2 SITE CHARACTERISTICS AND SITE PARAMETERS

This chapter of the safety evaluation report (SER) documents the U.S. Nuclear Regulatory Commission (NRC) staff's review of Chapter 2, "Site Characteristics and Site Parameters," of the NuScale Power, LLC (NuScale), Standard Design Approval Application (SDAA), Part 2, "Final Safety Analysis Report (FSAR)." The staff's regulatory findings documented in this report are based on Revision 2 of the SDAA, dated April 09, 2025 (Agencywide Documents Access and Management System Accession No. ML25099A237). The precise parameter values, as reviewed by the staff in this safety evaluation, are provided by the applicant in the SDAA 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 SDAA and not converted.

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

2.0 Site Characteristics and Site Parameters

2.0.1 Introduction

This chapter discusses the assumed site envelope for the NuScale Power Plant US460 standard 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 that references the NuScale Power Plant US460 standard design in a license application filed under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," will be required to demonstrate that the characteristics of the site fall within the postulated site parameters of the design identified in FSAR Table 2.0-1, "Site Parameters." If the actual site characteristics do not fall within the standard design site parameters, the applicant that references the NuScale Power Plant US460 standard design will be required to provide sufficient justification (e.g., by request for exemption or departure from the NuScale Power Plant US460 standard design) showing that the proposed facility is acceptable at the proposed site.

2.0.2 Summary of Application

SDAA Part 2 (FSAR): NuScale provided in FSAR Chapter 2, Section 2.0, "Site Characteristics and Site Parameters," a description and summary table identifying design-basis parameters for the NuScale Power Plant US460 standard design.

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 (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" (SRP), provides the relevant NRC staff requirements for these areas of review and the associated acceptance criteria, as summarized below:

- 10 CFR 52.137(a) requires a standard design approval (SDA) applicant to provide, among other things, site parameters postulated for the design. and an analysis and evaluation of the design in terms of those site parameters.

- The requirements in 10 CFR Part 100, "Reactor Site Criteria," give the siting factors and criteria that apply to determining an acceptable reactor site.

SRP Section 2.0 also includes review interfaces with other sections of the SRP. The following provides the acceptance criteria to meet the above requirements:

- The related sections of 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.

SDAAs do not contain general descriptions of site characteristics because this information is site specific and is addressed by the applicant that references the NuScale Power Plant US460 standard design in the COL FSAR.

Acceptance is based on the demonstration by the applicant that references the NuScale Power Plant US460 standard design that the characteristics of the site fall within the postulated site parameters of the SDA design. If the actual site characteristics do not fall within the standard design site parameters, the applicant that references the NuScale Power Plant US460 standard design would be required to provide sufficient justification (e.g., by request for exemption or departure from the NuScale Power Plant US460 standard design) that the proposed facility is acceptable at the proposed site, otherwise, the applicant must provide justification for any departures.

2.0.4 Technical Evaluation

The staff reviewed the SDA FSAR using the review guidance in SRP Section 2.0. The staff based its evaluation of the NuScale site parameters on a review of FSAR Chapter 2. The application addressed each of the pertinent site parameters described in 10 CFR 52.137(a)(1). NuScale 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 items as discussed in individual sections below, the postulated site parameters of the NuScale

design, as given in FSAR 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

The following table lists the COL information item related to FSAR Section 2.0 as provided in FSAR Table 1.8-1.

Table 2.0-1 NuScale COL Information Item for FSAR Section 2.0

Item No.	Description	FSAR Section
COL Item 2.0-1	An applicant that references the NuScale Power Plant US460 standard design will demonstrate that site-specific characteristics are bounded by the site parameters specified in Table 2.0-1. If site-specific values are not bounded by the values in Table 2.0-1, the applicant will demonstrate the acceptability of the site-specific values in the appropriate sections of its license application.	2.0

2.0.6 Conclusion

As described above, the staff reviewed the application to ensure that sufficient information was presented on the postulated site parameters in the SDAA. Accordingly, as described in more depth below, the staff concludes that the application has addressed NuScale Power Plant US460 standard design site parameters and thus meets the requirements in 10 CFR 52.137(a).

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, 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 NuScale'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

SDAA Part 2 (FSAR): FSAR Section 2.1, "Geography and Demography," states that the NuScale Power Plant US460 standard design considers that the exclusion area boundary (EAB) and low-population zone (LPZ) outer boundary are as close as 112.47 meters (m) (369 feet (ft)) from the nearest release point. The minimum distance to the EAB and LPZ boundary is a key site parameter and is included in Table 2.0-1. An applicant that references the NuScale Power Plant US460 standard design will provide site-specific information related to geographic and demographic characteristics, such as 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, 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), and 10 CFR 52.137(a)(1)-(2))

- 10 CFR Part 100, as it relates to (1) defining an exclusion area and setting 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 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 guidance:

- DCA (or SDAA) Reviews: DCAs (or SDAAs) 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 52.137(a)(1), a DCA (or an SDA) applicant must provide site parameters postulated for the design. However, the identification of site location and the description are not applicable for an SDAA review.

There are no postulated site parameters for an SDAA related to this SRP section. The site location and description are site specific and will be addressed by the applicant that references the NuScale Power Plant US460 standard design.

2.1.1.4 Technical Evaluation

FSAR Table 1.8-1 provides COL Items 2.1-1 and 2.2-1, which state that an applicant that references the NuScale Power Plant US460 standard design will describe the site’s geographic and demographic characteristics and nearby industrial, transportation, and military facilities; and the applicant that references the NuScale Power Plant US460 standard design will demonstrate that the design is acceptable for each of these potential hazards or provide site-specific design alternatives. The detailed information should include 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 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 an applicant that references the NuScale Power Plant US460 standard design, the NuScale SDAA does not contain this information. Accident source term information is provided in other sections of the SDAA.

2.1.1.5 Combined License Information Items

The following table lists the COL information item related to FSAR Section 2.1 as provided in FSAR Table 1.8-1.

Table 2.1-1 NuScale COL Information Item for FSAR Section 2.1

Item No.	Description	FSAR Section
COL Item 2.1-1	An applicant that references the NuScale Power Plant US460 standard design will describe the site geographic and demographic characteristics.	2.1

2.1.1.6 Conclusion

As described above, NuScale stated in the FSAR that the applicant that references the NuScale Power Plant US460 standard design will provide the site-specific information in accordance with COL Item 2.1-1. Because this information is site specific, the staff considers the statement in the FSAR that the applicant that references the NuScale Power Plant US460 standard design 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 FSAR, the staff concludes that, because this information is site specific, it will be addressed by the applicant that references the NuScale Power Plant US460 standard design, and therefore, would be reviewed at the licensing stage. The applicant that references the NuScale Power Plant US460 standard design 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 (NuScale) 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

NuScale addressed the need for exclusion area authority and control with a statement that an applicant referencing the NuScale Power Plant US460 standard design 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 52.137(a)(1)-(2))

- 10 CFR Part 100, as it relates to (1) defining an exclusion area and setting 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 52.137(a)(1)-(2), 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 for meeting the above requirements. To ensure that the acceptance criteria are followed to the extent applicable, the staff uses 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 SDAA-specific guidance:

- DCA or SDAA Reviews: DCAs (or SDAAs) 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 52.137(a)(1), a DCA (or an SDAA) applicant must provide site parameters postulated for the design and an analysis and evaluation of the design in terms of those site parameters. However, the identification of exclusion area authority and control is not applicable for a DCA (or an SDAA) review.

- Exclusion area authority and control is site specific and will be addressed by the COL applicant.

2.1.2.4 Technical Evaluation

NuScale needs not postulate a location for the EAB or outer boundary of the LPZ as site parameters because the points at which radiological doses are calculated under 10 CFR 52.137(a)(2)(iv) for these locations are implicit in the atmospheric dispersion factors (χ/Qs) discussed in Section 2.3, “Meteorology,” and Chapter 15, “Transient and Accident Analysis,” of this report.

In FSAR Table 1.9-3, “Conformance with NUREG-0800, Standard Review Plan and Design Specific Review Standard,” NuScale stated that information pertaining to exclusion area authority and control is a site-specific analysis. 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 SDAA 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 FSAR Section 2.1, as provided in SDAA FSAR Table 1.8-1.

2.1.2.6 Conclusion

As described above, NuScale stated in the FSAR that the applicant that references the NuScale Power Plant US460 standard design 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 statement in the FSAR that the applicant that references the NuScale Power Plant US460 standard design 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 SDAA, the staff also concludes that, because this information is site specific, it will be addressed by the applicant that references the NuScale Power Plant US460 standard design and, therefore, would be reviewed at the licensing stage. An applicant that references the NuScale Power Plant US460 standard design should include information sufficient to demonstrate that the site characteristics, including those related to the 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, as stated in SRP section 2.1.3,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 1⅓ 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

NuScale addressed the need for population distribution with a statement that an applicant that references the NuScale Power Plant US460 standard design 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), and 10 CFR 52.137, "Contents of Applications; Technical Information", 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 1⅓ 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 SDA-specific guidance:

- DCAs (or SDAAs) Reviews: DCAs (or SDAs) 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 52.137(a)(1), an SDA applicant must provide site parameters postulated for the design. However, the identification of population distribution is not applicable for this area of DCA (or) SDA review.

- The population distribution is site specific and will be addressed by the applicant that references the NuScale Power Plant US460 standard design.

2.1.3.4 Technical Evaluation

In the FSAR, NuScale stated that an applicant that references the NuScale Power Plant US460 standard design 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 1⅓ 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 SDA 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 FSAR Section 2.1, as provided in SDAA FSAR Table 1.8-1.

2.1.3.6 Conclusion

As set forth above, NuScale has stated in the SDAA FSAR that an applicant that references the NuScale Power Plant US460 standard design will provide the site-specific information in accordance with COL Item 2.1-1. Because this information is site specific, the staff considers NuScale's statement in FSAR that the applicant that references the NuScale Power Plant US460 standard design 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 SDA, the staff concludes that because this information is site specific, it will be addressed by the applicant that references the NuScale Power Plant US460 standard design and, therefore, would be reviewed at the licensing stage. The applicant that references the NuScale SDA should include information sufficient to demonstrate that the site-specific population information specified in its 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 SDAA, 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 describing location and transportation routes in an SDAA 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 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 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 FSAR 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. An applicant that references the NuScale Power Plant US460 standard design will describe nearby industrial, transportation, and military facilities (see COL Item 2.2-1 in Table 2.2-1 of this report). The applicant, referencing the NuScale Power Plant US460 standard design, 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

FSAR Section 2.2 addresses the need to identify potential hazards in the site vicinity with a statement that an applicant that references the NuScale Power Plant US460 standard design 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 52.137(a)(1) as it relates 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 52.137(a)(1), 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. To ensure that the acceptance criteria are followed to the extent applicable, the staff uses 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 agree 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 on 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 guidance:

- DCAs (or SDAAs) 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 52.137(a)(1), a DCA (or SDAA) applicant must provide site parameters postulated for the design. However, the identification of potential hazards in the site vicinity is not applicable for an SDA 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 FSAR Table 1.8-1, as well as FSAR Section 2.2, NuScale stated that an applicant that references the NuScale Power Plant US460 standard design 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 SDAA does not contain this type of information because the information is site specific.

2.2.1.5 Combined License Information Items

The following table lists the COL information item related to FSAR Section 2.2.1–2.2-2 as provided in FSAR Table 1.8-1.

