DANU-ISG-2022-02

Advanced Reactor Content of Application Project

Chapter 2, "Site Information"

Interim Staff Guidance

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INTERIM STAFF GUIDANCE

ADVANCED REACTOR CONTENT OF APPLICATION PROJECT

CHAPTER 2, "SITE INFORMATION"

DANU-ISG-2022-02

PURPOSE

The U.S. Nuclear Regulatory Commission (NRC or Commission) staff is providing this interim staff guidance (ISG) for two reasons. First, this ISG provides guidance on the contents of applications to an applicant submitting a risk-informed, performance-based application for a construction permit (CP) or operating license (OL) under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities" (Ref. 1), or for a combined license (COL), a manufacturing license (ML), a standard design approval (SDA), or a design certification (DC) under 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants" (Ref. 2), for a nonlight-water reactor (non-LWR). The application guidance found in this ISG supports the development of the portion of non-LWR application associated with an applicant's "Site Information."[1] Second, this ISG provides guidance to NRC staff on how to review such an application.

As of the date of this ISG, the NRC is developing a rule to amend 10 CFR Parts 50 and 52 (RIN 3150-AI66). The NRC staff notes this guidance may need to be updated to conform to changes to 10 CFR Parts 50 and 52, if any, adopted through that rulemaking. Further, as of the date of this ISG, the NRC is developing an optional performance-based, technology-inclusive regulatory framework for licensing nuclear power plants designated as 10 CFR Part 53, "Licensing and Regulation of Advanced Nuclear Reactors," (RIN 3150-AK31). After promulgation of those regulations, the NRC staff anticipates that this guidance will be updated and incorporated into the NRC's Regulatory Guide (RG) series or a NUREG series document to address content of application considerations specific to the licensing processes in this document.

BACKGROUND

This ISG is based on the advanced reactor content of application project (ARCAP), whose purpose is to develop technology-inclusive, risk-informed, and performance-based application guidance. The ARCAP is broader than, and encompasses, the industry-led technology-inclusive content of application project (TICAP). The guidance in this ISG supplements the guidance found in Division of Advanced Reactors and Non-power Production and Utilization Facilities (DANU)-ISG-2022-01, "Review of Risk-Informed, Technology-Inclusive Advanced Reactor Applications – Roadmap," issued in October 2023 (Ref. 3), which provides a roadmap for developing all portions of an application. The guidance in this ISG is limited to the portion of a

[1] The NRC is issuing this ISG to describe methods that are acceptable to the NRC staff for implementing specific parts of the agency's regulations, to explain techniques that the NRC staff uses in evaluating specific issues or postulated events, and to describe information that the NRC staff needs in its review of applications for permits and licenses. The guidance in this ISG that pertains to applicants is not NRC regulations and compliance with it is not required. Methods and solutions that differ from those set forth in this ISG are acceptable if supported by a basis for the issuance or continuance of a permit or license by the Commission.

non-LWR application associated with the development of risk-informed site information for the nuclear reactor plant applicant and the staff review of that portion of the application.

RATIONALE

The current application guidance related to site information is directly applicable only to light water reactors (LWRs) and may not fully identify the information to be included in a non-LWR application or efficiently provide a technology-inclusive, risk-informed, and performance-based review approach for non-LWR technologies. This ISG serves as the non-LWR application guidance for site information. This ISG provides both applicant content of application and NRC staff review guidance.

APPLICABILITY

This ISG is applicable to applicants for non-LWRs[2] permits and licenses that submit risk-informed, performance-based applications for CPs or OLs under 10 CFR Part 50 or for COLs, SDAs, DCs, or MLs under 10 CFR Part 52. This ISG is also applicable to the NRC staff reviewers of these applications.

PAPERWORK REDUCTION ACT

This ISG provides voluntary guidance for implementing the mandatory information collections in 10 CFR Parts 50 and 52 that are subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et. seq.). These information collections were approved by the Office of Management and Budget (OMB), approval numbers 3150-0011 and 3150-0151. Send comments regarding this information collection to the FOIA, Library, and Information Collections Branch (T6-A10M), U.S. Nuclear Regulatory Commission, Washington, DC 20555 0001, or by e-mail to Infocollects.Resource@nrc.gov, and to the OMB reviewer at: OMB Office of Information and Regulatory Affairs (3150-0011 and 3150-0151), Attn: Desk Officer for the Nuclear Regulatory Commission, 725 17th Street, NW Washington, DC 20503.

PUBLIC PROTECTION NOTIFICATION

The NRC may not conduct or sponsor, and a person is not required to respond to, a collection of information unless the document requesting or requiring the collection displays a currently valid OMB control number.

GUIDANCE

Chapter 2, “Site Information,” of the safety analysis report (SAR) should provide information on the demographic, geological, seismological, hydrological, and meteorological characteristics of the site and the surrounding area. It should also discuss the existing and projected population distribution and land use at the site and surrounding area, and site activities and controls. The purpose of this chapter of the SAR is twofold:

- First, it should demonstrate compliance with 10 CFR Part 100, “Reactor Site Criteria” (Ref. 4), Subpart B, “Evaluation Factors for Stationary Power Reactor Site Applications on or after January 10, 1997,” and the portions of 10 CFR Part 50 and 10 CFR Part 52 that

[2] Applicants desiring to use this ISG for a light water reactor application should contact the NRC staff to hold pre-application discussions on their proposed approach.

discuss site-related issues.

- Second, SAR Chapter 2 should describe the site characteristics used to inform the selection of the external hazards for the design and safety analysis in accordance with Regulatory Guide (RG) 1.233, "Guidance for a Technology-Inclusive, Risk-Informed, and Performance-Based Methodology to Inform the Licensing Basis and Content of Applications for Licenses, Certifications, and Approvals for Non-Light-Water Reactors" (Ref. 5). For each relevant external hazard, the applicant should consider the following:

    - Safety-related (SR) structures, systems, and components (SSCs) must be protected from or designed to withstand the corresponding design basis hazard levels (DBHLs) with no adverse impact on their capability to perform their required safety functions (RSFs).[3]

    - SR and non-safety-related with special treatment (NSRST) SSCs relied upon or credited in licensing basis events (LBEs) (i.e., anticipated operational occurrences (AOOs), design basis events (DBEs), beyond design basis events (BDBEs)) or to establish adequate defense-in-depth (DID) may need to be specially designed to withstand or be protected from the hazard (e.g., application of special treatments in accordance with NEI 18-04 and RG 1.233).

    - RG 1.233 and NEI 18-04, "Risk-Informed Performance-Based Technology Inclusive Guidance for Non-Light Water Reactors" (Ref. 6), describe the roles and responsibilities of the integrated decision process panel (IDPP). The staff notes that as determined by the IDPP, NSRST SSC(s) may need to withstand or be protected against beyond design basis external hazard events to ensure DID. For example, the IDPP may determine that for a specific beyond design basis external hazard (e.g., a low-frequency high-consequence seismic event), an NSRST SSC may warrant special treatment in the form of a more robust seismic design.

    - The SAR need only provide site characterization data (e.g., meteorological data, regional seismological data, and hydrological data) to the extent necessary to establish the bases for determining the magnitude of the external hazards considered in the design and safety analysis and the bases for excluding other external hazards.

The guidance in this chapter applies to applications for licenses or approvals for non-LWRs under 10 CFR Part 50 or 10 CFR Part 52. The guidance specifies the factors to be considered when evaluating sites, including seismic and nonseismic site characteristics and postulated site parameters. The SAR should describe the basis for the site characteristics or postulated site parameters used for the design and safety analysis. However, the SAR need not include data documenting historical records, detailed geological exploration data, data for use in environmental analyses, or other data not directly related to establishing site characteristics or postulated site parameters for the design or safety analysis. If not included in the SAR, this information should be documented in a separate report available for audit by the NRC staff and specifically referenced in the SAR.

[3] SR-classified SSCs are required to perform their RSFs following a Safe Shutdown Earthquake; NSRST and non-safety-related with no special treatment (NST) SSCs are required to meet Seismic II/I requirements (required not to interfere with the performance of SR SSC RSFs following a Safe Shutdown Earthquake).

Under 10 CFR 52.47(a)(1), DC applications must describe the site parameters postulated for the design. Similarly, under 10 CFR 52.137(a)(1) and 10 CFR 52.157(f)(19), respectively, SDA and ML applications must describe the site parameters postulated for their designs. Applicants for these types of licenses should include in Chapter 2 of their SARs the complete set of postulated site parameters considered in the design. Because evaluations of the safety of the design use the postulated site parameters, the actual characteristics of the site at which the facility is to be located must fall within the postulated site parameters specified in the design and safety analysis.

