52, as they relate to a detailed description and safety assessment of the site on which the facility is to be located (10 CFR 50.34(a)(1), 10 CFR 52.17(a)(1), and 10 CFR 52.79(a)(1))
- 10 CFR Part 100, as it relates to (1) defining an exclusion area and setting forth requirements on activities in that area (10 CFR 100.3, 10 CFR 100.21(a)), (2) addressing and evaluating factors that are used in determining the acceptability of the site as identified in 10 CFR 100.20(a) and (b), and (3) determining an exclusion area such that certain dose limits would not be exceeded in the event of a postulated fission product release as identified in 10 CFR 50.34(a)(1) and 10 CFR 52.79(a)(1), as it relates to site evaluation factors identified in 10 CFR Part 100
- 10 CFR 50.33, "Contents of Applications; General Information," as it relates to ownership and control of property

SRP Section 2.1.2 lists the following specific acceptance criteria adequate to meet the above requirements. In order to ensure the acceptance criteria are followed to the extent applicable, the staff utilizes the following review procedures. These procedures are based on the identified SRP acceptance criteria:

- Establishment of Authority: The information submitted by the applicant is adequate and meets the requirements if it provides sufficient detail to enable the staff to evaluate the applicant's legal authority within the designated exclusion area.
- Exclusion or Removal of Personnel and Property: The information submitted by the applicant is adequate and meets the requirements if it provides sufficient detail to enable the staff to evaluate the applicant's legal authority for the exclusion or removal of personnel or property from the exclusion area.
- Proposed and Permitted Activities: The information submitted by the applicant is adequate and meets the requirements if it provides sufficient detail to enable the staff to evaluate the applicant's legal authority over all activities within the designated exclusion area.

SRP Section 2.1.2 identifies the following DCA-specific guidance:

- Standard DC Reviews: DCAs do not contain general descriptions of site characteristics because this information is site specific and will be addressed by the COL applicant. Under 10 CFR 52.47(a)(1), a DC applicant must provide site parameters postulated for the design. However, the identification of exclusion area authority and control is not applicable for this area of standard DC review.
- Exclusion area authority and control is site specific and will be addressed by the COL applicant.

#### 2.1.2.4 *Technical Evaluation*

The applicant need not postulate a location for the EAB or outer boundary of the low-population zone (LPZ) as site parameters because the points at which radiological doses are calculated under 10 CFR 52.47(a)(2)(iv) for these locations are implicit in the atmospheric dispersion factors ( $\chi/Q_s$ ) discussed in Section 2.3, "Meteorology," of this report and FSER Chapter 15, "Transient and Accident Analysis."

In DCA Part 2 Tier 2, the applicant stated that a COL applicant referencing the NuScale power plant DC will address the site-specific information pertaining to exclusion area authority and control. SRP Section 2.1.2 addresses the specific criteria acceptable to meet the relevant requirements, which typically involve reviewing (1) the applicant's legal authority to determine all activities within the designated exclusion area, (2) the applicant's authority and control in excluding or removing personnel and property in the event of an emergency, (3) proposed or permitted activities in the exclusion area unrelated to the operation of the reactor to ensure they do not result in a significant hazard to public health and safety, (4) the presence of residences within the EAB (none are normally permitted; if so, the people who live within the EAB are subject to removal), and (5) traversal of highways, railways, or waterways across the exclusion area (which should not be close enough to the facility to interfere with normal operations).

The NuScale DCA does not contain this type of information because the information is site specific.

#### **2.1.2.5 Combined License Information Items**

Table 2.1-1 lists the COL information item related to DCA Part 2 Tier 2, Section 2.1.2, as provided in DCA Part 2 Tier 2, Table 1.8-2.

#### **2.1.2.6 Conclusion**

As set forth above, the applicant has stated in DCA Part 2 Tier 2, that the COL applicant will provide the site-specific information called for in COL Item 2.1-1. Because this information is site specific, the staff determined that the applicant's statement in DCA Part 2 Tier 2, that the COL applicant is to provide this site-specific information in accordance with COL Item 2.1-1 is acceptable. Based on the foregoing regulatory basis, corresponding SRP guidance, and review of the DCA, the staff also concludes that, because this information is site specific, it will be addressed by the COL applicant and, therefore, would be reviewed at the COL stage. The COL applicant should include information sufficient to demonstrate that the site characteristics, including those related to EAB and exclusion area authority and control, fall within the site parameters.

### **2.1.3 Population Distribution**

#### **2.1.3.1 Introduction**

The description of population distribution addresses the need for information about (1) the population in the site vicinity, including transient populations, (2) the population in the exclusion area, (3) whether appropriate protective measures could be taken on behalf of the populace in the specified LPZ in the event of a serious accident, (4) whether the nearest boundary of the closest population center containing 25,000 or more residents is at least 1½ times the distance from the reactor to the outer boundary of the LPZ, (5) whether the population density in the site vicinity is consistent with the guidelines in Regulatory Position C.4 of Regulatory Guide (RG) 4.7, "General Site Suitability Criteria for Nuclear Power Stations," Revision 3, issued March 2014, and (6) any additional information requirements in the "Contents of Application" sections of the applicable subparts of 10 CFR Part 52.



### 2.1.3.2 *Summary of Application*

This applicant addressed the need for population distribution with a statement that a COL applicant referencing the NuScale Power Plant DC will provide site-specific information related to population distribution, in accordance with COL Item 2.1-1.

### 2.1.3.3 *Regulatory Basis*

As specified in SRP Section 2.1.3, the following NRC regulations contain the relevant requirements generally applicable to population distribution:

- 10 CFR 50.34(a)(1), as it relates to consideration of the site evaluation factors in 10 CFR 100.3, 10 CFR 100.20, "Factors to Be Considered when Evaluating Sites," and 10 CFR 100.21, "Non-Seismic Site Criteria" (including consideration of population density); 10 CFR 52.47, "Contents of Applications; Technical Information"; and 10 CFR 52.79(a)(1)(v), as they relate to the applicant's SAR providing the existing and projected future population profile of the area surrounding the site
- 10 CFR 100.20 and 10 CFR 100.21, as they relate to determining the acceptability of a site for a power reactor, and 10 CFR 100.3, 10 CFR 100.20(a), and 10 CFR 100.21(b), which include definitions and other requirements for determining an exclusion area, LPZ, and population center distance

SRP Section 2.1.3 lists the acceptance criteria adequate to meet the above requirements, as well as review interfaces with other SRP sections. In order to ensure the acceptance criteria are followed to the extent applicable, the staff utilizes the following review procedures. These procedures are based on the identified SRP acceptance criteria:

- **Population Data:** The population data supplied by the applicant in the SAR are acceptable under the following conditions: (1) the SAR contains population data from the latest census and projected population at the year of plant approval and 5 years thereafter, consistent with the geographical format in Section 2.1.3 of RG 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants, LWR Edition," Revision 3, issued November 1978, and with the guidance in RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," issued June 2007, (2) the SAR describes the methodology and sources used to obtain the population data, including the projections, and (3) the SAR includes information on transient populations in the site vicinity.
- **Exclusion Area:** The exclusion area should either not contain any residents, or such residents should be subject to ready removal if necessary.
- **Low-Population Zone:** The specified LPZ is acceptable if a determination is made that appropriate protective measures could be taken on behalf of the enclosed populace in the event of a serious accident.
- **Nearest Population Center Boundary:** The nearest boundary of the closest population center containing 25,000 or more residents is at least  $1\frac{1}{2}$  times the distance from the reactor to the outer boundary of the LPZ.

- Population Density: If the population density exceeds the guidelines in Regulatory Position C.4 of RG 4.7, the applicant must consider alternative sites with lower population densities.

SRP Section 2.1.3 identifies the following DCA-specific guidance:

- Standard DC Reviews: DCAs do not contain general descriptions of site characteristics because this information is site specific and will be addressed by the COL applicant. Under 10 CFR 52.47(a)(1), a DC applicant must provide site parameters postulated for the design. However, the identification of population distribution is not applicable for this area of standard DC review.
- The population distribution is site specific and will be addressed by the COL applicant.

#### 2.1.3.4 *Technical Evaluation*

In DCA Part 2, Tier 2, the applicant stated that a COL applicant referencing the NuScale Power Plant DC will address the site-specific information on population distribution, population center, and population density. SRP Section 2.1.3 addresses the specific criteria deemed acceptable to meet the relevant regulatory requirements. Such requirements typically involve a review of the following:

- data about the population in the site vicinity
- the population in the exclusion area
- the LPZ to determine whether appropriate protective measures could be taken on behalf of the populace in that zone in the event of a serious accident
- the nearest boundary of the closest population center containing 25,000 or more residents to determine whether this boundary is at least  $1\frac{1}{3}$  times the distance from the reactor to the outer boundary of the LPZ
- the population density in the site vicinity, including the weighted transient population at the time of initial site approval and within 5 years thereafter to determine whether it exceeds 500 persons per square mile averaged over any radial distance out to 32.2 kilometers (20 miles)

The NuScale DCA does not contain this type of information because the information is site specific.

#### 2.1.3.5 *Combined License Information Items*

Table 2.1-1 lists the COL information item related to DCA Part 2 Tier 2, Section 2.1.3, as provided in DCA Part 2 Tier 2, Table 1.8-2.

#### 2.1.3.6 *Conclusion*

As set forth above, the applicant has stated in DCA Part 2 Tier 2, that the COL applicant will provide the site-specific information in accordance with COL Item 2.1-1. Because this information is site specific, the staff considers the applicant's statement in DCA Part 2 Tier 2,

that the COL applicant is to provide this site-specific information in accordance with COL Item 2.1-1 to be acceptable.

Based on the foregoing regulatory basis, corresponding SRP guidance, and review of the DCA, the staff concludes that because this information is site specific, it will be addressed by the COL applicant and, therefore, would be reviewed at the COL stage. The COL applicant should include information sufficient to demonstrate that the site-specific population information specified in the COL application complies with the applicable requirements of 10 CFR Part 100, including evaluation of the LPZ, population center distance, and population density, as described above.

## **2.2 Nearby Industrial, Transportation, and Military Facilities**

### **2.2.1 Identification of Potential Hazards in Site Vicinity**

#### **2.2.1.1 *Introduction***

With respect to the identification of potential hazards in the site vicinity, the staff reviews site-specific information on the identification and evaluation of potential hazards stemming from nearby industrial, transportation, and military facilities within the site vicinity, including an evaluation of the potential effect such hazards might have on the proposed facility, such as from explosions, toxic chemicals, and fires.

##### **2.2.1.1.1 *Location and Routes***

In an application for a DC, the description of locations and transportation routes provides information about potential external hazards or hazardous materials that are present or may reasonably be expected to be present during the projected lifetime of the proposed plant. The purpose of including a description of location and transportation routes in a DC application is for the NRC staff to evaluate the sufficiency of information on the presence and magnitude of potential external hazards, so that the staff can perform the reviews as described in SRP Section 2.2.3; SRP Section 3.5.1.5, "Site Proximity Missiles (Except Aircraft)"; and SRP Section 3.5.1.6, "Aircraft Hazards." For applications submitted under 10 CFR Part 52, the staff's review generally covers (1) the locations (identified on maps) of, and separation distances from the plant to, transportation facilities and routes, including airports and airways, roadways, railways, pipelines, and navigable bodies of water, (2) the presence of military and industrial facilities, such as fixed manufacturing, processing, and storage facilities, and (3) any additional information requirements in the "Contents of Application" sections of the applicable subparts of 10 CFR Part 52.

##### **2.2.1.1.2 *Descriptions***

Industrial, transportation, and military facilities are site-specific information. As stated in DCA Part 2 Tier 2, Section 2.2, "Nearby Industrial, Transportation, and Military Facilities," the NuScale Power Plant certified design does not postulate any hazards from nearby industrial, transportation, or military facilities. A COL applicant that references the NuScale Power Plant DC will describe nearby industrial, transportation, and military facilities (see COL Item 2.2-1 in Table 2.2-1 of this report). The COL applicant's information should describe the primary function of each facility and the nature of the hazards that it presents. This information for each facility should include the facility's primary function; major products; number of employees; materials regularly manufactured, stored, used, or transported near the site; and the hazards that could result from accidents at each facility.

### 2.2.1.2 *Summary of Application*

DCA Part 2 Tier 2, Section 2.2, addresses the need to identify potential hazards in the site vicinity with a statement that a COL applicant referencing the NuScale Power Plant DC will provide site-specific information related to the location and routes for nearby industrial, transportation, and military facilities, consistent with COL Item 2.2-1.

### 2.2.1.3 *Regulatory Basis*

As specified in SRP Section 2.2.1–2.2.2, “Identification of Potential Hazards in Site Vicinity,” the following NRC regulations contain the relevant requirements generally applicable to the identification of potential hazards in the site vicinity:

- 10 CFR 100.20(b), which requires that the applicant evaluate the nature and proximity of human-related hazards (e.g., airports, dams, transportation routes, military facilities, and chemical facilities) to establish site characteristics for use in determining whether the plant design can accommodate commonly occurring hazards and whether the risk of other hazards is very low
- 10 CFR 52.47(a)(1) and 10 CFR 52.79(a)(1)(iv), as they relate to the factors to be considered in the evaluation of sites that require the location and description of industrial, military, or transportation facilities and routes, and 10 CFR 52.79(a)(1)(vi), as it relates to compliance with 10 CFR Part 100

The guidance in SRP Section 2.2.1–2.2.2 lists the acceptance criteria adequate to meet the above requirements, as well as review interfaces with other SRP sections. In order to ensure the acceptance criteria are followed to the extent applicable, the staff utilizes the following review procedures. These procedures are based on the identified SRP acceptance criteria:

- The COL applicant will address the locations and distances from the plant of nearby industrial, military, and transportation facilities, and such data are in agreement with data obtained from other sources, when available.
- Descriptions of the nature and extent of activities conducted at the site and in its vicinity, including the products and materials likely to be processed, stored, used, or transported, are adequate to permit identification of the possible hazards cited in Section III, “Review Procedures,” of SRP Section 2.2.1–2.2.2.
- Sufficient statistical data with respect to hazardous materials establish a basis for evaluating the potential hazards to the plant or plants considered at the site.

SRP Section 2.2.1–2.2.2 identifies the following DCA-specific guidance:

- Standard DC Reviews: DCAs do not contain general descriptions of site characteristics because this information is site specific and will be addressed by the COL applicant. Under 10 CFR 52.47(a)(1), a DC applicant must provide site parameters postulated for the design. However, the identification of potential hazards in site vicinity is not applicable for this area of standard DC review.
- The identification of potential hazards in the site vicinity is site specific and will be addressed by the COL applicant.

#### 2.2.1.4 *Technical Evaluation*

In DCA Part 2 Tier 2, the applicant stated that a COL applicant referencing the NuScale Power Plant DC will address the site-specific information on the identification of potential hazards stemming from the nearby industrial, transportation, and military facilities within the site vicinity. SRP Section 2.2.1–2.2.2 addresses the specific criteria acceptable to meet the relevant regulatory requirements. Such requirements typically involve a review of the following:

- the locations and distances of industrial, military, and transportation facilities near the plant
- the nature and extent of activities conducted at the site and in its vicinity, including the products and materials likely to be processed, stored, used, or transported, to identify possible hazards
- statistical data with respect to hazardous materials to establish a basis for evaluating the potential hazard to the plant considered at the site

The NuScale DCA does not contain this type of information because the information is site specific.

#### 2.2.1.5 *Combined License Information Items*

Table 2.2-1 lists the COL information item related to DCA Part 2 Tier 2, Section 2.2.1–2.2.2, as provided in DCA Part 2 Tier 2, Table 1.8-2.

**Table 2.2-1 NuScale COL Information Items related to DCA Part 2 Tier 2, Section 2.2.1–2.2.2**

<b>Item No.</b>	<b>Description</b>	<b>DCA Part 2 Tier 2 Section</b>
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 of these potential hazards or provide site-specific design alternatives.	2.2

#### 2.2.1.6 *Conclusion*

As set forth above, the applicant stated in DCA Part 2 Tier 2, that the COL applicant will provide the site-specific information in accordance with COL Item 2.2-1. Because this information is site specific, the staff considers the applicant's statement in the DCA that the COL applicant is to provide this site-specific information in accordance with COL Item 2.2-1 to be acceptable. Based on the foregoing regulatory basis, corresponding SRP guidance, and review of the DCA, the staff concludes that, because this information is site specific, it will be addressed by the COL applicant and, therefore, would be reviewed at the COL stage. The COL applicant should include information sufficient to demonstrate that the site-specific, human-related hazard information specified in the COL application complies with the applicable requirements of 10 CFR Part 100 to establish site characteristics for use in determining whether the plant design

can accommodate commonly occurring hazards, and whether the risk of other hazards is very low.

## **2.2.2 Evaluation of Potential Accidents**

### **2.2.2.1 Introduction**

An application under 10 CFR Part 52 must identify any design-basis event (DBE) caused by nearby industrial, transportation, and military facilities and must evaluate potential accidents near the plant, including human-related hazards. As defined in SRP Section 2.2.3, "Evaluation of Potential Accidents," a DBE is an event with a probability of occurrence greater than an order of magnitude of  $1 \times 10^{-7}$  per year, resulting in a radiological dose exceeding the dose criteria in 10 CFR Part 100. If potential accidents having an unacceptable probability of occurrence with severe consequences are identified, the applicant must describe site-specific steps taken to mitigate the consequences.

The evaluation of potential accidents considers the applicant's probability analyses of potential accidents involving hazardous materials or activities on and near the proposed site to confirm that the applicant used appropriate data and analytical models. For applications submitted under 10 CFR Part 52, the staff's review generally covers (1) hazards associated with nearby industrial activities, such as manufacturing, processing, or storage facilities, (2) hazards associated with nearby military activities, such as military bases, training areas, or aircraft flights, and (3) hazards associated with nearby transportation routes, such as aircraft routes, highways, railways, navigable waters, and pipelines. Each hazard review area considers the following principal types of hazards:

- toxic vapors or gases and their potential for incapacitating nuclear plant control room operators
- overpressure resulting from explosions or detonations involving materials such as munitions, industrial explosives, or explosive vapor clouds resulting from the atmospheric release of gases (such as propane and natural gas) with a potential for ignition and explosion
- missile effects attributable to mechanical impacts (such as aircraft impact), impacts from explosion debris, and impacts from waterborne items (such as barges)
- thermal effects attributable to fires

### **2.2.2.2 Summary of Application**

In DCA Part 2 Tier 2, Section 2.2, the applicant addressed the need for an evaluation of potential accidents in the plant vicinity with a statement that a COL applicant referencing the NuScale DCA will provide site-specific information related to the evaluation of man-related hazards near the plant in accordance with COL Item 2.2-1.

### **2.2.2.3 Regulatory Basis**

The following NRC regulations contain the relevant requirements for this review:

- 10 CFR 52.47(a)(1) and 10 CFR 52.79(a)(1)(iv), as they relate to the factors to be considered in the evaluation of sites, which require the location and description of

industrial, military, or transportation facilities and routes, and 10 CFR 52.47(a)(1) and 10 CFR 52.79(a)(1)(vi), as they relate to general compliance with 10 CFR Part 100

- 10 CFR 100.20(b), which states that the nature and proximity of man-related hazards (e.g., airports, dams, transportation routes, military facilities, and chemical facilities) must be evaluated to establish site characteristics for use in determining whether a plant design can accommodate commonly occurring hazards and whether the risk of other hazards is very low
- 10 CFR 100.21(e), which states that potential hazards associated with nearby transportation routes and industrial and military facilities must be evaluated and site characteristics established to ensure that potential hazards from such routes and facilities will not pose undue risk to the type of facility proposed to be located at the site

The guidance in SRP Section 2.2.3 lists the acceptance criteria adequate to meet the above requirements, as well as review interfaces with other SRP sections. In order to ensure the acceptance criteria are followed to the extent applicable, the staff utilizes the following review procedures. These procedures are based on the identified SRP acceptance criteria:

- The identification of a DBE resulting from the presence of hazardous materials or activities near the plant or plants of a specified type is acceptable if it includes all postulated types of accidents for which the expected rate of occurrence of potential exposures resulting in radiological dose in excess of the limits in 10 CFR 50.34(a)(1), as it relates to the requirements in 10 CFR Part 100, is estimated to exceed the staff objective of an order of magnitude of  $1 \times 10^{-7}$  per year.
- The effects of a DBE have been adequately considered, in accordance with 10 CFR 100.20(b), if the applicant has analyzed the effects of those accidents on the safety-related features of the plant or plants of a specified type and has undertaken measures (e.g., hardening and fire protection) to mitigate the consequences of such events.

SRP Section 2.2.3 identifies the following DCA-specific guidance:

- Standard DC Reviews: DCAs do not contain general descriptions of site characteristics because this information is site specific and will be addressed by the COL applicant. Under 10 CFR 52.47(a)(1), a DC applicant must provide site parameters postulated for the design. However, the evaluation of potential accidents in the site vicinity is not applicable for this area of standard DC review.
- Exclusion area authority and control is site specific and will be addressed by the COL applicant.

#### *2.2.2.4 Technical Evaluation*

In DCA Part 2 Tier 2, the applicant stated that a COL applicant referencing the NuScale Power Plant DC will address the site-specific information on the evaluation of potential accidents within the plant vicinity. This includes hazards associated with nearby industrial activities (e.g., manufacturing, processing, or storage facilities), nearby military activities (e.g., military bases, training areas, or aircraft flights), and nearby transportation routes (e.g., aircraft routes, highways, railways, navigable waters, and pipelines). The applicant stated that the following

principal types of hazards will be considered with respect to each of the above areas of review if they have a probability of occurrence greater than  $1 \times 10^{-7}$  per year:

- missiles more energetic than the tornado missile spectra
- pressure effects in excess of the design-basis tornado
- explosions
- fires
- aircraft impacts
- release of flammable vapor clouds
- release of toxic chemicals

The NuScale DCA does not contain this type of information because the information is site specific.

#### *2.2.2.5 Combined License Information Items*

Table 2.2-1 in this report lists the COL information item related to DCA Part 2 Tier 2, Section 2.2.2, from DCA Part 2 Tier 2, Table 1.8-2.

#### *2.2.2.6 Conclusion*

As set forth above, the applicant has stated in DCA Part 2 Tier 2, that the COL applicant will provide the site-specific information under COL Item 2.2-1. Because this information is site specific, the staff considers the applicant's statement in the DCA that the COL applicant is to provide this site-specific information in accordance with COL Item 2.2-1 to be acceptable. Based on the foregoing regulatory basis, corresponding SRP guidance, and review of the DCA, the staff concludes that because this information is site specific it will be addressed by the COL applicant and, therefore, would be reviewed at the COL stage. The COL applicant should include information sufficient to demonstrate that the site-specific human-related hazard information specified in the COL application complies with the applicable requirements of 10 CFR Part 100 and should demonstrate that those hazards pose no undo risk to the proposed facility.

### **2.3 Meteorology**

DCA Part 2 Tier 2, Section 2.3, "Meteorology," states that "[t]he NuScale Power Plant is designed using meteorological parameters that are representative of a reasonable number of potential plant site locations in the United States." This is understood to include the contiguous (lower 48) states, the remainder of the continental United States (i.e., the State of Alaska), and the State of Hawaii. The DCA is silent with respect to the potential of the NuScale Power Plant design being deployed in U.S. territories.