Table 2.2-1 NuScale COL Information Item for FSAR Section 2.2.1

Item No.	Description	FSAR Section
COL Item 2.2-1	An applicant that references the NuScale US460 standard design will describe nearby industrial, transportation, and military facilities. The applicant will demonstrate that the design is acceptable for each of these potential hazards, or provide site-specific design alternatives.	2.2

2.2.1.6 Conclusion

As described above, the FSAR states that the applicant that references the NuScale US460 standard design will provide the site-specific information in accordance with COL Item 2.2-1. Because this information is site specific, the staff considers the statement in the FSAR that the applicant that references the NuScale Power Plant US460 standard design is to provide this site-specific information in accordance with COL Item 2.21 to be acceptable. Based on the foregoing regulatory basis, corresponding SRP guidance, and review of the FSAR, the staff concludes that, because this information is site specific, it will be addressed by the applicant that references the NuScale Power Plant US460 standard design and, therefore, would be reviewed at the licensing stage. The applicant that references the NuScale Power Plant US460 standard design should include information sufficient to demonstrate that the site-specific, human-related hazard information specified in its 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, a DBE is an event with a probability of occurrence of potential exposures resulting in doses in excess of the

10 CFR Part 100 dose criteria is greater than an order of magnitude of $1x10^{-7}$ per year. 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 FSAR Section 2.2, NuScale addressed the need for an evaluation of potential accidents in the plant vicinity with a statement that an applicant that references the NuScale Power Plant US460 standard design will provide site-specific information related to the evaluation of human-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 52.137(a)(1), as it relates 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 to general compliance with 10 CFR Part 100
- 10 CFR 100.20(b), which states that the nature and proximity of human 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. To ensure that the acceptance criteria are followed to the extent applicable, the staff uses 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 $1x10^{-7}$ 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 guidance:

- Staff Reviews: DC (and SDA) applications 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 52.137(a)(1), a DC (or SDA) applicant must provide site parameters postulated for the design. However, the evaluation of potential accidents in the site vicinity is not applicable for a DC (or SDA) review.

- Exclusion area authority and control is site specific and will be addressed by the COL applicant.

2.2.2.4 Technical Evaluation

In FSAR Table 1.8-1 and Section 2.2, NuScale stated in COL Item 2.2-1 that an applicant that references the NuScale Power Plant US460 standard design will describe nearby industrial, transportation, and military facilities. The applicant will demonstrate that the design is acceptable for each of these potential hazards, or provide site-specific design alternatives. According to the SRP, 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 NuScale SDAA does not postulate hazards from nearby industrial, transportation, or military facilities. This information is site specific.

2.2.2.5 Combined License Information Items

Table 2.2-1 lists the COL information item related to FSAR Section 2.2.2, as provided in SDAA FSAR Table 1.8-1.

2.2.2.6 Conclusion

As described above, the FSAR states that an applicant that references the NuScale US460 standard design will provide the site-specific information under COL Item 2.2-1. Because this information is site specific, the staff considers the statement in the FSAR that the applicant that references the NuScale Power Plant US460 standard design 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 FSAR, the staff concludes that because this information is site specific, it will be addressed by the applicant that references the NuScale Power Plant US460 standard design and, therefore, would be reviewed at the licensing stage.

2.3 Meteorology

FSAR Section 2.3, “Meteorology,” states, “The NuScale Power Plant US460 standard design uses meteorological parameters that are representative of a reasonable number of potential plant site locations in the United States.” This is understood to include the contiguous (lower 48) States, the remainder of the continental United States (i.e., Alaska), and the State of Hawaii.

This section discusses the staff’s review of the related information provided in FSAR Sections 2.3.1 through 2.3.5 and the values postulated in Table 2.0-1.

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

FSAR Section 2.3.1 identifies several climate-related conditions that are considered 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.

An applicant that references the NuScale Power Plant US460 standard design evaluates the characteristics of its proposed site in terms of these climate-related site parameters. The 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 SDAA 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 this design.

2.3.1.2 Summary of Application

FSAR Table 2.0-1 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 FSAR Section 2.3.1 and Section 2.3.4.2.2, "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 FSAR Sections 2.3.1 and 3.4.2.2)

- a 100-year return period 3-second (sec) wind gust speed of 84.94 meters per second (m/sec) (190 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 FSAR Section 2.3.1 and Section 3.3.1.1, "Design Parameters for Severe Wind")

- design-basis tornado (DBT) parameters (i.e., a maximum windspeed of 120.7 m/sec (270 mph), a translational speed of 24.59 m/sec (55 mph), a maximum rotational speed of 96.11 m/sec (215 mph), a radius of maximum rotational speed of 45.72 meters (m) (150 feet (ft)), a pressure drop of 11.03 kPa (1.6 pounds per square inch (psi)), and a rate of pressure drop of 6.21 kPa (0.9 psi/sec) (reiterated in FSAR 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 Regulatory Guide (RG) 1.76, Revision 1, "Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants," issued March 2007, for (tornado intensity) Region 1 (as indicated in FSAR Section 3.5.1.4, "Missiles Generated by Tornadoes and Extreme Winds")

- a maximum design-basis hurricane wind speed of 290 mph (reiterated in FSAR 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, Revision 0, "Design-Basis Hurricane and Hurricane Missiles for Nuclear Power Plants," issued October 2011, for the maximum design-basis hurricane wind speed (as indicated in FSAR 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°C (-40°F), respectively, representing historical limits excluding peaks less than 2 hours (as indicated or reiterated in FSAR Section 2.3.1)

- a maximum wet-bulb temperature of 26.7°C (80°F) coincident with the zero-percent exceedance maximum outdoor design dry-bulb temperature of 46.1°C (115°F)

- a zero-percent exceedance maximum noncoincident wet-bulb temperature of 27.2°C (81°F) representing a historical limit excluding peaks of less than 2 hours

- 1 percent (annual) exceedance maximum and minimum outdoor design dry-bulb temperatures of 37.8°C (100°F) and -23.3°C (-10°F), respectively, a maximum wet-bulb temperature of 25.0°C (77°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°C (80°F)

Inspection, Test, Analysis and Acceptance Criteria (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, 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 52.137(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. 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; postaccident 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 design 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 (Revision 3, issued March 2007), clarifies the staff's position on winter precipitation loads expressed in SRP Acceptance Criterion 6 in 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, 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. FSAR Section 9.2.5, "Ultimate Heat Sink," offers additional details on the UHS.

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

- The applicant should identify all references to FSAR sections in which meteorological conditions identified as site parameters are used for design purposes (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 US460 standard design as presented in FSAR Table 2.0-1, Section 2.3.1, and other related sections of the FSAR.

2.3.1.4.1 Design-Basis Maximum Precipitation Rates (Rainfall)

The 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). FSAR Section 3.4.2.2 refers to these values as “probable maximum precipitation [PMP]” rainfall rates “for roof design.”

In addition, FSAR 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 Design Certification Applications (DCAs) submitted for NRC review, several of which have been approved.

NuScale has selected the site parameters referenced above (i.e., maximum precipitation rates (as rainfall)) for plant (roof) design inputs. 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 in Alaska at which a NuScale Power Plant design might be deployed. However, applicants that references the NuScale Power Plant US460 standard design will need to evaluate this aspect in its applications and consider 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 SDAA does not address the potential of the NuScale Power Plant US460 standard design being deployed in U.S. territories.

The staff finds that NuScale satisfied the regulations in Appendix A to 10 CFR Part 50, GDC 2, and 10 CFR 52.137(a)(1), cited in Section 2.3.1.2 of this report, for 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 SDAA 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). FSAR Section 2.3.1 and Section 3.4.2.2 reiterate the postulated design-basis conditions. Further, FSAR 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, FSAR Sections 3.8.4.3.11 and 3.8.4.3.12 discuss the normal and extreme snow loads on seismic Category I structures. NuScale also cites ASCE 7-10, "Minimum Design Loads in [for] Buildings and Other Structures," in FSAR Section 3.8.4.1.11, "Snow Loads (S)."

FSAR Table 1.9-4, "Conformance with Interim Staff Guidance," indicates conformance with DC/COL-ISG-007, with respect to the assessment of normal and extreme winter precipitation loads on the roofs of seismic Category I structures. 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. FSAR Section 3.8.4.3.11 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 FSAR Section 3.8.4.3.11). 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 2.85 kPa (59.5 psf), and an extreme roof snow load of 75 psf converts to an extreme ground snow load of 4.28 kPa (89.3 psf).

In addition, the staff notes that NuScale 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 (Lb/Ft^2)," in 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 influence 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 2.85 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 2.85 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 influence 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 Alaska appear to have 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.

There appears to be little difference in the areas of the continental United States where the extreme ground snow load (i.e., 4.28 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 Alaska). Consistent with the review guidance in SRP Section 2.3.1 and DC/COL-ISG-007, the staff's observations include the following:

- The snow-load-related site parameters in FSAR Table 2.0-1, discussed in FSAR Section 3.8.4.3, 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.

- FSAR 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 applicants that references the NuScale Power Plant US460 standard design 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, SER Chapter 3).

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.

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 considers liquid winter precipitation events if the resulting contribution to the extreme roof load is greater than that associated with the controlling frozen winter precipitation event. The staff notes that FSAR 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 NuScale'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 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. Applicants that reference the NuScale Power Plant US460 standard design will need to evaluate this subject in its applications and consider its implications on a case-by-case basis if deployment of the NuScale Power Plant design is planned in any locations where snow loads in excess of these parameters may occur, or in areas where ASCE/SEI-7 calls for a case study.

2.3.1.4.3 Design-Basis Wind Speeds and Missile Spectra

FSAR Table 2.0-1 postulates three types of wind speed-related site parameters applicable to the NuScale Power Plant design. Based on FSAR Section 3.3, "Wind and Tornado Loadings," these design-basis parameters were used in determining or evaluating severe (i.e., nontornado 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.

2.3.1.4.4 Design-Basis Severe Wind speed (Nontornado or Straight-Line)

FSAR Table 2.0-1 provides a design-basis (nontornado or straight-line) wind speed and other related attributes postulated for the NuScale Power Plant design. A wind speed value of 190 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 FSAR Sections 2.3.1 and 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 FSAR 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 poses a risk to human life, health, and welfare.

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 (nontornado or straight-line) wind speed (i.e., 84.94 m/sec (190 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.

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, applicants that reference the NuScale Power Plant US460 standard design will need to evaluate this subject in its 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.

The staff finds that the 100-year return period severe (nontornado or straight-line) 3 sec gust wind speed site parameter, provided in FSAR Table 2.0-1 and referenced in FSAR Sections 2.3.1 and 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 NuScale 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 NuScale conforms to the applicable guidance and accordingly meets the regulations in GDC 2 and 10 CFR 52.137(a)(1). Conformance with GDC 4 is addressed in Sections 2.3.1.3.5 and 2.3.1.3.6 below.

2.3.1.4.5 Design-Basis Tornado Parameters and Missile Spectrum

The SDAA 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 120.7 m/sec (270 mph), 24.59 m/sec (55 mph), and 96.11 m/sec (215 mph), respectively; a radius of maximum rotational speed of 45.72 m (150 ft); a pressure drop of 11.03 kPa (1.6 psi); and a rate of pressure drop of 6.21 kPa/sec (0.9 psi/sec). FSAR Section 3.3.2.1 reiterates these values.

These site parameter values exceed 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 greater than 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.

NuScale also postulated a tornado missile spectrum, as indicated in FSAR 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. ASER 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 NuScale has provided an acceptable basis for the postulated DBT site parameters provided in FSAR Table 2.0-1 and referenced in FSAR Section 3.3.1.2. 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 US460 standard design might be deployed. The staff finds that NuScale satisfied the regulations cited in Section 2.3.1.3 of this report for the DBT parameters postulated for the NuScale Power Plant US460 standard design.

The staff notes that RG 1.76 does not specify DBT parameters for Alaska or Hawaii, nor did NuScale address this subject in the SDAA for those locations. Applicants that reference the NuScale Power Plant US460 standard design will need to evaluate this subject and its implications on a case-by-case basis for proposed deployment in these locations.

The staff finds that NuScale has provided an acceptable basis for the design-basis tornado wind speed and associated missiles, having used information in RG 1.76. Therefore, the staff finds that NuScale conforms to the applicable guidance and accordingly meets the regulations in GDC 2 and GDC 4.

2.3.1.4.6 Design-Basis Hurricane Wind Speed and Missile Spectrum

The SDAA 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)). FSAR Section 3.3.1.2 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, in Figure 2, located near the southern tip of the Florida peninsula near 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 $1x10^{-7}$ per year.

NuScale also postulated a hurricane missile spectrum, as indicated in FSAR 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. FSAR 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. SER 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 NuScale has provided an acceptable basis for the postulated design-basis hurricane wind speed provided in FSAR Table 2.0-1. 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 NuScale satisfied the regulations cited in Section 2.3.1.2 of this report with regards to the design-basis hurricane wind speed postulated for the NuScale Power Plant US460 standard design.