Under 10 CFR 52.79(b), a COL application referencing an ESP must either include or incorporate by reference the ESP site SAR; also, it must either provide additional information to demonstrate that (1) the site characteristics specified in the ESP fall within the site parameters postulated for the design (if the COL application also references a certified design), and (2) the design characteristics fall within the plant parameters specified in the ESP, or request a variance. An applicant for such a license should include the site-related information in Chapter 2 of the SAR.

Under 10 CFR 52.79(c)(1), (d)(1), and (e)(1), COL applications referencing SDAs, DCs, and MLs, respectively, must include or incorporate by reference the SDA, DC, or ML FSAR into their SARs and provide additional information to demonstrate that the site characteristics fall within the postulated site parameters specified for the SDA, DC, or ML. An applicant for such a license should include the site-related information in Chapter 2 of the SAR.

For an application for a CP (10 CFR 50.33, “Contents of applications; general information,” 10 CFR 50.34, “Contents of applications; technical information,” and 10 CFR 50.35, “Issuance of construction permits”), OL (10 CFR 50.33 and 10 CFR 50.34), or COL (10 CFR 52.79(a)(1)(i)–(vi)), Chapter 2 of the SAR should demonstrate that the requirements of 10 CFR Part 100, Subpart B, and the site-related portions of 10 CFR Part 50 or 10 CFR Part 52 are met.

For COL applications referencing an ESP (10 CFR 52.79(b)), an SDA (10 CFR 52.79(c)), a DC (10 CFR 52.79(d)), or an ML (10 CFR 52.79(e)), the issue finality provisions of 10 CFR 52.83, “Finality of referenced NRC approvals; partial initial decision on site suitability” apply. Section 52.83 refers to the provisions of 10 CFR 52.39, “Finality of early site permit determinations”; 10 CFR 52.63, “Finality of standard design certifications”; 10 CFR 52.145, “Finality of standard design approvals; information requests”; and 10 CFR 52.171, “Finality of manufacturing licenses; information requests,” each of which applies in a COL proceeding in which the application references an ESP, DC, SDA, or ML, respectively.

The descriptions in this chapter of the ISG are based on the information required by 10 CFR 50.79 in a final SAR for a standalone COL application, and therefore can also serve as relevant guidance for other licensing processes, such as for a 10 CFR Part 50 CP application. As stated in 10 CFR 50.34(a), a preliminary SAR for a CP application must contain information sufficient to show that the site evaluation factors of 10 CFR Part 100 are met. This means that the site information in the preliminary SAR needs to reflect final site characterization data. However, additional confirmatory site characterization work may sometimes take place during the construction period, in which case the CP application needs to describe any commitments to further characterize the site.

For the assessment of external hazards under RG 1.233, the applicant should select a set of DBHLs, which form an important part of the design and licensing basis. The DBHLs determine

the design-basis seismic events and other external events that the safety-related (SR) SSCs will be required to be protected from or to withstand. As noted above regarding the DBHLs, NSRST and NST SSCs are required not to interfere with the performance of SR SSC RSFs following a Safe Shutdown Earthquake. In addition to the DBHLs, other beyond-design basis hazards may be identified. SR and NSRST SSCs credited in LBEs or to establish adequate DID may need to be specially designed to withstand or be protected from these hazards.

When supported by available methods, data, design, site information, and guides and standards, the choice of the DBHLs will be informed by a probabilistic external hazard analysis, and the applicant will include the DBHLs in the probabilistic risk assessment (PRA) after defining the design features incorporated to enable the SR SSCs to withstand or be protected from the hazards. RG 1.233 also provides guidance on a screening approach for external hazards. External hazards not supported by a probabilistic external hazard analysis will be addressed by DBHLs identified using traditional deterministic methods or a combination of probabilistic and deterministic methods.

The NRC anticipates that in many cases, the initial selection of SR SSCs and of the design-basis accidents will be based on a PRA that includes internal events but has not yet been expanded to address external hazards. With the understanding that SR SSCs must be capable of performing their required safety functions in response to external events within the DBHLs, external hazards will not introduce any new design-basis accidents.

Some design-basis external events, such as external floods or seismic events, may affect multiple reactor modules concurrently; one design objective is to prevent a substantial release for such events. In addition, as noted above if relying on a particular SSC to establish the adequacy of DID, the applicant needs to perform an analysis to determine whether the SSC should be specially designed to withstand or be protected from a given hazard.

Acceptance criteria for the different applications are based on meeting the relevant requirements of 10 CFR Part 100, Subpart B; 10 CFR 50.33; 10 CFR 50.34; 10 CFR 50.35; 10 CFR 52.17; 10 CFR 52.47, “Contents of applications; technical information”; 10 CFR 52.79, “Contents of applications; technical information in final safety analysis report”; 10 CFR 52.137, “Contents of applications; technical information”; and 10 CFR 52.157, “Contents of applications; technical information in final safety analysis report.”

Contents of Chapter 2, “Site Information”

The following guidance applies to applications that establish site characteristics (i.e., CPs, OLs, and COLs not referencing an ESP). For an application for a DC, SDA, or ML, the applicant should identify a complete set of postulated site parameters, together with a summary statement of the basis for the selection of the value of each postulated parameter. These bases may, but need not, reflect the considerations for establishing site characteristics as described in section 2.1 and sections 2.4 through 2.6 below.[4] The values of each parameter should be reasonable, i.e., the parameters should be chosen so as to avoid limiting the potential sites at which the

[4] Site parameters for Sections 2.2, “Geography and Demography,” and 2.3, “Nearby Industrial, Transportation, and Military Facilities,” are not expected to be developed because they relate to site characteristics that are the actual physical, environmental, and demographic features of a site. Site characteristics for these sections are expected to be specified in an ESP, CP, or a COL that does not reference an ESP. A DC, SDA, or ML application should note that the applicant referencing the DC, SDA, or ML is responsible for providing the information described in Section 2.2, and 2.3 of this guidance.

proposed standard design could be built to a very small number. Applications that include a request for site approval (i.e., applications for a CP, an OL[5], an ESP, or a COL not referencing an ESP) should include the following information:

2.1 Site Characteristics and Site Parameters

2.1.1 *Application Guidance*

Under 10 CFR 100.20, and 10 CFR 100.3, this subsection should give an overview of the site location; the surrounding area; local and regional geological, seismological, hydrological, and meteorological characteristics; current and projected population distributions in the surrounding area; land use; and access control to surrounding areas. The paragraphs below detail the information requested and the acceptance criteria in each area. In providing the information requested, the applicant should identify the regulatory guidance used and justify it as appropriate for use. For a CP or COL application referencing a DC, SDA, or ML, the application should demonstrate that the site characteristics fall within the postulated site parameters in the referenced DC, SDA, or ML. The applicant should reference any previous studies used to justify conclusions about the site and should make such studies available for NRC staff inspection or audit.

Under 10 CFR 100.20(a) and 10 CFR 100.21(f)–(g), the application must confirm that the site poses no significant impediments to the development of emergency plans, that adequate security measures can be developed, and that the radiological risk to the public from potential accidents is low.

2.1.2 *Review Guidance*—Acceptance Criteria

The NRC staff reviewer should ensure that the application includes sufficient information to understand the site characteristics and site parameters. The reviewer should be able to reach and document the applicable safety findings for this topic in the NRC staff's safety evaluation report if the application includes the following information:

a. The application provides and substantiates sufficient information to establish the actual characteristics of the proposed site (for CP, OL, and for COL applications not referencing an ESP) or has postulated site parameters (for DC, SDA, and ML applications) that will be used to demonstrate that the facility meets the underlying regulatory requirements. More detailed information related to the review of site characteristics and site parameters is provided in the subsequent sections of this ISG.

b. For CPs and COLs that reference a DC, SDA, or ML, the actual site characteristics fall within (i.e., are bounded by) the corresponding site parameters postulated in the DC, SDA, or ML.

c. The information provided is sufficient to determine that there are no constrictions to egress pathways needed for emergency plans, and that there are multidirection egress pathways to support both the relocation of members of the public to a safe place and the

[5] As a general matter, the siting issues are resolved for the OL in the CP proceeding. The staff notes however that during the construction, site information may change (e.g., geology revealed during the excavation, additional meteorology collected during construction, changes in population around the site) such that review of such updated site information is appropriate at the OL stage.

ingress of emergency responders to the site, following or in anticipation of a release of radioactive material.

d. The application contains sufficient information to conclude that the site does not contain any geographical features that would give an attacker a tactical advantage or impede the establishment of effective security measures.

e. For a CP application or COL application that does not reference an ESP, SDA, DC, or ML, to demonstrate low radiological risk to the public, the application includes information to show that the requirements of 10 CFR 50.34(a)(1) or 10 CFR 52.79(a)(1)(vi), respectively, are met when using site-specific characteristics established at the proposed site, and that Part 20 limits for normal effluents are met.