Section 2.3 of this report discusses the staff's review of the related information provided in the DCA, including the values postulated in DCA Part 2 Tier 1, Table 5.0-1; DCA Part 2 Tier 2, Table 2.0-1; and supporting DCA Part 2, Tier 2, descriptions and documentation.

In its review, the staff used SRP Sections 2.3.1 through 2.3.5 and other related guidance and resources identified in or relevant to these SRP sections.



## 2.3.1 Regional Climatology

### 2.3.1.1 Introduction

DCA Part 2 Tier 2, Section 2.3.1, “Regional Climatology,” states that “[r]egional climatology is site-specific and is addressed by the COL applicant as part of the response to COL Item 2.3-1.” This DCA Part 2 section identifies several climate-related conditions that are taken into account in the safe design and operation of the proposed NuScale Power Plant design. Section 2.3.1.2 of this report summarizes these climate-related site parameters.

A COL applicant referencing the NuScale Power Plant design evaluates the characteristics of its proposed site in terms of these climate-related site parameters. A COL applicant also addresses other general climatic conditions in the site region (e.g., types of air masses, airflow patterns, synoptic-scale features, the influences of topography on the regional climatology, seasonal and annual frequencies of different weather elements and severe weather phenomena). However, these other climatic conditions are not within the scope of the DCA submittal because, while they provide context, they do not, of themselves, impact the design of the plant and are not specified as site parameters for the NuScale Power Plant design.

Section 2.3.1.3 of this report provides the regulatory basis for the staff’s review of DCA Part 2, Tier 2, Section 2.3.1, and the related postulated site parameters. This report also identifies applicable regulations, review guidance, acceptance criteria, and other relevant review documentation.

Section 2.3.1.4 of this report documents the staff’s evaluation of each of the climate-related site parameters. Reasonableness of the postulated site parameter values was reviewed with respect to the applicable regulatory bases and relative to the applicant’s clarified statement that the meteorological site parameters “are representative of a reasonable number of potential plant site locations in the United States.” For the reasons stated above, however, the technical evaluation under Section 2.3.1.4 of this report does not analyze or evaluate the design in terms of these site parameters from an engineering standpoint.

Section 2.3.1.5 of this report identifies COL information items applicable to the climate-related information in DCA Part 2 Tier 2, Section 2.3.1. Section 2.3.1.6 of this report summarizes the staff’s conclusions based on its technical evaluation of DCA Part 2 Tier 2, Section 2.3.1, and the corresponding postulated site parameters in DCA Part 2 Tier 1, Table 5.0-1, and DCA Part 2 Tier 2, Table 2.0-1.

### 2.3.1.2 Summary of Application

**DCA Part 2 Tier 1:** DCA Part 2 Tier 1, Table 5.0-1, includes the following climate-related site parameters:

- maximum precipitation rates for roof design (as rainfall) of 492.8 millimeters (mm) per hour (mm/hr) (19.4 inches (in.) per hour (in./hr)) and 160.0 mm (6.3 in.) for a 5-minute period (reiterated in DCA Part 2 Tier 2, Section 2.3.1, and Tier 2, Section 3.4.2.2, “Probable Maximum Precipitation”)
- normal and extreme roof snow loads of 2.394 and 3.591 kilopascals (kPa) (50 and 75 pounds per square foot (psf)), respectively (reiterated in DCA Part 2 Tier 2, Section 2.3.1 and Section 3.4.2.2)

- a 100-year return period 3-second (sec) wind gust speed of 64.8 meters per second (m/sec) (145 miles per hour (mph) for Exposure Category “C,” with an importance factor of 1.15 for the reactor building (RXB), control building (CRB), and radioactive waste building (RWB) (reiterated in DCA Part 2 Tier 2, Section 2.3.1, and DCA Part 2 Tier 2, Section 3.3.1.1, “Design Parameters for Severe Wind”)
- design-basis tornado (DBT) parameters (i.e., a maximum wind speed of 102.8 m/sec (230 mph), a translational speed of 20.6 m/sec (46 mph), a maximum rotational speed of 82.3 m/sec (184 mph), a radius of maximum rotational speed of 45.7 m (150 feet (ft)), a pressure drop of 8.274 kPa (1.2 pounds per square inch (psi)), and a rate of pressure drop of 3.447 kPa/sec (0.5 psi/sec) (reiterated in DCA Part 2 Tier 2, Section 3.3.2.1, “Design Parameters for Extreme Winds”))
- a tornado missile spectrum based on Table 2, “Design-Basis Tornado Missile Spectrum and Maximum Horizontal Speeds,” of RG 1.76, “Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants,” Revision 1, issued March 2007, for (tornado intensity) Region 1 (as indicated in DCA Part 2 Tier 2, Section 3.5.1.4, “Missiles Generated by Tornadoes and Extreme Winds”)
- a maximum design-basis hurricane wind speed of 129.6 m/sec (290 mph) (reiterated in DCA Part 2 Tier 2, Section 3.3.2.1)
- a hurricane missile spectrum based on Table 1, “Design-Basis Hurricane Missile Spectrum,” and Table 2, “Design-Basis Missile Velocities as a Function of Hurricane Windspeed,” of RG 1.221, “Design-Basis Hurricane and Hurricane Missiles for Nuclear Power Plants,” Revision 0, issued October 2011, for the maximum design-basis hurricane wind speed (as indicated in DCA Part 2 Tier 2, Section 3.5.1.4)
- zero-percent exceedance maximum and minimum outdoor design dry-bulb temperatures of 46.1 degrees Celsius (C) (115 degrees Fahrenheit (F)) and -40 degrees C (-40 degrees F), respectively, representing historical limits excluding peaks less than 2 hours (as indicated or reiterated in DCA Part 2 Tier 2, Section 2.3.1, and under DCA Part 2, Tier 2, Chapter 9, “Auxiliary Systems”)

**DCA Part 2 Tier 2:** The climate-related site parameters listed in DCA Part 2 Tier 1, Table 5.0-1, are a subset of the site parameters in DCA Part 2, Tier 2, Table 2.0-1. DCA Part 2 Tier 2, Table 2.0-1, includes these additional design-basis dry- or wet-bulb temperature values:

- a maximum wet-bulb temperature of 26.7 degrees C (80 degrees F) coincident with the zero-percent exceedance maximum outdoor design dry-bulb temperature of 46.1 degrees C (115 degrees F)
- a zero-percent exceedance maximum noncoincident wet-bulb temperature of 27.2 degrees C (81 degrees F) representing an historical limit excluding peaks of less than 2 hours
- 1-percent (annual) exceedance maximum and minimum outdoor design dry-bulb temperatures of 37.8 degrees C (100 degrees F) and -23.3 degrees C (-10 degrees F), respectively, a maximum wet-bulb temperature of 25.0 degrees C (77 degrees F)

coincident with the 1-percent (annual) exceedance maximum dry-bulb temperature, and a 1-percent (annual) exceedance maximum noncoincident wet-bulb temperature of 26.7 degrees C (80 degrees F)

- 5-percent (annual) exceedance maximum and minimum outdoor design dry-bulb temperatures of 35.0 degrees C (95 degrees F) and -20.6 degrees C (-5 degrees F), respectively, and a maximum wet-bulb temperature of 25.0 degrees C (77 degrees F) coincident with the 5-percent (annual) exceedance maximum dry-bulb temperature

These design-basis dry- and wet-bulb temperatures are as indicated or reiterated in DCA Part 2 Tier 2, Section 2.3.1, and under DCA Part 2 Tier 2, Chapter 9 and Chapter 10, "Steam and Power Conversion System." DCA Part 2 Tier 2, Table 2.0-1, also provides cross-references to where climate-related site parameters are applicable.

**ITAAC:** There are no ITAAC for this area of review.

**Technical Specifications:** There are no TS for this area of review.

**Technical Reports:** There are no technical reports associated with this area of review.

#### 2.3.1.3 *Regulatory Basis*

The following NRC regulations contain the relevant requirements for this review:

- 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," Appendix A, "General Design Criteria for Nuclear Power Plants," General Design Criterion (GDC) 2, "Design Bases for Protection Against Natural Phenomena," as it relates to consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area, with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated
- 10 CFR Part 50, Appendix A, GDC 4, "Environmental and Dynamic Effects Design Bases," as it relates to information on events and conditions outside the nuclear power plant, such as tornadoes and, where applicable, hurricane winds that generate missiles that could potentially affect structures, systems, and components (SSCs) important to safety
- 10 CFR 52.47(a)(1), which requires a DC applicant to provide site parameters postulated for its design and an analysis and evaluation of the design in terms of those site parameters

Section II, "Acceptance Criteria" of SRP Section 2.3.1, "Regional Climatology," under the heading, "SRP Acceptance Criteria," identifies site parameters and acceptance criteria considered to be acceptable in meeting the above requirements for DC applicants. The site parameters include the following:

- the ground-level weight of the 100-year return period snowpack and the ground-level weight of the 48-hour probable maximum winter precipitation for use in determining the weight of snow and ice on the roofs of safety-related structures

- DBT parameters to be used in establishing pressure and tornado missile loadings on SSCs important to safety
- the 100-year return period (straight-line) 3-sec gust wind speed to be used in establishing wind loading on plant structures
- ambient air temperature and humidity statistics for use in establishing heat loads for the design of normal plant heat sink systems; post-accident containment heat removal systems; and plant heating, ventilation, and air conditioning (HVAC) systems

The regulatory guidance documents listed below support the staff's review of a DC applicant's development of the corresponding site parameter values postulated for its design:

- DC/COL-Interim Staff Guidance (ISG)-007, "Interim Staff Guidance on Assessment of Normal and Extreme Winter Precipitation Loads on the Roofs of Seismic Category I Structures," dated June 23, 2009, issued subsequent to the current version of SRP Section 2.3.1, clarifies the staff's position on winter precipitation loads expressed in SRP Acceptance Criterion (6) under Section II of SRP Section 2.3.1.
- RG 1.76, Revision 1, provides guidance for selecting the characteristics of DBT parameters and design-basis, tornado-generated missiles, depending on plant location in the contiguous (lower 48) United States, that a nuclear power plant should be designed to withstand to prevent undue risk to public health and safety.
- RG 1.221, Revision 0, issued subsequent to the current version of SRP Section 2.3.1 (Revision 3, issued March 2007), provides guidance for selecting the design-basis hurricane wind speed and hurricane-generated missiles that a new nuclear power plant should be designed to withstand to prevent undue risk to public health and safety. Guidance applies to the contiguous United States other than the Pacific coast. The staff will evaluate potential sites located along the Pacific coast or in Alaska, Hawaii, or Puerto Rico (or other U.S. territories) on a case-by-case basis.

RGs do not address in detail other climate-related site parameter input to plant design and used to characterize a site where a given design might be deployed (e.g., design-basis straight-line wind speeds, ambient temperature and atmospheric moisture-related statistics) in terms of data selection and use. In those cases, the SRP acceptance criteria under Section II of SRP Section 2.3.1 call for that information to be presented and substantiated in accordance with acceptable practice and data as issued by the National Oceanic and Atmospheric Administration and as discussed in applicable industry standards and guidance documents (e.g., by the American Society of Civil Engineers (ASCE)/Structural Engineering Institute (SEI), American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)).

In the SRP Section 2.3.1 review guidance, the use of ambient temperature and atmospheric moisture statistics extends to the determination of maximum evaporation, minimum water cooling, and, if applicable, drift loss of water and the potential for water freezing in the ultimate heat sink (UHS) water storage facility. However, according to DCA Part 2 Tier 2, Section 1.2.2.4.2, "Ultimate Heat Sink," the NuScale Power Plant design uses a passive containment cooling system (PCCS) consisting of the water in the reactor, refueling, and spent fuel pools, all of which are located below grade within the RXB. Therefore, although cited among the acceptance criteria in SRP Section 2.3.1, RG 1.27, "Ultimate Heat Sink for Nuclear

Power Plants,” Revision 3, issued November 2015, does not apply to a passive plant that utilizes a PCCS as its UHS, such as the NuScale Power Plant design. As such, these statistics are not otherwise listed here, nor are their meteorological considerations evaluated under Section 2.3.1.4 of this report.

In addition, SRP Section 2.3.1 indicates the following among its review criteria:

- All references to DCA Part 2 sections in which meteorological conditions identified as site parameters are used for design purposes should be identified by an applicant (Section I, “Areas of Review”, Item 6, last paragraph).
- The postulated site parameters are representative of a reasonable number of sites that have been or may be considered for a COL application, the appropriate site parameters are included as Tier I information, pertinent parameters are stated in a site parameters summary table, and there is a basis for each of the site parameters (Section III, “Review Procedures”, Item 4(b)).

#### *2.3.1.4 Technical Evaluation*

The sections that follow discuss the staff’s evaluation of the climate-related site parameters and the corresponding values postulated for the NuScale Power Plant design as presented in DCA Part 2 Tier 1, Table 5.0-1, and DCA Part 2 Tier 2, Table 2.0-1, in DCA Part 2 Tier 2, Section 2.3.1, and in other related sections of the DCA.

The site parameters in DCA Part 2 Tier 1, Table 5.0-1; DCA Part 2 Tier 2, Table 2.0-1; and any related DCA Part 2 sections that reiterate these values for temperature, speed (or velocity), distance or depth, force (weight or pressure) per unit area, and change of pressure per unit time are given in the English system units of measure. However, standard convention in the FSER is for the SI units of measure to be presented first, followed by the given site parameter value in English units within parentheses. Note that the precision of any of these site parameter values is as given in the referenced DCA Part 2 tables and sections but not as indicated by the values converted to the SI units of measure for presentation.

##### *2.3.1.4.1 Design-Basis Maximum Precipitation Rates (Rainfall)*

The DCA Part 2 Tier 1 and Tier 2, site parameter tables referenced in Section 2.3.1.2 of this report indicate the postulated design-basis maximum precipitation rates (as rainfall) (i.e., 492.8 mm/hr (19.4 in./hr) and 160.0 mm (6.3 in.) for a 5-minute period). DCA Part 2 Tier 2, Section 3.4.2.2, refers to these values as “probable maximum precipitation [PMP]” rainfall rates “for roof design.”

In addition, DCA Part 2 Tier 2, Section 2.3.1, states that “[t]hese values come from NWS [National Weather Service] HMR [Hydrometeorological Report] No. 52,” and that they “address the majority of locations in the United States.” With respect to the latter statement, the staff notes that HMR No. 52, “Application of Probable Maximum Precipitation Estimates - United States East of the 105th Meridian,” issued August 1982, was based on measured precipitation rates for selected storms that occurred east of the 105th meridian in the contiguous United States (i.e., nominally, east of easternmost Montana and Wyoming, eastern Colorado and New Mexico, and western Texas). The staff also notes that these PMP rates have been included in most (if not all) of the DCAs submitted for NRC review, several of which have been approved.

The applicant has selected the site parameters referenced above (i.e., maximum precipitation rates (as rainfall)) for plant (roof) design inputs. (Section 2.4.1, “Consequential Flood-Causing Mechanisms,” of this report contains additional information.) The staff considers these values to be representative of a reasonable number of locations in the contiguous United States (given the limitations noted above for the area covered by HMR No. 52) and for the State of Alaska at which a NuScale Power Plant design might be deployed. However, COL and early site permit (ESP) applicants will need to evaluate this aspect in their applications and its implications on a case-by-case basis if deployment is planned where orographic (terrain) effects might influence these PMP rates or if a plant site is proposed in a coastal location (including the State of Hawaii) that is subject to potential impacts of tropical cyclone activity. The DCA is silent with respect to the potential of the NuScale Power Plant design being deployed in U.S. territories.

The staff finds that the applicant satisfied the regulations at Appendix A to 10 CFR Part 50, GDC 2, and 10 CFR 52.47(a)(1), cited in Section 2.3.1.3 of this report, regarding the design-basis maximum precipitation (rainfall) rates postulated for the NuScale Power Plant design by providing site parameters related to maximum precipitation rates.

#### *2.3.1.4.2 Design Normal and Extreme Roof Snow Loads*

The DCA Part 2, Tier 1 and Tier 2, site parameter tables referenced in Section 2.3.1.2 of this report indicate the postulated design-basis normal and extreme roof snow loads (i.e., 2.394 and 3.591 kPa (50 and 75 psf), respectively). DCA Part 2 Tier 2, Section 2.3.1 and Section 3.4.2.2, reiterate the postulated design-basis conditions. Further, DCA Part 2, Tier 2, Section 2.3.1, states that “[t]he design normal roof snow load is 50 psf” and that “[f]or the extreme roof snow load, a value of 150 percent of the normal roof snow load, or 75 psf was selected.” In addition, DCA Part 2 Tier 2, Section 3.4.2.2, refers to the (normal) roof snow load as the “design static roof load.” The applicant also cites ASCE 7-10, “Minimum Design Loads in [for] Buildings and Other Structures,” in DCA Part 2 Tier 2, Section 3.8.4.2.1, “Design Codes and Standards,” referring to that industry standard as being “applicable for all loads other than wind loading.” Neither DCA Part 2 Tier 1, nor DCA Part 2 Tier 2, discusses any other bases for the normal and extreme roof snow load site parameter values.

The staff notes that the postulated 2.394 kPa (50 psf) value for the normal or “design static” roof snow load is the same value as the maximum snow load for roof design for precipitation types, as designated in Table 1.2-6, “Envelope of ALWR [Advanced Light Water Reactor] Plant Site Design Parameters,” of the Advanced Light Water Reactor Utility Requirements Document (URD), Volume II, “ALWR Evolutionary Plant,” Chapter 1, “Overall Requirements,” Revision 8, published by the Electric Power Research Institute (EPRI), issued March 1999. This suggests that there has been no change to the value of this “site design parameter” up through the current revision of the EPRI URD, issued December 2014, which addresses small modular reactors.

Further, DCA Part 2 Tier 2, Table 1.9-4, “Conformance with Interim Staff Guidance,” indicates, with respect to the assessment of normal and extreme winter precipitation loads on the roofs of seismic Category I structures, conformance with DC/COL-ISG-007. While these postulated site parameters do represent the endpoint of the guidance in DC/COL-ISG-007 (i.e., estimation of the resulting normal and extreme winter precipitation live roof loads), the ISG first develops these values in terms of ground snow loads, which fall under the Section 2.3.1 review. DCA Part 2 Tier 2, Section 3.8.4.3.11, “Snow Loads (S),” provides an approach that allows ground snow loads to be back-calculated from the postulated roof snow loads (refer to Equation 3.8-1 in Section 3.8.4.3.11 of the DCA Part 2 Tier 2). Using this equation (as applied to seismic

Category I structures), a normal roof snow load of 2.394 kPa (50 psf) converts to a normal ground snow load of 2.849 kPa (59.5 psf), and an extreme roof snow load of 3.591 kPa (75 psf) converts to an extreme ground snow load of 4.276 kPa (89.3 psf).

In addition, the staff notes that the applicant did not specify any recurrence intervals for the postulated normal (i.e., 2.394 kPa (50 psf)) and extreme (i.e., 3.591 kPa (75 psf)) roof snow loads. However, the staff also notes that most of the ground snow loads for the contiguous United States shown in Figure 7-1, “Ground Snow Loads,  $P_g$ , for the United States ( $L_b/Ft^2$ ),” under Chapter 7, “Snow Loads,” of ASCE/SEI 7-10, which represent a 50-year mean recurrence interval, are less than the normal ground snow load back-calculated from the postulated normal roof snow load except for the following:

- portions of the northern tier of states (from about eastern North Dakota eastward to Maine)
- in the snow belts downwind of the Great Lakes
- in areas where ASCE/SEI 7-10 calls for case studies (designated in Figure 7-1 of that document as “CS”) to be performed where extreme local variations in ground snow loads occur
- where higher terrain elevation may have an influence on snowfall event totals or accumulation of snowpack over the snow year

About 45 percent of the locations listed in Table 7-1, “Ground Snow Loads,  $P_g$ , for Alaskan Locations,” of ASCE/SEI 7-10 are less than the back-calculated 2.849 kPa (59.5 psf) normal ground snow load. Table C7-3, “Factors for Converting from Other Annual Probabilities of Being Exceeded, and Other Mean Recurrence Intervals, to That Used in This Standard,” of ASCE/SEI 7-10 provides factors for converting from other mean recurrence intervals to the 50-year mean recurrence interval used for snow load values presented in that standard. The inverse of those factors would convert the 50-year mean recurrence interval ground snow load values to other return periods.

In determining the controlling ground snow load for the normal winter precipitation event, the guidance in DC/COL-ISG-007 considers, in part, the 100-year return period snowpack (snow depth). Dividing the 50-year mean recurrence interval ground snow loads by 0.82 (i.e., the factor in Table C7-3) is about equivalent to multiplying the 50-year values by a snow importance factor of 1.20 as specified in Table 1.5-2, “Importance Factors by Risk Category of Buildings and Other Structures for Snow, Ice, and Earthquake Loads,” of ASCE/SEI 7-10 to obtain 100-year return period values. Importance factors are applied in the calculation of various design loads, depending on the risk category assigned to the structure being evaluated, and are based on the risk to human life, health, and welfare associated with its damage or failure. In this case, the category considered appropriate for seismic Category I buildings at a nuclear power plant site is “Risk Category IV,” based on DC/COL-ISG-007.

Consequently, the staff applied a 20-percent increase to the 50-year mean recurrence interval ground snow loads shown in Figure 7-1 and Table 7-1 of ASCE/SEI 7-10 as an indication of the 100-year return period snow pack (snow depth) ground snow loads. This evaluation indicates the following to the staff:

- The areas in the contiguous United States where the 2.849 kPa (59.5 psf) normal ground snow load back-calculated from the postulated normal (i.e., 2.394 kPa (50 psf)) roof snow load could be exceeded are slightly larger for the 100-year return period snow pack (snow depth) ground snow loads than the area based on the 50-year mean recurrence interval ground snow loads from ASCE/SEI 7-10.
- These areas are still located along the northern tier of States (extending from about central North Dakota and north-central South Dakota eastward to Maine) and in the snow belts downwind of the Great Lakes.
- The areas where ASCE/SEI 7-10 calls for case studies to be performed because of extreme local variations in ground snow loads or where higher terrain elevation may have an influence on snowfall event totals or accumulation of snowpack over the snow year are still locations where the postulated site parameters may be exceeded.

Few of the locations (i.e., about 27 percent) listed in Table 7-1 of ASCE/SEI 7-10 for the State of Alaska appear to be less than the ground snow load back-calculated from the postulated normal roof snow load based on the 100-year return period snow pack (snow depth) ground snow loads compared to the 50-year mean recurrence interval ground snow loads.