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 Alaska or the State of Hawaii, nor did NuScale address this subject in the SDAA for those locations. Applicants that reference the NuScale Power Plant US460 standard design will need to evaluate this subject in its 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 SDAA does not address the potential of the NuScale Power Plant US460 standard design being deployed in U.S. territories.

The staff finds that NuScale has provided an acceptable basis for the design-basis hurricane wind speed and associated missiles, having used information in RG 1.221. Therefore, the staff finds that NuScale conforms to the applicable guidance and accordingly meets the regulations in GDC 2 and GDC 4.

2.3.1.4.7 Design-Basis Dry- and Wet-Bulb Temperatures

The SDAA site parameter tables referenced in Section 2.3.1.2 of this report provide the postulated design-basis dry- and wet-bulb temperatures. FSAR Section 2.3.1 states that these design temperatures "are based on the EPRI [Electric Power Research Institute] Utility Requirements Document [URD]." FSAR 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 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.

The postulated site parameters include zero-percent exceedance maximum and minimum outdoor design dry-bulb temperatures of 46.1°C and -40°C (115°F and -40°F), respectively, which represent historical limits excluding peaks less than 2 hours. These site parameters, included in FSAR Table 2.0-1, also include a maximum outdoor design wet-bulb temperature of 26.7°C (80°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 27.22°C (81°F). (The noncoincident value represents a historical limit excluding peaks less than 2 hours.)

In addition, FSAR Table 2.0-1 indicates 1 percent (annual) exceedance maximum and minimum outdoor design dry-bulb temperatures of 37.8°C and -23.3°C (100°F and -10°F), respectively, along with a maximum wet-bulb temperature of 25.0°C (77°F) coincident with the 1 percent exceedance maximum dry-bulb temperature, and a 1 percent (annual) exceedance maximum noncoincident wet-bulb temperature of 26.7°C (80°F).

The NRC staff recognizes that the NuScale Power Plant design has a smaller overall plant site layout and 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 non-traditional nuclear plant site locations outside of the contiguous United States. The staff considered this possibility 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 52.137(a)(1) and based on the regulations at GDC 2 (although temperature is not specifically listed among the examples of “natural phenomena” in the GDC).

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°C and -40.0°C (115°F and -40°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 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 SDAA. As with other climate-related site

parameters, applicants that reference the NuScale Power Plant US460 standard design will need to evaluate these aspects in its applications and consider their implications on a case-by-case basis if deployment of the NuScale Power Plant design is planned in locations with extreme temperature conditions.

Zero-Percent Exceedance Noncoincident Wet-Bulb Temperature

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 US460 standard design (i.e., 27.2°C (81°F)) has also been proposed for some other reactor designs (e.g., ABWR, APR1400). In some cases, subsequent revisions to design applications have incorporated higher values (e.g., AP1000) based on the applicant's responses to 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). In other cases, the initially postulated zero-percent exceedance noncoincident wet-bulb value of 27.2°C (81°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 RAI response submitted as part of the NuScale DCA review, RAI-9186, Question 02.03.01-7, dated February 13, 2018 (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 US460 standard design.

- The geographic 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.

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:

- 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 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 RAI response (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.

Applicants that reference the NuScale Power Plant US460 standard design will need to evaluate this issue in its applications and consider its implications on a case-by-case basis for proposed deployment in these locations. As noted earlier, the SDAA does not address the potential of the NuScale Power Plant US460 standard 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°C (80°F)) coincident with the zero-percent exceedance maximum outdoor dry-bulb temperature (i.e., 46.1°C (115°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 US460 standard 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°C (115°F)) may be challenged in the Western United States, primarily in the desert southwest and portions of California (i.e., areas 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°C (80°F)) is likely to be exceeded at multiple locations in the contiguous United States as well as in the State of Hawaii.

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°C and -23.3°C (100°F and -10°F), respectively) postulated for the NuScale Power Plant US460 standard 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 US460 standard 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 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 US460 standard 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.

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

The staff evaluated the 1 percent (annual) exceedance noncoincident wet-bulb temperature (i.e., 26.7°C (80°F)) postulated for the NuScale Power Plant US460 standard 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 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.

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°C (77°F)) coincident with the 1 percent (annual) exceedance maximum outdoor dry-bulb temperature (i.e., 37.8°C (100°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 referred to. However, 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 US460 standard 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°C (100°F)) may be challenged in the Western United States, primarily in the desert southwest and drier portions 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°C (77°F)) is likely to be exceeded at multiple locations in the contiguous United States, as well as in 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. The applicants that reference the NuScale Power Plant US460 standard design will need to evaluate this issue in its applications and consider its implications on a case-by-case basis. As noted before in this section and elsewhere, the SDAA does not address the potential of the NuScale Power Plant US460 standard design being deployed in U.S. territories.

2.3.1.5 Combined License Information Items

The following table lists the COL information items related to meteorology and climatology as provided in FSAR Table 1.8-1.

Table 2.3.1-1 NuScale COL Information Items for FSAR Section 2.3.1

Item No.	Description	FSAR Section
COL Item 2.0-1	An applicant that references the NuScale Power Plant US460 standard design will demonstrate that site-specific characteristics are bounded by the site parameters specified in Table 2.0-1. If site-specific values are not bounded by the values in Table 2.0-1, the applicant will demonstrate the acceptability of the site-specific values in the appropriate sections of its license application.	2.0
COL Item 2.3-1	An applicant that references the NuScale Power Plant US460 standard design will describe the site-specific meteorological characteristics for Section 2.3.1 through Section 2.3.5, as applicable.	2.3

2.3.1.6 Conclusion

The regional climatology is site specific and will be addressed by an applicant that references the NuScale Power Plant US460 standard design. An applicant that references the NuScale Power Plant US460 standard design should provide information sufficient to demonstrate that the actual site characteristics specified in its application fall within the values of the postulated

site parameters in the NuScale SDAA. In accordance with SRP Section 2.3.1, the staff evaluated the NuScale's postulated climate-related site parameters and, in general, considers them to be representative of a reasonable number of sites that have been or may be considered for a COL or ESP application and finds that NuScale provided an adequate technical basis for each site parameter.

2.3.2 Local Meteorology

2.3.2.1 Introduction

FSAR Section 2.3.2, "Local Meteorology," states "Local meteorology is site-specific." An applicant that references the NuScale Power Plant US460 standard design 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

SDAA Part 2 (FSAR): In FSAR Section 2.3.2, NuScale stated that local meteorology is site-specific (to be addressed by an applicant that references the NuScale Power Plant US460 standard design 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 52.137(a)(1), 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

The SDAA does not contain this type of information because it is site specific. An applicant that references the NuScale Power Plant US460 standard design will provide this information.

2.3.2.4 Technical Evaluation

The NuScale Power Plant SDAA 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 an applicant that references the NuScale Power Plant US460 standard design. The staff finds COL Item 2.3-1, requiring the 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

The following table lists the COL information item related to local meteorology as provided in FSAR Table 1.8-1.

Table 2.3.2-1 NuScale COL Information Item for FSAR Section 2.3.2

Item No.	Description	FSAR Section
COL Item 2.3-1	An applicant that references the NuScale Power Plant US460 standard design will describe the site-specific meteorological characteristics for Section 2.3.1 through Section 2.3.5, as applicable.	2.3

Section 2.3.1 of this report explains that NuScale has indicated that the NuScale Power Plant design could be deployed in the continental United States (including the contiguous lower 48 States and Alaska), as well as in the State of Hawaii. The staff also notes that the SDAA does not address the potential of this design being deployed in U.S. territories and recognizes that this design might be able to be sited in atypical large-scale nuclear plant site locations. Applicants that reference the NuScale Power Plant US460 standard design should consider this 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 SDAA has no postulated site parameters related to local meteorology. COL Item 2.3-1 indicates that an applicant that references the NuScale Power Plant US460 standard design 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 an applicant that references the NuScale Power Plant US460 standard design. Based on the above information, the staff finds NuScale's discussions in FSAR Section 2.3.2 acceptable.

2.3.3 Onsite Meteorological Measurements Programs

2.3.3.1 Introduction

SDAA Section 2.3.3, "Onsite Meteorological Measurements Programs," states, "Onsite meteorological measurement programs are site-specific." Accordingly, these programs are to be addressed by the applicant that references the NuScale Power Plant US460 standard design, as part of the response to COL Item 2.3-1. The 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 applicant that references the NuScale Power Plant US460 standard design is to also 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

SDAA Part 2 (FSAR): In FSAR Section 2.3.3, NuScale stated that the onsite meteorological measurement programs are site specific (to be addressed by the applicant that references the NuScale Power Plant US460 standard design 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. An applicant that references the NuScale Power Plant US460 standard design 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’ 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 as low as is reasonably achievable

- 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 holder will rely 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 SDAA does not contain this type of information because it is site specific. An applicant that references the NuScale Power Plant US460 standard design will provide this information.

2.3.3.4 Technical Evaluation

The staff reviewed the NuScale Power Plant SDAA in accordance with SRP Section 2.3.3. This guidance recognizes that FSAR Section 2.3.3 of an SDAA 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 the above guidance, FSAR Section 2.3.3 states, “Onsite meteorological measurement programs are site-specific.” This is an acknowledgment of the applicant’s, referencing the NuScale Power Plant US460 standard design, need for preoperational and

operational monitoring programs for measuring meteorological conditions at a site, consistent with the guidance in RG 1.23.

2.3.3.5 Combined License Information Items

The following table lists the COL information item related to the onsite meteorological measurements programs as provided in FSAR Table 1.8-1.

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 are evaluated in SER Section 13.3, "Emergency Planning."

Table 2.3.3-1 NuScale COL Information Item for FSAR Section 2.3.3

Item No.	Description	FSAR Section
COL Item 2.3-1	An applicant that references the NuScale Power Plant US460 standard design will describe the site-specific meteorological characteristics for Section 2.3.1 through Section 2.3.5, as applicable.	2.3

Section 2.3.1 of this report explains that NuScale has indicated that the NuScale Power Plant US460 standard design could be deployed in the continental United States (including the contiguous lower 48 States and Alaska), as well as in the State of Hawaii. The staff also notes that the SDAA does not address the potential of this design being deployed in U.S. territories and recognizes that this design might be able to be sited in non-traditional nuclear plant site locations outside of the contiguous United States. Applicants that reference the NuScale Power Plant US460 standard design should consider this 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 or ESP FSAR.

2.3.3.6 Conclusion

The NuScale Power Plant SDAA has no postulated site parameters related to the onsite meteorological measurements program. COL Item 2.3-1 indicates that an applicant that references the NuScale Power Plant US460 standard design 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 an applicant that references the NuScale Power Plant US460 standard design. Based on the above information, the staff finds NuScale's discussions in FSAR Section 2.3.3 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. These estimates address the requirements for developing conservative atmospheric dispersion factors (relative concentrations or χ/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 the postulated design-basis accident radioactive airborne releases.

2.3.4.2 Summary of Application

FSAR Section 2.3.4, "Short-Term Atmospheric Dispersion Estimates for Accident Releases," describes the methodology applied 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. FSAR, Table 2.0-1 contains accident release χ/Q site parameter values for these same receptors. FSAR Table 15.0-12, "Assumptions for Accident Airborne Effluent Release Point Characteristics for Offsite Receptors," lists the assumptions used to derive these χ/Q values (such as source and receptor locations, path directions and distances, and release point characteristics).

