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Subject:	Draft White Paper Associated with Advanced Reactor Content of Application Project Chapter 2, "Site Information"
Attachments:	ARCAP Chapter 2 - Site Information - Interim Staff Guidance_DRAFT.docx

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The purpose of this email is to transmit to you the draft white paper associated with the Advanced Reactor Content of Application Project (ARCAP) Chapter 2, “Site Information.”

The staff is re-baselining its ARCAP and Technology Inclusive Content of Application Project (TICAP) draft guidance documents in July of 2021. The daft guidance associated with ARCAP Chapter 2 was previously made publicly available on November 5, 2020 (see: https://www.nrc.gov/docs/ML2031/ML20316A013.pdf). The November 2020, version was not in a draft interim staff guidance (ISG) format. The attached version is in the ISG format and other minor formatting changes have been made to the document. The technical content of the document has not changed from the previous version. The staff is reissuing some of the earlier versions of the ARCAP and TICAP guidance documents such that the documents are in a consistent format.

This email (including the attachment) will be made publicly available in ADAMS such that the documents can be referenced in Table 2 of the ARCAP/TICAP public webpage (see https://www.nrc.gov/reactors/new-reactors/advanced/details.html#advRxContentAppProj).

Please let me know if you have any questions.

Sincerely,

Joe Sebrosky
Senior Project Manager
Advanced Reactor Policy Branch
Office of Nuclear Reactor Regulation
301-415-1132

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This draft staff white paper has been prepared and is being released to support ongoing public discussions. This draft white paper uses an interim staff guidance (ISG) format because the staff is considering using this format to provide staff guidance in the near future to support the review of advanced reactor applications.

This paper has not been subject to NRC management and legal reviews and approvals, and its contents are subject to change and should not be interpreted as official agency positions.

U.S.NRC

UNITED STATES NUCLEAR REGULATORY COMMISSION

Protecting People and the Environment

DANU [XX]-ISG-[YYYY-##]

Advanced Reactor Content of Application

Chapter 2 "Site Information"

Interim Staff Guidance

July X, 2021

DANU [XX]-ISG-[YYYY-##]
Advanced Reactor Content of Application
Chapter 2 "Site Information"
Interim Staff Guidance

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INTERIM STAFF GUIDANCE

ADVANCED REACTOR CONTENT OF APPLICATION

CHAPTER 2 "SITE INFORMATION"

DANU-ISG-YYYY-##

PURPOSE

The U.S. Nuclear Regulatory Commission (NRC, or Commission) staff is providing this interim staff guidance (ISG) to facilitate the review of advanced reactor content of application guidance that is used to support reviews of non-light water reactors (non-LWRs), stationary micro reactors, and small modular LWRs submitting risk-informed applications 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"; or for a combined license (COL), manufacturing license (ML), or design certification (DC) under 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." The guidance found in this ISG supports the development of the portion of an advanced reactor application associated with an applicant's "Site Information."

It is anticipated that this guidance will be updated to use for reviews of advanced nuclear reactor license and permit applications submitted under 10 CFR Part 53, "Licensing and Regulation of Advanced Nuclear Reactors," once the content of that regulation is developed.

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 found in this ISG supplements the guidance found in DANU-ISG-YYYY-##, "Advanced Reactor Content of Application Guidance," which provides a roadmap for developing all portions of an application. The guidance in this ISG is limited to the portion of an advanced reactor application associated with the development of risk-informed site information for the nuclear reactor plant applicant.

The Part 53 regulation is under development, and as such, the guidance found in this document is subject to change based on the outcome of this rulemaking. As the 10 CFR Part 53 requirements are developed, this ISG guidance will be supplemented, as necessary, to provide guidance for developing site information to reflect any differences in requirements between Part 50/52 and Part 53. The goal of the 10 CFR Part 53 rulemaking effort is to develop the regulatory infrastructure to support the licensing of advanced nuclear reactors. The term ''advanced nuclear reactor,'' for purposes of this rulemaking, means "a nuclear fission or fusion reactor with significant improvements compared to commercial nuclear reactors operating on the date of enactment of the Energy Act of 2020" or under construction as of January 2019. This rulemaking would revise the NRC's regulations by adding a risk-informed, technology-inclusive regulatory framework for advanced nuclear reactors, in response to a growing interest in possible licensing and deployment of advanced nuclear reactors and the related requirements

of the Nuclear Energy Innovation and Modernization Act (NEIMA; Public Law 115-439), as amended by the Energy Act of 2020. Key documents related to the Part 53 rulemaking, including preliminary proposed rule language and stakeholder comments, can be found at Regulations.gov under Docket ID NRC-2019-0062.