On the other hand, there appears to be little difference in the areas in the continental United States where the extreme ground snow load (i.e., 4.276 kPa (89.3 psf)) back-calculated from the postulated extreme roof snow load (i.e., 3.591 kPa (75 psf)) is exceeded based on either the 100-year return period snow pack (snow depth) ground snow loads or the 50-year mean recurrence interval ground snow loads (i.e., in extreme northern portions of Minnesota, Wisconsin, Michigan, and much of Maine in the contiguous United States, and about 20 percent of the locations listed in Table 7-1 of ASCE/SEI 7-10 for the State of Alaska). Consistent with the review guidance in SRP Section 2.3.1 and DC/COL-ISG-007, the staff notes the following, among other things:

- The snow load-related site parameters in DCA Part 2 Tier 1, Table 5.0-1, and DCA Part 2 Tier 2, Table 2.0-1, and discussed in DCA Part 2, Tier 2, Section 3.4.2.2, are specified only as normal and extreme roof snow loads as opposed (or in addition) to ground-level winter precipitation loads, as called for in the referenced guidance.
- No recurrence intervals appear to be associated with the postulated normal (i.e., 2.394 kPa (50 psf)) and extreme (i.e., 3.591 kPa (75 psf)) roof snow loads.
- DCA Part 2 Tier 2, Section 3.8.4.3.11, addresses the determination of live roof snow loads on seismic Category I and other buildings for normal and extreme winter precipitation events, which includes, among other factors, the ground-level snow (frozen winter precipitation) load (i.e., the equivalent ground-level site parameters can be back-calculated by COL applicants to compare to their corresponding site characteristics).

The scope of the SRP Section 2.3.1 review does not extend to an applicant's analysis and evaluation of the design in terms of those site parameters from an engineering standpoint (see, instead, FSER Chapter 3, "Design of Structures, Components, Equipment, and Systems").



The staff considered only one of the parameters used in estimating normal and extreme ground snow load values included in the guidance in DC/COL-ISG-007 (i.e., the 100-year return period snow pack (snow depth)) in evaluating the reasonableness of the postulated normal and extreme roof snow loads and back-calculated ground snow loads. Because these values are based on long-term observations at NWS stations, the staff considers this a reasonable approach at the DC stage.

The staff recognizes that in accordance with the guidance in DC/COL-ISG-007, the estimation of extreme roof loads caused by winter precipitation also takes into consideration liquid winter precipitation events if the resultant contribution to the extreme roof load is greater than that associated with the controlling frozen winter precipitation event. The staff notes that DCA Part 2, Tier 2, Section 3.8.4.3.10, "Rain Load (R)," discusses design characteristics of the RXB and CRB roofs and limits on their ability to accumulate liquid precipitation. Based on that information, the staff's evaluation focused primarily on the postulated roof snow loads (and back-calculated ground loads) associated with frozen winter precipitation events as discussed above.

The results of the staff's evaluation have been summarized above and suggest that the applicant's postulated normal and extreme roof snow load site parameters are representative of a reasonable number of potential locations in the continental United States where the NuScale Power Plant design might be deployed. However, exceptions include the area along the northern tier of States from about the Dakotas eastward to much of Maine, in the snow belts downwind of the Great Lakes, much of the State of Alaska, and in areas where ASCE/SEI 7-10 calls for case studies to be performed where extreme local variations in ground snow loads occur or where higher terrain elevation may influence snowfall event totals or the accumulation of snowpack over the snow year. COL and ESP applicants will need to evaluate this aspect in their applications and its implications on a case-by-case basis if deployment of the NuScale Power Plant design is planned in any such locations.

#### *2.3.1.4.3 Design-Basis Wind Speeds and Missile Spectra*

DCA Part 2 Tier 1, Table 5.0-1, and DCA Part 2 Tier 2, Table 2.0-1, postulate three types of wind speed-related site parameters applicable to the NuScale Power Plant design. Based on DCA Part 2 Tier 2, Section 3.3, "Wind and Tornado Loadings," these design-basis parameters were used in determining or evaluating severe (i.e., non-tornado or straight-line wind-induced) wind pressure forces, and extreme (tornado- and hurricane-induced) wind pressure forces and (tornado- and hurricane-wind-generated) missile impacts on the SSCs associated with the RXB, the CRB, and the RWB or nearby structures that are not seismic Category I and could adversely affect the seismic Category I RXB and seismic Category I portions of the CRB.

##### *2.3.1.4.3.1 Design-Basis Severe Wind Speed (Non-Tornado or Straight-Line)*

DCA Part 2 Tier 1, Table 5.0-1, and DCA Part 2 Tier 2, Table 2.0-1, provide a design-basis (non-tornado or straight-line) wind speed and other related attributes postulated for the NuScale Power Plant design. A wind speed value of 64.8 m/sec (145 mph) is designated as a "100-year return period 3-second wind gust speed" for Exposure Category C with an importance factor of 1.15 for the RXB, CRB, and RWB.

These design-basis conditions, reiterated in DCA Part 2 Tier 2, Section 2.3.1 and Section 3.3.1.1, both refer to this wind speed as a "design basis severe wind" and reference it to a height of 10 m (33 ft) above ground. In addition, these DCA Part 2 sections state that "[t]hese

design parameters are based upon ASCE/SEI 7-05” (“Minimum Design Loads for Buildings and Other Structures”).

The staff notes that a 3-sec gust wind speed and the indicated reference height and exposure category correspond to the “basic wind speed” as defined in Section 6.2, “Definitions,” and Figure 6-1, “Basic Wind Speed,” of ASCE/SEI 7-05 (i.e., an annual probability of 0.02 or a 50-year mean recurrence interval). The indicated importance factor corresponds to an occupancy (or risk) Category IV for structures designated as “essential facilities” in Table 1-1, “Occupancy Category of Buildings and Other Structures for Flood, Wind, Snow, Earthquake, and Ice Loads,” of ASCE/SEI 7-05 and where their damage or failure pose a risk to human life, health, and welfare.

SRP Acceptance Criterion 4 in Section II of SRP Section 2.3.1 calls for an applicant to provide “[t]he basic (straight-line) 100-year return period 3-second gust wind speed” and for it to be based on appropriate standards, which include ASCE/SEI 7-05. The staff recognizes that the term “basic” in the current SRP guidance is a misnomer because the 100-year return period in the guidance differs from the 50-year return period defined for the “basic wind speed” in the referenced industry standard. Nevertheless, the 100-year return period, 3-sec gust wind speed in the SRP guidance prevails.

Table C6-7, “Conversion Factors for Other Mean Recurrence Intervals,” in ASCE/SEI 7-05 provides conversion factors for estimating peak 3-sec gust wind speeds for mean recurrence intervals other than 50 years. In evaluating the reasonableness of the postulated design-basis severe (non-tornado or straight-line) wind speed (i.e., 64.8 m/sec (145 mph)), the staff used the 50- to 100-year return period conversion factor of 1.07 from Table C6-7 in interpreting the 50-year return period gust wind speed contours illustrated in Figure 6-1 of ASCE/SEI 7-05 (2 pages for the continental United States).

Taking into account this conversion factor, the staff’s evaluation indicates that the 100-year return period severe (non-tornado or straight-line) 3-sec gust wind speed site parameter postulated for the NuScale Power Plant design has the potential to be exceeded along a small portion of the immediate U.S. coastline from the western Gulf of Mexico (Texas) to the eastern Gulf of Mexico and the southeastern Atlantic coastlines (north to about the Carolinas). In addition, portions of the immediate western and southern coast of Alaska, including the Aleutian Islands, might also challenge the proposed 3-sec gust site parameter value of 64.8 m/sec (145 mph). Figure 6-1 of ASCE/SEI 7-05 also provides basic wind speed data for the State of Hawaii and certain U.S. territories, indicating that, among these, the postulated site parameter value might be exceeded on the islands of Puerto Rico, Guam, and the Virgin Islands. However, as noted in Section 2.3.1.4.1 of this report and elsewhere, the DCA is silent with respect to the potential of the NuScale Power Plant design being deployed in U.S. territories.

The staff notes that Figure 6-1 of ASCE/SEI 7-05 also indicates that “[m]ountainous terrain, gorges, ocean promontories and special wind regions shall be examined for unusual wind conditions.” Therefore, COL and ESP applicants will need to evaluate this aspect in their applications and its implications on a case-by-case basis if deployment of the NuScale Power Plant design is planned in any such locations in the United States.

Nevertheless, the staff finds that the 100-year return period severe (non-tornado or straight-line) 3-sec gust wind speed site parameter, provided in DCA Part 2 Tier 1, Table 5.0-1, and DCA Part 2 Tier 2, Table 2.0-1, and referenced in DCA Part 2 Tier 2, Section 2.3.1 and Section 3.3.1.1, is representative of a reasonable number of locations in the continental United

States and the State of Hawaii at which a NuScale Power Plant design might be deployed. The staff also finds that the applicant has provided an acceptable basis for this site parameter, having used information in ASCE/SEI 7-05 as cited in SRP Acceptance Criterion 4 in Section II of SRP Section 2.3.1. Therefore, the staff finds that the applicant conforms to the applicable guidance and accordingly meets the regulations in GDC 2 and 10 CFR 52.47(a)(1).

#### *2.3.1.4.3.2. Design-Basis Tornado Parameters and Missile Spectrum*

The DCA Part 2 Tier 1 and Tier 2, site parameter tables referenced in Section 2.3.1.2 of this report indicate postulated DBT parameters: maximum wind speed, translational speed, and maximum rotational speed of 102.8 m/sec (230 mph), 20.6 m/sec (46 mph), and 82.3 m/sec (184 mph), respectively; a radius of maximum rotational speed of 45.7 m (150 ft); a pressure drop of 8.274 kPa (1.2 psi); and a rate of pressure drop of 3.447 kPa/sec (0.5 psi/sec). DCA Part 2 Tier 2, Section 3.3.2.1, reiterates these values.

These site parameter values are the same as those listed for Tornado Intensity Region I in Table 1, "Design Basis Tornado Characteristics," of RG 1.76, Revision 1, and, as such, are associated with an exceedance probability of  $10^{-7}$  per year. As illustrated in Figure 1, "Tornado Intensity Regions for the Contiguous United States for Exceedance Probabilities of  $10^{-7}$  per Year," of RG 1.76, Region I includes most of the central and southeastern portions of the contiguous United States, also extending into western New York, and southward into western and north-central Pennsylvania. Region I represents the area where the most severe tornadoes frequently occur and, as a result, corresponds to the most severe DBT characteristics in that guidance.

The applicant also postulated a tornado missile spectrum, as indicated in DCA Part 2 Tier 2, Section 3.5.1.4 (i.e., a massive, high-kinetic energy missile, a rigid missile, and a solid steel sphere), with characteristics based on Table 2 of RG 1.76, Revision 1, for Tornado Intensity Region I. FSR Section 3.5.1.4 discusses the staff's review of the postulated tornado missile spectrum site parameters from an engineering standpoint.

The staff finds that the applicant has provided an acceptable basis for the postulated DBT site parameters provided in DCA Part 2 Tier 1, Table 5.0-1, and DCA Part 2 Tier 2, Table 2.0-1, and referenced in DCA Part 2 Tier 2, Section 3.3.2.1. Further, the staff finds that these postulated site parameter values are the most conservative specified in RG 1.76, Revision 1, and consequently should be representative of a reasonable number of locations in the contiguous United States where a NuScale Power Plant design might be deployed. The staff finds that the applicant satisfied the regulations cited in Section 2.3.1.3 of this report for the DBT parameters postulated for the NuScale Power Plant design.

The staff notes that RG 1.76 does not specify DBT parameters for Alaska or Hawaii, nor did the applicant address this subject in the DCA for those locations. COL and ESP applicants will need to evaluate this aspect in their applications and its implications on a case-by-case basis for proposed deployment in these locations. As noted in Section 2.3.1.4.1 of this report and elsewhere, the DCA is silent with respect to the potential of the NuScale Power Plant design being deployed in U.S. territories.

#### *2.3.1.4.3.3. Design-Basis Hurricane Wind Speed and Missile Spectrum*

The DCA Part 2, Tier 1 and Tier 2, site parameter tables referenced in Section 2.3.1.2 of this report indicate the postulated design-basis hurricane conditions (i.e., a maximum hurricane wind

speed of 129.6 m/sec (290 mph)). DCA Part 2 Tier 2, Section 3.3.2.1, reiterates that this value represents “the highest wind speed postulated in Regulatory Position 1 of RG 1.221, Rev. 0 which occurs in Figure 2 of RG 1.221.”

The staff confirmed that the postulated hurricane wind speed is based on the highest of the wind speed values shown on the referenced contour plots from RG 1.221 (specifically, Figure 2, located near the southern tip of the Florida peninsula in the vicinity of the Florida Keys). The area covered by Figures 1 to 3 in RG 1.221 includes the U.S. coastline along the western Gulf of Mexico, the eastern Gulf of Mexico and southeastern Atlantic coastline, and the mid- and northern Atlantic coastline, respectively, along with adjacent (nearby) interior States. The staff notes that the contours represent nominal 3-sec gust wind speeds at 10 m (33 ft) above ground over open terrain at exceedance probabilities of  $1 \times 10^{-7}$  per year.

The applicant also postulated a hurricane missile spectrum, as indicated in DCA Part 2 Tier 2, Section 3.5.1.4 (i.e., a massive, high-kinetic energy missile, a rigid missile, and a solid steel sphere), with characteristics based on Tables 1 and 2 of RG 1.221. DCA Part 2, Tier 2, Section 3.5.1.4, also provides the horizontal and vertical missile velocities associated with the postulated 129.6 m/sec (290 mph) hurricane wind speed for each missile type. FSER Section 3.5.1.4 discusses the staff’s review of the postulated hurricane missile spectrum site parameters from an engineering standpoint.

The staff finds that the applicant has provided an acceptable basis for the postulated design-basis hurricane wind speed provided in DCA Part 2 Tier 1, Table 5.0-1, and DCA Part 2, Tier 2, Table 2.0-1, and referenced in DCA Part 2 Tier 2, Section 3.3.2.1. Further, the staff finds that this postulated site parameter is the most conservative, based on RG 1.221, and consequently should be representative of potential, hurricane-prone site locations in the contiguous United States along, and for States adjacent to, the Gulf of Mexico and Atlantic coastlines. The staff finds that the applicant satisfied the regulations cited in Section 2.3.1.3 of this report with regards to the design-basis hurricane wind speed postulated for the NuScale Power Plant design.

However, the staff notes that RG 1.221 and its supporting documentation do not estimate design-basis hurricane-force wind speeds for locations along the Pacific Coast of the contiguous United States or for the States of Alaska or Hawaii, nor did the applicant address this subject in the DCA for those locations. COL and ESP applicants will need to evaluate this aspect in their applications and its implications on a case-by-case basis for proposed deployment in these locations. As noted in Section 2.3.1.4.1 of this report and elsewhere, the DCA is silent with respect to the potential of the NuScale Power Plant design being deployed in U.S. territories.

#### *2.3.1.4.4 Design-Basis Dry- and Wet-Bulb Temperatures*

The DCA Part 2 Tier 1 and Tier 2, site parameter tables referenced in Section 2.3.1.2 of this report provide the postulated design-basis dry- and wet-bulb temperatures. DCA Part 2 Tier 2, Section 2.3.1, states that these design temperatures “are based on the EPRI Utility Requirements Document.” DCA Part 2 Tier 2, Section 2.3.6, “References,” lists Revision 13 of the URD, issued by EPRI in 2014, as the source.

The staff notes that the postulated design-basis dry- and wet-bulb temperatures are the same site parameters and numeric values listed in Table 1.2-6, “Envelope of ALWR Plant Site Design Parameters,” of the Advanced Light-Water Reactor (ALWR) URD, Volume II, Chapter 1, Revision 8, published by EPRI in March 1999. This indicates that there has been no change to

the values of these “site design parameters” up through Revision 13 of the EPRI URD as cited above. However, the staff has also determined during its review that the coincident wet-bulb temperatures listed in the EPRI URD represent mean coincident values, which is consistent with the convention used by ASHRAE to report dry- and coincident wet-bulb temperatures, rather than the postulated maximum coincident values.

Nevertheless, the postulated site parameters include zero-percent exceedance maximum and minimum outdoor design dry-bulb temperatures of 46.1 degrees C and -40 degrees C (115 degrees F and -40 degrees F), respectively, which represent historical limits excluding peaks less than 2 hours. These site parameters are included in both DCA Part 2 Tier 1, Table 5.0-1, and DCA Part 2 Tier 2, Table 2.0-1. DCA Part 2 Tier 2, Table 2.0-1, also includes a maximum outdoor design wet-bulb temperature of 26.7 degrees C (80 degrees F) coincident with the zero-percent exceedance maximum design dry-bulb temperature as well as a zero-percent exceedance maximum noncoincident wet-bulb temperature of 81 degrees F. (The noncoincident value represents an historical limit excluding peaks less than 2 hours.)

In addition, DCA Part 2 Tier 2, Table 2.0-1, indicates 1-percent (annual) exceedance maximum and minimum outdoor design dry-bulb temperatures of 37.8 degrees C and -23.3 degrees C (100 degrees F and -10 degrees F), respectively, along with a maximum wet-bulb temperature of 25.0 degrees C (77 degrees F) coincident with the 1-percent exceedance maximum dry-bulb temperature, and a 1-percent (annual) exceedance maximum non-coincident wet-bulb temperature of 26.7 degrees C (80 degrees F). DCA Part 2 Tier 2, Table 2.0-1, also includes 5-percent (annual) exceedance maximum and minimum outdoor design dry-bulb temperatures of 35.0 degrees C and -20.6 degrees C (95 degrees F and -5 degrees F), respectively, along with a maximum wet-bulb temperature of 25.0 degrees C (77 degrees F) coincident with the 5-percent exceedance maximum dry-bulb temperature.

The postulated zero-percent exceedance maximum dry-bulb and maximum coincident wet-bulb temperatures, the zero-percent exceedance noncoincident wet-bulb temperature, and the zero-percent exceedance minimum dry-bulb temperature are associated with the design of the control room ventilation system (CRVS) (see DCA Part 2 Tier 2, Table 9.4.1-1, “CRVS Outdoor Air Design Conditions”).

The postulated 1-percent (annual) exceedance maximum dry-bulb and maximum coincident wet-bulb temperatures and the 1-percent (annual) exceedance minimum dry-bulb temperature specify design conditions for the RXB and RWB HVAC systems (see DCA Part 2 Tier 2, Table 9.4.2-1, “Outside Air Temperature Range for Reactor Building Ventilation System”). DCA Part 2 Tier 2, Table 9.4.3-1, “Outside Air Design Temperature for the Radioactive Waste Building HVAC System,” also provides more information.

The postulated 1-percent (annual) exceedance noncoincident wet-bulb temperature specifies design conditions for site cooling water system equipment and the circulating water system (see DCA Part 2 Tier 2, Table 9.2.7-1, “Site Cooling Water System Equipment Design Data,” and Table 10.4-9, “Circulating Water System Design Parameters,” respectively).

The postulated 5-percent (annual) exceedance maximum dry-bulb and maximum coincident wet-bulb temperatures and the 5-percent (annual) exceedance minimum dry-bulb temperature specify design conditions for the turbine generator building HVAC system (see DCA Part 2 Tier 2, Table 9.4.4-1, “Turbine Building HVAC System Outdoor Air Design Conditions”).

The NRC staff recognizes that the NuScale Power Plant design has a smaller overall plant site and likely a smaller size compared to that typical of larger light-water-reactor plant sites and structures. Consequently, this design might be able to be deployed in atypical nuclear plant site locations. The staff took this possibility into consideration in evaluating the dry- or wet-bulb temperatures, which are among “[t]he site parameters postulated for the design” of the NuScale Power Plant in accordance with 10 CFR 52.47(a)(1), and based on the regulations at GDC 2 (although temperature is not mentioned specifically among the examples of “natural phenomena” listed there).

#### Zero-Percent Exceedance Maximum and Minimum Dry-Bulb Temperatures

Based on its review (and, in some cases, approval) of previous DCAs, the staff notes that the zero-percent exceedance maximum and minimum outdoor dry-bulb temperatures (i.e., 46.1 degrees C and -40.0 degrees C (115 degrees F and -40 degrees F), respectively) postulated for the NuScale Power Plant design are the same for the Advanced Passive 1000 (AP1000), Advanced Boiling-Water Reactor (ABWR), Advanced Power Reactor 1400 (APR1400), U.S. Advanced Pressurized-Water Reactor (US-APWR), and U.S. Evolutionary Power Reactor (U.S. EPR) submittals. Therefore, the staff believes that these proposed site parameter values bound a reasonable number of potential COL and ESP sites for this design if deployed in most of the continental United States and in the State of Hawaii. However, the staff also recognizes that the postulated zero-percent exceedance maximum dry-bulb temperature may be challenged if deployment occurs in the western United States (i.e., primarily the desert southwest and drier portions of the State of California).

Similarly, the postulated zero-percent exceedance minimum outdoor design dry-bulb temperature may be challenged along the northern tier of the interior of the contiguous United States during the cold season (increasing in likelihood as possible siting progresses westward or with increasing elevation in these areas). Moreover, potential deployment of the NuScale Power Plant design in Alaska is more likely to experience exceedances of the postulated zero-percent exceedance minimum dry-bulb temperature at locations in the interior of that State or with increasing elevation and latitude. This may also necessitate additional design considerations (e.g., extended persistence of these extreme conditions, the presence of and potential effects on permafrost) not addressed in this DCA. As with other climate-related site parameters, COL and ESP applicants will need to evaluate these aspects in their applications and their implications on a case-by-case basis if deployment of the NuScale Power Plant design is planned in any such locations with extreme temperature conditions.

#### Zero-Percent Exceedance Noncoincident Wet-Bulb Temperature

Again, based on its review of previous DCAs, the staff notes that the zero-percent exceedance noncoincident wet-bulb temperature postulated for the NuScale Power Plant design (i.e., 27.2 degrees C (81 degrees F)) has also been proposed for some other reactor designs (e.g., ABWR, APR1400). In some cases, subsequent revisions to other DCAs have incorporated higher values (e.g., AP1000) considering the applicant's evaluation of related requests for additional information (RAIs) and the locations proposed for their first deployments. For other designs, higher zero-percent exceedance noncoincident wet-bulb temperatures have been initially proposed (e.g., US-APWR). And, in other cases, the initially postulated zero-percent exceedance noncoincident wet-bulb value of 27.2 degrees C (81 degrees F) has been retained (i.e., APR1400).

The staff had compared the postulated zero-percent exceedance noncoincident wet-bulb temperature to corresponding site characteristic values submitted in 17 docketed COL and ESP applications (see for reference the applicant's response to RAI 9186, Question 02.03.01-7, at ADAMS Accession No. ML18044A695). The staff found the following:

- Almost all of those applications identified a noncoincident wet-bulb temperature greater than the corresponding zero-percent exceedance noncoincident wet-bulb value proposed for the NuScale Power Plant design.
- The geographical area covered by these proposed site locations, while in the contiguous United States and east of the Rocky Mountains, is diverse not only in latitude and longitude but in a topographic setting (i.e., coastal and interior).
- Based on data compiled by ASHRAE in its "Weather Data Viewer" (Version 3.0), numerous other locations throughout the entire contiguous United States have reported maximum wet-bulb temperatures greater than the postulated site parameter value.

The applicant acknowledged and stated, in part, the following:

Lower postulated wet bulb temperatures used in a DC application would lead to some potential COL applicants in harsher environments departing from the standard design in order to assure year-round operation at full capacity. Higher postulated wet bulb temperatures used in a DC application would lead to some potential COL applicants in milder environments departing from the standard design to save money on the operation of oversized cooling systems that are not necessary for their typical meteorological conditions.

Further, the applicant has taken the position that, "[r]egardless, it is a business decision rather than a safety issue because NuScale's heating ventilation and air conditioning systems and cooling towers are not safety-related (as shown in [DCA Part 2] Tier 2 Table 3.2-1, "Classification of Structures, Systems, and Components") and has stated that "NuScale is not changing the postulated wet bulb temperatures used for the standard design."