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 (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 to 10 CFR Part 50, with respect to the meteorological considerations used to evaluate the personnel exposures during an emergency
- 10 CFR 52.137(a)(1), with respect to the postulated site parameters that an SDA applicant shall provide for the design
- 10 CFR 52.137(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

An SDAA does not contain general descriptions of site characteristics because this information is site specific and will be addressed by an applicant that references the NuScale Power Plant US460 standard design. However, under 10 CFR 52.137(a)(1), an SDA 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 (SDA) applicant should include EAB, LPZ, and MCR atmospheric dispersion factors (χ/Q values) for the appropriate time periods in the list of site parameters. The application should also contain figures and tables showing the design features that the applicant that references the NuScale Power Plant US460 standard design would use to generate MCR χ/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 FSAR 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 (χ/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 χ/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

- 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 SDAA, in accordance with the guidance in SRP Section 2.3.4, to ensure that (1) the SDAA included EAB, LPZ, and MCR χ/Q values in the list of standard plant site parameters, (2) the SDAA contained figures and tables describing the design features that the COL applicant would use to generate MCR χ/Q values, (3) the EAB, LPZ, and MCR standard plant site parameter χ/Q values are representative of a reasonable number of sites that may be considered within a COL or ESP application, and (4) the SDAA provides a basis for each of the EAB, LPZ, and MCR standard plant site parameter χ/Q values. The staff also reviewed the radiological consequence analyses presented in FSAR Chapter 15, “Transient and Accident Analyses.”

2.3.4.4.1 Offsite χ/Q Values

SRP Section 2.3.4 states that the DC (SDA) applicant should include EAB and LPZ boundary χ/Q values for the appropriate time periods in the list of site parameters. The staff noted that NuScale included accident release χ/Q values at the EAB and outer boundary of the LPZ as site parameters in FSAR Table 2.0-1. NuScale stated in FSAR Table 15.0-12, “Assumptions for Accident Airborne Effluent Release Point Characteristics for Offsite Receptors,” that the EAB and LPZ outer boundary (which are identical for the SDA) may be as close as 101.2 m (332 ft) from the closest release point.

FSAR Section 2.3.4 states that TR-0915-17565-P-A, Revision 4, 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 χ/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, which is endorsed by RG 1.194 for use in design-basis control room radiological habitability assessments. NuScale generated its accident offsite χ/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 reviewed 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 χ/Q values in adherence to the criteria outlined in RG 1.145 and RG 1.194. Therefore, based on this review, the staff concludes that, subject to the conditions and limitations specified in Section 6.0, “Conditions and Limitations,” of the NRC staff’s SER for the topical report (ML19297G520), the NuScale methodology described in TR-0915-17565-P-A, Revision 4, is acceptable for calculating accident offsite χ/Q values for the EAB and LPZ in the NuScale Power Plant SDAA.

If an applicant that references the NuScale Power Plant US460 standard design determines that its actual χ/Q site characteristic values do not fall within the corresponding site parameters postulated in the SDAA, the applicant that references the NuScale Power Plant US460 standard design will need to provide sufficient justification that the proposed facility is still acceptable at the proposed site.

2.3.4.4.2 Control Room χ/Q Values

SRP Section 2.3.4 states that the applicant should include MCR χ/Q values for the appropriate time periods in the list of site parameters. The staff noted that NuScale included accident release χ/Q values at the MCR/TSC door and HVAC intake as site parameters in FSAR Table 2.0-1.

NuScale generated MCR χ/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 χ/Q site parameters are representative of a reasonable number of sites that have been or may be considered in an application that references the NuScale Power Plant US460 standard design, the staff generated a set of site-specific χ/Q values for six nuclear power plant sites using the ARCON96 computer code with the source and receptor information presented in the NuScale US600 design certification application FSAR (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 NuScale's χ/Q values were bounding for five of the six sites. Consequently, the staff finds that NuScale has provided MCR and TSC doors and HVAC intake χ/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

The following table lists the COL information items related to short-term atmospheric dispersion estimates for accident releases as provided in FSAR Table 1.8-1.

COL Item 13.3-1 may relate to information addressed in Section 2.3.4 of this report; however, the appropriateness and adequacy of this COL item are evaluated in SER Section 13.3.

Table 2.3.4-1 NuScale COL Information Items for FSAR Section 2.3.4

Item No.	Description	FSAR Section

COL Item 2.0-1	An applicant that references the NuScale Power Plant US460 standard design will demonstrate that site-specific characteristics are bounded by the site parameters specified in Table 2.0-1. If site-specific values are not bounded by the values in Table 2.0-1, the applicant will demonstrate the acceptability of the site-specific values in the appropriate sections of its license application.	2.0
COL Item 2.3-1	An applicant that references the NuScale Power Plant US460 standard design will describe the site-specific meteorological characteristics for Section 2.3.1 through Section 2.3.5, as applicable.	2.3

Section 2.3.1 of this report explains that NuScale has indicated that the NuScale Power Plant US460 standard design could be deployed in the continental United States (including the contiguous lower 48 States and Alaska), as well as in the State of Hawaii. The staff also notes that the SDAA does not address 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 those typical of large-scale nuclear plant sites. Applicants that reference the NuScale Power Plant US460 standard design should consider this 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 NuScale has appropriately provided the short-term (accident release) χ/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 applicant that references the NuScale Power Plant US460 standard design. The applicant that references the NuScale Power Plant US460 standard design 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 US460 standard design.

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

SDAA Part 2 (FSAR): In FSAR Section 2.3.5, “Long-Term Atmospheric Dispersion Estimates for Routine Releases,” NuScale stated that the routine release χ/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 FSAR Section 11.3, “Gaseous Waste Management System.”

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: There are no topical 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 NuScale’s postulated site parameter values for atmospheric dispersion and deposition:

- Subpart D of 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 to 10 CFR Part 50, with respect to radioactive material in effluents released to unrestricted areas

An SDAA does not contain general descriptions of site characteristics because this information is site specific and will be addressed by an applicant that references the NuScale Power Plant US460 standard design. However, under 10 CFR 52.137(a)(1), an SDA applicant must provide site parameters postulated for the design.

SRP Section 2.3.5, “Long-Term Atmospheric Dispersion Estimates for Routine Releases,” Revision 3, issued March 2007, states that the staff’s evaluation should include the following topics:

- 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 FSAR 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 FSAR Section 2.3.5 in accordance with SRP Section 2.3.5, Revision 3. FSAR Table 2.0-1 lists the routine release atmospheric dispersion factors (χ/Q values) and atmospheric deposition factors (D/Q values) associated with the restricted area boundary. FSAR Section 2.3.5 states that these χ/Q and D/Q values at the restricted area boundary provided in FSAR Table 2.0-1 are used to calculate release concentrations for comparison to the activity release limits in 10 CFR Part 20, as discussed in FSAR Section 11.3.

NuScale stated that it selected conservative χ/Q and D/Q values, which are 9.98×10^{-6} seconds per cubic meter (s/m^3) and 9.98×10^{-8} per square meter ($1/m^2$), respectively. COL Item 11.3-2 requires an applicant that references the NuScale Power Plant US460 standard design to provide information to address these calculations. The gaseous effluent dose results shown in FSAR Table 11.3-7, “Gaseous Effluent Dose Results for 10 CFR 50 Appendix I,” are example calculations using assumed inputs (such as the routine release χ/Q and D/Q site parameter values) to show reasonable assurance that an applicant that references the NuScale Power Plant US460 standard design will be able to meet the design objectives of 10 CFR Part 50, Appendix I.

2.3.5.5 Combined License Information Items

The following table lists the COL information items related to long-term atmospheric dispersion estimates for routine releases as provided in FSAR Table 1.8-1.

Table 2.3.5-1 NuScale COL Information Items for FSAR Section 2.3.5

Item No.	Description	FSAR Section
COL Item 2.0-1	An applicant that references the NuScale Power Plant US460 standard design will demonstrate that site-specific characteristics are bounded by the site parameters specified in Table 2.0-1. If site-specific values are not bounded by the values in Table 2.0-1, the applicant will demonstrate the acceptability of the site-specific values in the appropriate sections of its license application.	2.0
COL Item 2.3-1	An applicant that references the NuScale Power Plant US460 standard design will describe the site-specific meteorological characteristics for Section 2.3.1 through Section 2.3.5, as applicable.	2.3
COL Item 11.3-2	An applicant that references the NuScale Power Plant US460 standard design 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 190.	11.3

Section 2.3.1 of this report explains that NuScale has indicated that the NuScale Power Plant US460 standard design could be deployed in the continental United States (including the contiguous lower 48 States and Alaska), as well as in the State of Hawaii. The staff also notes that the SDAA does not address 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 those typical of large-scale nuclear plant sites. Applicants that reference the NuScale Power Plant US460 standard design should consider this 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 NuScale are representative of a reasonable number of sites that have been or may be considered for a COL or ESP application. Long-term atmospheric dispersion and deposition characteristics are site specific and will be addressed by the applicant that references the NuScale Power Plant US460 standard design. The applicant that references the NuScale Power Plant US460 standard design 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 SDAA FSAR Section 2.4, “Hydrologic Engineering,” NuScale provided information associated with all hydrologically related design-basis performance requirements and the basis for the operation of safety-related SSCs. NuScale stated that the NuScale US460 standard design does not rely on an external water supply for its UHS or safety-related makeup water. FSAR Table 2.0-1 contains the site parameters selected to represent site conditions.

Consistent with guidance in SRP Sections 2.4.1 through 2.4.14, the staff reviewed FSAR Table 2.0-1 and FSAR Section 2.4 to determine the adequacy of the information submitted. The review areas covered in the SDAA correspond to SRP Sections 2.4.1 through 2.4.14 and are given below:

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

Site-specific hydrologic issues are not within the scope of the SDAA and are deferred to the applicant that references the NuScale Power Plant US460 standard design. This section of the FSAR is intended to address the hydrological site parameters that constitute the NuScale Power Plant US460 standard design basis for siting suitability presented by an 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 2.4.14 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 levels of equipment required for safe operation of the facility
- 10 CFR 100.20(c), which states 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 52.137(a)(1), as it relates to the site parameters postulated for the design
- 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 100.20(c)(3), as it relates to the probable maximum flood, and which states that, in establishing the design-basis flood, seismically induced floods and water waves that could adversely affect a site 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 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, “Quality standards and records,” 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, tsunami, and seiches, without loss of capability to perform their intended safety functions
- GDC 44, “Cooling water,” 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 suitably control 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 on 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 are adequate 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, “Ultimate Heat Sink for Nuclear Power Plants,” as it relates to UHS capabilities
- RG 1.29, “Seismic Design Classification for Nuclear Power Plants,” 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 (ML003740390), as it relates to the selection of surface water models

2.4.1 Hydrologic Description

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 NuScale Power Plant US460 standard design defers to the applicant that references the NuScale Power Plant US460 standard design to present the required site-specific information in the hydrologic description.

This section describes the site-specific hydrologic conditions for flood hazards that the applicant that references the NuScale Power Plant US460 standard design will address. As part of its review of this portion of the application, the staff considered the adequacy of the COL information items presented in FSAR Table 2.0-1.

The following table lists the COL information items related to site-specific flood hazard evaluations and hydrologic conditions as provided in FSAR Table 1.8-1.

Table 2.4.1-1 NuScale COL Information Items for FSAR Section 2.4

Item No.	Description	FSAR Section
COL Item 2.0-1	An applicant that references the NuScale Power Plant US460 standard design will demonstrate that site-specific characteristics are bounded by the site parameters specified in Table 2.0-1. If site-specific values are not bounded by the values in Table 2.0-1, the applicant will demonstrate the acceptability of the site-specific values in the appropriate sections of its license application.	2.0
COL Item 2.4-1	An applicant that references the NuScale Power Plant US460 standard design will investigate and describe the site-specific hydrologic characteristics for Section 2.4.1 through Section 2.4.14, except Section 2.4.8, Section 2.4.10, and Section 2.4.11.	2.4

2.4.1.2 Summary of Application

FSAR 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 applicant that references the NuScale Power Plant US460 standard design as part of the response to COL Item 2.4-1. NuScale 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.

2.4.1.3 Regulatory Basis

Section 2.4.0 of this report has already addressed the regulatory basis. The applicable NRC regulations for this section include 10 CFR 52.137(a), 10 CFR 52.137(a)(1), 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 FSAR Table 2.0-1 states that an applicant that references the NuScale Power Plant US460 standard design will demonstrate that site-specific characteristics are bounded by the site parameters. As shown in FSAR 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 0.61 m (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 SDAA does not contain site-specific information because that information will not be available until an application that references the NuScale Power Plant US460 standard design 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

US460 standard design site parameters described in FSAR Table 2.0-1. COL Item 2.0-1 in FSAR Chapter 2.0 provides additional information on addressing the site parameters.