RATIONALE

Note – this section will be updated with additional stakeholder interactions – expected during the periodic ARCAP meetings.

APPLICABILITY

This ISG is applicable to applicants for non-LWRs, stationary micro reactors, and small modular LWRs submitting risk-informed applications for a CP or OL under 10 CFR Part 50 or for a COL, DC, or ML under 10 CFR Part 52. Once the content of Part 53 is developed and this ISG is updated where necessary, this guidance will also apply to applicants for a power reactor CP, OL, DC, and ML under 10 CFR Part 53.

GUIDANCE

Chapter 2, "Site Information," of the safety analysis report (SAR) should provide information on the geological and demography, seismological, hydrological, and meteorological characteristics of the site and the surrounding vicinity. Present and projected population distribution, land use and site activities and controls should also be discussed. The purpose of this information is to demonstrate compliance with 10 CFR 100, Subpart B, "Evaluation Factors for Stationary Power Reactor Site Applications on or After January 10, 1997," and the relevant parts of 10 CFR 50 and 52 that discuss site related issues and to describe the site characteristics used in the design and safety analysis where (i) a design basis external hazard level must be specified for each system, structure, and component (SSCs) designed to withstand this hazard with no adverse impact on their capability to perform their required safety function (RSF) or (ii) an SSC is relied upon to establish the adequacy of defense-in-depth and must be designed with special treatment to withstand a given hazard. Site characterization data (e.g., meteorological, regional seismic, hydrologic) need only be provided to the extent that it is needed to provide the bases for 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 non-LWRs, stationary micro reactors and small modular LWRs submitting applications for a CP or OL under 10 CFR 50, for a COL under 10 CFR 52 or for an Early Site Permit (ESP) under 10 CFR 52. The guidance specifies the factors to be considered when evaluating sites, including seismic and non-seismic parameters. The information provided in the SAR needs to describe the basis for the site parameters selected for the design and safety analysis. However, data documenting historical records, detailed geological exploration, data for use in environmental assessments or other data not directly related to the establishment of parameters used in the design or safety analysis need not be included in the SAR. If not included in the SAR, the information should be documented in a separate report available for audit by the NRC staff, and specifically referenced in the SAR.

For design certification (DC) applications (10 CFR 52.47(a)(1)), Standard Design Approval (SDA) applications (10 CFR 52.137(a)(1)), and COL applications referencing an ESP (10 CFR 52.79(b)(1) and (2)), the Chapter 2 SAR content should describe the site-related parameters postulated for the design. Specifically, this section should address the complete set of postulated site parameters that have been considered in the design, i.e., top-level bounding site parameters that have been used to define a site as suitable for the facility. Because the postulated site parameters are used in evaluations of the safety of the design, the actual site where the design is to be located must fall within the postulated site parameters assumed in the design and safety analysis. NEI 10-01, "Industry Guideline for Developing a Plant Envelope in Support of an Early Site Permit", dated March 2010 (ADAMS Accession No. ML101050329) contains a comprehensive description of the site parameters that need to be defined to establish the site envelope.

For CP (10 CFR 50.33, 34 and 35), OL (10 CFR 50.33 and 34), ESP (10 CFR 52.17), COL (10 CFR 52.79(a)(1)(i) through (vi)), COL referencing a DC or an SDA (10 CFR 52.79) applications, this section of the SAR should demonstrate that the requirements of 10 CFR 100, Subpart B, and the site related parts of 10 CFR 50 or 52 are met and should describe the site parameters used in the design and safety analysis and their bases.

The descriptions in this chapter are based on the information that is expected to be provided in a final safety analysis report (FSAR). As described in 10 CFR 50.34(a), a preliminary safety analysis report (PSAR) should contain information sufficient to show that the site evaluation factors of 10 CFR 100 are met. This essentially means that the PSAR site information needs to reflect final site characterization data. However, in some cases additional confirmatory site characterization work may 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 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" (ADAMS Accession No. ML20091L698), a set of Design Basis External Hazard Levels (DBEHLs) will be selected to form an important part of the design and licensing basis. This will determine the design basis seismic events and other external events that the safety related (SR) SSCs will be required to withstand. When supported by available methods, data, design, site information, and supporting guides and standards, these DBEHLs will be informed by a probabilistic external hazards analysis and will be included in the probabilistic risk assessment (PRA) after the design features that are incorporated to withstand these hazards are defined. Other external hazards not supported by a probabilistic hazard analysis will be covered by DBEHLs that are determined using traditional deterministic methods.