Although the staff finds that this site parameter should allow a proposed facility referencing the NuScale Power Plant design to be sited at a number of locations in the continental United States, the staff makes the following observations and notes the following limitations on this finding:

- The staff's comparisons described above, are reiterated.
- Potential deployment in the State of Hawaii could pose similar challenges to the postulated zero-percent exceedance noncoincident wet-bulb temperature as in much of the coastal and southeastern United States as well as many other locations east of the Rocky Mountains based on the maximum observed wet-bulb temperatures summarized in the ASHRAE database.
- Potential deployment in drier climates of the western United States and the State of Alaska should offer fewer challenges to the zero-percent exceedance noncoincident wet-bulb temperature.

- Given the preceding evaluation by the staff and the applicant's response (refer to ADAMS Accession No. ML18044A695), a request for a departure, variance, or exemption might reasonably be expected from an applicant or licensee (as applicable) with respect to the postulated zero-percent exceedance noncoincident wet-bulb temperature.

COL and ESP applicants will need to evaluate this aspect in their applications and its implications on a case-by-case basis for proposed deployment in these locations. As noted earlier, the DCA is silent with respect to the potential of the NuScale Power Plant design being deployed in U.S. territories.

#### Maximum Wet-Bulb Temperature Coincident with the Zero-Percent Exceedance Maximum Dry-Bulb Temperature

Based on its review of previous DCAs, the staff notes that the postulated maximum wet-bulb temperature (i.e., 26.7 degrees C (80 degrees F)) coincident with the zero-percent exceedance maximum outdoor dry-bulb temperature (i.e., 46.1 degrees C (115 degrees F)) has also been proposed for other designs (e.g., ABWR, APR1400, US-APWR, U.S. EPR). However, while the numerical value of the coincident wet-bulb temperature is the same, the statistical bases differ. The site parameter value given in the applications indicated above represents a mean value coincident with the zero-percent exceedance dry-bulb temperature. On the other hand, the wet-bulb temperature coincident with the zero-percent exceedance maximum dry-bulb temperature postulated for the NuScale Power Plant design represents a maximum coincident value.

The staff understands that lower atmospheric moisture content (e.g., lower wet-bulb temperatures) is usually associated with relatively higher dry-bulb temperatures because increased atmospheric moisture tends to hold back the concurrent increase of the dry-bulb temperature. A mean coincident wet-bulb temperature provides more margin in a design-basis dry-bulb/coincident wet-bulb temperature pair compared to a maximum coincident wet-bulb temperature.

As indicated previously, the staff recognizes that the postulated zero-percent exceedance maximum dry-bulb temperature (i.e., 46.1 degrees C (115 degrees F)) may be challenged in the western United States, primarily in the desert southwest and portions of the State of California (i.e., characterized by a drier climate). Nevertheless, whatever the zero-percent exceedance maximum dry-bulb temperature is for a particular location, the ASHRAE database suggests that the postulated maximum coincident wet-bulb temperature (i.e., 26.7 degrees C (80 degrees F)) is likely to be exceeded at multiple locations in the contiguous United States as well as the State of Hawaii.

Consequently, a request for a departure, variance, or exemption might reasonably be expected from an applicant or licensee (as applicable) with respect to the postulated wet-bulb temperature coincident with the zero-percent exceedance maximum dry-bulb temperature. COL and ESP applicants will need to evaluate this aspect in their applications and its implications on a case-by-case basis. As noted before in this section and elsewhere, the DCA is silent with respect to the potential of the NuScale Power Plant design being deployed in U.S. territories.

#### One-Percent (Annual) Exceedance Maximum and Minimum Dry-Bulb Temperatures



The staff evaluated the 1-percent (annual) exceedance maximum and minimum dry-bulb temperatures (i.e., 37.8 degrees C and -23.3 degrees C (100 degrees F and -10 degrees F), respectively) postulated for the NuScale Power Plant design based on its review of the same values in the DCAs noted above for the zero-percent exceedance maximum and minimum dry-bulb temperatures, as well as for the Economic Simplified Boiling-Water Reactor design. On that basis, the staff believes that these postulated site parameter values bound a reasonable number of potential COL and ESP sites if the NuScale Power Plant design is deployed in much of the contiguous United States.

As with the corresponding zero-percent exceedance dry-bulb temperatures, the staff recognizes that the postulated 1-percent (annual) exceedance maximum dry-bulb temperature may be challenged if deployment occurs primarily in the desert southwest and drier portions of the State of California. Similarly, the postulated 1-percent (annual) exceedance minimum dry-bulb temperature may be challenged along the northern tier of the interior of the contiguous United States, also increasing in likelihood with increasing elevation in these areas. Further, potential deployment of the NuScale Power Plant design in Alaska is more likely to experience exceedances of the postulated 1-percent (annual) minimum dry-bulb temperature at locations in the interior of that State or with increasing elevation or latitude.

As with other climate-related site parameters, COL and ESP applicants will need to evaluate these aspects in their applications and their implications on a case-by-case basis if deployment of the NuScale Power Plant design is planned in any such locations with extreme temperature conditions. As noted before in this section and elsewhere, the DCA is silent with respect to the potential of the NuScale Power Plant design being deployed in U.S. territories.

#### One-Percent (Annual) Exceedance Noncoincident Wet-Bulb Temperature

The staff evaluated the 1-percent (annual) exceedance noncoincident wet-bulb temperature (i.e., 26.7 degrees C (80 degrees F)) postulated for the NuScale Power Plant design using meteorological data from the ASHRAE database for observing stations located in the contiguous United States and the State of Hawaii. The staff finds that this site parameter bounds a reasonable number of potential COL and ESP sites if this design is deployed in much of the contiguous United States, the State of Hawaii, and, most likely (based on professional judgment), the State of Alaska. However, potential deployment in the southeastern United States (including states along the Atlantic coast and Gulf of Mexico) could pose challenges to the postulated value.

COL and ESP applicants will need to evaluate this aspect in their applications and its implications on a case-by-case basis for proposed deployment in these locations. As noted before in this section and elsewhere, the DCA is silent with respect to the potential of the NuScale Power Plant design being deployed in U.S. territories.

#### Maximum Wet-Bulb Temperature Coincident with the One-Percent (Annual) Exceedance Maximum Dry-Bulb Temperature

Based on its review of previous DCAs, the staff notes that the postulated maximum wet-bulb temperature (i.e., 25.0 degrees C (77 degrees F)) coincident with the 1-percent (annual) exceedance maximum outdoor dry-bulb temperature (i.e., 37.8 degrees C (100 degrees F)) has also been proposed for other designs (e.g., ABWR, APR1400, US-APWR, U.S. EPR). The numerical value of the wet-bulb temperature coincident with the 1-percent (annual) exceedance maximum dry-bulb temperature is the same as in the DCAs listed above. But, like the maximum

wet-bulb temperature coincident with the zero-percent exceedance dry-bulb temperature, the statistical bases differ (i.e., the site parameter value in the indicated applications represents a mean coincident value, whereas the coincident wet-bulb temperature postulated for the NuScale Power Plant design represents a maximum coincident value).

As mentioned previously, the staff understands that lower atmospheric moisture content is usually associated with relatively higher dry-bulb temperatures because increased atmospheric moisture tends to hold back the concurrent dry-bulb temperature, and that a mean coincident wet-bulb temperature provides more margin than a maximum coincident wet-bulb temperature in a design-basis dry-bulb/coincident wet-bulb temperature pair.

The staff also recognizes that the postulated 1-percent (annual) exceedance maximum dry-bulb temperature (i.e., 37.8 degrees C (100 degrees F)) may be challenged in the western United States, primarily in the desert southwest and drier portions of the State of California. Nevertheless, whatever the 1-percent (annual) exceedance maximum dry-bulb temperature is for a particular location, the ASHRAE database suggests that the postulated maximum coincident wet-bulb temperature (i.e., 25.0 degrees C (77 degrees F)) is likely to be exceeded at multiple locations in the contiguous United States as well as the State of Hawaii.

Consequently, a request for a departure, variance, or exemption might reasonably be expected from an applicant or licensee (as applicable) with respect to the postulated wet-bulb temperature coincident with the 1-percent exceedance maximum dry-bulb temperature. COL and ESP applicants will need to evaluate this aspect in their applications and its implications on a case-by-case basis. As noted before in this section and elsewhere, the DCA is silent with respect to the potential of the NuScale Power Plant design being deployed in U.S. territories.

#### Five-Percent (Annual) Exceedance Maximum and Minimum Dry-Bulb Temperatures

ASHRAE's "Weather Data Viewer" (Version 3.0) database does not directly summarize 5-percent (annual) exceedance maximum and minimum dry-bulb temperatures. Rather, the database includes statistics for dry-bulb temperatures on a 0.4-percent, 1.0-percent, and 2.0-percent annual exceedance basis, as well as dry-bulb temperatures on a 99.6-percent and 99.0-percent annual exceedance basis. The exceedance value for a given parameter at a particular observing location over a specified period of record (typically 20 to 30 years) represents the value that is exceeded the indicated percentage of the time.

Consequently, the staff did not evaluate, in detail, the postulated 5-percent (annual) maximum and minimum dry-bulb temperature site parameter values presented in DCA Part 2 Tier 2, Table 2.0-1. However, the preceding results for the 1-percent (annual) exceedance maximum dry-bulb temperature, along with an indication from the 2-percent annual exceedance statistics in the ASHRAE database, suggest that the postulated 5-percent (annual) exceedance maximum dry-bulb temperature (i.e., 35.0 degrees C (95 degrees F)) can be accommodated at a reasonable number of potential COL and ESP sites in the contiguous United States and the States of Alaska and Hawaii.

The postulated 5-percent (annual) exceedance minimum dry-bulb temperature (i.e., -20.6 degrees C (-5 degrees F)) can also be accommodated at a reasonable number of potential COL and ESP sites in the contiguous United States and the State of Hawaii. However, as with the postulated zero- and 1-percent (annual) exceedance minimum dry-bulb temperatures, the staff notes that the 5-percent (annual) exceedance minimum dry-bulb temperature may be challenged along the northern tier of the interior of the contiguous United

States during the cold season (increasing in likelihood as possible siting progresses westward or with increasing elevation in these areas). Likewise, potential deployment of the NuScale Power Plant design in Alaska is more likely to experience exceedances of the postulated 5-percent minimum dry-bulb site parameter value at locations in the interior of that State or with increasing latitude.

As with other climate-related site parameters, COL and ESP applicants will need to evaluate these aspects in their applications and their implications on a case-by-case basis if deployment of the NuScale Power Plant design is planned in any such locations with extreme temperature conditions. As noted before in this section and elsewhere, the DCA is silent with respect to the potential of the NuScale Power Plant design being deployed in U.S. territories.

#### Maximum Wet-Bulb Temperature Coincident with the Five-Percent (Annual) Exceedance Maximum Dry-Bulb Temperature

The staff notes that the postulated maximum wet-bulb temperature (i.e., 25.0 degrees C (77 degrees F)) coincident with the 5-percent (annual) exceedance maximum dry-bulb temperature (i.e., 35.0 degrees C (95 degrees F)) is the same numerical value in the recently reviewed APR1400 DCA. However, like the maximum wet-bulb temperatures coincident with the zero-percent exceedance and the 1-percent (annual) exceedance dry-bulb temperatures, the statistical bases are different (i.e., the site parameter value in the APR1400 DCA represents a mean coincident value but the coincident wet-bulb temperatures postulated for the NuScale Power Plant design represent maximum coincident values).

The staff understands that lower atmospheric moisture content is usually associated with relatively higher dry-bulb temperatures because increased atmospheric moisture tends to hold back the concurrent dry-bulb temperature, and that a mean coincident wet-bulb temperature provides more margin than a maximum coincident wet-bulb temperature in a design-basis dry-bulb/coincident wet-bulb temperature pair.

As mentioned before, the postulated 5-percent (annual) exceedance maximum dry-bulb temperature (i.e., 35.0 degrees C (95 degrees F)) can be accommodated at a reasonable number of potential COL and ESP sites in the contiguous United States and the States of Alaska and Hawaii. The staff also recognizes that this parameter may be challenged in the western United States, primarily in the desert southwest and drier portions of the State of California. Nevertheless, whatever the 5-percent (annual) exceedance maximum dry-bulb temperature is for a particular location, the ASHRAE database suggests that the postulated maximum coincident wet-bulb temperature (i.e., 25.0 degrees C (77 degrees F)) is likely to be exceeded at multiple locations in the contiguous United States and possibly in the State of Hawaii as well.

Consequently, a request for a departure, variance, or exemption might reasonably be expected from an applicant or licensee (as applicable) with respect to the postulated wet-bulb temperature coincident with the 5-percent exceedance maximum dry-bulb temperature. COL and ESP applicants will need to evaluate this aspect in their applications and its implications on a case-by-case basis. As noted before in this section and elsewhere, the DCA is silent with respect to the potential of the NuScale Power Plant design being deployed in U.S. territories.

### 2.3.1.5 Combined License Information Items

Table 2.3.1-1 lists COL information items related to DCA Part 2 Tier 2, Section 2.3.1, as provided in DCA Part 2 Tier 2, Table 1.8-2.

COL Items 3.3-1, 3.5-3, 3.5-4, and 19.1-7 may relate to information addressed in Section 2.3.1 of this report; however, the appropriateness and adequacy of these COL items are evaluated in FSER Chapter 3 and Chapter 19, "Probabilistic Risk Assessment and Severe Accident Evaluation for New Reactors," respectively.

**Table 2.3.1-1 NuScale COL Information Items Related to DCA Part 2 Tier 2, Section 2.3.1**

Item No.	Description	DCA Part 2 Tier 2 Section
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 site 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 2.3-1	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

### 2.3.1.6 Conclusion

The regional climatology is site specific and will be addressed by a COL applicant (see DCA Part 2 Tier 2, Table 1.8 2, COL Item 2.0-1). A COL or ESP applicant should provide information sufficient to demonstrate that the actual site characteristics specified in its COL application fall within the values of the postulated site parameters in the NuScale DCA Part 2. In accordance with SRP Section 2.3.1, the staff evaluated the applicant's postulated, climate-related site parameters (a subset of which is included as Tier 1 information) and, in general, considers them to be representative of a reasonable number of sites that have been or may be considered for a COL application and that the applicant provided a technical basis for each site parameter.

## 2.3.2 Local Meteorology

### 2.3.2.1 Introduction

DCA Part 2 Tier 2, Section 2.3.2, "Local Meteorology," states that "[l]ocal meteorology is site-specific and is addressed by the COL applicant as part of the response to COL Item 2.3-1." The COL applicant is to provide summaries of the local (site) meteorology, including normal and extreme values for meteorological parameters, an assessment of the construction and operation impacts of the plant and its facilities on the local meteorology, and a topographical description of the site and its surroundings.

#### 2.3.2.2 *Summary of Application*

**DCA Part 2 Tier 1:** There is no information for this area of review.

**DCA Part 2 Tier 2:** In DCA Part 2, Tier 2 Section 2.3.2, the applicant stated that local meteorology is site specific and is addressed by the COL applicant as part of the response to COL Item 2.3-1.

**ITAAC:** There are no ITAAC for this area of review.

**Technical Specifications:** There are no TS for this area of review.

**Technical Reports:** There are no technical reports associated with this area of review.

#### 2.3.2.3 *Regulatory Basis*

The following NRC regulations contain the relevant requirements for this review:

- 10 CFR 52.79(a)(1)(vi), as it relates to using site meteorology to evaluate offsite radiological consequences caused by postulated fission product releases
- 10 CFR 100.20(c)(2) and 10 CFR 100.21(d) with respect to the consideration given to the local meteorological characteristics of the site

The guidance in SRP Section 2.3.2, "Local Meteorology," lists the acceptance criteria adequate to meet the above requirements, as well as review interfaces with other SRP sections. SRP Section 2.3.2 indicates that the review of local meteorology includes the following specific areas:

- summaries of local meteorological data based on onsite measurements and NWS station summaries or other standard installation summaries from appropriate locations in proximity
- a discussion and evaluation of the impact of the plant and its facilities on the local meteorological and air quality conditions and identification of potential changes in normal and extreme values resulting from plant construction and operation
- a complete topographical description of the site and the associated environment out to a distance of 80 kilometers (50 miles) from the plant

DCAs do not contain this type of information because it is site specific. A COL applicant referencing the NuScale Power Plant DC will address this information.

#### 2.3.2.4 *Technical Evaluation*

The NuScale Power Plant DCA has no postulated site parameters related to local meteorology. A description of the anticipated local meteorological conditions and the impacts of a proposed plant and associated facilities on the local meteorological conditions (e.g., effects of plant structures, terrain modification, and heat and moisture sources caused by plant operation) are site specific and should be presented by a COL applicant referencing the NuScale DC. The staff finds COL Item 2.3-1, requiring the COL applicant to provide site-specific meteorological information for Sections 2.3.1 through 2.3.5, acceptable.

#### 2.3.2.5 Combined License Information Items

Table 2.3.2-1 lists the COL information item related to DCA Part 2 Tier 2, Section 2.3.2, as provided in DCA Part 2 Tier 2, Table 1.8-2.

**Table 2.3.2-1 NuScale COL Information Items Related to DCA Part 2 Tier 2, Section 2.3.2**

Item No.	Description	DCA Part 2 Tier 2 Section
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

Section 2.3.1 of this report explains that the applicant has indicated that the NuScale Power Plant design could be deployed in the continental United States (including the contiguous lower 48 States and the State of Alaska) as well as the State of Hawaii. The staff also notes that the DCA is silent with respect to the potential of this design being deployed in U.S. territories and recognizes that this design might be able to be sited in other-than-typical large-scale nuclear plant site locations. COL and ESP applicants should take this into consideration in evaluating the general language of COL Item 2.3-1 with respect to potential issues related to Section 2.3.2, “Local Meteorology,” of a COL FSAR.

#### 2.3.2.6 Conclusion

The NuScale Power Plant DCA has no postulated site parameters related to local meteorology. COL Item 2.3-1 indicates that a COL applicant that references the NuScale DC will describe the local meteorological conditions for Section 2.3.2. The staff acknowledges that local meteorological conditions are site specific and will be addressed by a COL applicant referencing the NuScale Power Plant DC. Based on the above information, the staff finds the applicant’s discussions in Section 2.3.2 of the NuScale Power Plant DCA acceptable.

### 2.3.3 Onsite Meteorological Measurements Programs

#### 2.3.3.1 Introduction

DCA Part 2 Tier 2, Section 2.3.3, “Onsite Meteorological Measurements Programs,” states that “[o]nsite meteorological measurement programs are site-specific and are addressed by the COL applicant as part of the response to COL Item 2.3-1.” The COL applicant is to describe meteorological instrumentation, including sensor siting, sensor type and performance specifications, methods and equipment for recording sensor output, a quality assurance program for sensors and recorders, data acquisition and reduction procedures, and special considerations for complex terrain sites. These areas of review are relevant to both the preoperational and operational phases of a proposed facility. The COL applicant is also to provide a copy of the resulting onsite meteorological database and discuss the amenability of the data for use in characterizing atmospheric dispersion conditions.

#### 2.3.3.2 Summary of Application

**DCA Part 2 Tier 1:** There is no information for this area of review.

**DCA Part 2 Tier 2:** In DCA Part 2 Tier 2, Section 2.3.3, the applicant stated that the onsite meteorological measurement programs are site specific and are addressed by the COL applicant as part of the response to COL Item 2.3-1.

**ITAAC:** There are no ITAAC for this area of review.

**Technical Specifications:** There are no TS for this area of review.

**Technical Reports:** There are no technical reports associated with this area of review.

#### 2.3.3.3 *Regulatory Basis*

From a preoperational standpoint, the onsite meteorological measurements program supports safety analyses that rely on a site's meteorological conditions or that may have an impact on plant design. A COL applicant referencing the NuScale Power Plant DC will use onsite meteorological data from a preoperational monitoring program to satisfy the following regulatory requirements:

- Subpart D, "Radiation Dose Limits for Individual Members of the Public," of 10 CFR Part 20, "Standards for Protection Against Radiation," with respect to demonstrating compliance with dose limits for individual members of the public
- GDC 19, "Control Room," in Appendix A to 10 CFR Part 50, with respect to demonstrating compliance with dose limits inside the control room during radiological accident conditions
- Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation To Meet the Criterion 'As Low As Is Reasonably Achievable' [ALARA] for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents," to 10 CFR Part 50, with respect to the means to be employed for determining compliance with the numerical guides for design objectives and limiting conditions for operation to meet the requirement that radioactive material in effluents released to unrestricted areas be kept ALARA
- 10 CFR 100.21(c), with respect to evaluating site atmospheric dispersion characteristics and establishing dispersion parameters so that (1) the plant can meet radiological effluent release limits associated with normal operation for any individual located off site and (2) radiological dose consequences of postulated accidents meet prescribed dose guidelines at the EAB and the outer boundary of the LPZ

During the operational phase, a COL applicant or licensee relies on information about, and data from, an established and acceptably maintained onsite meteorological measurements program to meet the following regulatory requirements:

- 10 CFR 50.47(b)(4), 10 CFR 50.47(b)(8), and 10 CFR 50.47(b)(9), and Sections IV.E.2 and VI.2(a) of Appendix E, "Emergency Planning and Preparedness for Production and Utilization Facilities," to 10 CFR Part 50, with respect to available meteorological equipment and information necessary for determining the magnitude and continuously assessing the impact of releases of radioactive materials to the environment during a radiological emergency

The guidance in SRP Section 2.3.3, "Onsite Meteorological Measurements Program," lists the acceptance criteria adequate to meet the above requirements, as well as review interfaces with other SRP sections. Other regulatory guidance to be considered in establishing and maintaining an acceptable onsite meteorological measurements program includes the following:

- RG 1.23, "Meteorological Monitoring Programs for Nuclear Power Plants," Revision 1, issued March 2007

The NuScale Power Plant DCA does not contain this type of information because it is site specific. A COL applicant referencing the NuScale Power Plant DC will address this information.

#### *2.3.3.4 Technical Evaluation*

The staff reviewed the NuScale Power Plant DCA in accordance with SRP Section 2.3.3. This guidance recognizes that Section 2.3.3 of a DCA has no postulated site parameters and that the onsite meteorological monitoring program is site specific and will be addressed by a COL applicant.

Consistent with that understanding, DCA Part 2 Tier 2, Section 2.3.3, acknowledged the COL applicant's need for preoperational and operational monitoring programs for measuring meteorological conditions at a site, consistent with the guidance in RG 1.23. Further, DCA Part 2 Tier 2, Section 2.3, reiterated COL Item 2.3-1 in DCA Part 2 Tier 2, Table 1.8-2, on the site-specific nature of the meteorological measurements program (along with other climatological, meteorological, and atmospheric dispersion-related information under Section 2.3).

The staff also notes that the applicant identified relationships between the onsite meteorological measurements program and the systems, equipment, and information required for emergency preparedness planning and for availability in the appropriate emergency response facilities under those emergency conditions (i.e., as part of the postaccident monitoring system described in DCA Part 2 Tier 2, Chapter 7, "Instrumentation and Controls," and Section 13.3, "Emergency Planning"). This is responsive to the cited regulations at 10 CFR 50.47(b)(4), 10 CFR 50.47(b)(8), and 10 CFR 50.47(b)(9), and Sections IV.E.2 and VI.2(a) of Appendix E to 10 CFR Part 50.