An applicant that references the NuScale Power Plant US460 standard design 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. This information is the basis for determining whether the site characteristics fall within the site parameters stated in the FSAR 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 applicant that references the NuScale Power Plant US460 standard design will investigate and describe the site-specific hydrologic characteristics for the reactor site and vicinity. The applicant that references the NuScale Power Plant US460 standard design should provide information sufficient to demonstrate that the actual site characteristics described in its application fall within the range of site parameter values, otherwise, must provide sufficient justification (e.g., by requesting an exemption or departure from the SDA design) that the proposed facility is acceptable at the proposed site.

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 FSAR Table 2.0-1.

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 US460 standard design 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 an applicant that references the NuScale Power Plant US460 standard design will demonstrate site-specific characteristics and provide the flood hazard information related to FSAR 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 an applicant that references the NuScale Power Plant US460 standard design. Based on the above information, the staff finds NuScale's discussions in FSAR Sections 2.4.1 through 2.4.7 and 2.4.9 acceptable.

If the actual site characteristics do not fall within the site parameters postulated in the SDAA, the applicant that references the NuScale Power Plant US460 standard design must provide sufficient justification (e.g., by requesting an exemption or departure from the SDA design) that the proposed facility is acceptable at the proposed site.

2.4.2 Floods

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

FSAR Section 2.4.2, “Floods,” states, “The design assumes the maximum flood elevation (including wind-induced wave run-up) is one foot below baseline plant elevation. The baseline plant elevation is the top of concrete of the ground floor of the RXB. This maximum flood elevation is a key design parameter.” Accordingly, the SDAA does not provide flood protection requirements. FSAR 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 SDAA 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.

2.4.2.3 Regulatory Basis

Section 2.4.0 of this report addresses the regulatory basis. The applicable NRC regulations for this section include 10 CFR 52.137(a)(1), 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 SDAA postulates a maximum flooding level below which no flood protection will be needed. The SDAA does not contain information on flood protection requirements for site specific maximum flood values that are at or above the baseline plant elevation. The determination of the actual maximum flooding level is site specific, and an applicant that references the NuScale Power Plant US460 standard design should provide information sufficient to demonstrate that the actual site characteristics described in its 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. If site-specific maximum flood values are not bounded by the values in the NuScale SDAA FSAR Table 2.0-1, the applicant should demonstrate the acceptability of the site-specific values in the appropriate sections of its license application.

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 on 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 NuScale’s statement that the external flood protection requirements for these features are not needed. The applicant that references the NuScale Power Plant US460 standard design should provide information sufficient to demonstrate that the actual site characteristics described in its application fall within the range of site parameters related to flood protection, otherwise, must provide sufficient justification (e.g., by requesting an exemption or departure from the SDA design) that the proposed facility is acceptable at the proposed site.

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 FSAR Table 2.0-1.

COL Item 2.4-1, which specifies that an applicant that references the NuScale Power Plant US460 standard design should investigate and describe site-specific hydrological characteristics, is not applicable to this section since the NuScale Power Plant US460 standard 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 an applicant that references the NuScale Power Plant US460 standard design 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., demonstrate that the standard design remains adequate).

2.4.2.6 Conclusion

The NuScale Power Plant US460 standard 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 FSAR Table 2.0-1. The staff concludes that the NuScale Power Plant US460 standard design provides an appropriate site parameter in 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 applicant that references the NuScale Power Plant US460 standard design to demonstrate that the proposed facility grade falls within the specified site parameter in the SDAA. The applicant that references the NuScale Power Plant US460 standard design should provide protection measures against external flood if the site-specific maximum flood elevation exceeds the site parameter.

2.4.3 Probable Maximum Flood on Streams and Rivers

2.4.3.1 Introduction

This section describes the hydrometeorological design basis that is required to determine the extent of any flood protection required for those SSCs necessary to ensure the capability to shut down the reactor and maintain it in a safe-shutdown condition.

2.4.3.2 Summary of Application

FSAR Section 2.4.3, “Probable Maximum Floods on Stream and Rivers,” states, “The probable maximum flood is site-specific.” Accordingly, the SDAA does not provide flood protection requirements. FSAR 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 SDAA 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.

The probable maximum flood, as discussed in SRP Section 2.4.3, is site specific and will be addressed by the applicant that references the NuScale Power Plant US460 standard design.

2.4.3.3 Regulatory Basis

Section 2.4.0 of this report has already addressed the regulatory basis. The applicable NRC regulations for this section include 10 CFR 52.137(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.

2.4.3.4 Technical Evaluation

The SDAA 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. An applicant that references the NuScale Power Plant US460 standard design should provide information sufficient to demonstrate that the actual site characteristics described in any COL or ESP 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 on 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 NuScale's statement that the external flood protection requirements for these features are not needed. The applicant that references the NuScale Power Plant US460 standard design should provide information sufficient to demonstrate that the actual site characteristics described in its application fall within the range of site parameters related to flood protection.

The staff confirmed that COL Items 3.4-1, 3.4-2, 3.4-3 and 3.4-4, provided in FSAR Table 1.8-1, address the necessary information related to preventing internal flooding associated with FSAR Section 3.4.

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 presented in FSAR Table 1.8-1.

COL Item 2.4-1, which specifies that an applicant that references the NuScale Power Plant US460 standard design should investigate and describe site-specific hydrological characteristics, is not applicable to this section since the NuScale Power Plant US460 standard 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 an applicant that references the NuScale Power Plant US460 standard design 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., demonstrate that the standard design remains adequate).

2.4.3.6 Conclusion

The NuScale Power Plant US460 standard design assumes as 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 FSAR Table 2.0-1. The staff concludes that the NuScale Power Plant US460 standard design provides an appropriate site parameter in 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 probable maximum flood elevation must be estimated by the applicant that references the NuScale Power Plant US460 standard design to demonstrate that the proposed facility grade falls within the specified site parameter in the NuScale Power Plant US460 standard design. The applicant that references the NuScale Power Plant US460 standard design should provide protection measures against external flood if the site-specific maximum flood elevation exceeds the site parameter.

2.4.4 Potential Dam Failures

2.4.4.1 Introduction

This section describes the hydrometeorological design basis that is required to determine the potential hazard to the safety-related facilities due to the failure of onsite, upstream, and downstream water control structures and to ensure that the plant design considers these hazards.

2.4.4.2 Summary of Application

FSAR Section 2.4.4, “Potential Dam Failures,” states that potential dam failures, as discussed in SRP Section 2.4.4, are site specific and will be addressed by the COL applicant.

2.4.4.3 Regulatory Basis

Section 2.4.0 of this report has already addressed the regulatory basis. The applicable NRC regulations for this section include 10 CFR 52.137(a)(1), 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.

2.4.4.4 Technical Evaluation

The NuScale Power Plant US460 standard design does not contain information on potential dam failures because the determination of the actual maximum flooding level from potential dam failures is site specific. An applicant that references the NuScale Power Plant US460 standard design should provide information sufficient to demonstrate that the actual site characteristics described in its 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.

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 presented in FSAR Table 1.8-1.

COL Item 2.4-1, which specifies that an applicant that references the NuScale Power Plant US460 standard design should investigate and describe site-specific hydrological characteristics, is not applicable to this section since the NuScale Power Plant US460 standard 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 an applicant that references the NuScale Power Plant US460 standard design propose a baseline plant elevation less than 0.3 m (1 ft) above the maximum flood elevation, including flooding from potential dam failures, the applicant would need to justify the departure from the approved standard design (i.e., demonstrate that the standard design remains adequate).

2.4.4.6 Conclusion

The NuScale Power Plant US460 standard design assumes as 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 FSAR Table 2.0-1. The staff concludes that the NuScale US460 standard design provides an appropriate site parameter in that the maximum flood elevation, including wind-wave runup, and flooding from potential dam failures, 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 applicant that references the NuScale Power Plant US460 standard design must estimate the site-specific flood elevation from potential dam failures to demonstrate that the proposed facility grade falls within the specified site parameter in the NuScale Power Plant US460 standard design. The applicant that references the NuScale Power Plant US460 standard design should provide protection measures against external floods if the site-specific maximum flood elevation exceeds the site parameter.

2.4.5 Probable Maximum Surge and Seiche Flooding

2.4.5.1 Introduction

This section describes the hydrometeorological design basis that is required to determine the potential hazard to the safety-related facilities due to the effects of probable maximum surge and seiche as considered in the design of the plant.

2.4.5.2 Summary of Application

FSAR Section 2.4.4, “Probable Maximum Surge and Seiches,” states that surge and seiche flooding, as discussed in SRP Section 2.4.5, is site specific and will be addressed by the applicant that references the NuScale Power Plant US460 standard design.

2.4.5.3 Regulatory Basis

Section 2.4.0 of this report has already addressed the regulatory basis. The applicable NRC regulations for this section include 10 CFR 52.137(a)(1), 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.

2.4.5.4 Technical Evaluation

The NuScale Power Plant US460 standard design does not contain information on probable maximum surge and seiche because the determination of the actual maximum flooding level from probable maximum surge and seiche is site specific. The applicant that references the NuScale Power Plant US460 standard design should provide information sufficient to demonstrate that the actual site characteristics described in its application including probable maximum surge and seiche, 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.

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 presented in FSAR Table 1.8-1.

COL Item 2.4-1, which specifies that an applicant that references the NuScale Power Plant US460 standard design should investigate and describe site-specific hydrological characteristics, is not applicable to this section since the NuScale Power Plant US460 standard 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 an applicant that references the NuScale Power Plant US460 standard design propose a baseline plant elevation less than 0.3 m (1 ft) above the maximum flood elevation, including probable maximum surge and seiche, the applicant would need to justify the departure from the approved standard design (i.e., demonstrate that the standard design remains adequate).

2.4.5.6 Conclusion

The NuScale Power Plant US460 standard design assumes as a site parameter that the maximum flood elevation (including probable maximum surge and seiche) is 0.3 m (1 ft) below the baseline plant elevation, as shown in NuScale Power Plant US460 standard design FSAR Table 2.0-1. The staff concludes that the NuScale Power Plant US460 standard design provides an appropriate site parameter in that the maximum flood elevation, including probable maximum surge and seiche, 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 applicant that references the NuScale Power Plant US460 standard design must estimate the site-specific flood elevation from probable maximum surge and seiche to demonstrate that the proposed facility grade falls within the specified site parameter in the NuScale Power Plant US460 standard design. The applicant that references

the NuScale Power Plant US460 standard design should provide protection measures against external flood if the site-specific maximum flood elevation exceeds the site parameter.

2.4.6 Probable Maximum Tsunami Hazards

2.4.6.1 Introduction

This section describes the hydrometeorological design basis that is required to determine the potential hazard to the safety-related facilities due to the effects of probable maximum tsunami hazards as considered in the design of the plant.

2.4.6.2 Summary of Application

FSAR Section 2.4.6, “Probable Maximum Tsunami Hazards,” states that tsunamis, as discussed in SRP Section 2.4.6, are site specific and will be addressed by the COL applicant.

2.4.6.3 Regulatory Basis

Section 2.4.0 of this report has already addressed the regulatory basis. The applicable NRC regulations for this section include 10 CFR 52.137(a)(1), 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.

2.4.6.4 Technical Evaluation

The NuScale Power Plant US460 standard design does not contain information on probable maximum tsunami hazards because the determination of the actual maximum flooding level from probable maximum tsunami hazards is site specific. An applicant that references the NuScale Power Plant US460 standard design should provide information sufficient to demonstrate that the actual site characteristics described in its 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.

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 presented in FSAR Table 1.8-1.

COL Item 2.4-1, which specifies that an applicant that references the NuScale Power Plant US460 standard design should investigate and describe site-specific hydrological characteristics, is not applicable to this section since the NuScale US460 standard 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 an applicant that references the NuScale Power Plant US460 standard design 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., demonstrate that the standard design remains adequate).