In many cases, it is expected that the initial selection of SR SSCs and selection of the design basis accidents (DBAs) 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 are required to be capable of performing their required safety functions in response to external

events within the DBEHL, there will be no new design basis accidents introduced by external hazards.

Some design basis external events such as external floods or seismic events may impact multiple reactor modules concurrently; therefore, a design objective would be to prevent a substantial release for such events. If an SSC is relied upon to establish the adequacy of defense-in-depth, analysis may require that the SSC be designed with special treatment to withstand a given hazard.

Acceptance criteria are based on meeting the relevant requirements of the following Commission regulations:

- 10 CFR 100, Subpart B,
- 10 CFR 52.47(a)(1)),
- 10 CFR 52.137(a)(1),
- 10 CFR 52.79(b)(1) and (2),
- 10 CFR 50.33, 34 and 35,
- 10 CFR 50.33 and 34
- 10 CFR 52.17,
- 10 CFR 52.79(a)(1)(i) through (vi),
- 10 CFR 52.79, and
- 10 CFR 50.34(a)

Contents of *Site Information*

The following subsections describe the information expected to be included in the SAR for those applications that include a request for site approval (i.e. CP, OL, COL, ESP and COL referencing a DC or an SDA):

2.1 Site Characteristics and Site Parameters (Overview)

As required by 10 CFR 100.20(c), this subsection should provide an overview of the site location, the surrounding area, local and regional geological, seismological, hydrological, and meteorological characteristics. Current and projected area population distributions surrounding the site should be identified as well as land use and access control to surrounding areas. The sections below provide additional descriptions of the information requested and the acceptance criteria applicable in each of these areas. In providing the information requested in the sections below, the regulatory guidance used by the applicant should be identified and justified as appropriate for use. Deviations from the regulatory guidance used should be explained and justified. Methods used as an alternative to regulatory guidance should be described and justified. Previous studies used to justify conclusions about the site should be referenced and made available for NRC staff audit.

In accordance with 10 CFR 100.20(a), 21(f) and 21(g), the application should confirm the site does not pose any 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.

Acceptance Criteria

a. The application provides and substantiates sufficient information to establish actual characteristics of the proposed site (for CP, OL, ESP and COL applications) or has postulated site parameters used in DC or SDA applications that will likely bound actual site parameters for sites that may be proposed for locating a DC or SDA design.

b. The information provided is sufficient for the reviewer to determine that in the development of emergency plans, there are no constrictions to egress pathways and that there are multi-direction egress pathways that would support relocating members of the public to a safe location following or in anticipation of a release of radioactive material and, likewise, would support emergency responders ingress to the site.

c. 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 affect the establishment of effective security measures.

d. Regarding the demonstration of low radiological risk to the public, the application shows that the requirements of 10 CFR 50.34(a)(1) are met when using site specific parameters.

e. Regulatory guidance used is identified along with justification for its use. Alternatives to regulatory guidance or previous studies used are likewise identified and justified.

2.2 Geography and Demography

2.2.1 Site Location and Description

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 (USGS)) to the nearest 100 meters (328 feet). The applicant should consult the USGS map index for specific names of the 7½-minute quadrangles that bracket the site area. This section should also identify the Federal, State and county (or other political subdivisions) in which the site is located, as well as the location of the site with respect to prominent natural features (such as rivers and lakes) and manmade features (such as industrial, military, and transportation facilities).

Acceptance Criteria

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

b. The site map should contain sufficient information to allow the reviewer to identify the types and locations of natural and manmade features and potential hazards on or near the site and the local, State or Federal jurisdictions associated with the site and its surrounding area.

2.2.2 Exclusion Area Authority and Control

This subsection should include descriptions of the exclusion area and the applicant's legal rights with respect to all areas that lie within the designated exclusion area. As specified by 10 CFR 100.21(a), this description should establish that the applicant has the authority to determine all activities, including control of traffic and exclusion and removal of personnel and property from the area. The discussion should also address the status of mineral rights and easements within this area.

If the applicant has not obtained ownership of all land within the exclusion area, it should use a scaled map of the exclusion area to clearly describe those parcels of land not owned within the area. 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 (EAB) 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 authority over this portion of the exclusion area.

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

Acceptance Criteria

a. The information provided by the applicant provides sufficient detail to enable the reviewer to evaluate the applicant's legal authority within the designated exclusion area.

b. The information provided by the applicant confirms that any activities permitted within the exclusion area pose no hazard to the facility and there is reasonable assurance that persons engaged in such activities can be

evacuated without receiving additional radiation doses in excess of the values given in 10 CFR 50.34(a)(1).

c. The application confirms that the applicant has the authority to determine all activities within the exclusion area, including exclusion, traffic control, or removal of personnel or property from the area.