#### *2.3.3.5 Combined License Information Items*

Table 2.3.3-1 lists the COL information item related to DCA Part 2 Tier 2, Section 2.3.3, as provided in DCA Part 2 Tier 2, Table 1.8-2.

COL Item 13.3-3 may relate to information addressed in Section 2.3.3 of this report; however, the appropriateness and adequacy of this COL Item is evaluated in FSER Section 13.3, "Emergency Planning."



**Table 2.3.3-1 NuScale COL Information Items Related to DCA Part 2 Tier 2, Section 2.3.3**

Item No.	Description	DCA Part 2 Tier 2 Section
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

Section 2.3.1 of this report explains that the applicant has indicated that the NuScale Power Plant design could be deployed in the continental United States (including the contiguous lower 48 States and the State of Alaska) as well as the State of Hawaii. The staff also notes that the DCA is silent with respect to the potential of this design being deployed in U.S. territories and recognizes that this design might be able to be sited in other-than-typical large-scale nuclear plant site locations. COL and ESP applicants should take this into consideration in evaluating the general language of COL Item 2.3-1 with respect to potential issues related to Section 2.3.3, “Onsite Meteorological Measurements Program,” of a COL FSAR.

#### **2.3.3.6 Conclusion**

The NuScale Power Plant DCA has no postulated site parameters related to the onsite meteorological measurements program. COL Item 2.3-1 indicates that a COL applicant that references the NuScale Power Plant DC will provide a detailed description of its onsite meteorological measurements program and the resulting database. The staff acknowledges that an onsite meteorological monitoring program is site specific and will be addressed by a COL applicant referencing the NuScale Power Plant DC. Based on the above information, the staff finds the applicant’s discussions in Section 2.3.3 of the DCA acceptable.

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

#### **2.3.4.1 Introduction**

Short-term atmospheric dispersion estimates for accident releases are used to determine the amount of airborne radioactive materials expected to reach a specific location during an accident situation. These estimates address the requirements for developing conservative atmospheric dispersion factors (relative concentrations or  $\chi/Q$  values) at the EAB, at the outer boundary of the LPZ, and at the main control room (MCR) and Technical Support Center (TSC) for postulated design-basis accident radioactive airborne releases.

#### **2.3.4.2 Summary of Application**

**DCA Part 2 Tier 1:** DCA Part 2 Tier 1, Table 5.0-1, contains accident release  $\chi/Q$  site parameters values at the MCR/TSC door and HVAC intake and at the EAB and outer boundary of the LPZ.

**DCA Part 2 Tier 2:** DCA Part 2 Tier 2, Section 2.3.4, “Short-Term Atmospheric Dispersion Estimates for Accident Releases,” describes the methodology used for establishing and calculating the atmospheric dispersion factors used to determine accident radiological consequences at the MCR and TSC doors and HVAC intake and at the EAB and outer

boundary of the LPZ. DCA Part 2 Tier 2, Table 2.0-1, contains accident release  $\chi/Q$  site parameter values for these same receptors. The assumptions used to derive these  $\chi/Q$  values (such as source and receptor locations, path directions and distances, and release point characteristics) are listed in DCA Part 2 Tier 2, Table 15.0-20, "Assumptions for Accident Airborne Effluent Release Point Characteristics for Offsite Receptors"; Figure 2.3-1, "Limiting Analytical Distance to EAB and LPZ Outer Boundary"; Figure 2.3-2, "Source to Control Building Door Distances"; and Figure 2.3-3, "Source to Control Building HVAC Intake Distance."

**ITAAC:** There are no ITAAC for this area of review.

**Technical Specifications:** There are no TS for this area of review.

**Technical Reports:** There are no technical reports associated with this area of review.

**Topical Reports:** NuScale Power LLC, Licensing Topical Report TR-0915-17565-NP-A, "Accident Source Term Methodology," Revision 4, February 2020 (ADAMS Accession No. ML20057G132, nonproprietary version).

#### 2.3.4.3 *Regulatory Basis*

Acceptance criteria for short-term dispersion estimates for accidental releases are based on meeting the relevant requirements of the following Commission regulations:

- GDC 19, with respect to the meteorological considerations used to demonstrate compliance with dose limits inside the MCR during radiological accident conditions
- Paragraph VI.2.a of Appendix E, "Emergency Planning and Preparedness for Production and Utilization Facilities," to 10 CFR Part 50, with respect to the meteorological considerations used to evaluate the personnel exposures inside the TSC during an emergency
- 10 CFR 52.47(a)(1), with respect to the postulated site parameters that a DC applicant shall provide for the design
- 10 CFR 52.47(a)(2)(iv), with respect to an assessment of the plant design features intended to mitigate the radiological consequences of accidents, which includes consideration of postulated site meteorology to evaluate the offsite radiological consequences at any point on the EAB and on the outer boundary of the LPZ

A DCA does not contain general descriptions of site characteristics because this information is site specific and will be addressed by a COL applicant. However, under 10 CFR 52.47(a)(1), a DC applicant must provide site parameters postulated for the design.

SRP Section 2.3.4, "Short-Term Atmospheric Dispersion Estimates for Accident Releases," states that the DC applicant should include EAB, LPZ, and MCR atmospheric dispersion factors ( $\chi/Q$  values) for the appropriate time periods in the list of site parameters. The DCA should also contain figures and tables showing the design features that the COL applicant would use to generate MCR  $\chi/Q$  values (e.g., intake heights, release heights, building cross-sectional areas, and distance to receptors). SRP Section 2.3.4 also states that the postulated site parameters should be representative of a reasonable number of sites that may be considered within a COL application and that a basis should be provided for each of the site parameters.

The staff's review of DCA Part 2 Tier 2, Section 2.3.4, "Short-Term Atmospheric Dispersion Estimates for Accident Releases," also considered the following RGs and other related guidance documents (as applicable):

- RG 1.23, which includes guidance on the measurement and processing of onsite meteorological data for use as input to atmospheric dispersion models in support of plant licensing and operation
- RG 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants," Revision 1, issued February 1983, which provides guidance on appropriate dispersion models for estimating offsite relative air concentrations ( $\chi/Q$  values) as a function of downwind direction and distance (i.e., at the EAB and outer boundary of the LPZ) for various short-term time periods (up to 30 days) after an accident
- RG 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors," issued July 2000, which discusses the need for an evaluation of the radiological consequences of design-basis accidents at emergency response facilities (such as the MCR and TSC)
- RG 1.194, "Atmospheric Relative Concentrations for Control Room Radiological Habitability Assessments at Nuclear Power Plants," issued June 2003, which discusses acceptable approaches for estimating short-term (i.e., 2 hours to 30 days after an accident) average  $\chi/Q$  values near the buildings at MCR ventilation air intakes and at other locations of significant air in-leakage to the control room envelope caused by postulated design-basis accident radiological airborne releases
- RG 1.206, which summarizes the types of information identified in SRP Section 2.3.4 that an applicant should provide in DCA Part 2 Tier 2, Section 2.3.4, for estimating dispersion factors ( $\chi/Q$  values) used to assess the consequences of design-basis and other atmospheric radiological releases on MCR habitability
- NUREG/CR-2858, "PAVAN: An Atmospheric-Dispersion Program for Evaluating Design-Basis Accidental Releases of Radioactive Materials from Nuclear Power Stations," issued November 1982 (prepared by Pacific Northwest Laboratory (PNL-4413)), which is the user's manual for the NRC-sponsored PAVAN dispersion model that implements the guidance in RG 1.145
- NUREG/CR-6331, "Atmospheric Relative Concentrations in Building Wakes," Revision 1, issued May 1997 (prepared by Pacific Northwest National Laboratory (PNNL-10521)), which is the user's manual for the NRC-sponsored ARCON96 dispersion model that is referenced in RG 1.194

#### 2.3.4.4 *Technical Evaluation*

The staff reviewed the DCA, in accordance with the guidance provided in SRP Section 2.3.4, to ensure that (1) the DCA included EAB, LPZ, and MCR  $\chi/Q$  values in the list of standard plant site parameters, (2) the DCA contained figures and tables describing the design features that the COL applicant would use to generate MCR  $\chi/Q$  values, (3) the EAB, LPZ, and MCR standard plant site parameter  $\chi/Q$  values are representative of a reasonable number of sites that may be considered within a COL application, and (4) the DCA provides a basis for each of

the EAB, LPZ, and MCR standard plant site parameter  $\chi/Q$  values. The staff also reviewed the radiological consequence analyses presented in DCA Part 2, Tier 2, Chapter 15, "Transient and Accident Analyses," the control building habitability system description presented in DCA Part 2 Tier 2, Section 6.4, "Control Room Habitability," and the CRVS description presented in DCA Part 2, Tier 2, Section 9.4, "Air Conditioning, Heating, Cooling, and Ventilation Systems," to ensure that the assumed fission product transport to the environment for each accident was compatible with the  $\chi/Q$  values used to model the assumed release pathways.

#### 2.3.4.4.1 Offsite $\chi/Q$ Values

SRP Section 2.3.4 states that the DC applicant should include EAB and LPZ boundary  $\chi/Q$  values for the appropriate time periods in the list of site parameters. The staff noted that the applicant included accident release  $\chi/Q$  values at the EAB and outer boundary of the LPZ as site parameters in DCA Part 2 Tier 1, Table 5.0-1, and in DCA Part 2 Tier 2, Table 2.0-1. The applicant stated in DCA Part 2 Tier 2, Section 2.3.4, that the EAB and LPZ outer boundary may be as close as 122 meters (m) (400 ft) from the closest release point. DCA Part 2 Tier 2, Figure 2.3-1, shows the assumed source and receptor relationships used to derive the 122-m (400-ft) source-to-receptor distance.

DCA Part 2 Tier 2, Section 2.3.4, states that TR-0915-17565 describes the methodology for calculating accident offsite atmospheric dispersion factors (i.e., at the EAB and outer boundary of the LPZ). The topical report describes using the computer code ARCON96 methodology in lieu of the computer code PAVAN to calculate design-basis accident  $\chi/Q$  values for radiological releases to the EAB and outer boundary of the LPZ. The PAVAN computer code implements the guidance in RG 1.145 to estimate downwind ground-level air concentrations at the EAB and outer boundary of the LPZ, whereas ARCON96 implements a model for calculating relative concentrations in the vicinity of buildings that is endorsed by RG 1.194 for use in design-basis control room radiological habitability assessments. NuScale generated its accident offsite  $\chi/Q$  site parameter values using its topical report methodology with meteorological data from an 80th–90th percentile site. NuScale chose this meteorological data set from a study of atmospheric dispersion factors for 241 sites located across the United States. The NRC staff conducted a review of the NuScale licensing topical report TR-0915-17565, Revision 4. The staff reviewed the NuScale methodology and performed an independent verification of the methodology as part of an audit involving this topical report. The staff found that the methodology could be executed to produce  $\chi/Q$  values in adherence to the criteria outlined RG 1.145 and RG 1.194. Therefore, based on this review, staff concludes that, subject to the conditions and limitations specified in Section 6.0, "Conditions and Limitations," of the NRC staff's safety evaluation report for the topical report (ADAMS Accession No. ML19297G520), the NuScale methodology described in the licensing topical report TR-0915-17565, Revision 4, is acceptable for calculating accident offsite  $\chi/Q$  values for the EAB and LPZ in a NuScale Power Plant DC application or in a COL application referencing the NuScale DC.

To determine whether the NuScale EAB and outer boundary of LPZ  $\chi/Q$  site parameter values bound a reasonable number of sites that may be considered within a COL application, the staff used a portion of the NuScale ARCON96 methodology to calculate  $\chi/Q$  values, based on meteorological data collected at six nuclear power plant sites and assuming EAB and LPZ outer boundary distances of 122 m (400 ft). The staff determined that one of these six sites had  $\chi/Q$  values that are bounded by all of the NuScale site parameter values. The staff informed NuScale of these results (refer to the summary of public meetings on January 24, 2018, and January 31, 2018; ADAMS Accession No. ML18044A070). If a COL applicant that references the NuScale design determines that its actual  $\chi/Q$  site characteristic values do not fall within the

corresponding site parameters postulated in the DC, the COL applicant will need to provide sufficient justification that the proposed facility is still acceptable at the proposed site. However, based on the staff's experience with other COL applications, the staff expects that COL applicants will typically have EAB and outer boundary of the LPZ distances greater than 122 m (400 ft), which would result in lower site characteristic  $\chi/Q$  values that could be bounded by the corresponding NuScale DCA site parameter  $\chi/Q$  values.

#### 2.3.4.4.2 *Control Room $\chi/Q$ Values*

SRP Section 2.3.4 states that the DC applicant should include MCR  $\chi/Q$  values for the appropriate time periods in the list of site parameters. The staff noted that the applicant included accident release  $\chi/Q$  values at the MCR/TSC door and HVAC intake as site parameters in DCA Part 2, Tier 1, Table 5.0-1, and in DCA Part 2 Tier 2, Table 2.0-1. DCA Part 2 Tier 2, Figures 2.3-2 and 2.3-3, show the assumed source and receptor relationships for releases to the MCR/TSC door and HVAC intake, respectively. The applicant stated that the two source locations shown in DCA Part 2 Tier 2, Figure 2.3-2 and Figure 2.3-3, are the limiting source locations because they are the closest source locations to the MCR personnel doors and MCR HVAC intake.

The applicant generated MCR  $\chi/Q$  site parameter values using ARCON96 with meteorological data from the same 80th–90th percentile site discussed above.

To confirm that the MCR/TSC door and HVAC intake  $\chi/Q$  site parameters are representative of a reasonable number of sites that have been or may be considered within a COL application, the staff generated a set of site-specific  $\chi/Q$  values for six nuclear power plant sites using the ARCON96 computer code with the source and receptor information presented in the DCA Part 2 (assuming the NuScale plant north was aligned to true north at each site), and the site-specific hourly nuclear power plant meteorology data sets. The staff found that the applicant's  $\chi/Q$  values were bounding for five of the six sites. Consequently, the staff finds that the applicant has provided MCR and TSC doors and HVAC intake  $\chi/Q$  site parameter values that bound a reasonable number of sites that may be considered for a COL application. Therefore, these values are acceptable.

#### 2.3.4.5 *Combined License Information Items*

Table 2.3.4-1 lists COL information items related to DCA Part 2 Tier 2, Section 2.3.4, as provided in DCA Part 2 Tier 2, Table 1.8-2.

COL Item 13.3-3 may relate to information addressed in Section 2.3.4 of this report; however, the appropriateness and adequacy of this COL item is evaluated in FSER Section 13.3.

**Table 2.3.4-1 NuScale COL Information Items Related to DCA Part 2 Tier 2, Section 2.3.4**

Item No.	Description	DCA Part 2 Tier 2 Section
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 site 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 2.3-1	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

Section 2.3.1 of this report explains that the applicant has indicated that the NuScale Power Plant design could be deployed in the continental United States (including the contiguous lower 48 States and the State of Alaska), as well as the State of Hawaii. The staff also notes that the DCA is silent with respect to the potential of this design being deployed in U.S. territories and recognizes that this design might be able to be sited in locations other than typical large-scale nuclear plant site locations. COL and ESP applicants should take this into consideration in evaluating the general language of COL Item 2.3-1 with respect to potential issues related to Section 2.3.4 of a COL FSAR.

#### **2.3.4.6 Conclusion**

The staff concludes that the applicant has appropriately provided the short-term (accident release)  $\chi/Q$  site parameters referenced above for plant design inputs. The short-term atmospheric dispersion characteristics for accidental release are site specific and will be addressed by the COL applicant. The COL applicant should include information sufficient to demonstrate that the actual site characteristics, including the short-term atmospheric dispersion factors, fall within the values of the site parameters in the NuScale Power Plant DCA Part 2.

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

#### **2.3.5.1 Introduction**

Long-term atmospheric dispersion and deposition factors are a direct input to the calculation of long-term (annual) radiological doses from routine releases to individual members of the public at offsite locations and, in some cases, to members of the public located at the plant site (e.g., during construction of additional units at, or adjacent to, an operating facility).

#### **2.3.5.2 Summary of Application**

**DCA Part 2 Tier 1:** There is no information for this area of review.

**DCA Part 2 Tier 2:** The applicant listed, as site parameters in DCA Part 2 Tier 2, Table 2.0-1, routine release atmospheric dispersion factors ( $\chi/Q$  values) at the restricted area boundary that (1) reflect neither radioactive decay nor depletion by deposition effects (undepleted or no decay  $\chi/Q$  values), (2) include a decay half-life of 2.26 days without depletion (undepleted or 2.26-day decay  $\chi/Q$  values), and (3) account for a decay half-life of 8 days with depletion effects (depleted or 8.00-day decay  $\chi/Q$  values). DCA Part 2 Tier 2, Table 2.0-1, also includes a routine release atmospheric deposition factor (D/Q value).

In DCA Part 2 Tier 2, Section 2.3.5, "Long-Term Atmospheric Dispersion Estimates for Routine Releases," the applicant stated that the routine release  $\chi/Q$  and D/Q values at the restricted area boundary in Table 2.0-1 are conservatively estimated and used to calculate release concentrations for comparison to the activity release limits in 10 CFR Part 20, as discussed in DCA Part 2, Tier 2, Section 11.3, "Gaseous Waste Management System." In DCA Part 2 Tier 2, Section 2.3.5, the applicant also stated that the routine release  $\chi/Q$  and D/Q values in 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.

**ITAAC:** There are no ITAAC for this area of review.

**Technical Specifications:** There are no TS for this area of review.

**Technical Reports:** There are no technical reports associated with this area of review.

#### 2.3.5.3 *Regulatory Basis*

The acceptance criteria for evaluating the analysis of long-term atmospheric dispersion and deposition conditions for routine releases of radiological effluents to the atmosphere during normal plant operation are based on meeting the relevant requirements in 10 CFR Part 20 and 10 CFR Part 50. The staff considered the following regulatory requirements in its review of the applicant's postulated site parameter values for atmospheric dispersion and deposition:

- Subpart D, "Radiation Dose Limits for Individual Members of the Public," to 10 CFR Part 20, with respect to establishing atmospheric dispersion-related site parameters for demonstrating compliance with dose limits for individual members of the public
- 10 CFR 50.34a, "Design Objectives for Equipment to Control Releases of Radioactive Material in Effluents—Nuclear Power Reactors," and Sections II.B, II.C, and II.D to Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation To Meet the Criterion, 'As Low As Is Reasonably Achievable,' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents," to 10 CFR Part 50, with respect to radioactive material in effluents released to unrestricted areas

A DCA does not contain general descriptions of site characteristics because this information is site specific and will be addressed by a COL applicant. However, under 10 CFR 52.47(a)(1), a DC applicant must provide site parameters postulated for the design.

SRP Section 2.3.5, "Long-Term Atmospheric Dispersion Estimates for Routine Releases," which states the staff's review of a standard DCA under 10 CFR Part 52, includes the following aspects:

- The postulated site parameters are representative of a reasonable number of sites that have been or may be considered for a COL application.
- The applicant has provided a basis for each of the site parameters.

The staff's review of DCA Part 2 Tier 2, Section 2.3.5, also considered the following RGs and other related guidance documents (as applicable):

- Revision 1 to RG 1.23 includes guidance on the measurement and processing of onsite meteorological data for use as input to atmospheric dispersion models in support of plant licensing and operation.
- RG 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, issued October 1977, includes guidance on identifying the location of potential receptors of interest.
- RG 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," Revision 1, issued July 1977, discusses different types of atmospheric transport and diffusion models and criteria for characterizing long-term (annual) average atmospheric dispersion and deposition conditions.
- RG 1.112, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Power Reactors," Revision 1, issued March 2007, includes guidance on identifying release point characteristics.
- NUREG/CR-2919, "XOQDOQ: Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations," issued September 1982 (prepared by Pacific Northwest Laboratory (PNL-4380)), is the user's manual for the NRC-sponsored XOQDOQ dispersion model, which is intended to implement portions of RG 1.111.

#### 2.3.5.4 *Technical Evaluation*

The staff reviewed DCA Part 2 Tier 2, Section 2.3.5, in accordance with SRP Section 2.3.5, Revision 3, issued March 2007.

DCA Part 2 Tier 2, Table 2.0-1, lists the routine release atmospheric dispersion factors ( $\chi/Q$  values) and atmospheric deposition factors ( $D/Q$  values) associated with the restricted area boundary. DCA Part 2 Tier 2, Section 2.3.5, states that these  $\chi/Q$  and  $D/Q$  values at the restricted area boundary provided in DCA Part 2 Tier 2, Table 2.0-1, are conservatively estimated and are used to calculate release concentrations for comparison to the activity release limits in 10 CFR Part 20, as discussed in DCA Part 2 Tier 2, Section 11.3.

The applicant stated that there are three normal gaseous effluent release points for the NuScale Power Plant: the NuScale plant exhaust stack, which is 128 m (420 ft) from the site boundary, and the two turbine generator buildings, which are each 122 m (400 ft) from the site boundary. Approximately 99 percent of the contribution to gaseous offsite concentrations from normal radioactive effluent discharges from the NuScale Power Plant are from releases from the plant



exhaust stack. (The staff RAI at ADAMS Accession No. ML17307A376 and the applicant's response at ADAMS Accession No. ML18257A297 provide details.)

The applicant stated that it selected conservative  $\chi/Q$  and D/Q values, which are  $1.44 \times 10^{-5}$  seconds per cubic meter ( $s/m^3$ ) and  $1.44 \times 10^{-7}$  per square meter ( $1/m^2$ ), respectively. The applicant also stated that it used the XOQDOQ computer code to confirm the conservatism of the  $\chi/Q$  and D/Q values by running the XOQDOQ with an example meteorological data set and comparing the output with the selected values.

Further, the applicant stated that the calculated offsite gaseous effluent doses from a NuScale plant are highly site specific due to distinct site features such as terrain, meteorology, and site receptors having an effect on results. COL Item 11.3-2 requires a COL applicant to provide information to address these calculations. The gaseous effluent dose results shown in DCA Part 2, Tier 2, Table 11.3-8, "Gaseous Effluent Dose Results for 10 CFR 50 Appendix I," are example calculations using assumed inputs (such as the routine release  $\chi/Q$  and D/Q site parameter values) to show reasonable assurance that a COL applicant will be able to meet the design objectives of 10 CFR Part 50, Appendix I. The applicant noted that it would be acceptable for a COL applicant to use RG 1.111 and the XOQDOQ computer code to perform these calculations.

The staff independently evaluated the applicant's  $\chi/Q$  and D/Q site parameter values with the XOQDOQ code using meteorological data from a number of nuclear power plant sites, assuming two release points (ground-level turbine generator building release and a 37-m (121-ft) elevated plant stack release). The staff developed composite  $\chi/Q$  and D/Q values by multiplying the ground-level turbine generator building release  $\chi/Q$  and D/Q values by 0.01 and the elevated plant stack release  $\chi/Q$  and D/Q values by 0.99 and summing the two values, respectively. The staff determined that the applicant's  $1.44 \times 10^{-5} s/m^3$   $\chi/Q$  and  $1.44 \times 10^{-7} 1/m^2$  D/Q site parameter values are bounding.

Based on the applicant's explanation and staff's independent verification, the staff finds the above information acceptable.