2.4.6.6 Conclusion

The NuScale Power Plant US460 standard design assumes as a site parameter that the maximum flood elevation (including probable maximum tsunami hazards) is 0.3 m (1 ft) below the baseline plant elevation, as shown in FSAR Table 2.0-1. The staff concludes that the NuScale US460 standard design provides an appropriate site parameter in that the maximum flood elevation, including probable maximum tsunami hazards, 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 applicant that references the NuScale Power Plant US460 standard design must estimate the site-specific flood elevation from probable maximum tsunami hazards to demonstrate that the proposed facility grade falls within the specified site parameter in the NuScale Power Plant US460 standard design. The applicant that references the NuScale Power Plant US460 standard design should provide protection measures against external flood if the site-specific maximum flood elevation exceeds the site parameter.

2.4.7 Ice Effects

2.4.7.1 Introduction

This section describes the hydrometeorological design basis that is required to determine that the potential hazard to the safety-related facilities due to ice effects is considered in the design of the plant.

2.4.7.2 Summary of Application

FSAR Section 2.4.7, “Ice Effects,” states that ice effects, as discussed in SRP Section 2.4.7, do not affect safety-related cooling because the design does not rely on a safety-related intake structure.

2.4.7.3 Regulatory Basis

Section 2.4.0 of this report has already addressed the regulatory basis. The applicable NRC regulations for this section include 10 CFR 52.137(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.

2.4.7.4 Technical Evaluation

The NuScale Power Plant US460 standard design does not contain information on ice effects because the design does not rely on a safety-related intake for the reactor pool. An applicant that references the NuScale Power Plant US460 standard design should provide information sufficient to demonstrate that the actual site characteristics described in its 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 protection from ice effects is adequate. Should an applicant that references the NuScale Power Plant US460 standard design propose a site where the actual site characteristics of the baseline plant are

outside plant parameter values, the applicant would need to justify the departure from the approved standard design (i.e., demonstrate that the standard design remains adequate).

2.4.7.5 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 FSAR Table 1.8-1.

COL Item 2.4-1 specifies that an applicant that references the NuScale Power Plant US460 standard design should investigate and describe site-specific hydrological characteristics. Should an applicant that references the NuScale Power Plant US460 standard design propose a site where the actual site characteristics of the baseline plant are outside plant parameter values, the applicant would need to justify the departure from the approved standard design (i.e., demonstrate that the standard design remains adequate).

2.4.7.6 Conclusion

The NuScale Power Plant US460 standard design assumes as 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 FSAR Table 2.0-1. The staff concludes that the NuScale US460 standard design provides an appropriate site parameter in 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 NuScale Power Plant US460 standard design does not contain information on ice effects because the design does not rely on a safety-related intake for the reactor pool.

The staff also concludes that the applicant that references the NuScale Power Plant US460 standard design must estimate the site-specific ice effects to demonstrate that the proposed facility falls within the specified site parameter in the NuScale Power Plant US460 standard design. The applicant that references the NuScale Power Plant US460 standard design should provide protection measures against ice effects if those effects exceed the site parameters.

2.4.8 Cooling Water Canals and Reservoirs

2.4.8.1 Introduction

This section describes the hydraulic design basis for canals and reservoirs used to transport and impound water supplied to the SSCs important to safety.

2.4.8.2 Summary of Application

FSAR Section 2.4.8, “Cooling Water Canals and Reservoirs,” states, ”The design does not rely on safety-related cooling water canals or reservoirs as a makeup source for the reactor pool, which acts as the ultimate heat sink. Therefore, cooling water canals or reservoirs do not affect safety-related cooling.” Consistent with the guidance in SRP Section 2.4.8 cooling water canals and reservoirs are not used for NuScale Power Plant US460 standard design safety-related cooling.

2.4.8.3 Regulatory Basis

Section 2.4.0 of this report has already discussed the regulatory basis. The applicable NRC regulations for this section include 10 CFR 52.137(a), 10 CFR 52.137(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.

2.4.8.4 Technical Evaluation

The NuScale Power Plant US460 standard design 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. NuScale stated that the power plant design does not rely on 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.

2.4.8.5 Combined License Information Items

COL Item 2.4-1, which specifies that an applicant that references the NuScale Power Plant US460 standard design should investigate and describe site-specific hydrological characteristics, does not apply to cooling water canals and reservoirs that transport and impound water for safety-related SSCs, since the NuScale Power Plant US460 standard design does not rely on safety-related cooling water canals and reservoirs.

2.4.8.6 Conclusion

The NuScale Power Plant US460 standard design does not rely on a safety-related source of makeup water external to the facility, and, therefore, flooding from cooling water canals and reservoirs that transport and impound water for safety-related SSCs would not affect safety-related systems.

2.4.9 Channel Diversions

2.4.9.1 Introduction

This section describes the potential for flooding effects due to the migration or diversion of flowing channels, streams, or rivers to ensure that SSCs important to safety can perform their safety functions.

2.4.9.2 Summary of Application

FSAR Section 2.4.9, “Channel Diversions,” states, ”The design does not rely on a safety-related makeup water source. Therefore, upstream channel diversions would not adversely affect safety-related cooling.” Consistent with the guidance in SRP Section 2.4.9 channel diversions do not adversely affect NuScale Power Plant US460 standard design safety-related cooling

2.4.9.3 Regulatory Basis

Section 2.4.0 of this report has already addressed the regulatory basis. The applicable NRC regulations for this section include 10 CFR 52.137(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.

2.4.9.4 Technical Evaluation

The NuScale Power Plant US460 standard design does not rely on a safety-related cooling water source for the reactor pool, which would act as the UHS. Therefore, no safety-related cooling water systems could be affected by flooding from channel diversions. NuScale's application does not address the potential for flooding effects due to the migration or diversion of flowing channels, streams, or rivers to ensure that SSCs important to safety can perform their safety functions.

2.4.9.5 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 FSAR Table 1.8-1.

COL Item 2.4-1 specifies that an applicant that references the NuScale Power Plant US460 standard design should investigate and describe site-specific hydrological characteristics. Should an applicant that references the NuScale Power Plant US460 standard design propose a site whose actual site characteristics (including the potential for migration or diversion of flowing channels, streams or rivers) are outside plant parameter values, the applicant would need to justify the departure from the approved standard design (i.e., demonstrate that the standard design remains adequate).

2.4.9.6 Conclusion

The NuScale Power Plant US460 standard design does not rely on a safety-related source of makeup water external to the facility, and, therefore, channel diversions would not affect safety-related systems. An applicant that references the NuScale Power Plant US460 standard design should demonstrate that the actual site characteristics (including the potential for migration or diversion of flowing channels, streams or rivers) are within the approved standard design site parameters

2.4.10 Flood Protection Requirements

2.4.10.1 Introduction

This section describes the locations and elevations of all safety-related facilities to identify SSCs exposed to flooding.

2.4.10.2 Summary of Application

FSAR Section 2.4.10, “Flood Protection Requirements,” as discussed in SRP Section 2.4.10, does not apply since the design assumes the baseline plant elevation is 0.3 m (1 ft) above the maximum flood elevation.

2.4.10.3 Regulatory Basis

Section 2.4.0 of this report has already addressed the regulatory basis. The applicable NRC regulations for this section include 10 CFR 52.137(a), 10 CFR 52.137(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.

2.4.10.4 Technical Evaluation

The NuScale Power Plant US460 standard design does not contain information on flood protection since the maximum flood elevation is 0.3 m (1 ft) below the plant elevation.

2.4.10.5 Combined License Information Items

COL Item 2.4-1, which specifies that an applicant that references the NuScale Power Plant US460 standard design should investigate and describe site-specific hydrological characteristics, does not apply to flood protection since the NuScale design assumes the maximum flood elevation is 0.3 m (1 ft) below the plant elevation.

2.4.10.6 Conclusion

The NuScale Power Plant US460 standard design does not have any flood protection requirements since the plant elevation is 0.3 m (1 ft) above the maximum flood elevation. An applicant that references the NuScale Power Plant US460 standard design should demonstrate that the actual site characteristics (including the potential for flooding) are within the approved standard design site parameters.

2.4.11 Low Water Considerations

2.4.11.1 Introduction

This section describes the potential for natural events to reduce or limit the available safety-related cooling water.

2.4.11.2 Summary of Application

FSAR Section 2.4.11, “Low Water Considerations,” as discussed in SRP Section 2.4.11, does not apply since “[t]he design does not rely upon a safety-related source of makeup water. Low flow from surges, seiches, tsunamis, downstream dam failures, future water controls, ice effects, upstream channel diversions, or other sources of low water would not adversely affect safety-related cooling.”

2.4.11.3 Regulatory Basis

Section 2.4.0 of this report has already addressed the regulatory basis. The applicable NRC regulations for this section include 10 CFR 52.137(a), 10 CFR 52.137(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.

2.4.11.4 Technical Evaluation

The NuScale Power Plant US460 standard design does not contain information on low water considerations because the standard power plant design does not rely on external sources of water as a safety-related water supply.

2.4.11.5 Combined License Information Items

COL Item 2.4-1, which specifies that an applicant that references the NuScale Power Plant US460 standard design should investigate and describe site-specific hydrological characteristics, does not apply to low water considerations since the NuScale Power Plant US460 standard design does not rely on safety-related cooling water external to the facility.

2.4.11.6 Conclusion

The NuScale Power Plant US460 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.

2.4.12 Ground Water

2.4.12.1 Introduction

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

2.4.12.2 Summary of Application

FSAR Section 2.4.12, “Groundwater,” states, “The design does not employ a permanent dewatering system,” and “groundwater is assumed to be a minimum of two feet below site grade.” The ground water is one of the key site parameters to be evaluated for a candidate site.

2.4.12.3 Regulatory Basis

Section 2.4.0 of this report has already addressed the regulatory basis. The applicable NRC regulations for this section include 10 CFR 52.137(a)(1),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.

2.4.12.4 Technical Evaluation

The NuScale Power Plant US460 standard design does not contain information on ground water because that issue is site specific. However, the NuScale Power Plant US460 standard design provides a site parameter related to the maximum ground water elevation, to be 0.61 m (2 ft) below the baseline plant elevation, as shown in FSAR Table 2.0-1. The actual maximum ground water elevation is site specific and will be addressed by the applicant that references the NuScale Power Plant US460 standard design in response to COL Items 2.0-1 and 2.4-1. The applicant that references the NuScale Power Plant US460 standard design should provide information sufficient to demonstrate that the actual site characteristics described in its 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 applicant that references the NuScale Power Plant US460 standard design 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 the FSAR.

2.4.12.5 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 FSAR Table 1.8-1.

Because these COL information items call for an applicant that references the NuScale Power Plant US460 standard design to determine maximum ground water elevation and compare that elevation to the corresponding site parameter in the NuScale Power Plant US460 standard design, the staff concludes that the information items are adequate.

2.4.12.6 Conclusion

The staff concludes that the NuScale Power Plant US460 standard design provides an appropriate site parameter in that the maximum ground water elevation is 0.61 m (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 applicant that references the NuScale Power Plant US460 standard design. The applicant that references the NuScale Power Plant US460 standard design should include information sufficient to demonstrate that the actual site characteristics fall within the values of the site parameters in the NuScale Power Plant US460 standard design. The staff finds this acceptable.

If the actual site characteristics do not fall within the site parameters postulated in the SDAA, the applicant that references the NuScale Power Plant US460 standard design must provide sufficient justification (e.g., by requesting an exemption or departure from the SDA design) that the proposed facility is acceptable at the proposed site.

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

2.4.13.1 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 applicant that references the NuScale Power Plant US460 standard design.

2.4.13.2 Summary of Application

FSAR Section 2.4.13, “Accidental Releases of Radioactive Liquid Effluents in Groundwater and Surface Waters,” states the following:

> Dilution factors, dispersion coefficients, flow velocities, travel times, adsorption, and pathways of liquid contaminants for radioactive liquid effluents from accidental releases into groundwater or surface water are site-specific. The source term provided in Table 12.2-9 associated with the pool surge control system storage tank is assumed to be contained by the passive and durable mitigative design feature (a metal-lined concrete catch basin) in an analysis to evaluate the effects of an accidental release of radioactive liquid demonstrating the adequacy of the site’s hydrogeologic properties.