2.2 Geography and Demography

2.2.1 Site Location and Description

2.2.1.1 *Application Guidance*

This subsection should include a suitably scaled map depicting the site area, with explanatory text as necessary. The application should specify the location of each reactor at the site by latitude and longitude to the nearest second and by Universal Transverse Mercator coordinates (zone number, northing, and easting, as found on topographical maps prepared by the U.S. Geological Survey) to the nearest 100 meters (328 feet). The applicant should consult the U.S. Geological Survey map index for the specific names of the 7½-minute quadrangles that bracket the site area. This section should also identify the Federal, State, and county jurisdictions (or other political subdivisions) in which the site is located, as well as the location of the site relative to prominent natural features (such as rivers and lakes) and human-made features (such as industrial, military, and transportation facilities).

2.2.1.2 *Staff Review Guidance*—Acceptance Criteria

The NRC staff reviewer should ensure that the application includes sufficient information to understand site geography and demography. The reviewer should be able to reach and document the applicable safety findings for this topic in the NRC staff's safety evaluation report if the application includes the following information:

a. The site map describes highways, railroads, and waterways that traverse the exclusion area and provides a complete topographical description of the site and surrounding area out to 80 kilometers (km) (50 miles).

b. The site map contains sufficient information to identify the types and locations of natural and human-made features and potential hazards on or near the site and the local, State, and Federal jurisdictions associated with the site and its surrounding area.

2.2.2 Exclusion Area Authority and Control

2.2.2.1 *Application Guidance*

This subsection should describe the exclusion area and the applicant's legal rights with respect to all areas that lie within the designated exclusion area. The description should establish that

the applicant has the authority to determine all activities within the exclusion area, including control of traffic and exclusion and removal of personnel and property from the area. It should also address the status of mineral rights and easements within this area.

If the applicant does not own all land within the exclusion area, it should provide a scaled map of the exclusion area that clearly identifies the parcels of land not owned. The applicant should also clearly describe the status of the proceedings and the schedule to obtain ownership or the required authority over the land for the life of the facility. This section should give the minimum distance to and direction of the exclusion area boundary for both present and proposed ownership. If the exclusion area extends into a body of water, the application should specifically address the bases upon which it has been determined that the applicant holds (or will hold) the required authority over this portion of the exclusion area.

The application should describe all activities that will be permitted within the exclusion zone or that are unrelated to facility operation (aside from transit through the area). These activities should not pose a significant hazard to public health and safety. The application should discuss limitations and conditions imposed to control activities unrelated to facility operations, including the prevention of accidents associated with such activities, arrangements for traffic control, and abandonment or relocation of roads.

2.2.2.2 *Staff Review Guidance*—Acceptance Criteria

The NRC staff reviewer should ensure that the application includes sufficient information to understand the exclusion area authority and control. The reviewer should be able to reach and document the applicable safety findings for this topic in the NRC staff's safety evaluation report if the application includes the following information:

a. The application has provided and substantiated information concerning its plan to obtain legal authority to determine all activities within the designated exclusion area for the staff to conclude that the applicant's plan is in compliance with the exclusion area control requirements of 10 CFR 100.21(a) and 10 CFR 100.3.

b. The application demonstrates that activities permitted within the exclusion area pose no hazard to the facility and that persons engaged in such activities can be evacuated when necessary.

c. A DC, SDA, or ML application postulates an EAB for the purposes of calculating doses to meet the criteria in §§ 52.47(a)(2)(iv)(A), 52.137(a)(2)(iv)(A), or 52.157(d)(1), respectively.

2.2.3 Population Distribution

2.2.3.1 *Application Guidance*

Under 10 CFR 100.3, "Definitions," and 10 CFR 100.21(a), (b), and (h), the application should provide population data, based on the latest census data, for the projected year of facility approval and each decade thereafter, through the end of the requested operating period for the facility (which does not exceed 40 years), using a geographical format as given in RG 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants" (Ref. 7). The application should identify and describe the specific location(s) of potentially affected populations surrounding the site. It should discuss proposed exclusion area boundaries and

local and surrounding-area access control, activities, traffic, and transient and permanent population densities that may be influenced by the facility or surrounding recreational land use. The level of detail and extent of these discussions should be commensurate with the potential vulnerabilities and risks associated with normal and off-normal facility operations. This section should describe the following:

- the population within the outer edge of the plume exposure pathway emergency planning zone
- population information necessary for ingestion response planning
- the transient population
- the low-population zone (LPZ)
- the nearest boundary of the closest population center containing 25,000 or more residents
- the population density out to 32 km (20 miles) from the proposed facility site (refer to RG 4.7, "General Site Suitability Criteria for Nuclear Power Stations," (Ref. 8)[6]

2.2.3.2 *Staff Review Guidance*—Acceptance Criteria

The NRC staff reviewer should ensure that the application includes sufficient information to understand the population distribution. The reviewer should be able to reach and document the applicable safety findings for this topic in the NRC staff's safety evaluation report if the application includes the following information:

a. The application confirms that the population data provided are based on the latest census, describes the methods and sources used to make future population projections, confirms that these methods and sources are reasonable, and provides projected population distributions for the year of projected facility approval and throughout the requested operating period for the facility (which does not exceed 40 years).

b. The application describes the timing and magnitude of any transient populations in the vicinity of the site, as well as the reasons for their presence.

c. The application defines the LPZ and demonstrates that protective measures can be taken for the population within the LPZ.

d. The application shows that the distance from the facility to the nearest population center containing 25,000 or more people is at least 1.33 times the distance from the facility to the outer edge of the LPZ, so that the facility is located away from densely populated centers.

[6] In a Staff Requirements Memorandum titled, "Staff Requirements – SECY-20-0045 – Population-Related Siting Considerations for Advanced Reactors," dated July 13, 2022 (ADAMS Accession No. ML22194A885), the Commission directed the staff to revise the guidance in RG 4.7. The revised guidance is to provide technology-inclusive, risk-informed, and performance-based criteria to assess population-related issues in siting advanced reactors.

e. The population density data conform to the guidelines in RG 4.7; and

f. The exclusion area does not contain any residents, OR if people reside within the exclusion area, they are subject to ready removal, if necessary.

g. A DC, SDA, or ML application postulates an LPZ for the purposes of calculating doses to meet the criterion in §§ 52.47(a)(2)(iv)(B), 52.137(a)(2)(iv)(B), or 52.157(d)(2), respectively.

2.3 Nearby Industrial, Transportation, and Military Facilities

2.3.1 *Application Guidance*

Under 10 CFR 100.20(b) and 10 CFR 100.21(e), the applicant must evaluate potential hazards associated with nearby transportation routes, industrial and military facilities, and civilian and military airports. The application should describe potential external hazards or hazardous materials that are present or transported near the proposed facility, or that may reasonably be expected to be present or transported near the proposed facility, during the projected lifetime of the proposed facility. The applicant should also determine whether bulk storage or transportation of hazardous materials may occur at or near the site and should assess the impact of potential explosions (see RG 1.91, "Evaluations of Explosions Postulated to Occur at Nearby Facilities and on Transportation Routes near Nuclear Power Plants," (Ref. 9)) and hazardous chemical releases on facility safety. The application should include an assessment of the nature and extent of nearby activities, including their location, distance from the site, and frequency, as well as the potential hazard they pose to the proposed facility.

The application should assess the hazards associated with industrial and military activities within 8 km (5 miles) of the site, with special attention to activities within 1 km (0.6 miles) of the site that could damage the facility. Facilities and activities at distances greater than 8 km (5 miles) should also be considered if they could affect SR features of the facility. For example, major airports within 16 km (10 miles) should be identified. The evaluation should be based on statistical data for each identified hazard. If the applicant cannot determine the frequency of the hazard, it is acceptable to use an initiating event frequency of one in one million per year and provide a qualitative justification that the realistic frequency is lower. If the event sequence has the potential to cause a release exceeding the dose guidelines, the application should consider the hazard, and the applicant should identify the design functions for the SSCs credited with mitigating the event sequence associated with the hazard.

RG 1.233 and NEI 18-04 describe how to assess the inclusion of hazards when identifying and evaluating LBEs under the licensing modernization project (LMP) approach. The application should show that these hazards pose no undue risk to the facility, because they either are rare events,[7] have negligible consequences, or are considered in the facility safety design. RG 4.7 further explains the scope of the hazards to be considered.