The applicant explained that (1) releases from the RXB and the turbine generator building should be assumed to occur from the closest part of each building to the dose location at ground level with a minimum building cross-sectional area, (2) the plant exhaust stack is not a part of the NuScale standard design, and the plant exhaust stack in DCA Part 2 Tier 2, Table 1.8-1, "Summary of NuScale Certified Design Interfaces with Remainder of Plant," is a design interface for the NuScale certified design, and (3) the  $\chi/Q$  and D/Q values listed in DCA Part 2 Tier 2, Table 2.0-1, are weighted averaged values of ground-level turbine generator building releases and plant exhaust stack elevated releases. Because the applicant clarified the release locations, the status of the exhaust stack, and its calculation of the  $\chi/Q$  and D/Q values, the staff was able to perform its independent verification of the long-term (routine release) site parameter values. Therefore, the staff finds the above information acceptable. (The staff RAI and the applicant's response at ADAMS Accession Nos. ML18149A342 and ML18257A297 provide details.)

#### 2.3.5.5 *Combined License Information Items*

Table 2.3.5-1 lists COL information items related to DCA Part 2 Tier 2, Section 2.3.5, as provided in DCA Part 2 Tier 2, Table 1.8-2.

COL Items 11.5-2 and 11.5-3 may relate to information addressed in Section 2.3.5 of this report; however, the appropriateness and adequacy of these COL items are evaluated in FSEER Chapter 11, "Radioactive Waste Management."

**Table 2.3.5-1 NuScale COL Information Items Related to DCA Part 2 Tier 2, Section 2.3.5**

Item No.	Description	DCA Part 2 Tier 2 Section
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 site 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 2.3-1	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 11.3-2	A COL applicant that references the NuScale Power Plant design certification will calculate doses to members of the public using the site-specific parameters, compare those gaseous effluent doses to the numerical design objectives of 10 CFR Part 50, Appendix I, and comply with the requirements of 10 CFR 20.1302 and 40 CFR Part 190.	11.3

Section 2.3.1 of this report explains that the applicant has indicated that the NuScale Power Plant design could be deployed in the continental United States (including the contiguous lower 48 States and the State of Alaska), as well as the State of Hawaii. The staff also notes that the DCA is silent with respect to the potential of this design being deployed in U.S. territories and recognizes that this design might be able to be sited in locations other than typical large-scale nuclear plant site locations. COL applicants should take this into consideration in evaluating the general language of COL Item 2.3-1, with respect to potential issues related to Section 2.3.5 of a COL FSAR.

#### **2.3.5.6 Conclusion**

Based on the above information, the staff finds that the long-term (routine release) site parameter values selected by the applicant are representative of a reasonable number of sites that have been or may be considered for a COL application. Long-term atmospheric dispersion and deposition characteristics are site specific and will be addressed by the COL applicant. The COL applicant should include information sufficient to demonstrate that site characteristics, including the long-term atmospheric dispersion factors and deposition factors specified in the application, are bounded by the standard design site parameters.

## **2.4 Hydrologic Engineering**

In DCA Part 2 Tier 2, Section 2.4, “Hydrologic Engineering,” the applicant provided information associated with all hydrologically related design-basis performance requirements and the basis for the operation of safety-related SSCs. The applicant stated that the NuScale Power Plant design does not rely upon an external water supply for its UHS or safety-related makeup water. DCA Part 2 Tier 1, Table 5.0-1, and DCA Part 2 Tier 2, Table 2.0-1, contain the site parameters selected to represent site conditions.

Consistent with guidance in the SRP Sections 2.4.1 through 2.4.14, the staff reviewed DCA Part 2 Tier 1, Table 5.0-1; DCA Part 2 Tier 2, Table 2.0-1; and DCA Part 2 Tier 2, Section 2.4, to determine the adequacy of the information submitted. The review areas covered in SRP Sections 2.4.1 through 2.4.14 are addressed in the following six consolidated sections of this report: Section 2.4.1, “Consequential Flood-Causing Mechanisms,” Section 2.4.2, “Flood Protection Requirements,” Section 2.4.3, “Low-Water Considerations and Cooling Water Canals and Reservoirs,” Section 2.4.4, “Ground Water Monitoring,” Section 2.4.5, “Accidental Releases of Radioactive Liquid Effluents in Ground and Surface Waters,” and Section 2.4.6, “Technical Specifications and Emergency Operation Requirements.” These sections of this report correspond to the following sections in the SRP:

- Section 2.4.1 corresponds to SRP Sections 2.4.1, “Hydrologic Description,” 2.4.2, “Floods,” 2.4.3, “Probable Maximum Flood (PMF) on Streams and Rivers,” 2.4.4, “Potential Dam Failures,” 2.4.5, “Probable Maximum Surge and Seiche Flooding,” 2.4.6, “Tsunami Hazards,” 2.4.7, “Ice Effects,” and 2.4.9, “Channel Migration or Diversion.”
- Section 2.4.2 corresponds to SRP Section 2.4.10, “Flood Protection Requirements.”
- Section 2.4.3 corresponds to SRP Sections 2.4.8, “Cooling Water Canals and Reservoirs,” and 2.4.11, “Low Water Consideration.”
- Section 2.4.4 corresponds to SRP Section 2.4.12, “Groundwater.”
- Section 2.4.5 corresponds to SRP Section 2.4.13, “Accidental Releases of Radioactive Liquid Effluents in Ground and Surface Waters.”
- Section 2.4.6 corresponds to SRP Section 2.4.14, “Technical Specification and Emergency Operation Requirements.”

Site-specific hydrologic issues are not within the scope of the DCA and are deferred to the COL applicant. This section of DCA Part 2 is intended to address the hydrological site parameters that constitute the NuScale standard power plant design basis for siting suitability presented by a COL applicant under 10 CFR Part 52 or included in an application under 10 CFR Part 50.

### **2.4.0 Regulatory Basis**

The NRC regulations and guidance listed below are applicable for Sections 2.4.1 through 2.4.6 of this report.

The following NRC regulations contain the relevant requirements for this review:

- 10 CFR 50.36(c)(2), which details the lowest functional capability or performance of equipment required for safe operation of the facility

- 10 CFR 52.17(a) and 10 CFR 100.20(c), which state that the consideration of the acceptability of a site will include such physical characteristics of the site as seismology, meteorology, geology, and hydrology
- 10 CFR 52.47(a)(1), as it relates to the site parameters postulated for the design
- 10 CFR 52.79(a) and 10 CFR 100.20(c), which state that consideration of the acceptability of a site will include such physical characteristics of the site as seismology, meteorology, geology, and hydrology
- 10 CFR 52.79(a)(1)(iii), as it relates to the hydrologic characteristics of the proposed site with appropriate consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area and with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated
- 10 CFR 100.20(c)(3), as it relates to the probably maximum flood, and which states that, in establishing the design-basis flood, seismically induced floods and water waves that could adversely affect a site from either locally or distantly generated seismic activity must be determined
- 10 CFR 100.21, which provides non-seismic siting criteria
- 10 CFR 100.23, "Geologic and Seismic Siting Criteria," which requires the applicant to evaluate siting factors (including the cooling water supply), taking into account information concerning the physical and hydrological properties of the materials underlying the site
- 10 CFR 100.23(d)(3), as it relates to establishing the design-basis flood, seismically induced floods, and water waves that could adversely affect a site from either locally or distantly generated seismic activity
- GDC 1 in Appendix A to 10 CFR Part 50, which states that SSCs important to safety must be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed
- GDC 2 in Appendix A to 10 CFR Part 50, which states that SSCs important to safety must be designed to withstand the effects of natural phenomena, such as earthquakes, tornadoes, hurricanes, floods, tsunamis, and seiches, without loss of capability to perform their intended safety functions
- GDC 44 in Appendix A to 10 CFR Part 50, which states that a system must be provided to transfer heat from SSCs important to safety to a UHS. The system's safety function must be to transfer the combined heat load of these SSCs under normal operating and accident conditions
- GDC 60, "Control of Releases of Radioactive Material to the Environment," in Appendix A to 10 CFR Part 50, which states that (1) the nuclear power unit design must include a means to control suitably the release of radioactive materials in gaseous and liquid effluents and to handle radioactive solid wastes produced during normal reactor

operation, including anticipated operational occurrences, and (2) sufficient holdup capacity must be provided for the retention of gaseous and liquid effluents containing radioactive materials, particularly where unfavorable site environmental conditions can be expected to impose unusual operational limitations upon the release of such effluents to the environment

The relevant NRC guidance used for this review includes the following:

- The guidance in SRP Sections 2.4.1 through 2.4.14 for hydrologic engineering list the acceptance criteria that could be used to meet the above requirements, as well as review interfaces with other SRP sections.

The staff also used the following guidance documents in conducting its review:

- RG 1.27 as it relates to UHS capabilities
- RG 1.29, "Seismic Design Classification," as it relates to seismic design bases for safety-related SSCs
- RG 1.59, "Design Basis Floods for Nuclear Power Plants," as it relates to hydrometeorological design bases
- RG 1.102, "Flood Protection for Nuclear Power Plants," as it describes acceptable flood protection measures intended to prevent SSCs from being adversely affected
- RG 1.113, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I," Revision 1, issued April 1977, as it relates to the selection of surface water models

## **2.4.1 Consequential Flood-Causing Mechanisms**

### **2.4.1.1 Introduction**

Because the standard power plant design basis is intended to be suitable for a variety of sites and conditions, the DC applicant defers to the COL applicant to present the required site-specific information in the hydrologic description.

This section describes the site-specific hydrologic conditions for consequential flood hazards that will be addressed by the COL applicant. As part of its review of this portion of the application, the staff considered the adequacy of the COL information items presented in DCA Part 2 Tier 2, Table 1.8-2.

COL information items related to site-specific flood hazard evaluations and hydrologic conditions, listed in Table 2.4.1-1 of this report, are provided in DCA Part 2 Tier 2, Table 1.8-2, as well as in DCA Part 2 Tier 2, Sections 2.0 and 2.4, respectively.

**Table 2.4.1-1 NuScale COL Information Items Related to DCA Part 2 Tier 2, Section 2.4 Hydrologic Engineering**

Item No.	Description	DCA Part 2 Tier 2 Section
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 site 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 2.4-1	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, except Section 2.4.8 and Section 2.4.10.	2.4

#### *2.4.1.2 Summary of Application*

DCA Part 2 Tier 2, Sections 2.4.1 through 2.4.7 and 2.4.9, are for different consequential flood-causing mechanisms that are site specific and are deferred to the COL applicant as part of the response to COL Item 2.4-1. The applicant indicated eight topics related to the flood-causing mechanisms, including hydrologic description, floods, probable maximum flood, potential dam failures, probable maximum surge and seiche flooding, probable maximum tsunami hazards, ice effects, and channel diversions.

**DCA Part 2 Tier 1:** DCA Part 2 Tier 1, Table 5.0-1, contains relevant site parameter information on the maximum flood elevation (probable maximum flood and coincident wind wave and other effects on maximum flood level (0.3 m (1 ft) below the baseline plant elevation), maximum elevation of ground water (2 ft below the baseline plant elevation), and maximum precipitation rate (492.8 mm per hour (19.4 in. per hour) and 160 mm (6.3 in.) for a 5-minute period).

**DCA Part 2 Tier 2:** The hydrologic condition and flood hazards are site specific as indicated in DCA Part 2 Tier 2, Sections 2.4.1 through 2.4.7 and Section 2.4.9. DCA Part 2 Tier 2, Table 2.0-1, contains relevant site parameter information on the maximum flood elevation, maximum elevation of ground water, and maximum precipitation rate.

**ITAAC:** The ITAAC are not applicable for this section and are not provided.

**Technical Specifications:** The TS are not applicable for this section and are not provided.

**Technical Reports:** No technical reports are provided for this section.

#### *2.4.1.3 Regulatory Basis*

The regulatory basis has been already addressed in Section 2.4.0 of this report. The applicable NRC regulations for this section include 10 CFR 52.47(a), 10 CFR 52.47(a)(1), 10 CFR 52.79(a), 10 CFR 52.79(a)(1)(iii), 10 CFR 100.20(c), 10 CFR 100.20(c)(3),

10 CFR 100.23(d)(3), GDC 1, GDC 2, GDC 44, and GDC 60. The applicable NRC guidance for this section includes RG 1.27, RG 1.29, RG 1.59, and RG 1.102.

#### *2.4.1.4 Technical Evaluation*

COL Item 2.0-1 in DCA Part 2 Tier 2, Table 1.8-2, states that a COL applicant referencing the NuScale Power Plant DC will demonstrate that site-specific characteristics are bounded by the site parameters. As shown in DCA Part 2, Tier 1, Table 5.0-1, and DCA Part 2 Tier 2, Table 2.0-1, the NuScale design assumes site parameters such that (1) the maximum flood elevation is 0.3 m (1 ft) below the baseline plant elevation, (2) the maximum elevation of ground water is 2 ft below the baseline plant elevation, and (3) the maximum precipitation rate is 492.8 mm/hr (19.4 in./hr) and 160 mm (6.3 in.) for a 5-minute period. The NuScale DCA does not contain site-specific information because that information will not be available until a COL application identifies a specific site and the associated site-specific information. The specific site is acceptable if the site characteristics are within the NuScale Power Plant site parameters described in DCA Part 2 Tier 1, Table 5.0-1, and DCA Part 2 Tier 2, Table 2.0-1. DCA Part 2 Tier 2, Chapter 2, provides additional information on the site parameters in COL Item 2.0-1.

The COL applicant referencing the NuScale Power Plant DC will provide the site-specific information on the eight topics indicated in Section 2.4.1.2 of this report to satisfy the requirements in 10 CFR Parts 50, 52, and 100 and form the basis for determining whether the site characteristics fall within the site parameters stated in DCA Part 2 or for otherwise performing the hydrologic evaluation. The need for this site-specific information is addressed as part of the response to COL Item 2.4-1, which notes that the COL applicant will investigate and describe the site-specific hydrologic characteristics for the reactor site and vicinity. The COL applicant referencing the NuScale Power Plant DC should provide information sufficient to demonstrate that the actual site characteristics described in any COL application fall within the range of site parameter values.

#### *2.4.1.5 Combined License Information Items*

As part of its review of this portion of the application, the staff considered the adequacy of the COL information items presented in DCA Part 2 Tier 2, Table 1.8-2.

Table 2.4.1-1 of this report lists COL information items related to consequential flood causing mechanisms.

#### *2.4.1.6 Conclusion*

The NuScale Power Plant DCA includes three site parameters related to the hydrologic description: maximum flood elevation, maximum elevation of ground water, and maximum rate of precipitation. COL Items 2.0-1 and 2.4-1 specify that a COL applicant referencing the NuScale Power Plant DC will demonstrate site-specific characteristics and provide the flood hazard information related to DCA Part 2 Tier 2, Sections 2.4.1 through 2.4.7 and 2.4.9. The staff acknowledges that the consequential flood-causing mechanisms are site specific and will be addressed for the selected reactor site and vicinity by a COL applicant referencing the NuScale Power Plant DC. Based on the above information, the staff finds the applicant's discussions in DCA Part 2 Tier 2, Sections 2.4.1 through 2.4.7 and Section 2.4.9, acceptable.

If the actual site characteristics do not fall within the site parameters postulated in the DC, the COL applicant must provide sufficient justification (e.g., by requesting an exemption or departure from the DC) that the proposed facility is acceptable at the proposed site.

## 2.4.2 Flood Protection Requirements

### 2.4.2.1 Introduction

This section describes the locations and elevations of safety-related facilities and components credited for flood protection. It also examines the design-basis flood conditions to determine whether flood effects need to be considered in the power plant design or in emergency procedures.

### 2.4.2.2 Summary of Application

DCA Part 2, Tier 2, Section 2.4.10, "Flood Protection Requirements," states that "[t]he design assumes that the baseline plant elevation is one foot above the maximum flood level. Therefore, there are no flood protection requirements." Accordingly, the DCA does not provide flood protection requirements. DCA Part 2 Tier 2, Table 2.0-1, indicates that the maximum flood level considered in the power plant design is 0.3 m (1 ft) below the baseline elevation for the finished power plant grade. The DCA states that the standard baseline power plant elevation is intended to be 0.3 m (1 ft) above the maximum flood level; there are no applicable flood protection requirements.

**DCA Part 2 Tier 1:** There is no Tier 1 information on flood protection requirements.

**DCA Part 2 Tier 2:** There are no flood protection requirements because the design assumes that the baseline power plant elevation is 0.3 m (1 ft) above the maximum flood level, as indicated in DCA Part 2 Tier 2, Section 2.4.10.

**ITAAC:** The ITAAC are not applicable for this section and are not provided.

**Technical Specifications:** The TS are not applicable for this section and are not provided.

**Technical Reports:** No technical reports are provided for this section.

### 2.4.2.3 Regulatory Basis

The regulatory basis has been already addressed in Section 2.4.0 of this report. The applicable NRC regulations for this section include 10 CFR 52.17(a), 10 CFR 100.20(c), GDC 1, GDC 2, and GDC 44. The applicable NRC guidance for this section includes RG 1.29, RG 1.59, and RG 1.102.

### 2.4.2.4 Technical Evaluation

The NuScale Power Plant DCA does not contain information on flood protection requirements because the standard design postulates a maximum flooding level below which no flood protection will be needed. The determination of the actual maximum flooding level is site specific. The COL applicant should provide information sufficient to demonstrate that the actual site characteristics described in any COL application fall within the range of site parameter values. This information is used to satisfy the requirements in 10 CFR Part 52 and 10 CFR Part 100 and, in doing so, demonstrates that the flood protection requirements are adequate.

The staff notes that the baseline plant elevation is 0.3 m (1 ft) above the maximum flood level, and the design does not rely upon a safety-related intake structure (canal or reservoir) or an external water supply as a makeup source for the reactor pool, which would act as the UHS.



Therefore, the staff agrees with the applicant's statement that the external flood protection requirements for these features are not needed. The COL applicant should provide information sufficient to demonstrate that the actual site characteristics described in any COL application fall within the range of site parameters related to flood protection.

The staff confirmed that both COL Items 3.4-1 and 3.4-4 provided in DCA Part 2 Tier 2, Table 1.8-2, address the information need related to preventing internal flooding associated with DCA Part 2 Tier 2, Section 3.4.

#### **2.4.2.5 Combined License Information Items**

As part of its review of this portion of the application, the staff considered the adequacy of the COL information items presented in DCA Part 2 Tier 2, Table 1.8-2.

COL Item 2.4-1, which specifies that a COL applicant should investigate and describe site-specific hydrological characteristics, is not applicable to this section since the NuScale Power Plant design sets the baseline plant elevation at 0.3 m (1 ft) above the maximum flood elevation and, therefore, does not require flood protection. Should a COL applicant propose a baseline plant elevation less than 0.3 m (1 ft) above the maximum flood elevation, the applicant would need to justify the departure from the approved standard design (i.e., that the standard design remains adequate).

#### **2.4.2.6 Conclusion**

The NuScale Power Plant design assumes a site parameter that the maximum flood elevation (including wind-induced wave runup) is 0.3 m (1 ft) below the baseline plant elevation, as shown in DCA Part 2 Tier 1, Table 5.0-1, and DCA Part 2 Tier 2, Table 2.0-1. The staff concludes that the NuScale Power Plant DCA provides an appropriate site parameter that the maximum flood elevation, including wind-wave runup, caused by the bounding flood-causing mechanism, is 0.3 m (1 ft) below the baseline plant elevation for the plant design and, therefore, does not require flood protection.

The staff also concludes that the site-specific maximum flood elevation must be estimated by the COL applicant to demonstrate that proposed facility grade falls within the specified site parameter in the DCA. The COL applicant should provide flood protection measures against external flood if the site-specific maximum flood elevation exceeds the site parameter.

### **2.4.3 Low-Water Considerations and Cooling Water Canals and Reservoirs**

#### **2.4.3.1 Introduction**

This section describes the potential for an adequate water source during low water-supply conditions to ensure that sufficient safety-related cooling water is available for safely shutting down the power plant. This section also describes the hydraulic design basis that is developed for canal and reservoirs used to transport and impound water supplied to the safety-related facilities.

Low water considerations, as discussed in SRP Section 2.4.11, are site specific and will be addressed by the COL applicant. As discussed in SRP Section 2.4.8, the hydraulic design basis of cooling water canals and reservoirs is site specific and will be addressed by the COL applicant.

#### 2.4.3.2 *Summary of Application*

DCA Part 2 Tier 2, Section 2.4.8, “Cooling Water Canals and Reservoirs,” states that “[t]he design does not rely upon safety-related cooling water canals or reservoirs as a makeup source for the reactor pool, which act as the ultimate heat sink.”

DCA Part 2 Tier 2, Section 2.4.11, “Low Water Considerations,” states that “[t]he design does not rely upon a safety-related source of makeup water.” Therefore, low flow conditions in streams, rivers, or water-supply canals have no impact on the safety-related facilities in the power plant.

Section 2.4.11 also states that “[t]he potential effects of low water levels on non-safety-related water supplies is site-specific and is addressed by the COL applicant as part of the response to COL Item 2.4-1.”

The staff notes that DCA Part 2 Tier 2, Section 2.4.11, includes nonsafety-related water supplies for low-water impacts as part of the response to COL Item 2.4-1.

**DCA Part 2 Tier 1:** There is no Tier 1 information on the potential for low-water considerations and on the cooling water canals and reservoirs.

**DCA Part 2 Tier 2:** The NuScale Power Plant standard design does not rely upon safety-related cooling water canals or reservoirs as a makeup source for the reactor pool, which acts as the UHS, as indicated in DCA Part 2 Tier 2, Section 2.4.8.

The low-water considerations do not affect safety-related cooling as indicated in DCA Part 2 Tier 2, Section 2.4.11. However, in this section, the applicant indicated that the effects of low-water considerations for the nonsafety-related water supply will be addressed by a COL applicant as part of the responses to COL Item 2.4-1.

**ITAAC:** The ITAAC are not applicable for this section and are not provided.

**Technical Specifications:** The TS are not applicable for this section and are not provided.

**Technical Reports:** No technical reports are provided for this section.

#### 2.4.3.3 *Regulatory Basis*

The regulatory basis has been already addressed in Section 2.4.0 of this report. The applicable NRC regulations for this section include 10 CFR 52.17(a), 10 CFR 52.47(a)(1), 10 CFR 100.20(c), GDC 1, GDC 2, and GDC 44. The applicable NRC guidance for this section includes RG 1.27, RG 1.29, RG 1.59, and RG 1.102.

#### 2.4.3.4 *Technical Evaluation*

The NuScale Power Plant DCA does not contain information on cooling water canals and reservoirs because the standard power plant design does not rely on such canals or reservoirs as any safety-related water supply. The applicant stated that the power plant design does not rely upon safety-related cooling water canals and reservoirs as a makeup water supply source for the reactor pool, which would act as the UHS. Therefore, no safety-related cooling water systems could be affected by flooding or blockage in the canals and reservoirs.

As discussed in SRP Section 2.4.8, the COL applicant should provide the information used to describe the site-specific surface water parameters and properties for water supplied to safety-related SSCs. Since the power plant design does not rely upon cooling water canals and reservoirs as a safety-related water supply source, the need for the site-specific information is thus not considered applicable to the design, as currently proposed. This issue is addressed in COL Item 2.4-1 and in DCA Part 2 Tier 2, Table 1.8-2, which notes that the COL applicant needs to describe the hydrologic characteristics of the reactor site and vicinity, except DCA Part 2, Tier 2, Section 2.4.8 and Section 2.4.10.

