U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

2.4.6 PROBABLE MAXIMUM TSUNAMI HAZARDS

REVIEW RESPONSIBILITIES

Primary - Organization responsible for the review of issues related to hydrology

Secondary - None

I. AREAS OF REVIEW

Chapter 2 of the Standard Review Plan (SRP) discusses the site characteristics that could affect the safe design and siting of the plant. The staff reviews information presented by the applicant for a construction permit (CP), operating license (OL), design certification (DC), early site permit (ESP), or combined license (COL) concerning hydrological setting of the site as it relates to safety-related structures, systems, and components (SSC). This SRP section applies to reviews performed for each of these types of applications. The staff's review and findings are described in the appropriate section of the safety evaluation report (SER).

In this section of the safety analysis report (SAR), the geohydrological design basis is developed to ensure that any potential hazards to the SSC important to safety due to the effects of probable maximum tsunami are considered in the plant design. The staff's review of the SAR covers the following specific areas:

USNRC STANDARD REVIEW PLAN

This Standard Review Plan, NUREG-0800, has been prepared to establish criteria that the U.S. Nuclear Regulatory Commission staff responsible for the review of applications to construct and operate nuclear power plants intends to use in evaluating whether an applicant/licensee meets the NRC's regulations. The Standard Review Plan is not a substitute for the NRC's regulations, and compliance with it is not required. However, an applicant is required to identify differences between the design features, analytical techniques, and procedural measures proposed for its facility and the SRP acceptance criteria and evaluate how the proposed alternatives to the SRP acceptance criteria provide an acceptable method of complying with the NRC regulations.

The standard review plan sections are numbered in accordance with corresponding sections in the Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)." Not all sections of the standard format have a corresponding review plan section. The SRP sections applicable to a combined license application for a new light-water reactor (LWR) will be based on Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," until the SRP itself is updated.

These documents are made available to the public as part of the NRC's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Individual sections of NUREG-0800 will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience. Comments may be submitted electronically by email to NRR_SRP@nrc.gov.

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1. Historical Tsunami Data. The staff reviews historical tsunami data, including paleotsunami mappings and interpretations, regional records and eyewitness reports, and more recently available tide gauge and real-time bottom pressure gauge data.

2. Probable Maximum Tsunami. The staff reviews the probable maximum tsunami[1] (PMT) that may pose hazards to the site. The staff also reviews tsunamigenic sources mechanisms, source parameters, propagation models, and near-shore inundation models. The staff's review of PMT will include the following topics:

   A. Potential tsunamigenic sources, both near and far field

   B. Tsunamigenic source mechanisms including earthquakes, submarine and subaerial landslides, and volcanoes

   C. Characteristics of tsunamigenic sources

      i. Earthquake source parameters, including magnitude, focal depth, fault dimension and orientation, and displacement; volume and dynamics of landslides; volcanic explosions and resulting pyroclastic flows, caldera collapses and flank failures; etc.

      ii. Efficiency of tsunami generation

      iii. Maximum initial displacement of water surface

   D. Propagation of tsunami waves

      i. Propagation in deep waters (linear wave dynamics)

      ii. Propagation in shallow waters (nonlinear wave dynamics)

3. Tsunami Propagation Models

   A. The staff reviews tsunami wave propagation models and model parameters used to simulate the tsunami wave propagation from the source towards the site.

   B. The staff reviews input data, including bathymetry and topography data, used in tsunami wave propagation models.

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(1) The PMT is defined as that tsunami for which the impact at the site is derived from the use of best available scientific information to arrive at a set of scenarios reasonably expected to affect the nuclear power plant site taking into account (a) appropriate consideration of the most severe of the natural phenomena that have been historically reported or determine from geological and physical data for the site and surrounding area, with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated, (b) appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena, and (c) the importance of the safety functions to be performed.

4. Wave Runup, Inundation, and Drawdown. The staff reviews extent and duration of wave runup during the inundation phase of the PMT event.

5. Hydrostatic and Hydrodynamic Forces. The staff reviews static and dynamic force metrics, including the inundation and drawdown depths, current speed, acceleration, inertial component, and momentum flux that quantify the forces on any safety-related SSC that may be exposed to the tsunami waves.

6. Debris and Water-Borne Projectiles. The staff reviews the debris and water-borne projectiles that accompany tsunami currents and may impact safety-related SSC.

7. Effects of Sediment Erosion and Deposition. The staff reviews the effects of sediment erosion and deposition caused by tsunami waves that may result in blockage or loss of function of safety-related SSC.

8. Consideration of Other Site-Related Evaluation Criteria. The staff reviews the potential effects of seismic and non-seismic information on the postulated design bases and how they relate to tsunami in the vicinity of the site and the site region.

9. Additional Information for 10 CFR Part 52 Applications. The staff reviews additional information that will be presented depending on the type of application. For a COL application, the need for additional information depends on whether the application references an ESP, a DC, both, or neither. Information requirements are prescribed within the "Contents of Application" sections of the applicable subparts to 10 CFR Part 52.

Review Interfaces

The listed SRP sections interface with this section as follows:

1. For DC applications and COL applications referencing a DC, review of the site parameters in the Design Control Document (DCD) Tier 1, Chapter 2 of the DCD Tier 2, and the supporting information in DCD Tier 2, Section 14.3, submitted by the applicant is performed under SRP Section 14.3.1, "Site Parameters (Tier 1)."

2. The flooding protection measures, if necessary for the SSC important to safety, are reviewed in SRP Section 2.4.10.

3. The review to ensure that adverse environmental conditions, including those from loss of water due to drawdown during the receding tsunami waves, seiching induced by tsunami, or blockage from sedimentation, will not preclude the safety function of the ultimate heat sink is performed under SRP Section 9.2.5, "Ultimate Heat Sink."