2.3.2 *Staff Review Guidance*—Acceptance Criteria

The NRC staff reviewer should ensure that the application includes sufficient information to understand nearby industrial, transportation, and military facilities. The reviewer should be able

[7] An applicant should consult event specific guidance whether an event is rare or not.

to reach and document the applicable safety findings for this topic in the NRC staff's safety evaluation report if the application includes the following information:

a. The application gives a complete and current overview of the facilities, activities, and materials located in or transported through the vicinity of the proposed site.

b. The application describes the nature and extent of activities conducted at and near the site, including (1) the products and materials likely to be processed, stored, used, or transported and (2) the nature and location of nearby facilities, their distance from the proposed facility, and the nature of any hazards they pose to the proposed facility.

c. The application provides sufficient data to establish the basis for assessing each potential hazard to the facility associated with nearby transportation routes, industrial and military facilities at the proposed site.

d. The application assesses each potential hazard at the site using the data presented and appropriate methodologies (as recommended in NEI 18-04, Revision 1, or in justified alternative guidance).

e. If applicable, the application assesses aircraft hazards associated with nearby airports, federal airways, holding and approach patterns, military airports, training routes, and training areas in accordance with NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," Section 3.5.1.6, "Aircraft Hazards" (Ref. 10). See Appendix A of this ISG for guidance that the NRC staff is considering developing in this area.

2.4 Regional Climatology, Local Meteorology, and Atmospheric Dispersion

2.4.1 *Application Guidance*

In accordance with 10 CFR 100.20 and 10 CFR 100.21, this subsection of the application should describe meteorological characteristics at the site and the surrounding area, including sources for the severity of meteorological hazards used to establish the design bases, as reflected in site characteristics (CPs, OLs, ESPs, and COLs not referencing an ESP) or postulated site parameters (DCs, SDAs and MLs). The application should describe the overall climate of the region, including general airflow patterns (wind direction and speed), temperature and humidity, precipitation (rain, snow, sleet, and freezing rain), potential influences from regional topography, and relationships between synoptic-scale atmospheric processes and local (site) meteorological conditions.

Regional meteorological data should be based on climate summaries produced by the National Oceanic and Atmospheric Administration (NOAA) and severe weather data from the National Weather Service (NWS), military sources, or other recognized organizations. The application should reflect the results of an examination of historical records on temperatures and annual and seasonal (if available) frequencies of severe weather phenomena, including hurricanes, tornadoes and waterspouts, thunderstorms, severe wind events, lightning, hail (including probable maximum size), and high air pollution potential. Where applicable, the annual frequency of occurrence, amount, and time duration of freezing rain (ice storms) and dust (sand) storms should be provided.

RG 1.76, “Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants,” (Ref. 11), and RG 1.221, “Design-Basis Hurricane and Hurricane Missiles for Nuclear Power Plants,” (Ref. 12), contain information on developing the site characteristics (standalone CPs, OLs, and COLs) for tornado and hurricane hazards, respectively. The application should reflect sufficient data to support the definition of design-basis wind velocities, precipitation (rain, snow, sleet, hail, and freezing rain), temperatures, and tornadoes and tornado missiles, including the effects of these phenomena on the ultimate heat sink (UHS) (see RG 1.27, “Ultimate Heat Sink for Nuclear Power Plants,” (Ref. 13), for additional guidance).

In general, the 100-year return period should be used to select the extremes in rainfall, snowpack, windspeed, humidity, and temperature. Data on severe weather phenomena should be based on standard meteorological records from nearby representative NWS, military, or other stations recognized as standard installations that have long periods of data on record. The applicability of these data to represent site conditions during the expected period of reactor operation should be substantiated.

As described in RG 1.23, “Meteorological Monitoring Programs for Nuclear Power Plants,” (Ref. 14), atmospheric dispersion estimates for use in accident analysis should be based on a representative consecutive 2-year period (at a minimum) of onsite meteorological data. Long-term atmospheric dispersion estimates for routine (normal) release should also be based on at least 2 years of onsite meteorological data and should cover special receptors out to 80 km (50 miles). If 2 years of onsite data are not available when the application is submitted, the applicant should provide at least one annual cycle of meteorological data collected on site with the application. The applicant should then continue to monitor the data and submit the complete 2-year data set when it has been collected. RG 1.23 also provides other options that an applicant may choose for collecting meteorological data for an ESP. Three or more years of data are preferable and, if available, should be submitted with the application.

If the historical information is not included in the application, it should be available in a separate report for NRC staff audit, if necessary. At a minimum, the application should summarize the basis for establishing the meteorological parameters and values selected for design.

An onsite meteorological measurement program may be necessary to support the analysis. RG 1.23 contains guidance for acceptable onsite meteorological programs; deviations from this guidance should be discussed and justified.

Sufficient information should be provided to enable estimation of (1) short-term atmospheric dispersion during accident releases and (2) long-term atmospheric dispersion for routine releases, during both normal and off-normal facility operating conditions. Guidance for obtaining the short-term atmospheric dispersion estimates appear in RG 1.145, “Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants,” (Ref. 15) and can be implemented through the use of the PAVAN computer model (Ref. 16). Guidance for obtaining the long-term (routine-release) atmospheric dispersion estimates appear in RG 1.111, “Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors,” (Ref. 17) and can be implemented through the use of the XOQDOQ computer model (Ref. 18).

If a reactor design includes a control room and calls for operator action either to perform required safety functions or to implement DID measures, the application should provide sufficient information to estimate atmospheric dispersion values for design-basis control room radiological habitability assessments. RG 1.194, “Atmospheric Relative Concentrations for

Control Room Radiological Habitability Assessments at Nuclear Power Plants," (Ref. 19), describes methods acceptable for estimating these values using the ARCON (either ARCON96 or ARCON 2) computer model.

2.4.2 *Staff Review Guidance*—Acceptance Criteria

The NRC staff reviewer should ensure that the application includes sufficient information to understand regional climatology, local meteorology, and atmospheric dispersion. The reviewer should be able to reach and document the applicable safety findings for this topic in the NRC staff's safety evaluation report if the application includes the following information:

a. The application's description of the regional climate is based on climate summaries produced by NOAA or conforms to NRC guidance documents that cover specific site characteristics or for DCs, SDAs, or MLs the application includes postulated climatological parameters.

b. The application's data on severe weather that may affect the facility are based on data from NOAA, the NWS, military sources, or other recognized organizations or conform to NRC guidance documents that cover specific site characteristics or for DCs, SDAs, or MLs the application includes postulated climatological parameters.

c. The application's descriptions of tornado characteristics and associated missiles for the site or for DCs, SDAs, or MLs postulated tornado and associated missile parameters conform to the guidance in RG 1.76.

d. The application's descriptions of hurricane wind and associated missile characteristics for the site or for DCs, SDAs, or MLs postulated hurricane wind and associated missile parameters conform to RG 1.221.

e. The application describes the other local meteorological characteristics or for DCs, SDAs, or MLs the postulated meteorological parameters (e.g., temperatures, humidity, rainfall) that are used in the design or that may affect the UHS and assesses the effects of these phenomena on the UHS. The application follows the guidance in RG 1.27 to assess the performance of UHS systems that rely on water sources to reject heat. As recognized in RG 1.232, "Guidance for Developing Principal Design Criteria for Non-Light-Water Reactors," (Ref. 20), some advanced reactor design may use the surrounding atmosphere as the UHS. In such cases RG 1.27 may not directly apply and the application should include local climate characteristics or for DCs, SDA, or MLs postulated meteorological parameters that ensure that the UHS meets the principal design criteria for the design.

f. The application provides joint frequency distributions (see RG 1.23 for a description) for use in the atmospheric dispersion models described in RG 1.145 and RG 1.111.

g. If the reactor design includes a control room and calls for operator action either to perform RSFs or to implement DID measures, the application provides hourly meteorological data from the onsite meteorological monitoring program (see RG 1.23) for use in the atmospheric dispersion model described in RG 1.194.

2.5 Hydrological Description

2.5.1 *Application Guidance*

Under 10 CFR 100.20(c) and 10 CFR 100.21(d), applications should describe all site hydrological characteristics (CPs, OLs, ESP, and COLs not referencing an ESP) or postulated hydrological site parameters (DCs, SDAs, and MLs) (e.g., probable maximum flood, ground water table, aquifers) and summarize the design bases for the site characteristics or postulated site parameters and values selected for the design of SR SSCs and the analysis of the transport of radioactive material resulting from postulated spills or leaks of liquid waste. Details of the hydrological information used to establish site characteristics or postulated site parameters may be documented in a separate report that is made available for NRC staff audit.