2.2.3 Population Distribution

In accordance with 10 CFR 100.3 and 21.(a), (b) and (h), population data, based on the latest census data, should be provided based on the projected year of facility approval and each decade thereafter out to the requested operating period of the facility not to 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." Specific location(s) of potentially affected populations surrounding the site should be identified and described. Discussion should include proposed exclusion area boundaries, 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. Discussions should be at a level and extent commensurate with the potential vulnerabilities and risks associated with normal and off-normal facility operations. This section should describe information regarding:

- Population within the outer edge of the plume exposure pathway emergency planning zone
- Population information necessary to provide ingestion response planning
- Transient population
- Description of the low population zone (LPZ) – refer to Regulatory Guide 4.7, "General Site Suitability Criteria for Nuclear Power Stations."
- The nearest boundary of the closest population center containing 25,000 or more residents
- Population density out to 20 miles (32 km) from the proposed facility site

Acceptance Criteria

a. The application confirms that the population data provided is based on the latest census and that the methods and sources used to make future population projections are described, reasonable and used to project population distribution at the year of facility approval and out to the requested operating period of the facility not to exceed 40 years.

b. The application describes the timing, magnitude and rationale for any transient populations in the vicinity of the site.

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

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

e. Population density conforms to the guidelines in RG 4.7.

f. When Commission direction is received on SECY-20-0045, "Population-Related Siting Considerations for Advanced Reactors", that direction will need to be factored into the acceptance criteria.

2.3 Nearby Industrial, Transportation, and Military Facilities

In accordance with 10 CFR 100.20(b) and 21(e), potential hazards associated with nearby transportation routes, industrial and military facilities, and civilian and military airports must be evaluated. The review focuses on potential external hazards or hazardous materials that are present, transported or may reasonably be expected to be present or transported during the projected lifetime of the proposed facility. The evaluation should cover the nature and extent of the nearby activities, including location, distance from the site, frequency of the activities, and the potential hazard they pose to the proposed facility.

The application should evaluate the industrial and military activities within 5 miles (8 km) from the facility site for hazardous activities with special attention to activities within 0.6 miles (1 km) from the site that can potentially damage the facility. Facilities and activities at distances greater than 5 miles (8 km) should also be considered if they have the potential for affecting facility safety-related features. The evaluation should be based on statistical data for each identified hazard. Each hazard that has the potential to result in an event sequence with an estimated frequency of occurrence greater than 5 in 10 million per year should be evaluated for its potential to affect the facility such that the 10 CFR 100 dose guidelines (i.e. 10 CFR 50.34(a)) could be exceeded. If the frequency of the hazard cannot be determined, it is acceptable to use an initiating event frequency of one in one million per year, provided there is qualitative justification that the realistic frequency is lower. If the event sequence has the potential to exceed the 10 CFR 100 dose guidelines, the hazard shall be considered a licensing-basis event and the design parameters for the affected SSCs identified.

The assessment of each hazard for its potential to become a licensing-basis event for the proposed facility are described in NEI 18-04 and RG 1.233. The applicant should also determine whether bulk storage of hazardous materials is present at or near the site and assess the impact of explosions (see RG 1.91, "Evaluation of Explosions Postulated to Occur at Nearby Facilities and on Transportation Routes Near NPPs") and/or hazardous chemical releases on facility safety. The evaluation needs to show that there

is no undue risk to the applicant's facility from these hazards because they are rare events, they have negligible consequences, or are considered in the facility safety design.

Additional explanation regarding the scope of the hazards to be considered can be found in Regulatory Guide 4.7, "General Site Suitability Criteria for Nuclear Power Stations."

Acceptance Criteria

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

b. The application describes 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 and facilities nearby including their location and distance from the facility and the nature of the hazard they pose to the proposed facility.

c. The application provides sufficient statistical data to establish the basis for evaluating each potential hazard to the facility at the proposed site.

d. The application assessed each potential hazard at the site using appropriate methodology (recommended in NEI 18-04 Rev 1, or in justified alternative guidance) and data.

2.4 Regional Climatology, Local Meteorology, and Atmospheric Dispersion

In accordance with 10 CFR 100.21(c), this subsection of the application should describe meteorological characteristics at the site and the surrounding area, including sources for the meteorological hazards used as design parameters (note that more updated sources may be available). The general climate of the region should be described with respect to 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 Oceanographic and Atmosphere Administration (NOAA) and severe weather based on data from the National Weather Service (NWS), military or other recognized organization. Historical records should be examined with respect to temperatures, 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. Annual frequency of occurrence, amount, and time duration of freezing rain (ice storms) and dust (sand) storms should be provided where applicable.