The NuScale Power Plant DCA does not contain information on low-water considerations because the standard power plant design does not rely on any safety-related water supply. However, a COL application will provide information on the potential effects of low-water conditions as needed for site-specific water supplies that are not safety related. Based on the information provided in DCA Part 2 Tier 2, Section 2.4.11, the staff noted that the design does not rely upon an external, safety-related source for makeup water. Therefore, the staff concludes that a low water level in canals and reservoirs need not be considered in the staff evaluation of this design. The applicant stated in the DCA that the potential effect of low water levels on nonsafety-related water supplies is site specific and is addressed by the COL applicant as needed. The staff determined this item should be addressed as part of the response to COL Item 2.4-1.

Accordingly, the COL applicant will provide the site-specific information on hydrological parameters and hydraulic properties relevant to low-water conditions for water supplies that are not safety related. The need for this site-specific information is addressed as part of the response to COL Item 2.4-1 and in DCA Part 2 Tier 2, Table 1.8-2, which notes that the COL applicant needs to describe the hydrologic characteristics of the reactor site and vicinity relevant to low-water conditions for water supplies that are not safety related.

Lastly, in the matter of water supply that is not safety related, the staff notes that the evaluation of the external water supply is site specific and should be addressed by the COL applicant.

#### *2.4.3.5 Combined License Information Items*

As part of its review of this portion of the application, the staff considered the adequacy of the COL information items provided in DCA Part 2 Tier 2, Table 1.8-2.

Table 2.4.1-1 of this report lists COL Item 2.4-1 related to this section on low-water considerations for water supplies that are not safety related, which is site specific, from DCA Part 2 Tier 2, Table 1.8-2.

COL Item 2.4-1, which specifies that a COL applicant should investigate and describe site-specific hydrological characteristics, applies to cooling water canals and reservoirs only to the extent they supply makeup water to SSCs that are not safety related, since the NuScale design does not rely on safety-related cooling water canals and reservoirs as a makeup water supply source for the reactor pool, which is the UHS for the standard design.

#### *2.4.3.6 Conclusion*

The NuScale Power Plant standard design does not rely on a safety-related source of makeup water external to the facility, and, therefore, low-water considerations would not affect safety-related systems. Hence, low water levels resulting from some probable maximum tsunami, ice effects, storm surge and seiche, channel diversions, downstream dam failures, and

potential ground water concerns will not affect safety-related cooling. However, in DCA Part 2 Tier 2, Section 2.4.11, the applicant factored water supplies that are not safety related into an evaluation of low-water impacts as part of the response to COL Item 2.4-1.

Thus, the COL applicant should evaluate the potential effects of low-water considerations on water supplies that are not safety related. The staff finds this acceptable.

The applicant indicated that the standard power plant design does not rely on cooling water canals and reservoirs as a makeup water supply source for the reactor pool, which is the UHS for the standard design. Therefore, a COL applicant that references the NuScale Power Plant DC does not need to describe the makeup water supply source for safety-related SSCs. The staff finds this acceptable.

## **2.4.4 Ground Water Monitoring**

### **2.4.4.1 Introduction**

This section describes the ground water effects on power plant foundations and the reliability of safety-related water supply and dewatering systems.

Ground water effects are site specific and will be addressed by the COL applicant.

### **2.4.4.2 Summary of Application**

DCA Part 2 Tier 2, Section 2.4.12, "Groundwater," states that "[t]he design does not employ a permanent dewatering system," "[g]roundwater is assumed a minimum of two feet below site grade," and "[g]roundwater is site-specific and is addressed by the COL applicant as part of the response to COL Item 2.4-1." The ground water elevation is a site-specific consideration and is one of key site parameters to be evaluated for a candidate site.

The COL applicant is to describe local and regional ground water characteristics and use, effects on plant foundations and other safety-related SSCs, and the reliability of ground water resources and systems used for safety-related purposes.

**DCA Part 2 Tier 1:** DCA Part 2 Tier 1, Table 5.0-1, contains relevant site parameter information on the maximum ground water elevation.

**DCA Part 2 Tier 2:** The ground water is site specific, as indicated in DCA Part 2 Tier 2, Section 2.4.12. DCA Part 2 Tier 2, Table 2.0-1, contains relevant site parameter information on the maximum ground water elevation.

**ITAAC:** ITAAC are not applicable for this section and are not provided.

**Technical Specifications:** TS are not applicable for this section and are not provided.

**Technical Reports:** No technical reports are provided for this section.

### **2.4.4.3 Regulatory Basis**

The regulatory basis has been already addressed in Section 2.4.0 of this report. The applicable NRC regulations for this section include 10 CFR 52.47(a)(1), 10 CFR 52.79(a)(1)(iii), 10 CFR 100.20(c), 10 CFR 100.20(c)(3), and 10 CFR 100.23. The applicable NRC guidance for this section includes RG 1.27.

#### *2.4.4.4 Technical Evaluation*

The NuScale Power Plant DCA does not contain information on ground water because it is site specific. However, the DCA provides a site parameter related to the maximum ground water elevation, to be 2 ft below the baseline plant elevation, as shown in DCA Part 2 Tier 1, Table 5.0-1, and DCA Part 2 Tier 2, Table 2.0-1. The actual maximum ground water elevation is site specific and will be addressed by the COL applicant in response to COL Items 2.0-1 and 2.4-1. The COL applicant should provide information sufficient to demonstrate that the actual site characteristics described in any COL application fall within the range of site parameter values. This information is used to satisfy the requirements in 10 CFR Part 52 and 10 CFR Part 100.

Accordingly, the COL applicant will provide the site-specific hydrogeological information and hydraulic parameters regarding ground water elevation for the reactor site and vicinity. The need for this site-specific information is addressed as part of the response to COL Item 2.4-1 in DCA Part 2 Tier 2.

#### *2.4.4.5 Combined License Information Items*

As part of its review of this portion of the application, the staff considered the adequacy of the COL information items provided in DCA Part 2 Tier 2, Table 1.8-2.

Table 2.4.1-1 of this report lists COL information items related to this section on ground water. Because these COL information items call for a COL applicant to determine maximum ground water elevation and compare that elevation to the corresponding site parameter in the DCA, the staff concludes the information items are adequate.

#### *2.4.4.6 Conclusion*

The staff concludes that the NuScale Power Plant DCA provides an appropriate site parameter that the maximum ground water elevation is 2 ft below baseline plant elevation for plant design. Both the baseline plant elevation and the maximum ground water elevation are site specific and will be addressed by the COL applicant. The COL applicant should include information sufficient to demonstrate that the actual site characteristics fall within the values of the site parameters in the NuScale Power Plant certified design. The staff finds this acceptable.

If the actual site characteristics do not fall within the site parameters postulated in the DC, the COL applicant must provide sufficient justification (e.g., by requesting an exemption or departure from the DC) that the proposed facility is acceptable at the proposed site.

### **2.4.5 Accidental Releases of Radioactive Liquid Effluents in Ground and Surface Waters**

#### *2.4.5.1 Introduction*

This section discusses the effects of accidental releases of radioactive liquid effluents into ground and surface waters on existing uses and known future uses of these water resources.

The effects of accidental releases of radioactive liquid effluents in ground and surface waters are site specific and will be addressed by the COL applicant.

#### 2.4.5.2 *Summary of Application*

DCA Part 2 Tier 2, Section 2.4.13, “Accidental Releases of Radioactive Liquid Effluents in Groundwater and Surface Waters,” states that “[d]ilution 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 is site-specific and is addressed by the COL applicant as part of the response to COL Item 2.4-1.” The source term provided in DCA Part 2 Tier 2, Table 12.2-10, is associated with the pool surge control system storage tank. This source term is to be used in the COL applicant’s site-specific analysis to evaluate the effects of an accidental release of radioactive liquid. This information is to be provided as part of the response to COL Item 2.4-1, demonstrating the adequacy of the site’s hydrogeologic properties.

Because the standard power plant design basis is intended to be suitable for a variety of sites and conditions for hazards caused by accidental releases in ground water and surface water, DCA Part 2 Tier 2, Chapter 2, defers to the COL applicant the presentation of the required site-specific information on this hydrologic design topic. The COL applicant is to describe alternate conceptual models, pathways, characteristics that affect transport, and consideration of the accidental releases combined with the potential effects of seismic and non-seismic events.

**DCA Part 2 Tier 1:** There is no Tier 1 information about the accidental releases of radioactive liquid effluents in ground and surface waters.

**DCA Part 2 Tier 2:** The accidental releases of radioactive liquid effluents in ground and surface waters are site specific, as indicated in DCA Part 2 Tier 2, Section 2.4.13.

**ITAAC:** ITAAC are not applicable for this section and are not provided.

**Technical Specifications:** TS are not applicable for this section and are not provided.

**Technical Reports:** No technical reports are provided for this section.

#### 2.4.5.3 *Regulatory Basis*

The regulatory basis has been already addressed in Section 2.4.0 of this report. The applicable NRC regulations for this section include 10 CFR 52.17(a), 10 CFR 100.20(c), 10 CFR 100.20(c)(3), 10 CFR 100.21, and GDC 60. The applicable NRC guidance for this section includes RG 1.113.

#### 2.4.5.4 *Technical Evaluation*

The applicant stated, in DCA Part 2 Tier 2, Section 2.4.13, that a COL applicant referencing the NuScale Power Plant certified design will address the site-specific information pertaining to flooding and other related hydrodynamic phenomena. Accordingly, the COL applicant will provide the site-specific information that is used to satisfy the requirements in 10 CFR Part 52 and 10 CFR Part 100 and to describe the site-specific accidental releases of radioactive liquid effluents in ground and surface waters.

The need for this site-specific information is addressed as part of the response to COL Item 2.4-1 in DCA Part 2 Tier 2, which notes that the COL applicant is to describe both the surface and subsurface hydrologic characteristics of the reactor site and vicinity. Special

attention should be given to the consideration of those physicochemical properties that affect contaminant fate and transport of radioactive effluents.

#### **2.4.5.5 Combined License Information Items**

As part of its review of this portion of the application, the staff considered the adequacy of the COL information items provided in DCA Part 2 Tier 2, Table 1.8-2.

Table 2.4.1-1 of this report lists COL information items related to this section on accidental releases of radioactive liquid effluents in ground and surface waters.

#### **2.4.5.6 Conclusion**

The NuScale Power Plant DCA has identified the source term provided in DCA Part 2 Tier 2, Table 12.2-10, “Reactor Pool Cooling, Spent Fuel Pool Cooling, Pool Cleanup and Pool Surge Control System Component Source Terms—Radionuclide Content,” to be used in the site-specific analysis related to the accidental releases of radioactive liquid effluents in ground and surface waters. A COL applicant that references the NuScale Power Plant DC will describe accidental releases of radioactive liquid effluents in ground and surface waters for DCA Part 2 Tier 2, Section 2.4.13, as part of the response to COL Item 2.4-1. The staff acknowledges that the accidental release of radioactive liquid effluents in ground and surface waters is site specific and will be addressed by a COL applicant referencing the NuScale Power Plant DC. Based on the above information, the staff finds the applicant’s discussions in DCA Part 2 Tier 2, Section 2.4.13, acceptable.

### **2.4.6 Technical Specifications and Emergency Operation Requirements**

#### **2.4.6.1 Introduction**

This section describes the TS and emergency procedures that are required to implement protection against floods for safety-related facilities and to ensure that an adequate water supply for power plant shutdown and cooldown is available.

The implementation of TS and emergency operation requirements is site specific and will be addressed by the COL applicant.

#### **2.4.6.2 Summary of Application**

DCA Part 2 Tier 2, Section 2.4.14, “Technical Specifications and Emergency Operation Requirements,” states that “[t]he design does not require emergency protective measures to minimize the impact of adverse hydrology-related events on safety-related facilities.” However, the same section also states that “[s]ite-specific emergency protective measures are addressed by the COL applicant as part of the response to COL Item 2.4-1.”

DCA Part 2 Tier 2, Table 2.0-1, and DCA Part 2 Tier 1, Table 5.0-1, indicate how the power plant design considers the basic hydrologic design basis related to the maximum water level. Because the site-specific hazards related to any emergency condition for power plant operation or limiting conditions of operation are not available at the DC stage, DCA Part 2 Tier 2, Section 2.4.14, defers to the COL applicant the presentation of the required site-specific information on this hydrologic design topic.

**DCA Part 2 Tier 1:** There is no Tier 1 information about the TS and emergency operation requirements.

**DCA Part 2 Tier 2:** The NuScale Power Plant standard design does not require emergency protective measures to minimize the impact of adverse hydrology-related events on safety-related facilities, as indicated in DCA Part 2 Tier 2, Section 2.4.14. However, in this section, the applicant indicated that site-specific emergency protective measures are addressed by the COL applicant as part of the response to COL Item 2.4-1.

**ITAAC:** ITAAC are not applicable for this section and are not provided.

**Technical Specifications:** TS are not applicable for this section and are not provided.

**Technical Reports:** No technical reports are provided for this section.

#### *2.4.6.3 Regulatory Basis*

The regulatory basis has been already addressed in Section 2.4.0 of this report. The applicable NRC regulations for this section include 10 CFR 50.36(c)(2) and GDC 2. The applicable NRC guidance for this section includes RG 1.29, RG 1.59, and RG 1.102.

#### *2.4.6.4 Technical Evaluation*

The applicant stated in DCA Part 2 Tier 2, Section 2.4.14, that a COL applicant referencing the NuScale Power Plant DC will address the site-specific emergency protective measures pertaining to flooding and other related hydrodynamic phenomena. Accordingly, the COL applicant will provide the site-specific information that is used to satisfy the requirements in 10 CFR 50.36(c)(2) and to describe the site-specific emergency operating procedures during anticipated flooding conditions. The need for this information is identified as COL Item 2.4-1 in DCA Part 2 Tier 2, which notes that the COL applicant is to describe the hydrologic characteristics of the reactor site and vicinity.

#### *2.4.6.5 Combined License Information Items*

As part of its review of this portion of the application, the staff considered the adequacy of the COL information items provided in DCA Part 2 Tier 2, Table 1.8-2.

Table 2.4.1-1 of this report lists a COL information item related to this section on TS and emergency operation requirements.

#### *2.4.6.6 Conclusion*

The NuScale DCA has no postulated site parameters related to TS and emergency operation requirements. A COL applicant that references the NuScale Power Plant DC will describe TS and emergency operation requirements for DCA Part 2 Tier 2, Section 2.4.14, as part of the response to COL Item 2.4-1. The staff acknowledges that TS and emergency operation requirements are site specific and will be addressed by a COL applicant referencing the NuScale Power Plant DC. Based on the above information, the staff finds the applicant's discussions in DCA Part 2 Tier 2, Section 2.4.14, acceptable.



## **2.5 Geology, Seismology, and Seismic Information**

### **2.5.1 Basic Geologic and Seismic Information**

#### *2.5.1.1 Introduction*

This section documents the staff's review of regional and site geologic and seismic information for the NuScale Power Plant design.

#### *2.5.1.2 Summary of Application*

**DCA Part 2 Tier 1:** DCA Part 2 Tier 1, Table 5.0-1, provides site parameters related to regional and site geologic and seismic information. Sections 2.5.2 through 2.5.5 of this report discuss these site parameters.

**DCA Part 2 Tier 2:** DCA Part 2 Tier 2, Section 2.5.1, "Basic Geologic and Seismic Information," states that basic regional and site geologic and seismic information is site specific and will be addressed by the COL applicant.

#### *2.5.1.3 Regulatory Basis*

The following NRC regulations contain the relevant requirements for this review:

- 10 CFR 52.47, "Contents of Applications; Technical Information," requires a DC applicant to provide site parameters postulated for the design and an analysis and evaluation of the design in terms of those site parameters.
- 10 CFR 100.23 relates to obtaining geologic and seismic information necessary to determine site suitability and ascertain that any new information derived from site-specific investigations would not affect the ground motion response spectra (GMRS) derived by a probabilistic seismic hazard analysis. However, each applicant shall investigate all geologic and seismic factors (for example, volcanic activity) that may affect the design and operation of the proposed nuclear power plant irrespective of whether such factors are explicitly included in this section.

The guidance in SRP Section 2.5.1, "Basic Geologic and Seismic Information," lists the acceptance criteria adequate to meet the above requirements, as well as review interfaces with other SRP sections, such as Sections 2.5.2 and 2.5.4, which provide the following:

- The staff reviews information presented by the applicant for a DC to determine whether the site parameters postulated for the design, with respect to basic geologic and seismic information, are correctly identified, are representative of a reasonable number of sites that have been or may be considered for a COL application, and are appropriately justified.

The following document provides additional criteria or guidance in support of the SRP acceptance criteria to meet the above requirements.

- RG 1.208, "A Performance-Based Approach to Define Site-Specific Earthquake Ground Motion," issued March 2007

#### 2.5.1.4 Technical Evaluation

Regional and site geologic and seismic information provides the basis for a site suitability determination for any reactor design. As stated in the SRP, the regional and site geologic and seismic information is site specific and must be provided and evaluated by ESP, COL, or construction permit (CP) applicants, and DCA Part 2 Tier 2, Section 2.5.1, specifies that basic regional and site geologic and seismic information is site specific and is to be addressed by the COL applicant. COL applicants referencing the NuScale Power Plant DC are responsible for providing adequate regional and site geologic and seismic information to be bounded by NuScale Power Plant design parameters.

#### 2.5.1.5 Combined License Information Items

Table 2.5-1 lists a COL information item related to basic geologic and seismic information, as provided in DCA Part 2 Tier 2, Table 1.8-2.

**Table 2.5-1 NuScale COL Information Items Related to DCA Part 2 Tier 2, Section 2.5.1**

Item No.	Description	DCA Part 2 Tier 2 Section
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

#### 2.5.1.6 Conclusion

The applicant specified in COL Item 2.5-1 the need for the COL applicant referencing the NuScale Power Plant DC to describe regional and site geologic and seismic information. The staff concludes that the applicable requirements of 10 CFR 52.47 and 10 CFR 100.23 can be met by addressing this COL information item, and, therefore, the staff finds this acceptable.

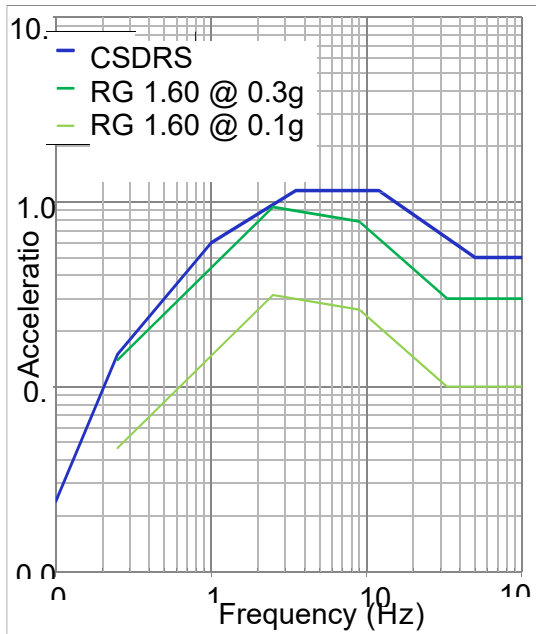
### 2.5.2 Vibratory Ground Motion

#### 2.5.2.1 Introduction

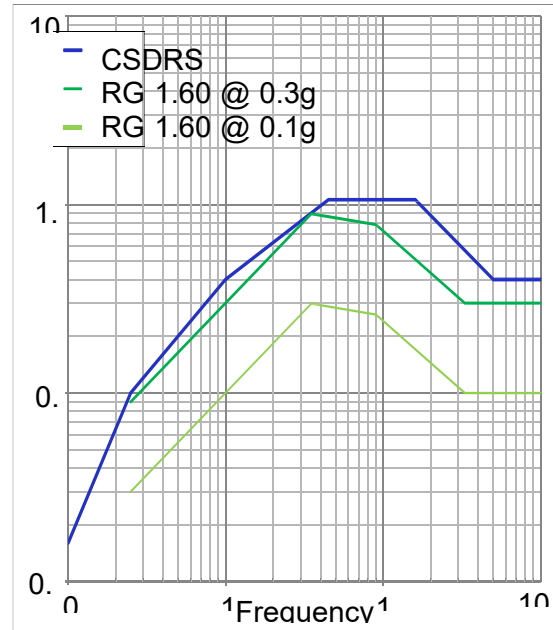
This section documents the staff's review of vibratory ground motion for the NuScale Power Plant design.

#### 2.5.2.2 Summary of Application

**DCA Part 2 Tier 1:** DCA Part 2 Tier 1, Table 5.0-1, specifies CSDRS that form the seismic loading design basis and can be used to compare with the site-specific GMRS and to determine the safe-shutdown earthquake (SSE). Figures 2.5 1 and 2.5 2 of this report illustrate these CSDRS.

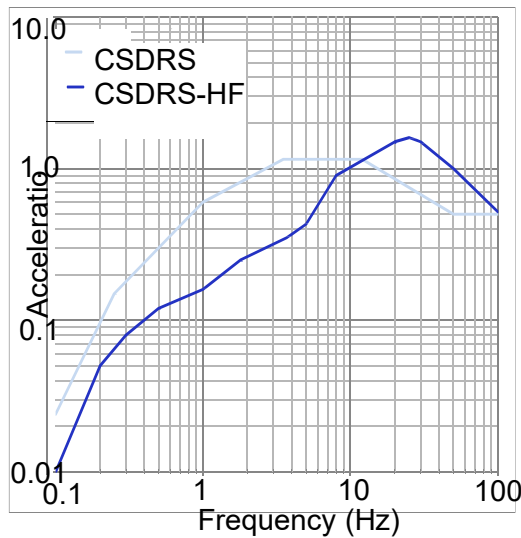


(a)

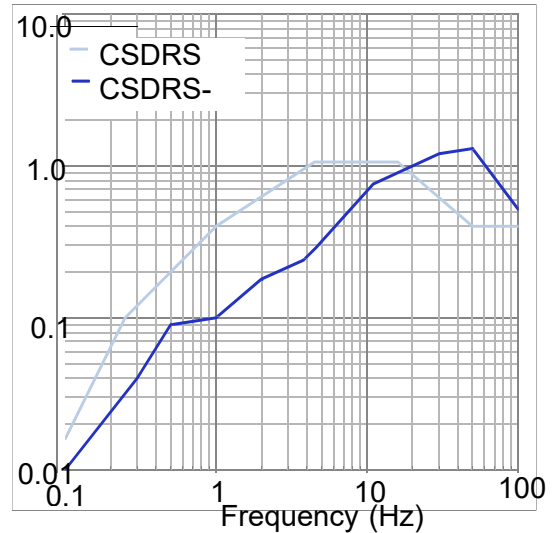


(b)

**Figure 2.5-1 NuScale horizontal (a) and vertical (b) certified seismic design response spectra 5-percent damping (after DCA Part 2 Tier 1, Figures 5.0-1 and 5.0-2)**



(c)



(d)

**Figure 2.5-2 NuScale horizontal (c) and vertical (d) certified seismic design response spectra high-frequency 5-percent damping (after DCA Part 2 Tier 1, Figures 5.0-3 and 5.0-4)**

**DCA Part 2 Tier 2:** DCA Part 2 Tier 2, Section 2.5.2, "Vibratory Ground Motion," states that the CSDRS and the CSDRS-high frequency (CSDRS-HF) were developed by reviewing earthquake design data from the U.S. nuclear industry and are intended to bound most of the central and

eastern United States, as well as sites in the western United States. It also states that local vibratory ground motion, including development of an SSE, is site specific and to be addressed by the COL applicant.