2.5.2 *Staff Review Guidance*—Acceptance Criteria

The NRC staff reviewer should ensure that the application includes sufficient information to understand the hydrology of the site. The reviewer should be able to reach and document the applicable safety findings for this topic in the NRC staff's safety evaluation report if the application includes the following information:

a. The application provides sufficient data to determine the surface water and groundwater hazards that could occur in the vicinity of the facility that could affect the SR SSCs at the facility and to assess pathways and travel times through surface and ground water for carrying radioactive material offsite.

b. The application provides sufficient data on the interface of the facility with the flood plain for floods of different sizes, as well as data on the possible causes of the floods.

c. A DC, SDA, or ML application includes postulated site parameters for the items identified in (a) and (b) above.

2.5.3 Floods

2.5.3.1 *Application Guidance*

For sites located in river valleys, on flood plains, or along coastlines with a potential for flooding, the application should describe the potential for floods and define the probable maximum flood. The applicant should describe the potential for flooding using RG 4.7 and RG 1.59, "Design Basis Floods for Nuclear Power Plants," (Ref. 21). The level of analysis presented in this subsection may range from conservative analysis, based on simplifying assumptions, to detailed analytical estimates.

The applicant should consider the following phenomena or conditions:

- floods resulting from the probable maximum precipitation, both on site and on the contributing drainage area
- runoff floods for streams, reservoirs, adjacent drainage areas, and site drainage, and flood waves resulting from dam failures induced by runoff floods
- surges, seiches, and wave action

- tsunami
- nonrunoff-induced flood waves attributable to dam failures or landslides, and floods attributable to failure of onsite or near-site water control structures
- ice jam flooding
- combinations of various flood types (e.g., riverine flood plus dam failure flood)
- stream channel migration hazards related to flooding and mudflows

In addition, the applicant should consider the following:

- how blockages due to natural events, low-water or drought effects, channel migrations and diversions, and capacity requirements could affect required safety functions and DID measures associated with cooling water sources
- dilution and dispersion of accidental releases to the hydrosphere affecting existing and potential future users of surface and ground water resources

2.5.3.2 *Staff Review Guidance*—Acceptance Criteria

The NRC staff reviewer should ensure that the application includes sufficient information to understand flooding of the site. The reviewer should be able to reach and document the applicable safety findings for this topic in the NRC staff's safety evaluation report if the application includes the following information:

a. The application describes the design-basis flood proposed for the site, and its basis conforms to the guidance in RG 1.59. The applicant has followed the guidance in RG 1.233 to determine DBHLs for external hazards (e.g., for seismic or flood events) that the SR SSCs will be required to be protected from or to withstand.

b. The application describes the probable maximum precipitation at the site, the drainage paths, and their potential for blockage.

c. For coastal sites, the application describes the potential for storm surge tsunamis and seiches, including their sources and any past or future postulated events in the vicinity.

d. The application describes the potential for and effects of upstream and downstream dam failures.

e. The application describes any other mechanisms that could cause floods (e.g., ice jams) or low-water situations at the site, and their impact on the design's required safety functions or DID measures.

f. For DC, SDA, or ML applications, the application provides a flooding site parameter for the design. The DC should note that an applicant referencing the DC must demonstrate that the flooding site characteristic falls within the flooding site parameter. (A DC may set a maximum design basis flood height at a specified distance below the plant grade and

the COL applicant is responsible for ensuring the flooding site characteristic falls within such a site parameter or request a departure.)

2.5.4 Flooding Protection

2.5.4.1 *Application Guidance*

The application should identify site elevations, structures, exterior accesses, equipment, and systems that could affect required safety functions or DID measures, and it should describe these from the standpoint of flood hazard (both surface and subsurface). The application should include a topographic map of the site showing any proposed changes to natural drainage features. RG 1.102, "Flood Protection for Nuclear Power Plants," (Ref. 22), contains guidance on identifying and establishing the necessary protections for SR SSCs that may be exposed to flooding and on implementing appropriate protection measures. If relying on a particular SSC to establish the adequacy of DID, the applicant needs to perform an analysis to determine whether the SSC should be specially designed to withstand or be protected from a flooding hazard.

The application should discuss existing and proposed water control structures, both upstream and downstream, that may influence conditions at the site. For these structures, the application should reflect the following:

- Contributions of all drainage areas.
- Types of structures, all appurtenances, ownership, seismic design criteria, and spillway design criteria.
- Elevation-area-storage relationships and short-term and long-term storage allocations for pertinent reservoirs.

If the application credits temporary flood protection, the application should provide the time frame and basis for executing the temporary flood protection measures, including procedures, before an anticipated severe storm or flooding event.

2.5.4.2 *Staff Review Guidance*—Acceptance Criteria

The NRC staff reviewer should ensure that the application includes sufficient information to understand flooding protection for the site. The reviewer should be able to reach and document the applicable safety findings for this topic in the NRC staff's safety evaluation report if the application includes the following information:

a. The application describes the SR SSCs exposed to flooding and the measures included in the design to protect them. NSRST SSCs credited in LBE sequences or to establish adequate DID may need to be specially designed to withstand or be protected from flood hazards.

b. If temporary flood protection measures are provided, these flood temporary measures are determined to be adequate to protect the SR SSC and that the time frame and basis for executing these measures is reasonable.

c. For DC, SDA, or ML applications, the application provides flooding protection measures associated with the design.

2.5.5 Ground Water

2.5.5.1 *Application Guidance*

The application should describe the location, size, shape, and other hydrological characteristics of streams, lakes, shore regions, and ground water environments near the site.

A regional map showing major hydrologic features should be provided. The application should list the owner, location, and rate of use of surface and groundwater by users whose intakes could be adversely affected by accidental release of contaminants.

2.5.5.2 *Staff Review Guidance*—Acceptance Criteria

The NRC staff reviewer should ensure that the application includes sufficient information to understand ground water of the site. The reviewer should be able to reach and document the applicable safety findings for this topic in the NRC staff's safety evaluation report if the application includes the following information:

a. The application describes the local and regional ground water usage.

b. The application describes the effects of ground water on foundations of SR structures and other SR SSCs. NSRST SSCs credited in LBE sequences or to establish adequate DID may need to be specially designed to withstand or be protected from the effects of ground water.

c. The application describes the measures taken to protect SR foundations and SSCs from ground water effects and prevent their deterioration. NSRST SSCs credited in LBE sequences or to establish adequate DID may need to be specially designed to withstand or be protected from the effects of ground water.

d. The application describes any measures taken (e.g., dewatering systems) to keep ground water within the design basis and as applicable the treatment of such systems (e.g., whether such systems are SR, non-safety-related with special treatment).

e. The application contains a regional map showing major hydrological features, including the owners and rates of use of surface and ground water resources.

f. For DC, SDA, or ML applications, the application provides a description of the design features associated with the protection of the facility from ground water effects.

2.6 Geology, Seismology, and Geotechnical Engineering

In accordance with 10 CFR 100.21(d) and 10 CFR 100.23, "Geologic and seismic siting criteria," the application should provide sufficient information on the seismological and geological characteristics of the site and surrounding region to permit an analysis of the proposed site for load bearing capability and seismic activity. This analysis should include derivation of the site-specific ground motion response spectrum (GMRS) and support analysis of the structures

and seismic effects on SSCs at the proposed site. The GMRS[8] is determined based on the geological, seismological, and engineering characteristics of the site and its environs. The size of the region to be investigated and the type of data pertinent to the investigations is described in RG 1.208, "A Performance -Based Approach to Define the Site-Specific Earthquake Ground Motion," Revision 0, issued March 2007 (Ref. 23), and should be determined based on an initial evaluation of the regional seismic hazards and their potential impact on the proposed facility. The application should summarize the relevant studies describing the site, the investigations performed, and the investigation results and conclusions. Detailed geological information should be documented in a separate report that is available for the NRC staff to audit.

The staff notes that it is considering updating the guidance found in RG 1.208. Appendix A of this document notes some of the updates that are under consideration. Should an applicant want to use an approach that departs from approved guidance, it should discuss its plans with the NRC staff during the preapplication phase.