RG 1.76, "Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants," and RG 1.221, "Design-Basis Hurricane and Hurricane Missiles for Nuclear Power Plants,"

contain information on developing the design parameters for tornado and hurricane hazards, respectively. Sufficient data should be collected to support defining design basis wind velocities, precipitation (rain, snow, sleet, hail, and freezing rain), temperatures, tornados and tornado missiles, including their effect on the Ultimate Heat Sink (UHS) (see RG 1.27, “Ultimate Heat Sink for NPPs”, for additional guidance).

In general, the 100-year return period should be used to select the extremes in rainfall, snowpack, wind speed, 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, atmospheric dispersion estimates for use in accident analysis should be based on at least 2 years of onsite meteorological data. Long-term atmospheric dispersion estimates for routine (normal) release should also be based on 2 years of onsite meteorological data and should provide estimates for special receptors out to 50 miles (80 km). If 2 years of onsite data are not available at the time 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 continue to monitor the data and submit the complete 2-year data set when it has been collected. RG 1.23 also provides additional options for collection of meteorological data for an ESP that an applicant can choose to follow.

If the historical information is not included in the application, it should be available in a separate report for NRC staff audit and to submit on the docket, 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 required to support the analysis. If it is determined an on-site meteorology program is necessary, RG 1.23, “Meteorological Monitoring Program for Nuclear Power Plants,” 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 estimates during accident releases, and (2) Long-term atmospheric dispersion estimates for routine releases, during both normal and off-normal facility operating conditions. Guidance for determining the short-term atmospheric dispersion estimates is contained in RG 1.145, “Atmospheric Dispersion Models for Potential Accident Consequence Assessment at Nuclear Power Plants.” Guidance for determining the long-term (routine-release) dispersion estimates is contained in RG 1.111, “Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water Cooled Reactors.”

If a reactor design includes a control room that requires operator action to either accomplish required safety functions or to implement defense-in-depth measures, sufficient information should be provided to estimate atmospheric dispersion values in

support of design basis control room radiological habitability assessments. RG 1.194, "Atmospheric Relative Concentrations for Control Room Radiological Habitability Assessments at Nuclear Power Plants," describes methods acceptable for estimating these values.

Acceptance Criteria

a. The description in the application of the regional climate is based upon climatic summaries produced by NOAA or NRC guidance documents that cover specific design parameters.

b. The application data on severe weather that may impact the facility is based on NOAA, NWS, military or other recognized organization data or NRC guidance documents that cover specific design parameters.

c. Tornado parameters and associated missiles for the site described in the application are consistent with the latest revision to RG 1.76, "Design Basis Tornado and Tornado Missiles for Nuclear Power Plants."

d. Hurricane wind and missiles parameters for the site described in the application are consistent with RG 1.221, "Design-Basis Hurricane and Hurricane Missiles for Nuclear Power Plants."

e. Other local climate parameters (temperatures, humidity, rainfall, etc.) that are used in design or can affect the UHS are described and their effects on the UHS evaluated. The performance of UHS systems that rely on water sources to maintain SSCs should be determined following the guidance in the latest revision to RG 1.27, "Ultimate Heat Sink for Nuclear Power Plants."

f. Joint frequency distributions (see RG 1.23 for description) for use in the atmospheric dispersion models described in RG 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessment at NPPs," and RG 1.111, "Methods for Estimating Atmospheric Transport and Dispersion Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," are provided.

g. If the reactor design includes a control room that requires operator action to either accomplish required safety functions or to implement defense-in-depth measures, hourly meteorological data from the onsite meteorological monitoring program (see RG 1.23, "Meteorological Monitoring Programs for Nuclear Power Plants") should be provided for use in the atmospheric dispersion model described in RG 1.194.

2.5 Hydrological Description

In accordance with 10 CFR 100.20 (c)(3) and 10 CFR 100.21(d), applications should describe all hydrologically related site characteristics (e.g. probable maximum flood, groundwater table, aquifers, etc.) and summarize the design bases for the site parameters and values selected for the design of safety related SSCs and analysis of

the transport of radioactive material resulting from spills or leaks of liquid waste. Detailed hydrological information used to establish design parameters may be documented in a separate report that is made available for NRC staff audit.

Acceptance Criteria

a. The application provides sufficient data to determine the surface water and groundwater uses in the vicinity of the facility that could affect the safety related water supply to the facility or could be pathways for carrying radioactive material offsite.

b. The application provides sufficient data showing the interface of the facility with the flood plain for different size floods, including the possible causes of the floods.