2.4.13.3 Regulatory Basis

Section 2.4.0 of this report has already addressed the regulatory basis. The applicable NRC regulations for this section include 10 CFR 52.137(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.

2.4.13.4 Technical Evaluation

NuScale stated in FSAR Section 2.4.13 that an applicant that references the NuScale Power Plant US460 standard design will address the site-specific information pertaining to flooding and other related hydrodynamic phenomena. Accordingly, the applicant that references the NuScale Power Plant US460 standard design 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 the FSAR, which notes that an applicant that references the NuScale Power Plant US460 standard design 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.

2.4.13.5 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 FSAR Table 1.8-1.

2.4.13.6 Conclusion

The NuScale Power Plant US460 standard design has identified the source term in FSAR 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. An applicant that references the NuScale Power Plant US460 standard design will describe accidental releases of radioactive liquid effluents in ground and surface waters for FSAR 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 an applicant that references the NuScale Power Plant US460 standard design. Based on the above information, the staff finds NuScale's discussions in FSAR Section 2.4.13 acceptable.

2.4.14 Technical Specifications and Emergency Operation Requirements

2.4.14.1 Introduction

This section describes the technical specifications (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.

2.4.14.2 Summary of Application

FSAR Section 2.4.14, “Technical Specifications and Emergency Operation Requirements,” states, “The design does not require emergency protective measures nor technical specifications to minimize the impact of adverse hydrology-related events on safety-related facilities.”

2.4.14.3 Regulatory Basis

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

2.4.14.4 Technical Evaluation

NuScale stated in FSAR Section 2.4.14 that the design does not require emergency protective measures or TS for hydrology-related events. Consistent with COL Item 2.4-1, an applicant that references the NuScale Power Plant US460 standard design will address this topic, as appropriate.

2.4.14.5 Combined License Information Items

As part of its review of this portion of the application, the staff considered the adequacy of the COL Item 2.4-1 provided in FSAR Table 1.8-1.

2.4.14.6 Conclusion

The NuScale Power Plant US460 standard design has no postulated site parameters related to TS and emergency operation requirements. Consistent with COL Item 2.4-1, an applicant that references the NuScale Power Plant US460 standard design will address this topic, as appropriate.

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

SDAA Part 2 (FSAR): FSAR Section 2.5.1, "Basic Geologic and Seismic Information," states that basic regional and site geologic and seismic information is site specific.

2.5.1.3 Regulatory Basis

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

- 10 CFR 52.137, "Contents of applications; technical information," paragraph (a)(1), requires an SDAA to include 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, "Vibratory Ground Motion," and 2.5.4, "Stability of Subsurface Materials and Foundations," which provide the following:

- The staff reviews information presented by the applicant for an SDA 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 CP or COL application, and are appropriately justified.

Additional criteria or guidance in support of the SRP acceptance criteria appear in 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 part of 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 CP applicants, and FSAR Section 2.5.1 specifies that basic regional and site geologic and seismic information is site specific. An applicant that references the NuScale Power Plant US460 standard design is responsible for providing adequate regional and site geologic and seismic information to be bounded by NuScale Power Plant US460 standard design parameters.

2.5.1.5 Combined License Information Items

The following table lists a COL information item related to basic geologic and seismic information, as provided in FSAR Table 1.8-1.

Table 2.5-1 NuScale COL Information Item for FSAR Section 2.5.1

Item No.	Description	FSAR Section
COL Item 2.5-1	An applicant that references the NuScale Power Plant US460 standard design will describe the site-specific geology, seismology, and geotechnical characteristics for Section 2.5.1 through Section 2.5.5.	2.5

2.5.1.6 Conclusion

The applicant specified in COL Item 2.5-1 the need for the applicant that references the NuScale Power Plant US460 standard design to describe regional and site geologic and seismic information. The staff concludes that the applicable requirements of 10 CFR 52.137 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

FSAR Section 2.5.2, “Vibratory Ground Motion,” states that the certified seismic design response spectra (CSDRS) and the certified seismic design response spectra - high frequency

(CSDRS-HF) are developed by reviewing earthquake design data from the United States nuclear industry and are intended to bound most of the Central and Eastern United States, as well as sites in less seismically-active portions of the Western United States.- All site-specific seismological characteristics including the safe shutdown earthquake will be described by any applicant that references the NuScale US460 standard design as stated in COL Item 2.5-1.

FSAR Section 2.5.2 refers to Section 3.7.1 of the FSAR for the CSDRS. FSAR Table 3.7.1-1 specifies the CSDRS that form the seismic loading design basis and can be used to compare with the site-specific GMRS and to determine the SSE. Figures 2.5-1 and 2.5-2 of this report illustrate these CSDRS.

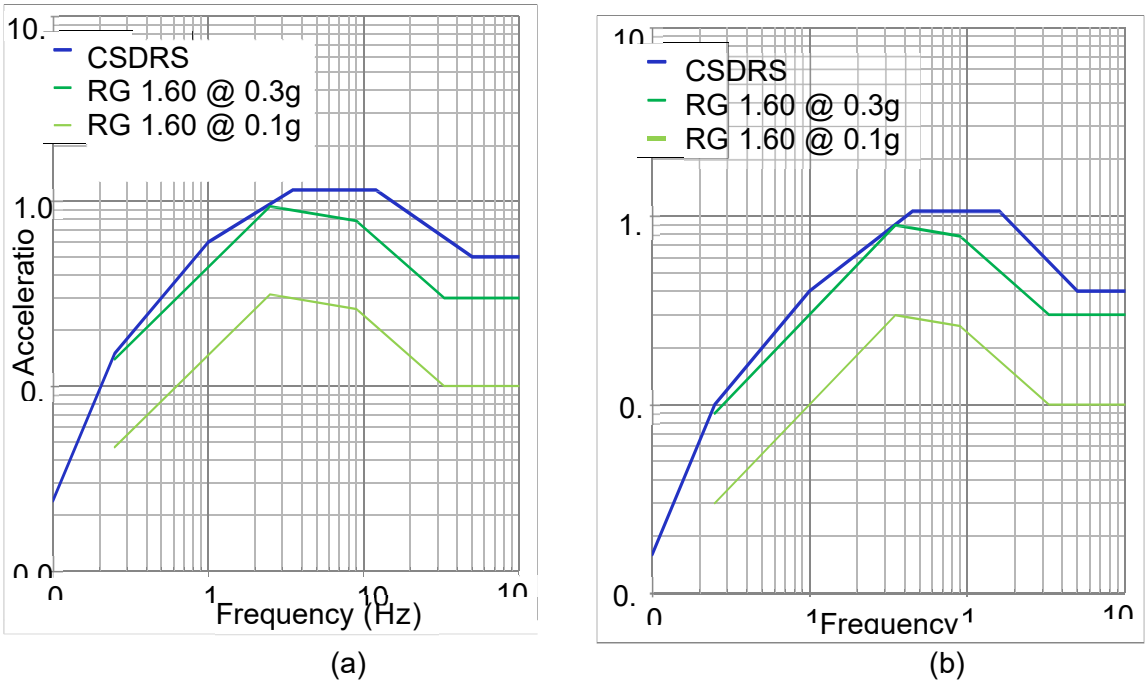
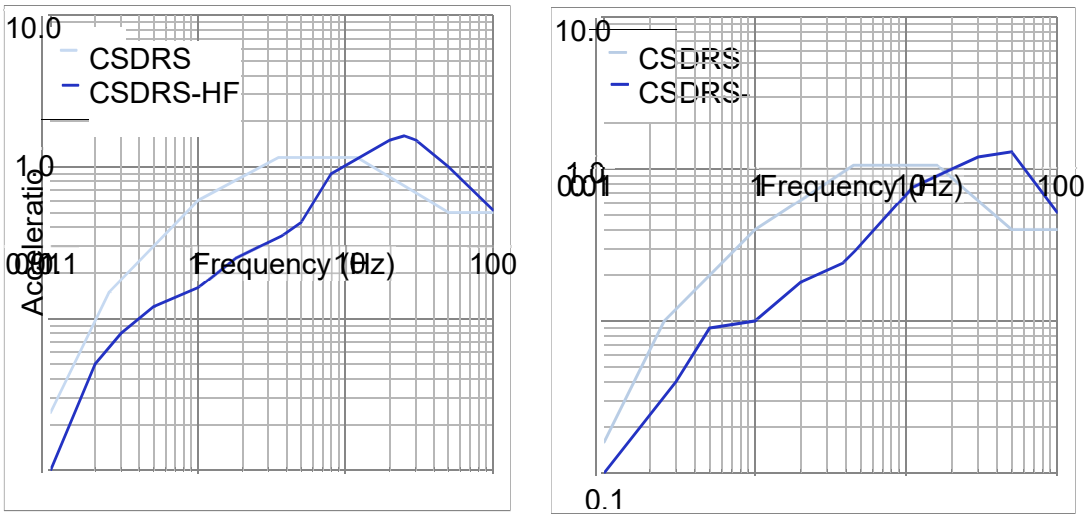


Figure 2.5-1 NuScale horizontal (a) and vertical (b) certified seismic design response spectra 5-percent damping (after FSAR Figures 3.7.1-1 and 3.7.1-2)



(c) (d)

Figure 2.5-2 NuScale horizontal (c) and vertical (d) certified seismic design response spectra high-frequency 5 percent damping (after FSAR Figures 3.7.1-3 and 3.7.1-4)

2.5.2.3 Regulatory Basis

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

- 10 CFR 52.137, 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 an SDA 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 July 2014

2.5.2.4 Technical Evaluation

The CSDRS and the CSDRS-HF are key design parameters as discussed in FSAR Section 3.7.1, “Seismic Design Parameters.” The CSDRS are shown in FSAR 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 FSAR 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.” SDAA 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 (like those in RG 1.60), which are 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 than the CSDRS. These are 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 NuScale’s CSDRS and evaluated the completeness and adequacy of those site parameters. The staff examined the CSDRS as well as the CSDRS-HF, which are intended to cover sites in most of the Central and Eastern United States, as well as sites of low seismicity in the Western United States. The staff 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 the applicants that reference the NuScale Power Plant US460 standard design. NuScale stated in FSAR Section 2.5.2 that local vibratory ground motion, including development of an SSE, is site specific and to be addressed by the applicant that references the NuScale Power Plant US460 standard design as part of the response to COL Item 2.5-1. Applicants that reference the NuScale Power Plant US460 standard design are responsible for providing adequate information on local vibratory ground motion, including development of an SSE, to be bounded by NuScale Power Plant US460 standard design parameters.

2.5.2.5 Combined License Information Items

Table 2.5-1 of this report lists the COL information item related to vibratory ground motion.

2.5.2.6 Conclusion

Based on the staff’s review of FSAR Section 2.5.2, the staff concludes that NuScale provided the necessary seismic plant design parameters, CSDRS and CSDRS-HF, that the spectra are consistent with 10 CFR 100.23, and that NuScale specified the scope of the information associated with those site parameters in COL Item 2.5-2 that, when addressed by an applicant that references the NuScale Power Plant US460 standard design, will meet the applicable requirements of 10 CFR 52.137(a)(1) and 10 CFR 100.23. The staff, therefore, finds the

vibratory ground motion site parameters specified in the NuScale Power Plant US460 standard design acceptable.

2.5.3 Surface Deformation

2.5.3.1 Introduction

This section documents the staff's review of surface deformation for the NuScale Power Plant US460 standard design.

2.5.3.2 Summary of Application

SDAA Part 2 (FSAR): FSAR Section 2.5.3, "Surface Deformation," states that the design analysis assumes that there is no fault displacement potential under the plant structures.

2.5.3.3 Regulatory Basis

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

- 10 CFR 52.137(a)(1), 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.

Additional criteria or guidance in support of the SRP acceptance criteria appear in 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. FSAR 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. An applicant that references the NuScale Power Plant US460 standard design is responsible for providing adequate information on the potential for surface deformation to be bounded by NuScale Power Plant US460 standard design parameters.

2.5.3.5 Combined License Information Items

Table 2.5-1 of this report lists the COL information item related to surface faulting.