2.6.1 Geologic Hazards

2.6.1.1 *Application Guidance*

The application should provide the geological and seismological information that forms the basis for the seismic source characterization model (SSCM) used for the probabilistic seismic hazard analysis (PSHA) for the site. For sites in the central and eastern United States (CEUS), the model in NUREG-2115, "Central and Eastern United States Seismic Source Characterization for Nuclear Facilities," issued January 2012 (Ref. 24), is acceptable as a starting point for the SSCM. For potential seismic sources within the site region (i.e., within 320 km (200 miles) of the site) that are not included in the NUREG-2115 CEUS seismic source characterization model (SSCM), the applicant should conduct geologic investigations to determine whether these features warrant inclusion in the final SSCM. RG 1.208 provides guidance for performing these geologic investigations. For sites in the western United States (WUS), the applicant should develop the SSCM following the guidance in NUREG-2213, "Updated Implementation Guidelines for SSHAC Hazard Studies," issued October 2018 (Ref. 25). In particular, the applicant should describe the data, models, and methods relevant to the development of the SSCM for the site and should include an estimate of the uncertainty associated with each hazard input used in the model. As well as developing the SSCM, the applicant should identify any potential hazard conditions caused by human activities (e.g., mining, quarrying, fluid injection or withdrawal) that may influence the site's suitability.

The application should reflect consideration of the following:

(1) Regional geology—all geologic, seismic, tectonic, and nontectonic hazards within the site region, including the regional tectonics (with emphasis on the Quaternary Period), structural geology, seismology, paleoseismology, physiography, geomorphology, stratigraphy, and geological history within the site region (i.e., within 320 km (200 miles) of the site)

[8] For DCs, SDAs, and MLs the designer develops certified seismic design response spectra (CSDRS). The designer uses the CSDRS in the analysis of the structures and seismic effects on SSCs at a hypothetical site. The CSDRS are reviewed by the staff and described as part of the DC, SDA, and ML safety analysis reports. An applicant referencing a DC, SDA, or ML to place a reactor at a specific site needs to provide information in the application that demonstrates the site-specific GMRS falls within the CSDRS developed for the standard design in the DC, SDA, or ML, or the applicant justifies a departure.

(2) Site geology—the site-related geologic features, seismic conditions, and conditions caused by human activities, at appropriate levels of detail, within areas approximately defined by radii of 40 km (25 miles), 8 km (5 miles), and 1 km (0.6 miles) around the site

2.6.1.2 *Staff Review Guidance*—Acceptance Criteria

The NRC staff reviewer should ensure that the application includes sufficient information to understand geological, seismological, and engineering characteristics of the site and its environs. The reviewer should be able to reach and document the applicable safety findings for this topic in the NRC staff's safety evaluation report if the application includes the following information:

a. The application describes the SSCM and its basis.

b. The application evaluates the potential hazard conditions caused by human activities.

2.6.2 Vibratory Ground Motion

2.6.2.1 *Application Guidance*

The application should describe the ground motion characterization (GMC) model and site response analysis used in the PSHA in order develop seismic hazard curves and the GMRS for the site. Consistent with the development of the SSCM, the applicant should describe the data, models, and methods relevant to the development of the GMC model for the region, including an estimate of the uncertainty associated with the model. For CEUS sites, the Next Generation Attenuation-East GMC model should be used. For WUS sites, the Southwestern United States GMC model has been previously approved and may be suitable with regional and local adjustments to the model. To quantify the influence of the site geologic profile on the amplitude and frequency of seismic waves propagating to the profile surface, the applicant should perform a site response analysis. The site response analysis may be performed as part of the GMC model development or separately if a regionally developed GMC model is used. In either case, the site response analysis should also capture alternative data, models, and methods in developing the site adjustment factors. The site response analyses used to determine the GMRS should also be used to determine the foundation input response spectra (FIRS) for each seismic Category I structure.

2.6.2.2 *Staff Review Guidance*—Acceptance Criteria

The NRC staff reviewer should ensure that the application includes sufficient information to understand the vibratory ground motion of the site. The reviewer should be able to reach and document the applicable safety findings for this topic in the NRC staff's safety evaluation report if the application includes the following information:

a. The application describes the GMC model and its basis.

b. The application describes the data, models, and methods used to develop the site adjustment factors.

c. The application describes the approach used to perform the PSHA for the site.

d. The application provides the basis for the adequacy of the site GMRS and FIRS as inputs for the design ground motions for the facility.

e. For DC, SDA, or ML applications, the application includes the certified seismic design response spectra (CSDRS). The designer uses the CSDRS in the analysis of the structures and seismic effects on SSCs at a hypothetical site. The CSDRS are reviewed by the staff and described as part of the DC, SDA, and ML safety analysis reports. (An applicant referencing a DC, SDA, or ML to place a reactor at a specific site needs to provide information in the application that demonstrates the site-specific GMRS falls within the CSDRS developed for the standard design in the DC, SDA, or ML, or the applicant justifies a departure.)

2.6.3 Surface Deformation

2.6.3.1 *Application Guidance*

The application should state whether there is a potential for surface deformation that could affect the site. It should summarize the surface and subsurface geological, seismological, geophysical, and geotechnical investigations performed around the site that provide the basis for this conclusion. RG 1.208 provides guidance on acceptable methods for investigations on potential surface deformation.

2.6.3.2 *Staff Review Guidance*—Acceptance Criteria

The NRC staff reviewer should ensure that the application includes sufficient information to understand surface deformation. The reviewer should be able to reach and document the applicable safety findings for this topic in the NRC staff's safety evaluation report if the application includes the following information:

a. For site investigations on surface deformation, the applicant provides a description of the methods and results of the investigations.

b. A demonstration that the site does not have the potential for surface deformation.

c. For DC, SDA, or ML applications, the application provides a discussion on whether the design considered the possibility of local surface deformation that could potentially impact safety-significant SSCs.

2.6.4 Stability of Subsurface Materials and Foundations

2.6.4.1 *Application Guidance*

The application should describe the properties and stability of all soils and rock layers that may affect the nuclear power plant facilities, under both static and dynamic conditions, including the vibratory ground motions associated with the GMRS. The applicant should follow the guidance in RG 1.132, "Geologic and Geotechnical Site Characterization Investigations for Nuclear Power Plants," Revision 3, issued December 2021 (Ref. 26), for investigating the load-bearing properties of the soil and rock. The applicant should conduct laboratory and field testing to estimate the properties of rock and soil layers in the subsurface underneath the facility following RG 1.138, "Laboratory Investigations of Soils and Rocks for Engineering Analysis and Design of Nuclear Power Plants," Revision 3, issued December 2014 (Ref. 27). The application should

describe how the stability of these materials influences the safety of seismic Category I facilities and discuss the site conditions and geologic features that may affect nuclear power plant structures or their foundations. The application should include information on excavations and backfilling, providing earthwork analyses where these activities involve seismic Category I facilities. The application should describe the sources, qualities, and quantities of backfill materials needed; justify the compaction specifications and procedures to be used; and discuss quality control methods for backfill compaction. The applicant should investigate the potential for liquefaction at the site following the guidance in RG 1.198, “Procedures and Criteria for Assessing Seismic Soil Liquefaction at Nuclear Power Plant Sites,” Revision 0, issued November 2003 (Ref. 28).

2.6.4.2 *Staff Review Guidance*—Acceptance Criteria

The NRC staff reviewer should ensure that the application includes sufficient information to understand the stability of subsurface materials and foundations. The reviewer should be able to reach and document the applicable safety findings for this topic in the NRC staff’s safety evaluation report if the application includes the following information:

a. The application describes the geological, engineering, and hydrogeological characteristics of the proposed site and conforms with the guidance in RG 1.132 (or a justified alternative).

b. The application describes the subsurface soil and rock properties and conforms with the guidance in RG 1.138 (or a justified alternative). The application contains sufficient data to justify the soil and rock properties used in the analysis of foundations for seismic Category I structures.

c. The foundations of seismic Category I structures have adequate bearing capacity, and the predicted total and differential settlements of the foundations are within the design limits of the reactor system. If two or more reactors are placed in close proximity, the settlement analysis adequately considers the interactions between them, including any time delay in applying major structural load on the foundation.

d. The application confirms the availability of sufficient quantities and appropriate qualities of backfill. The application describes an acceptable procedure to compact the backfill and an adequate quality control program.

e. The application describes the potential for liquefaction using the guidance in RG 1.198 (or a justified alternative) and an acceptable factor of safety against liquefaction potential.

f. For DC, SDA, or ML applications, the application provides the design attributes associated with excavation, bearing capacity, settlement, liquefaction, and subsurface uniformity.

2.6.5 Stability of Slopes

2.6.5.1 *Application Guidance*

The application should present information on the static and dynamic stability of all natural and human-made earth or rock slopes (such as cuts, fills, embankments, and dams) whose failure,

under any conditions to which they could be exposed during the proposed life of the facility, could adversely affect the safety of the nuclear power plant facilities. The application should discuss site conditions, geologic features (including weak strata and the joints in the soil or rock layers), and the engineering properties of the materials comprising the slopes and their foundations. The analyses should be based on current practices and should use conservative soil and rock geometric and material properties and conservative safety margins. They should account for uncertainties in defining the boundaries between the soil/rock layers, their properties, the failure surface corresponding to the minimum factor of safety, and the location of the water table. The application should present the results of the slope stability analyses. For the stability analysis of human-made slopes, the application should include summary data and discuss construction procedures, testing, and instrumentation monitoring to ensure high-quality earthwork.