2.5.1 Floods

For sites located in river valleys, on flood plains, or along coastlines where a potential for flooding exists, this subsection should describe the potential for floods and define the probable maximum flood (PMF). Regulatory Guide 4.7, “General Site Suitability Criteria for Nuclear Power Stations,” and Regulatory Guide 1.59, “Design Basis Floods for Nuclear Power Plants,” should be used to describe the potential for flooding. The level of analysis presented in this section may range from conservative, based on simplifying assumptions, to detailed analytical estimates.

The following phenomena or conditions should be considered:

- probable maximum precipitation, 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
- non-runoff-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)

- dilution and dispersion of severe accidental releases to the hydrosphere relating to existing and potential future users of surface water and groundwater resources

- stream channel migration hazard related to flood and mud flows

Effects of blockage by natural events, low water and/or drought effects, channel migrations and diversions, and capacity requirements should be considered in addition to the items listed above for the required safety functions and defense-in-depth associated with cooling water sources.

Acceptance Criteria

a. The application describes the Design Basis Flood proposed for the site and its basis consistent with the guidance in Regulatory Guide 1.59. 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 Reactors,” provides guidance to determine design-basis external events (e.g., seismic or flood events) that the safety related SSCs will be required to withstand.

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

c. For coastal sites, the application describes the potential for tsunamis and/or seiches, including their sources and any past 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 the site to be flooded (e. g. ice dams) or result in low water situations, and their impact on the required safety functions or defense-in-depth associated with the design.

2.5.2 Flooding Protection

Site elevations as well as structures, exterior accesses, equipment, and systems that impact a required safety function or defense-in-depth function should be identified and described from the standpoint of flood hazard (both surface and subsurface). A topographic map of the site should be provided showing any proposed changes to natural drainage features. RG 1.102, “Flood Protection for Nuclear Power Plants,” provides guidance on identifying and establishing the necessary protections for safety related SSCs that may be exposed to flooding and implementing appropriate protection measures. If an SSC is relied upon to establish the adequacy of defense-in-depth, then analysis is needed to determine

whether it needs to be designed with special treatment to withstand a flooding hazard.

Descriptions of existing and proposed water control structures, both upstream and downstream, that may influence conditions at the site should be discussed. For these structures, the applicant should:

- tabulate contributing drainage areas
- describe types of structures, all appurtenances, ownership, seismic design criteria, and spillway design criteria
- provide elevation-area-storage relationships and short-term and long-term storage allocations for pertinent reservoirs

Acceptance Criteria

a. The application describes the safety related SSCs exposed to flooding and the measures included in the design to protect them.

b. If a temporary flood protection for the facility is needed, a sufficient time frame of executing the flood protection procedures prior to a forecasted severe storm or anticipated flooding event as well as the basis for establishing the time frame, is provided.

2.5.3 Groundwater

The location, size, shape, and other hydrologic characteristics of streams, lakes, shore regions, and groundwater environments in the vicinity of the site should be described.

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

Acceptance Criteria

a. The application describes the local and regional groundwater usage.

b. The application describes the effects of groundwater on foundations of safety related structures and other safety related SSCs.

c. The application describes the protective measures taken to protect and prevent deterioration of safety related foundations and SSCs, resulting from groundwater effects.

d. The application describes any measures (e. g. dewatering system) taken to keep groundwater within the design basis and its safety related.

e. The application contains a regional map showing major hydrologic features, including the owner and rates of use of surface water and groundwater.

2.6 Geology, Seismology, and Geotechnical Engineering

In accordance with 10 CFR 100.21(d) and 23, the application should provide sufficient information regarding the seismic and geologic characteristics of the site and surrounding region to permit an evaluation of the proposed site for load bearing capability, seismic activity, including evaluations to develop the site-specific safe shutdown earthquake ground motion (SSE) response spectrum and to support analysis of the structures and seismic effects on SSCs at the proposed site. A summary of studies that include a brief description of the site, investigations performed, results of investigations, conclusions, and identification of who did the work, should be provided. Detailed geologic information should be documented in a separate report and made available for the NRC staff to audit.