#### 2.5.2.3 *Regulatory Basis*

The following NRC regulations contain the relevant requirements for this review:

- 10 CFR 52.47, as summarized in Section 2.5.1.3 of this report
- 10 CFR 100.23, as summarized in Section 2.5.1.3 of this report

The guidance in SRP Section 2.5.2 lists the acceptance criteria adequate to meet the above requirements, as well as review interfaces with other SRP sections:

- The staff reviews information presented by a DC applicant to determine whether the site parameters postulated for the design, with respect to seismic ground motion, are correctly identified, are representative of a reasonable number of sites that have been or may be considered for a COL application, and are appropriately justified.

The following documents provide additional criteria or guidance in support of the SRP acceptance criteria to meet the above requirements:

- RG 1.208, as listed in Section 2.5.1.3 of this report
- RG 1.60, "Design Response Spectra for Seismic Design of Nuclear Power Plants," Revision 2, issued August 1977

#### 2.5.2.4 *Technical Evaluation*

As stated in DCA Part 2 Tier 2, Section 2.5.2, the CSDRS and the CSDRS-HF are key design parameters. DCA Part 2 Tier 2, Section 3.7.1, "Seismic Design Parameters," discusses these parameters. The CSDRS are shown in DCA Part 2 Tier 2, Figure 3.7.1-1, "NuScale Horizontal CSDRS at 5 Percent Damping," and Figure 3.7.1-2, "NuScale Vertical CSDRS at 5 Percent Damping." The CSDRS-HF is shown in DCA Part 2, Tier 2, Figure 3.7.1-3, "NuScale Horizontal CSDRS-HF at 5 Percent Damping," and Figure 3.7.1-4, "NuScale Vertical CSDRS-HF at 5 Percent Damping." DCA Part 2 Tier 2, Tables 3.7.1-1 and 3.7.1-2, provide the horizontal and vertical control points for the CSDRS and CSDRS-HF at 5-percent damping.

The CSDRS are broad spectra (similar to what is in RG 1.60), which is intended to encompass the GMRS at most sites except hard rock sites in the central and eastern United States. To improve the range of acceptable locations, site-independent seismic Category I SSCs are also evaluated using spectra that have more content above 10 hertz (Hz) than the CSDRS. This is identified as the CSDRS-HF. The CSDRS are developed at 5-percent damping. The horizontal components of the CSDRS have a peak ground acceleration (PGA) of 0.5g, and the vertical components have a PGA of 0.4g. The vertical response spectrum is two-thirds or more of the horizontal response spectrum. Both the horizontal and the vertical CSDRS bound the RG 1.60 response spectra and are anchored at PGAs greater than the minimum required 0.1g. Accordingly, the staff finds this acceptable.

The staff reviewed the applicant's CSDRS and evaluated the completeness and adequacy of those site parameters. The staff examined the CSDRS and CSDRS-HF, which are intended to cover sites in most of the central and eastern United States, as well as sites in the western

United States, and concludes that those CSDRS can cover numerous potential sites in the United States, and, accordingly, they are acceptable. As stated in the SRP, the regional and site geologic and seismic information is site specific and must be provided and evaluated by ESP, COL, or CP applicants. The applicant stated, in DCA Part 2 Tier 2, Section 2.5.2, that local vibratory ground motion, including development of an SSE, is site specific and to be addressed by the COL applicant as part of the response to COL Item 2.5-1. COL applicants referencing the NuScale Power Plant DC are responsible for providing adequate information on local vibratory ground motion, including development of an SSE, to be bounded by NuScale Power Plant design parameters.

#### *2.5.2.5 Combined License Information Items*

The COL information item related to vibratory ground motion is listed in Table 2.5-1 of this report.

#### *2.5.2.6 Conclusion*

Based on the review of DCA Part 2 Tier 2, Section 2.5.2, the staff concludes that the applicant provided the necessary seismic plant design parameters, CSDRS and CSDRS-HF, that the spectra are consistent with 10 CFR 100.23, and the applicant specified the scope of the information associated with those site parameters in COL Item 2.5-2 that, when addressed by COL applicants, will meet the applicable requirements of 10 CFR 52.47 and 10 CFR 100.23. The staff, therefore, finds the vibratory ground motion site parameters specified in the NuScale Power Plant design acceptable.

### **2.5.3 Surface Deformation**

#### *2.5.3.1 Introduction*

This section documents the staff's review of surface faulting for the NuScale Power Plant design.

#### *2.5.3.2 Summary of Application*

**DCA Part 2 Tier 1:** DCA Part 2 Tier 1, Table 5.0-1, specifies that there should be no-fault displacement potential at a site.

**DCA Part 2 Tier 2:** DCA Part 2 Tier 2, Section 2.5.3, "Surface Faulting," states that the design analysis assumes that there is no-fault displacement potential under the plant structures. It also states that detailed surface and subsurface geological, seismological, and geophysical information, including surface faulting, is site specific and to be addressed by the COL applicant.

#### *2.5.3.3 Regulatory Basis*

The following NRC regulations contain the relevant requirements for this review:

- 10 CFR 52.47, as summarized in Section 2.5.1.3 of this report
- 10 CFR 100.23, as summarized in Section 2.5.1.3 of this report

The guidance in SRP Section 2.5.3, "Surface Deformation," lists the acceptance criteria adequate to meet the above requirements, as well as review interfaces with other SRP sections such as 2.5.2 and 2.5.4, as discussed in Section 2.5.1.3 of this report.

The following document provides additional criteria or guidance in support of the SRP acceptance criteria to meet the above requirements:

- RG 1.198, "Procedures and Criteria for Assessing Seismic Soil Liquefaction at Nuclear Power Plant Sites," issued November 2003

#### **2.5.3.4      *Technical Evaluation***

As stated in SRP Section 2.5.3, surface deformation is one of the geologic hazards that will affect the suitability of a site for a nuclear power plant and the stability of facilities at the site. DCA Part 2 Tier 2, Section 2.5.3, specifies that the design analysis assumes that there is no-fault displacement potential under the plant structures, thus eliminating any potential adverse impact on the plant structures from this geologic hazard. SRP Section 2.5.3 states that the surface deformation characteristics are site specific, provided by the applicant for an ESP, COL, or CP, and reviewed by the staff. In DCA Part 2 Tier 2, Section 2.5.3, the applicant stated that detailed surface and subsurface geological, seismological, and geophysical information, including surface faulting, will be addressed by the COL applicant, consistent with COL Item 2.5-1. COL applicants referencing the NuScale Power Plant DC are responsible for providing adequate information regarding the potential for surface deformation to be bounded by NuScale Power Plant design parameters.

#### **2.5.3.5      *Combined License Information Items***

The COL information item related to surface faulting is listed in Table 2.5-1 of this report.

#### **2.5.3.6      *Conclusion***

Consistent with the fact that surface deformation is one of the important geologic characteristics and potential hazards for a nuclear power plant site, and it is site specific, the applicant specified that its design is based on the assumption of no-fault displacement potential under the plant structures. The applicant also specified in COL Item 2.5-1 the scope of the information associated with geotechnical characteristics enveloping surface deformation. Based on its review of DCA Part 2 Tier 2, Section 2.5.3, the staff concludes that the applicant has clearly defined the design basis of no-fault displacement potential, and this meets the applicable requirements of 10 CFR 100.23. The applicant specified in COL Item 2.5-1 the need for the COL applicant referencing the NuScale Power Plant DC to describe site-specific geology, seismology, and geotechnical characteristics to include the potential for surface deformation pertaining to Section 2.5.3 of the DCA. The staff concludes that the applicable requirements of 10 CFR 52.47 and 10 CFR 100.23 can be met by addressing this COL information item, and, therefore, the staff finds this acceptable.

### **2.5.4      *Stability of Subsurface Materials and Foundations***

#### **2.5.4.1      *Introduction***

This section documents the staff's review of the stability of subsurface materials and foundations for the NuScale Power Plant design.

#### **2.5.4.2      *Summary of Application***

**DCA Part 2 Tier 1:** DCA Part 2 Tier 1, Table 5.0-1, provides the following specific site parameters related to subsurface materials and foundation designs:

- minimum soil bearing capacity ( $Q_{ult}$ ) beneath safety-related structures: 75 kips per square foot (ksf)
- lateral soil variability uniform site: <20-degree dip
- minimum soil angle of internal friction: 30 degrees
- minimum shear wave velocity:  $\geq 1,000$  ft/second at bottom of foundation
- maximum settlement for the RXB, CRB, and RWB:
  - total settlement: 4 in.
  - tilt settlement: maximum of 0.5 in. per 50 ft of building length or 1 in. total in any direction at any point in these structures
  - differential settlement (between RXB and CRB, and RXB and RWB): 0.5 in.

**DCA Part 2 Tier 2:** In addition to the site parameters listed in DCA Part 2 Tier 1, Table 5.0-1, DCA Part 2 Tier 2, Table 2.0-1, provides the following site parameters:

- Coefficient of friction (CoF) between concrete foundation and soil  $\geq 0.58$  where  $\text{CoF} = \tan(\phi)$
- CoF between concrete foundation and soil (CRB nonlinear analysis)  $\geq 0.55$
- CoF between walls and soil  $\geq 0.50$

DCA Part 2 Tier 2, Section 2.5.4, “Stability of Subsurface Materials and Foundations,” specifies that there is to be no potential for soil liquefaction under the site-specific SSE condition. Section 2.5.4 also states that there are no rigid safety-related connections between the structures and there are no safety-related connections to other site structures, and a settlement tilt limit of 1 in. total or half an in. per 50 ft (<0.1 degree) does not affect the structural analysis.

The applicant stated that characteristics of the subsurface materials are site specific and to be discussed by the COL applicant.

#### 2.5.4.3 *Regulatory Basis*

The following NRC regulations contain the relevant requirements for this review:

- 10 CFR 52.47, as summarized in Section 2.5.1.3 of this report
- GDC 1, as it requires that SSCs important to safety be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed
- 10 CFR Part 50, Appendix S, “Earthquake Engineering Criteria for Nuclear Power Plants,” as it applies to the design of nuclear power plant SSCs important to safety to withstand the effects of earthquakes
- 10 CFR 100.23, as summarized in Section 2.5.1.3 of this report

The guidance in SRP Section 2.5.4, “Stability of Subsurface Materials and Foundations,” lists the acceptance criteria adequate to meet the above requirements, as well as review interfaces with other SRP sections:

- The staff reviews information presented by the applicant for a DC to determine whether the postulated site parameters for the design, with respect to stability of the soil and rock underlying the site, are correctly identified, are representative of a reasonable number of sites that has been or may be considered for a COL application, and are appropriately justified.

The following document provides additional criteria or guidance in support of the SRP acceptance criteria to meet the above requirements:

- RG 1.198, as listed in Section 2.5.3.3 of this report

#### *2.5.4.4 Technical Evaluation*

The staff reviewed the site parameters that are related to the stability of subsurface materials and foundations for seismic Category 1 structures and evaluated the completeness and adequacy of those site parameters.

The staff evaluated the site parameter of minimum ultimate bearing capacity,  $Q_{ult}$ , for supporting materials beneath safety-related structures. This foundation-bearing capacity parameter is based on the maximum foundation pressures obtained from structural stability analyses under design loading conditions, including static and dynamic or seismic loadings. The applicant presented the analysis results in DCA Part 2 Tier 2, Section 3.8.5, “Foundations.” The applicant also stated, in DCA Part 2 Tier 2, Section 2.5.4, that the minimum ultimate bearing capacity is sufficient to provide a factor of safety greater than 3.0 for foundations under static loading conditions and greater than 2.0 for dynamic loading conditions. The staff confirmed that those factor of safety values are commonly used in industrial standards and provide adequate margin to prevent failure of the support material caused by maximum foundation pressures under design loading conditions. Accordingly, the staff finds the proposed site parameter for ultimate bearing capacity of materials beneath safety-related structures acceptable.

In DCA Part 2 Tier 2, Section 2.5.4, the applicant specified that there is no potential for soil liquefaction from the site-specific SSE. As soil liquefaction will greatly affect the stability of foundations and structures, the staff acknowledges that not having a soil liquefaction potential at a site will eliminate the instability of soil underlying plant structures caused by soil liquefaction.

As great uncertainty and variability of subsurface materials exist at any real site, site uniformity parameters need to be defined based on the design assumptions. The applicant specified that its plant design applies to sites with uniform lateral soil variability and no more than a 20-degree inclination of geologic layers. This site parameter is defined as part of the design basis, and the characteristics of an actual site must fall within the parameter or the COL or CP applicant must justify a departure from the parameter.

The applicant also specified several soil property-related site parameters, such as a minimum shear wave velocity of 304.8 m/sec (1,000 feet per second) for in situ materials, coefficient of friction greater than or equal to 0.58 at all interfaces between the concrete foundation and soil, coefficient of friction greater than or equal to 0.5 between concrete walls and soil, and 30 degrees of minimum soil angle of internal friction. These site parameters provide specific soil properties used in this design and are within the range of normal values for soils used in



nuclear power plant construction. Accordingly, the staff concludes that those parameters are acceptable.

The staff noted that the backfill material properties were not included as site parameters. While backfill material surrounding structures was used in safety-related structure analysis models, according to the applicant's explanation, COL Items 2.5-1, 3.7-3, 3.7-5, 3.7-6, and 3.8-2, provided in DCA Part 2 Tier 2, Table 1.8-2, call for the COL applicant that references the NuScale Power Plant DC to develop appropriate site-specific soil profiles and perform soil-structure interaction (SSI) and structure-soil-structure interaction (SSSI) analyses. The applicant indicated that these analyses are to confirm the suitability of the design using the site-specific non-seismic and seismic demands, and the site-specific soil profile that includes backfill materials. (Staff RAI 9049, Question 02.05.04-1, as well as the applicant's response, at ADAMS Accession No. ML17285B465, provide details.) Based on the above statement, the staff considers that each actual site has its specific characteristics, and the COL applicant will perform SSI and SSSI analyses if the site-specific soil profile, including backfill materials, deviate from the soil profiles used in the NuScale design. The site-specific SSI and SSSI analyses will use the site-specific properties of backfill materials in the analysis models, and the COL applicant will need to provide details on how to ensure that the in-place backfill materials possess the properties as described. The staff concludes that the aforementioned COL items will be addressed in a future COL application and will ensure proper backfill materials to be used during construction; therefore, it is acceptable that specific backfill material properties not be included in the site parameters for this design.

The staff noted that there was no limit established for total settlement and there were no other differential settlement limits specified for the NuScale Power Plant structure and foundation designs, which does not follow the commonly accepted engineering standards and guidelines (e.g., U.S. Army Corps of Engineers (USACE) EM 1110-1-1904, "Engineering and Design - Settlement Analysis," issued 1990), and large settlement will have negative impact on the integrity of structures. The applicant revised DCA Part 2, Tier 1, Table 5.0-1; DCA Part 2 Tier 2, Table 2.0-1; and DCA Part 2 Tier 2, Section 2.5.4, to include the limits of total settlement and differential settlement between buildings, as well as the limits of differential settlement for the RXB, CRB, and RWB. (The staff's RAI 9049, Question 02.05.04-2, as well as the applicant's response, at ADAMS Accession No. ML17284A859, provide details.) The revised settlement limits include the following:

- maximum allowable total settlement for the RXB, CRB, and RWB: 10 cm (4 in.)
- maximum allowable differential settlement for the RXB, CRB, and RWB (tilt settlement): 2.5 cm (1 in.) total or 1.25 cm per 15.2 m (½ in. per 50 ft), or 1/1200, in any direction at any point in any of these structures
- maximum allowable differential settlement between the RXB and CRB, and the RXB and RWB: 1.25 cm (½ in.)

The staff examined the revised site parameters related to foundation settlement and finds, in conjunction with the staff review of DCA Part 2 Tier 2, Section 3.8.5.6, "Results Compared with Structural Acceptance Criteria," that the revised maximum allowable differential settlement of 2.5 cm (1 in.) total or 1/1200 tilt is well within the commonly accepted engineering standards and guidelines, for example, the limits of 1/1250 to 1/600 as specified in USACE EM 1110-1-1904. The specified total settlement of 10 cm (4 in.) for all seismic Category 1 structures is also reasonable because the total settlement in conjunction with specified limits of

differential settlement, both within a structure and between structures, will not have an adverse effect on the normal operation and stability of the structures. Accordingly, the staff concludes that the specified structure and foundation settlement-related site parameters are consistent with industrial standards and are reasonable.

Regarding determination of the lateral earth pressure on the embedded portions of the safety-related structures, the applicant provided additional information on how it calculated the static lateral soil pressure. It assumed that the soil is completely confined and cannot move, and that the soil is submerged for the whole embedment depth as the water table is designed at near grade level. The total maximum static lateral soil pressure at a depth was calculated as the sum of the hydrostatic pressure, the effective lateral pressure, and the surcharge lateral pressures. (Staff RAI 9049, Question 02.05.04-3, as well as the applicant's response, at ADAMS Accession Nos. ML17285B465 and ML17320B122, provide details.) The applicant stated that it computed the seismic soil pressure from the SASSI2010 SSI analysis. The applicant also provided a table that summarized total static soil pressures on the four walls and total overturning moments induced by the soil pressures. The applicant further stated that COL Items 2.5-1, 3.7-3, 3.7-5, 3.7-6, and 3.8-2 specify the site-specific geology and SSI analysis needed for NuScale-designed power plants. Further, the applicant provided detailed information on bounding dynamic soil pressures on the exterior walls of the CRB, RXB, and RWB. DCA Part 2 Tier 2, Figures 3.8.4-28 to 3.8.4-33, and DCA Part 2 Tier 2, Tables 3.8.4-15 through 3.8.4-20, present the results. The applicant used standalone models for each of the buildings to estimate the dynamic soil pressure on the individual buildings. The applicant also used a triple building (CRB-RXB-RWB) model to consider the interaction among the buildings. The applicant then revised DCA Part 2 Tier 2, Section 3.8.4, "Other Seismic Category I Structures," accordingly. (Staff RAI 8971, Question 03.08.04-14, as well as the applicant's response, at ADAMS Accession No. ML18120A309, provide details.)

The staff finds that the methods and assumptions used in the estimate of total static lateral earth pressure, and the bounding dynamic (seismic) soil pressures for the safety-related buildings, are reasonable because the applicant used widely accepted methods in engineering practice, the assumptions are based on the designed site conditions, and the input parameter values used in the calculations are within the normal ranges of those parameters. (FSER Section 3.8.4 contains a detailed evaluation of this information.) The staff also noted that DCA Part 2, COL Item 3.7-5, states that "[t]he COL applicant will confirm that the site-specific seismic demands of the standard design for all critical structures, systems, and components in Appendix 3B are bounded by the corresponding design certified seismic demands," which will include comparisons of forces and moments for all critical sections that are below grade level under design loading conditions. The staff concludes that the application contains adequate information on the static and dynamic lateral earth pressure determinations in the design, which are reasonable and are consistent with pertinent industry standards. The applicant also specified pertinent COL information items to ensure that COL applicants referencing this design meet all design requirements.

#### *2.5.4.5 Combined License Information Items*

The COL information item related to the stability of subsurface materials and foundations is listed in Table 2.5-1 of this report.

#### *2.5.4.6 Conclusion*

Based on its review of the site parameters related to subsurface material and foundation stability, as presented in the DCA Part 2 and RAI responses, the staff concludes that the

applicant provided the necessary site parameters that are used in foundation stability design and analyses. The applicant specified in COL Items 2.5-1, 3.7-3, 3.7-5, 3.7-6, and 3.8-2 the need for the COL applicant referencing the NuScale Power Plant DC to describe site-specific geology, seismology, and geotechnical characteristics to include subsurface material and foundation stability evaluations pertaining to Section 2.5.4 of the DCA. The staff concludes that the applicable requirements of 10 CFR 52.47 and 10 CFR 100.23 can be met by addressing this COL information item, and, therefore, the staff finds this acceptable.

## **2.5.5 Stability of Slopes**

### **2.5.5.1 Introduction**

This section documents the NRC staff's review of stability of slopes for the NuScale Power Plant design.

### **2.5.5.2 Summary of Application**

**DCA Part 2 Tier 1:** DCA Part 2 Tier 1, Table 5.0-1, specifies that this design assumes there should be no slope failure potential at a site.

**DCA Part 2 Tier 2:** DCA Part 2 Tier 2, Section 2.5.5, "Stability of Slopes," states that the standard plant layout assumes a uniform, graded site and no slope failure potential as a key design parameter.

DCA Part 2 Tier 2, Section 2.5.5 also states that the stability of slopes on or near the site is confirmed by the COL applicant and that the analysis may be performed with the site-specific SSE.

### **2.5.5.3 Regulatory Basis**

The following NRC regulations contain the relevant requirements for this review:

- 10 CFR 52.47, as summarized in Section 2.5.1.3 of this report
- 10 CFR Part 50, Appendix S, as summarized in Section 2.5.1.3 of this report
- 10 CFR 100.23, as summarized in Section 2.5.1.3 of this report

The guidance in SRP Section 2.5.5, "Stability of Slopes," lists acceptance criteria adequate to meet the above requirements, as well as review interfaces with other SRP sections:

- The staff reviews information presented by the applicant for a DC about the postulated site parameters for the design, with respect to the stability of slopes, to ensure they are correctly identified, are representative of a reasonable number of sites that have been or may be considered for a COL application, and are appropriately justified.

The following document provides additional criteria or guidance in support of the SRP acceptance criteria to meet the above requirements:

- RG 1.198, as listed in Section 2.5.1.3 of this report

### **2.5.5.4 Technical Evaluation**

Slope stability at a nuclear power plant site will affect the stability of facilities at the site. DCA Part 2 Tier 2, Section 2.5.5, specifies that the standard plant layout assumes a uniform, graded

site and no slope failure potential as a key design parameter, which will eliminate any potential adverse impact to the plant structures by slope failure at a site. Since the characteristics of a slope, both natural and manmade, are site specific and must be provided and evaluated by ESP, COL, or CP applicants, DCA Part 2 specifies that detailed surface and subsurface geological, seismological, and geophysical information, including slope characteristics at a site, will be addressed by the COL applicant. COL applicants referencing the NuScale Power Plant DC are responsible for providing an adequate slope stability evaluation to be bounded by the NuScale design parameters.

#### *2.5.5.5 Combined License Information Items*

The COL information item related to the stability of slopes is listed in Table 2.5-1 of this report.

#### *2.5.5.6 Conclusion*

The failure of slopes at a nuclear power plant site may have an adverse impact on the stability of facilities. The applicant specified that its design is based on the assumption that there is no potential slope failure at the site. The applicant also specified adequate information requirements in COL Item 2.5-1. The applicant specified in COL Item 2.5-1 the need for the COL applicant referencing the NuScale Power Plant DC to describe site-specific geology, seismology, and geotechnical characteristics to include slope stability evaluations pertaining to Section 2.5.5 of the DCA. The staff concludes that the applicable requirements of 10 CFR 52.47, 10 CFR 100.23, and 10 CFR Part 50, Appendix S, can be met by addressing this COL information item, and, therefore, the staff finds this acceptable.