2.6.5.2 *Staff Review Guidance*—Acceptance Criteria

The NRC staff reviewer should ensure that the application includes sufficient information to understand the stability of slopes. The reviewer should be able to reach and document the applicable safety findings for this topic in the NRC staff's safety evaluation report if the application includes the following information:

a. The application describes the methods used to analyze slope stability and confirms that the analysis uses appropriate soil and rock properties. The assessment methods are commensurate with the risk associated with the reactor type.

b. The application describes the safety margins used in the analysis and confirms that these margins are consistent with state-of-the-art practice.

c. For DC, SDA, or ML applications, the application provides the design attributes associated with slope stability.

2.7 Volcanic Hazards and Screening Approach to Other External Hazards

To meet the siting requirements under 10 CFR 100.21, "Non-seismic site criteria," and 10 CFR 100.23 with respect to external hazards, the applicant must evaluate the physical characteristics of the site, including meteorology, geology, seismology, and hydrology, and must establish that potential threats from site physical characteristics will pose no undue risk to the proposed facility. The NRC developed RG 4.26, "Volcanic Hazards Assessment for Proposed Nuclear Power Reactor Sites," Revision 1, issued August 2023 (Ref. 29), to provide an acceptable risk-informed framework for the consideration of volcanic hazards in licensing new reactors. Although volcanic activity currently occurs only at certain locations in the United States, applicants may be considering siting new nuclear reactors in areas with past volcanic activity, where potential volcanic hazards may exist. The screening approach for volcanic hazards may also be applied to other external hazards. See Appendix A of this ISG for guidance that the NRC staff is considering developing in this area.

2.7.1 Volcanic Hazards

2.7.1.1 *Application Guidance*

RG 4.26 includes a screening approach for assessing volcanic hazards. The need to consider volcanic hazards is determined by information gathered during the site characterization process

required under 10 CFR 100.23(c). An additional assessment of potential volcanic hazards is indicated by either (1) a Quaternary volcano within 320 km (200 miles) of the proposed site, or (2) a volcanic deposit within 40 km (25 miles) of the proposed site, from a Quaternary volcano located more than 320 km (200 miles) away. If neither of these conditions exists, the applicant need not assess volcanic hazards.

For sites that screen in for a volcanic hazard assessment, the application should describe the potential for and effects of the following phenomena or conditions:

- ash fall
- potential for the opening of a new volcanic vent
- lava flows
- pyroclastic density currents
- debris flow
- volcanic earthquakes
- other proximal hazards

2.7.1.2 *Staff Review Guidance*—Acceptance Criteria

The NRC staff reviewer should ensure that the application includes sufficient information to understand the volcanic hazards. The reviewer should be able to reach and document the applicable safety findings for this topic in the NRC staff's safety evaluation report if the application includes the following information:

a. For sites that screen in for a volcanic hazard assessment, the application assesses the hazard consistent with the guidance in RG 4.26. The application has followed the guidance in RG 1.233 to determine DBHLs from which the SR SSCs will be protected or that the SR SSCs will be required to be protected from or to withstand. NSRST SSCs credited in LBE sequences or to establish adequate DID may need to be specially designed to withstand or be protected from volcanic hazards.

b. For DC, SDA, or ML applications, the application provides a discussion on whether the design considered the possibility of effects from volcanic hazards listed above.

2.7.2 Screening Approach for Other External Hazards

As an important part of the design and licensing basis, consistent with NEI 18-04 and RG 1.233, the applicant should select a set of DBHLs. This will determine the DBHLs that the SR SSCs will be required to be protected from or to withstand. As noted above, NSRST and NST SSCs are required not to interfere with the performance of SR SSC RSFs following a Safe Shutdown Earthquake. In addition to the DBHLs, beyond-design basis hazards may be identified. SR and NSRST SSCs credited in LBE sequences or to establish adequate DID may need to be specially designed to withstand or be protected from these hazards.

The choice of DBHLs will be informed by a probabilistic external hazard analysis when methods, data, design, site information, and guides and standards are available to support this. In this case, the applicant will include the DBHLs in the PRA after defining the design features incorporated to enable the SR SSCs to be protected from or to withstand the hazards. External hazards not supported by a probabilistic hazard analysis will be covered by DBHLs identified using traditional deterministic methods. RG 1.247 (for trial use), "Acceptability of Probabilistic

Risk Assessment Results for Non-Light-Water Reactor Risk-Informed Activities," (Ref. 30) includes an Appendix B, "Hazards for Consideration in a Probabilistic Risk Assessment," that provides additional information regarding the external hazards that should be considered as part of an application that uses the LMP-based approach.

An applicant may use a hazard screening flow diagram, such as the one for volcanic hazard assessment (refer to RG 4.26, Figure 1, "Flowchart for an acceptable volcanic hazards assessment"), to determine that some external hazards (e.g., ice jams) have no impact on the design and do not exceed regulatory limits. Applicants choosing to follow such a screening approach for hazards other than volcanic hazards should discuss their approaches with the NRC staff during the preapplication phase of the review. DANU-ISG-2022-01 contains additional guidance on preapplication discussions.

2.8 Summary of External Hazards

The application should summarize the external design-basis hazards identified for the proposed facility based on the results of the site characterization or postulated site parameters described in this chapter. For an application referencing a DC, SDA, or ML, the postulated site parameters constitute the design-basis seismic events and other external events that the SR SSCs are required to be protected from or to withstand with no adverse impact on their capability to perform their required safety functions. For an OL or COL application not referencing a DC, SDA, or ML, the site characteristics constitute the design-basis seismic and other external events. Where supported by a probabilistic hazard analysis, these design-basis external events should be included in the PRA after the design features incorporated to enable the SR SSCs to be protected from or to withstand these hazards are defined. The external design-basis hazards assessment should consider that NSRST and NST SSCs are required not to interfere with the performance of SR SSC RSFs following a Safe Shutdown Earthquake. For beyond design basis external hazards, SR and NSRST SSCs credited in LBE sequences or to establish adequate DID may need to be specially designed to withstand or be protected from these hazards.

External hazards not supported by a probabilistic hazard analysis can be identified using traditional deterministic methods. For those CP, OL, and COL applicants referencing a DC, SDA, or ML that includes postulated site parameters, the application must justify that the specific site characteristics associated with the proposed facility fall within the postulated site parameters in the referenced DC, SDA, or ML, or propose modifications to the facility, or include exemptions, as appropriate.

IMPLEMENTATION

The NRC staff will use the information discussed in this ISG to review non-LWR applications for CPs, OLs, COLs, SDAs, DCs, and MLs under 10 CFR Part 50 and 10 CFR Part 52. The NRC staff intends to incorporate this guidance in updated form in the RG or NUREG series, as appropriate.

BACKFITTING AND ISSUE FINALITY DISCUSSION

The NRC staff may use DANU-ISG-2022-02 as a reference in its regulatory processes, such as licensing, inspection, or enforcement. However, the NRC staff does not intend to use the guidance in this ISG to support NRC staff actions in a manner that would constitute backfitting as that term is defined in 10 CFR 50.109, "Backfitting," and as described in NRC Management Directive 8.4, "Management of Backfitting, Forward Fitting, Issue Finality, and Information

Requests" (Ref.31), nor does the NRC staff intend to use the guidance to affect the issue finality of an approval under 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." The staff also does not intend to use the guidance to support NRC staff actions in a manner that constitutes forward fitting as that term is defined and described in Management Directive 8.4. If a licensee believes that the NRC is using this ISG in a manner inconsistent with the discussion in this paragraph, then the licensee may file a backfitting or forward fitting appeal with the NRC in accordance with the process in Management Directive 8.4.

CONGRESSIONAL REVIEW ACT

DANU-ISG-2022-02 is a rule as defined in the Congressional Review Act (5 U.S.C. 801-808). However, the Office of Management and Budget has not found it to be a major rule as defined in the Congressional Review Act.

FINAL RESOLUTION

The NRC staff will transition the information and guidance in this ISG into the RG or NUREG series, as appropriate. Following the transition of all pertinent information and guidance in this document into the RG or NUREG series, or other appropriate guidance, this ISG will be closed.