2.6.1 Geologic Hazards

The geologic and seismic information that forms the basis for the seismic source characterization (SSC) model used for the probabilistic seismic hazard analysis (PSHA) for the site should be provided. For central and eastern US (CEUS) sites, the use of the model in NUREG-2115, “Central and Eastern US Seismic Source Characterizations for Nuclear Facilities”, is acceptable as a starting point for the SSC. Geologic investigations of potential seismic sources within the site region (200 miles (320 km)) that are not included in the NUREG-2115 CEUS SSC model should be conducted to determine if these features warrant inclusion in the final SSC model. ANS/ANSI 2.27-2020, “Criteria for Investigations of Nuclear Facility Sites for Seismic Hazard Assessments,” provides guidance for performing these geologic investigations. For western US (WUS) sites, the guidance in ANS/ANSI 2.27-2020 and ANS/ANSI 2.29-2020, “Probabilistic Seismic Hazard Analysis,” should be followed for development of the SSC model. Consistent with the guidance in NUREG-2213, “Updated Implementation Guidelines for SSHAC Hazard Studies,” the applicant should provide its evaluation of the data, models, and methods relevant to the development of the SSC model for the site, including an estimate of the uncertainty associated with each of the hazard inputs used in the model. In addition to development of the SSC model, the applicant should evaluate whether there are any potential hazard conditions caused by human activities (e.g., impacts of mining, quarrying, fluid injection or withdrawal) that may influence the site suitability.

The geologic investigations should consider:

(1) Regional Geology - All geologic, seismic, tectonic, and nontectonic hazards within the site region. A review of the regional tectonics, with emphasis on the Quaternary period, structural geology, seismology,

paleoseismology, physiography, geomorphology, stratigraphy, and geologic history within a distance of 200 miles (320 km) from the site (site region).

(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 25 miles (40 km), 5 miles (8 km), and 0.6 miles (1 km) around the site.

Acceptance Criteria

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

b. The application describes its evaluation of the potential hazard conditions caused by human activities.

2.6.2 Vibratory Ground Motion

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 ground motion response spectrum (GMRS) for the site. Guidance regarding the development of the GMC model is provided in ANS/ANSI 2.29-2020. For CEUS sites, the Next Generation Attenuation-East GMC model should be used. For WUS sites, the South Western United States GMC model has been previously approved and may be suitable with regional adjustments to the model. The guidance provided in ANSI/ANS-2.29-2020 should be used to perform a site response evaluation and a PSHA. Criteria for selection of the appropriate seismic design category is provided in ANSI/ANS-2.26-2004, “Categorization of Nuclear Facility Structures, Systems, and Components for Seismic Design”, and the corresponding target risk-informed design factors used to determine the GMRS are provided in ASCE/SEI 43-19, “Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities.” Using the GMRS, foundation input response spectra (FIRS) for each of the seismic Category I structures, the SSE and operating basis earthquake (OBE) should then be developed.

Acceptance Criteria

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

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

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

d. The application provides the basis for the selected seismic design category, target risk design factor, GMRS and FIRS for the site.

e. The applicant demonstrates that the SSE and OBE response spectra developed from the GMRS, meet the requirements of 10 CFR Part 50, Appendix S.

2.6.3 Surface Deformation

The application should provide information describing whether a potential exists for surface deformation that could affect the site. The surface and subsurface geological, seismological, geophysical, and geotechnical investigations performed around the site providing the basis for this information should be summarized. RG 1.208, “A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion ANS/ANSI 2.27-2020 provides guidance regarding acceptable methods for the investigation of surface deformation.

Acceptance Criteria

a. The site investigations of surface deformation follow the guidance in RG 1.208 or alternate methods (e.g. ANS/ANSI 2.27-2020) are used, described and justified.

b. The application contains sufficient information to conclude that the site does not have the potential for surface deformation.

2.6.4 Stability of Subsurface Materials and Foundations

The application should present information concerning 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 guidance in RG 1.132, “Site Investigations for Foundations of NPPs,” should be followed for investigating the soil and rock load bearing properties. Additional guidance from ANSI/ANS-2.27-2020 “American National Standard Criteria for Investigations of Nuclear Facility Sites for Seismic Hazard Assessments” may be used for a graded approach to site characterization for assessing the stability of the subsurface and foundations for a facility with lesser overall risk. The laboratory and field testing to estimate the properties of rock and layers in the subsurface underneath the facility is conducted following RG 1.138, “Laboratory Investigations of Soils and Rocks for Engineering Analysis and Design of Nuclear Power Plants.” The application should describe the stability of these materials as they influence 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 regarding excavations, backfill, and earthwork analyses where these activities involve seismic Category I facilities. The source, qualities, and quantities of backfill materials needed should be described. Compaction specification and procedures to be used are justified.

Quality control methods for backfill compaction are discussed. The guidance in RG 1.198, “Procedures and Criteria for Assessing Seismic Soil Liquefaction at NPP Sites,” should be followed for the investigation of the potential for liquefaction at the site.

Acceptance Criteria

a. The proposed site has been investigated following the guidance given in RG 1.132 (or a justified alternative, such as ANSI/ANS-2.27-2020) for determining the geological, engineering, and hydrogeological characteristics of a prospective facility site.

b. The subsurface soil and rock properties are estimated following the guidance in RG 1.138. The application contains sufficient data to demonstrate that the soil and rock properties used in the analysis of foundations for seismic Category I structures are justified.