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, NuScale 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 FSAR 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 an applicant that references the NuScale Power Plant US460 standard design to describe site-specific geology, seismology, and geotechnical characteristics to include the potential for surface deformation pertaining to FSAR Section 2.5.3. The staff concludes that the applicable requirements of 10 CFR 52.137 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 US460 standard design.

2.5.4.2 Summary of Application

SDAA Part 2 (FSAR): FSAR Table 2.0-1 provides the following specific site parameters related to subsurface materials and foundation designs:

- lateral soil variability uniform site: <20-degree dip
- minimum allowable soil-bearing capacities:
  - RXB static bearing capacity: 16 ksf
  - RXB dynamic bearing capacity: 34 ksf
  - CRB static bearing capacity: 6 ksf
  - CRB dynamic bearing capacity: 25 ksf
- minimum soil angle of internal friction: 30 degrees
- minimum shear wave velocity: ≥1,000 ft/sec at bottom of foundation
- liquefaction potential: no liquefaction potential
- Static Coefficient of friction (CoF) ≥0.58 where CoF = tan(φ)
- Kinetic CoF between the concrete foundation and soil for the CRB nonlinear analysis: ≥0.50

- maximum settlement for the RXB, CRB, and RWB:

		RXB	CRB	RWB
–	maximum tilt per 50 ft:	0.1 inches	0.2 inches[1]	0.3 inches
–	maximum total settlement:	1.5 inches	1.0 inches	1.3 inches[2]
–	maximum differential settlement:	0.2 inches	0.3 inches	0.7 inches

FSAR Section 2.5.4, “Stability of Subsurface Materials and Foundations,” states that there are no rigid safety-related connections between the structures and no safety-related connections to other site structures.

NuScale further stated that the maximum allowable total settlement, maximum total settlement, maximum tilt, and maximum differential settlement values are provided in FSAR Table 2.0-1. For sites not meeting these parameters, site-specific analyses demonstrate the adequacy of the standard plant design.

2.5.4.3 Regulatory Basis

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

- 10 CFR 52.137, 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 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 an SDA 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 CP or COL application; and are appropriately justified.

[1] For the seismic Category I portion of the building.
[2] At the edge of the tunnels that extend towards the RXB.

RG 1.198, as listed in Section 2.5.3.3 of this report, provides additional criteria or guidance in support of the SRP acceptance criteria to meet the above requirements:

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 allowable soil bearing capacity, 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. NuScale presented the analysis results in FSAR Section 3.8.5, “Foundations.” NuScale stated in FSAR Section 2.5.4 that a factor of safety of at least 3.0 applies to non-seismic/static bearing capacity condition of the CRB and RXB and that a factor of safety of at least 2.0 applies to seismic/dynamic bearing capacity conditions for the CRB and RXB. In addition, NuScale stated that, as part of the response to COL Item 2.5-1, an applicant that references the NuScale Power Plant US460 standard design will apply these factors of safety values to obtain the site-specific minimum allowable bearing capacities. 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. The staff noted that as part of COL Item 2.0-1, an applicant that references the NuScale Power Plant US460 standard design will demonstrate that site-specific characteristics are bounded by the site parameters specified in FSAR Table 2.0-1, which includes the minimum allowable soil bearing capacity values. Accordingly, the staff finds the proposed site parameter for allowable soil bearing capacity of materials beneath safety-related structures acceptable.

In FSAR Section 2.5.4, NuScale specified that there is no potential for soil liquefaction, and that this analysis can be performed with the site-specific ground motion response spectrum (GMRS). 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. NuScale specified that its plant design applies to sites with uniform lateral soil variability (less than a 20-degree dip of soil layers). The staff noted that NuScale used horizontal layers for the seismic soil--structure interaction (SSI) analysis; based on NUREG/CR-0693, “Seismic Input and Soil-Structure Interaction,” issued February 1979, for soil strata having slopes up to 20 degrees, it is appropriate to model a site as horizontally layered. According to COL Items 3.7-3, 3.7-4, and 3.7-6 provided in FSAR Table 1.8-1, an applicant that references the NuScale US460 standard design will account for complexities in subsurface layer profiles and will address nonvertically propagating seismic waves, which is expected to be the case for a site with soil layers with significant dip -angle variations. The staff reviewed the information regarding this site parameter and noted that NuScale defined it as part of the design basis; thus, the characteristics of an actual site must fall within the parameter, or the applicant that references the NuScale Power

Plant US460 standard design shall justify a departure from the parameter. Accordingly, the staff finds the proposed site parameter for lateral variability acceptable.

NuScale also specified several soil property-related site parameters, such as a minimum shear wave velocity of 304.8 m/sec (1,000 ft/sec) for in situ materials, minimum coefficient of static friction greater than or equal to 0.58 at the interfaces between the basemat and soil, CoF greater than or equal to 0.5 between the CRB basemat and soil (nonlinear analysis), and 30 degrees of minimum soil angle of internal friction. These site parameters provide the 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 COL Items 2.5-1, 3.7-3, 3.7-9, and 3.8-3 provided in FSAR Table 1.8-1, an applicant that references the NuScale US460 standard design shall develop appropriate -site-specific soil profiles and perform SSI analysis. In FSAR Section 3.7.2.16, NuScale indicated that this analysis is to confirm that the site independent seismic Category I structures can be constructed without modification. The staff noted that this analysis will confirm the suitability of the design when using the site-specific non-seismic and seismic demands and the site-specific soil profiles that include backfill materials. The staff considers that each actual site has its specific characteristics and acknowledges that an applicant that references the NuScale Power Plant US460 standard design will perform SSI analysis if the site-specific soil profile, including backfill materials, deviates from the soil profiles used in the NuScale Power Plant US460 standard design. The site-specific SSI analysis will use the site-specific properties of backfill materials in the analysis models, and the applicant will need to provide details on how to ensure that the in-place backfill materials possess the properties described. The staff concludes that the aforementioned COL items will be addressed in a future application that references the NuScale Power Plant US460 standard design 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.

In FSAR Table 2.0-1, NuScale provided site parameters for maximum settlement for the RXB, CRB, and RWB, including maximum tilt, maximum total settlement, and maximum differential settlement for each building. The staff examined the site parameters related to foundation settlement and finds, in conjunction with the staff review of FSAR Section 3.8.5.7, “Settlement,” that these settlement values specified in FSAR Table 2.0-1 are based on the analytical results from NuScale’s computational model and are well below the maximum allowable settlements commonly accepted by engineering standards and guidelines (e.g., U.S. Army Corps of Engineers (USACE) EM 1110-1-1904, “Engineering and Design—Settlement Analysis,” issued 1990). Therefore, the staff notes that the specified site parameters related to foundation settlement will not have an adverse effect on the normal operation and stability of the structures. The staff acknowledges that in the event of exceedances on any of the settlement site parameters referenced in FSAR Table 2.0-1 and in accordance with COL Item 2.0-1 and COL Item 2.5-1, an applicant that references the NuScale Power Plant US460 standard design shall demonstrate the acceptability of the site-specific settlement parameters. Accordingly, the staff

concludes that the specified maximum settlement-related site parameters for the RXB, CRB, and RWB are acceptable.

NuScale provided information in FSAR Section 3.8.4.3.3 regarding the determination of the lateral earth pressure on the embedded portions of the safety-related structures. In FSAR Section 3.8.5.4, NuScale indicated that the CRB exterior walls are not subject to static and dynamic soil pressure loads because the CRB is not embedded in the soil. Further, NuScale stated that the RXB exterior walls that are embedded below grade are subjected to static and dynamic soil pressure due to a seismic event. The staff noted that for the static soil pressures NuScale 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. NuScale calculated the total maximum static lateral soil pressure at a depth as the sum of the hydrostatic pressure, the effective lateral pressure, and the surcharge lateral pressures. NuScale stated that the dynamic soil pressure was determined from the SSI double building (RXB-RWB) analysis. The staff noted that the RXB embedded walls are designed considering several load combinations, including seismic demand, which incorporates the active and passive earth pressure implicitly within the limitation of the linear, elastic soil and bonded soil-structure interface models. NuScale provided information for the total and static soil pressures and total overturning moments induced by the soil pressures.

The staff finds that the methods and assumptions used in the estimate of total static lateral earth pressure, and the dynamic (seismic) soil pressures for the safety-related buildings, are reasonable because NuScale used methods widely accepted 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. SER Section 3.8.4 contains a detailed evaluation of this information. The staff noted that COL Items 2.5-1, 3.7-4, and 3.7-9 specify the need to describe the site-specific geology and seismic and geotechnical engineering parameters and the need to conduct SSI analyses for an applicant that references the NuScale Power Pant US460 standard design. Specifically, COL Item 3.7-9 states, in part, “The applicant will confirm that the site-specific seismic demands of the standard design for 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 consistent with pertinent industry standards. NuScale also specified pertinent COL information items to ensure that applicants that reference the NuScale Power Plant US460 standard design meet all design requirements.

2.5.4.5 Combined License Information Items

Table 2.5-1 of this report lists the COL information item related to the stability of subsurface materials and foundations.

2.5.4.6 Conclusion

Based on its review of the site parameters related to subsurface material and foundation stability, as presented in the FSAR, the staff concludes that NuScale provided the necessary site parameters that are used in foundation stability design and analyses. The application

specified in COL Items 2.5-1, 3.7-3, 3.7-4, 3.7-6, 3.7-9 and 3.8-3 the need for a COL applicant that references the NuScale Power Plant US460 standard design to describe site--specific geology, seismology, and geotechnical characteristics to include subsurface material and foundation stability evaluations pertaining to FSAR Section 2.5.4. The staff concludes that the applicable requirements of 10 CFR 52.137, 10 CFR 100.23, and Appendix S to 10 CFR Part 50 can be met by addressing these COL information items, 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 the stability of slopes for the NuScale Power Plant US460 standard design.

2.5.5.2 Summary of Application

SDAA Part 2 (FSAR): FSAR Table 2.0-1 provides no slope failure potential as a specific site parameter related to the stability of slopes. FSAR Section 2.5.5, "Stability of Slopes," states that the standard plant layout assumes a uniform, graded site and that the no slope failure potential is a key design parameter.

2.5.5.3 Regulatory Basis

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

- 10 CFR 52.137, 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 an SDA applicant on 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 CP or COL application, and are appropriately justified.

RG 1.198, as listed in section 2.5.1.3 of this report, provides additional criteria or guidance in support of the SRP acceptance criteria to meet the above requirements:

2.5.5.4 Technical Evaluation

Slope stability at a nuclear power plant site will affect the stability of facilities at the site. FSAR Section 2.5.5 specifies that the standard plant layout assumes a uniform and graded site (less than 20-degree dip of soil layers), and no slope failure potential as a key design parameter. Since the characteristics of a slope, both natural and manmade, are site specific and must be provided and evaluated by an applicant that references the NuScale Power Plant US460

standard design, in accordance with COL Item 2.0-1, an applicant that references the NuScale Power Plant US460 standard design is responsible for providing an adequate slope stability evaluation to be bounded by the NuScale Power Plant US460 standard design parameters.

2.5.5.5 Combined License Information Items

Table 2.5-1 of this report lists the COL information item related to the stability of slopes.

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. NuScale specified that its design is based on the assumption that there is no potential slope failure at the site. In FSAR Table 2.0-1, the applicant specified no slope failure potential as a key design parameter, and in accordance with COL Item 2.0-1, an applicant that references the NuScale Power Plant US460 standard design will demonstrate that site-specific characteristics are bounded by the site parameters specified in FSAR Table 2.0-1, or justify its site-specific parameters. In addition, NuScale specified adequate information requirements in COL Item 2.5-1. COL Item 2.5-1 specifies the need for an applicant that references the NuScale Power Plant US460 standard design to describe site-specific geology, seismology, and geotechnical characteristics to include slope stability evaluations pertaining to FSAR Section 2.5.5. The staff concludes that the applicable requirements of 10 CFR 52.137, 10 CFR 100.23, and Appendix S to 10 CFR Part 50 can be met by addressing this COL information item, and, therefore, the staff finds this acceptable.