ACRONYMS

AOO	anticipated operational occurrence
ARCAP	advanced reactor content of application project
BDBE	beyond-design basis event
CEUS	central and eastern US
CFR	*Code of Federal Regulations*
COL	combined license
CP	construction permit
DANU	Division of Advanced Reactors and Non-power Production and Utilization Facilities
DBA	design basis accident
DBE	design basis event
DBHL	design basis hazard levels
DBGMs	design basis ground motions
DC	design certification
DID	defense-in-depth
EAB	exclusion area boundary
ESP	early site permit
FIRS	foundation input response spectra
FSAR	final safety analysis report
GMC	ground motion characterization
GMRS	ground motion response spectrum
IBR	incorporate by reference
ISG	interim staff guidance
LBE	licensing basis event
LMP	licensing modernization project
LPZ	low population zone
LWR	light-water reactor
ML	manufacturing license
NEI	Nuclear Energy Institute
NOAA	National Oceanographic and Atmosphere Administration

NRC	Nuclear Regulatory Commission
NWS	National Weather Service
OL	operating license
PRA	probabilistic risk assessment
PSAR	preliminary safety analysis report
PSHA	probabilistic seismic hazard analysis
RG	regulatory guide
RSF	required safety function
SAR	safety analysis report
SDA	standard design approval
SR	Safety-Related
SSC	structure, system, and component
SSCM	seismic source characterization model
TICAP	technology inclusive content of application project
UHS	ultimate heat sink
USGS	United States Geological Survey
WUS	Western United States

REFERENCES

1. Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, “Domestic Licensing of Production and Utilization Facilities.”

2. 10 CFR Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants.”

3. U.S. Nuclear Regulatory Commission, DANU-ISG-2022-01, “Review of Risk-Informed, Technology-Inclusive Advanced Reactor Applications – Roadmap,” issued March 2024 (ADAMS Accession No. ML23277A139).

4. 10 CFR Part 100, “Reactor Site Criteria.”

5. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.233, ““Guidance for a Technology-Inclusive, Risk-Informed, and Performance-Based Methodology to Inform the Licensing Basis and Content of Applications for Licenses, Certifications, and Approvals for Non-Light-Water Reactor,” Washington DC.

6. Nuclear Energy Institute, NEI 18-04, “Risk-Informed Performance-Based Technology Guidance for Non-Light Water Reactors,” Revision 1 (ADAMS Accession No. ML19241A366).

7. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.70, “Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants,” Washington, DC

8. U.S. Nuclear Regulatory Commission, Regulatory Guide 4.7, “General Site Suitability Criteria for Nuclear Power Stations,” Washington, DC

9. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.91, “Evaluation of Explosions Postulated to Occur at Nearby Facilities and on Transportation Routes Near NPPs,” Washington, DC

10 U.S. Nuclear Regulatory Commission, NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition,” Section 3.5.1.6, “Aircraft Hazards,” Washington DC

11. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.76, “Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants,” Washington, DC

12. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.221, “Design-Basis Hurricane and Hurricane Missiles for Nuclear Power Plants,” Washington, DC

13. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.27, “Ultimate Heat Sink for NPPs,” Washington, DC

14. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.23, “Meteorological Monitoring Programs for Nuclear Power Plants,” Washington, DC

15. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.145, “Atmospheric Dispersion Models for Potential Accident Consequence Assessment at Nuclear Power Plants,” Washington, DC

16. U.S. Nuclear Regulatory Commission, NUREG/CR-2858, “PAVAN: An Atmospheric Dispersion Program for Evaluating Design Basis Accidental Releases of Radioactive Materials from Nuclear Power Plants,” November 1982 (ADAMS Accession No. ML12045A149).

17. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.111, “Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water Cooled Reactors,” Washington, DC

18. U.S. Nuclear Regulatory Commission, NUREG/CR-2919, “XOQDOQ: Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations,” September 1982 (ADAMS Accession No ML081360412).

19. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.194, “Atmospheric Relative Concentrations for Control Room Radiological Habitability Assessments at Nuclear Power Plants,” Washington, DC

20. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.232, “Guidance for Developing Principal Design Criteria for Non-Light-Water Reactors,” Revision 0, April 2018 (ADAMS Accession No. ML17325A611).

21. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.59, “Design Basis Floods for Nuclear Power Plants,” Washington, DC

22. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.102, “Flood Protection for Nuclear Power Plants,” Washington, DC

23. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.208, “A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion,” March 2007 (ADAMS Accession No. ML070310619).

24. U.S. Nuclear Regulatory Commission, NUREG-2115, “Central and Eastern US Seismic Source Characterizations for Nuclear Facilities,” (Available at: https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr2115/).

25. U.S. Nuclear Regulatory Commission, NUREG-2213, ““Updated Implementation Guidelines for SSHAC Hazard Studies,” October 2018 (ADAMS Accession No. ML18281A082).

26. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.132, “Site Investigations for Foundations of NPPs,” Revision 3, December 2021 (ADAMS Accession No. ML21298A054).

27. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.138, “Laboratory Investigations of Soils and Rocks for Engineering Analysis and Design of Nuclear Power Plants,” Revision 3, December 2014 (ADAMS Accession No. ML14289A600).

28. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.198, “Procedures and Criteria for Assessing Seismic Soil Liquefaction at NPP Sites,” Revision 0, November 2003 (ADAMS Accession No. ML033280143).

29. U.S. Nuclear Regulatory Commission, Regulatory Guide 4.26, Revision 1, “Volcanic Hazards Assessment for Proposed Nuclear Power Reactor Sites,” August 2023 (ADAMS Accession No. ML23167A078).

30. U.S. Nuclear Regulatory Commission, Regulatory Guide 1.247 (for trial use), “Acceptability of Probabilistic Risk Assessment Results for Non-Light-Water Reactor Risk-Informed Activities,” March 2022 (ADAMS Accession No. ML21235A008).

31. U.S. Nuclear Regulatory Commission, Management Directive 8.4, “Management of Backfitting, Forward Fitting, Issue Finality, and Information Requests.”

Appendix A - Draft Advanced Reactor Content of Application Project (ARCAP) Guidance Documents Under Development as of October 2023

The purpose of this appendix is to identify a list of draft guidance documents that are under consideration for future updates to this ARCAP interim staff guidance (ISG) document. These draft documents are under development and have not received a complete staff review; therefore, they do not represent official NRC staff positions. If an applicant relies on these draft documents, they will be at risk that a final NRC position will conflict with the position provided in the draft document. The table below lists the guidance under development that has the potential to cause the ARCAP ISG to be updated to reflect the final version of the draft documents listed in the second column.

Item #	Draft Document Being Considered for Possible Update	Comments
1	Regulatory Guide 1.208, "A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion," Revision 0.	The NRC staff is considering updating this guidance document to endorse the following standard with appropriate additions and clarifications: • ANSI/ANS-2.27-2020, "Criteria for Investigations of Nuclear Facility Sites for Seismic Hazard Assessments • ANSI/ANS-2.29-2020, "Probabilistic Seismic Hazard Analysis" • ASCE/SEI 43-19, "Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities" Applicants that wish to use these standards prior to the issuance of the Revision to RG 1.208 should discuss their plans with the NRC staff during the preapplication phase. The NRC staff further notes that the guidance in ASCE/SEI 43-19 uses a graded approach and that SSCs designed to seismic design criterion 5 would generally meet the requirement in 10 CFR Part 50 Appendix S. For SSCs designed to other seismic design criteria, the applicant needs to demonstrate these SSCs have sufficient margin such that 10 CFR Part 50 Appendix S requirements are met. If an applicant is using multiple design spectra that do not meet 10 CFR Part 50 Appendix S, the applicant should engage the staff during preapplication phase to discuss its plans.
2	Aircraft Impact Assessment	The NRC staff is considering updating the guidance found in NUREG-0800, "Standard Review Plan for the Review of Safety

Item #	Draft Document Being Considered for Possible Update	Comments
		Analysis Reports for Nuclear Power Plants: LWR Edition," Section 3.5.1.6, "Aircraft Hazards." The data referenced in this section is old and does not reflect that accidental aircraft impact frequency has been reduced over the years. The American Nuclear Society (ANS) is considering developing a new standard - ANS 2.36-202x, "Accident Analysis for Aircraft Crash into Reactor and Nonreactor Nuclear Facilities." The NRC staff is monitoring the development of this proposed standard and will update this ISG, as appropriate, based on the NRC staff's review and possible endorsement of this standard.
3	Revision to RG 1.59, "Design-Basis Floods for Nuclear Power Plants."	The NRC staff is considering a revision to RG 1.59 to include an Appendix K, "Considerations for Applying Guidance to Advanced Reactors and Small Modular Reactors." DG-1290 (ADAMS Accession No. ML19289E561) includes Appendix K, which would take a screening approach for design basis floods.