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 more than one reactor is placed in close proximity, the interactions between them should be adequately considered in the settlement analysis including any time delay in applying major structural load on the foundation.

d. The availability of sufficient quantities and appropriate qualities of backfill are confirmed. The backfill will be compacted using an acceptable procedure and adequate quality control program would be exercised.

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

2.6.5 Stability of Slopes

The application should present information concerning the static and dynamic stability of all natural and manmade earth or rock slopes (such as cuts, fills, embankments, and dams) for which failure, under any of the 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. A discussion of site conditions, geologic features including weak strata and/or the joints in the soil or rock layers, and the engineering properties of the materials comprising the slope and its foundation should be included. The evaluations should be based on current practices, such as those used by the U.S. Army Corps of Engineers, 2003. EM1110-2-1902, “Slope Stability,” and use conservative soil and rock geometric and material properties and conservative safety margins. Uncertainties in defining the boundaries between the soil/rock layers and their properties, failure surface corresponding to the minimum factor of safety, and the location of the water table should be appropriately accounted for. The results of the slope

stability evaluations should be presented. For the stability evaluation of manmade slopes, summary data and a discussion of construction procedures, testing, and instrumentation monitoring to ensure high-quality earthwork should be included. Whenever possible, comparative field performance of similar slopes should be discussed.

Acceptance Criteria

a. The application describes the methods used for analyzing the slope stability and confirms that appropriate soil and/or rock properties have been used in the analysis. The methods used to assess the stability of the slope 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. The application describes the performance of similar slope designs and confirms their stability.

2.7 Summary of Design Basis External Hazards

Based on the results of the site characterization described in this chapter, the design basis external hazards identified for the design of the proposed facility should be summarized. These constitute the design basis seismic events and other external events that the safety-related SSCs are required to withstand with no adverse impact on their capability to perform their RSFs. Where supported by a probabilistic hazards analysis, these design basis external events should be included in the PRA after the features designed to withstand these hazards are defined. External hazards not supported by a probabilistic hazard analysis can be determined using traditional deterministic methods.

IMPLEMENTATION

The staff will use the information discussed in this ISG to determine the following:

[Identify how the information will facilitate staff review of license amendments, license renewal applications, etc.]

BACKFITTING AND ISSUE FINALITY DISCUSSION

[OGC provides this discussion, but the staff can propose text for OGC consideration].

Example: The NRC staff issuance of this ISG is not considered backfitting as defined in 10 CFR 50.109(a)(1), nor is it deemed to be in conflict with any of the issue finality provisions in 10 CFR Part 52.

CONGRESSIONAL REVIEW ACT

[OGC provides this discussion to support issuance of the final ISG. However, the staff can propose text for OGC consideration].

Example: This ISG 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

By [insert date], this information will be transitioned into [identify the appropriate regulatory process (Standard Review Plan (SRP), Regulatory Guide (RG))]. Following the transition of this guidance to the [SRP, RG], this ISG will be closed.

APPENDIX

A. Resolution of Public Comments

APPENDIX A

Resolution of Public Comments

A notice of opportunity for public comment on this Interim Staff Guidance (ISG) was published in the *Federal Register* (*insert FR Citation #)* on [date] for a 30-60 day comment period. [Insert number of commenters] provided comments which were considered before issuance of this ISG in final form.

Comments on this ISG are available electronically at the NRC's electronic Reading Room at http://www.nrc.gov/reading-rm/adams.html. From this page, the public can gain entry into ADAMS, which provides text and image files of NRC's public documents. Comments were received from the following individuals or groups:

Letter No.	ADAMS No.	Commenter Affiliation	Commenter Name	Abbreviation
1				
2				
3				
4				
5				

The comments and the staff responses are provided below.

Comment 1: [Each comment summary must clearly identify the entity that submitted the comment and the comment itself].

NRC Response: Comment responses should begin with a direct statement of the NRC staff's position on a comment, e.g., "the NRC staff agrees with the comment" or the "NRC staff disagrees with the comment".

- If the NRC staff agrees, explain why and provide a clear statement as to how the relevant language was revised or supplemented to address the comment. Include the following language at the end of the comment response: "The final ISG was changed by <*describe the change; if necessary by quoting the newly revised language*>."
- If the NRC disagrees with a comment and no change was made to the generic communication, then explain why and provide the following language at the end of the comment response: "No change was made to the final ISG as a result of this comment."

APPENDIX B

References