4. The organization responsible for the review of issues related to geophysics engineering provides information regarding the seismic displacement that may result in tsunami or tsunami-like waves.

The specific acceptance criteria and review procedures are contained in the referenced SRP sections.

II. ACCEPTANCE CRITERIA

Requirements

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

1. 10 CFR Part 100, as it relates to identifying and evaluating hydrological features of the site. The requirements to consider physical site characteristics in site evaluations are specified in 10 CFR 100.10(c) for applications before January 10, 1997, and in 10 CFR 100.20(c) for applications on or after January 10, 1997.

2. 10 CFR 100.23(d) sets forth the criteria to determine the siting factors for plant design bases with respect to seismically induced floods and water waves the site.

3. 10 CFR Part 50, Appendix A, General Design Criterion (GDC) 2, for CP and OL applications, as it relates to consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area, with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated.

4. 10 CFR 52.17(a)(1)(vi), for ESP applications, and 10 CFR 52.79(a)(1)(iii), for COL applications, as they relate to identifying climatic site characteristics with appropriate consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area and with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated.

SRP Acceptance Criteria

Specific SRP acceptance criteria acceptable to meet the relevant requirements of the NRC's regulations identified above are as follows for each review described in Subsection I of this SRP section. The SRP is not a substitute for the NRC's regulations, and compliance with it is not required. However, an applicant is required to identify differences between the design features, analytical techniques, and procedural measures proposed for its facility and the SRP acceptance criteria and to evaluate how the proposed alternatives to the SRP acceptance criteria provide acceptable methods of compliance with the NRC regulations.

Appropriate sections of the following Regulatory Guides are used by the staff for the identified acceptance criteria:

Regulatory Guide 1.27 describes the applicable ultimate heat sink capabilities.

Regulatory Guide 1.29 identifies seismic design bases for safety-related structures, systems, and components.

Regulatory Guide 1.59 provides guidance for developing the hydrometeorological design bases.

Regulatory Guide 1.102 describes acceptable flood protection to prevent the SSC important to safety from being adversely affected.

1. Historical Tsunami Data. The application should provide a complete description of historical tsunami data near the proposed plant site. This description should be sufficient to establish the history of tsunamis and tsunami-like waves in the vicinity of the site.

2. Probable Maximum Tsunami. The application should provide an assessment of the PMT for the proposed site. The PMT assessment should include a review of tsunamigenic sources from historical, geological, and physical data, both near and far field, relevant to the proposed plant site. If no tsunami hazard exists for the proposed site, it should be so stated with justification based on the history and location of the proposed site.

   The tsunamigenic sources in this review should include earthquakes, submarine and sub-aerial landslides, and volcanoes. The characteristics of tsunamigenic sources should be described including parameter values associated with the PMT. The results from numerical simulations of PMT waves towards the proposed site should be provided. This simulation should use shallow water wave approximation where appropriate, and use nonlinear wave dynamics where the approximation is not valid.

3. Tsunami Propagation Models. The application should provide a description of the tsunami wave propagation models used in the applicant's SAR. The parameters used in the PMT wave propagation simulations should be listed and discussed with respect to their conservativeness. A discussion of all data used to input the tsunami wave propagation models should also be included.

4. Wave Runup, Inundation, and Drawdown. The application should provide the extents and durations of inundation and drawdown near the proposed site. The methods and models used to simulate inundation and drawdown caused by the PMT should be described. The parameters used in the simulation of inundation and drawdown should be discussed with respect to their conservativeness. The maximum extents and the longest durations of inundation and drawdown should be provided. These effects should be considered in establishing the design bases of the affected safety-related SSC.

5. Hydrostatic and Hydrodynamic Forces. The application should provide a set of metrics that describes the hydrostatic and hydrodynamic forces caused by the PMT on the safety-related SSC. This set should include the inundation and drawdown depths, current speed, acceleration, inertial component, and momentum flux near the proposed locations of safety-related SSC. These effects should be considered in establishing the design bases of the affected safety-related SSC.

6. Debris and Water-Borne Projectiles. The application should provide an assessment of the debris and water-borne projectiles that may accompany PMT currents. An assessment of the hazard posed by the debris and projectiles on safety-related SSC should be provided. These effects should be considered in establishing the design bases of the affected safety-related SSC.

7. Effects of Sediment Erosion and Deposition. The application should provide an assessment of the effects of sediment erosion and deposition near the proposed locations of safety-related SSC. A description of and an estimate of these effects on the design bases of safety-related SSC should be provided. These effects should be considered in establishing the design bases of the affected safety-related SSC.

8. Consideration of Other Site-Related Evaluation Criteria. The application should provide an evaluation of the potential effects of site-related proximity, seismic, and non-seismic information as they affect tsunamis near the plant site and site regions. This assessment should be sufficient to demonstrate that the applicant's design bases appropriately account for these effects.

Technical Rationale

The technical rationale for application of these requirements and/or SRP acceptance criteria to the areas of review addressed by this SRP section is discussed in the following paragraphs:

1. Pursuant to GDC 2, nuclear power plant SSC important to safety must be designed to withstand the effects of natural phenomena such as earthquake, tornado, hurricane, flood, tsunami, and seiche without loss of capability to perform their safety functions. The criterion further specifies that the design bases for these SSC shall reflect the following:

   A. Appropriate consideration of the most severe natural phenomena historically reported for the site and surrounding area, with sufficient margin for the limited accuracy, quantity, and time period in which the historical data have been accumulated;

   B. Appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena; and

   C. The importance of the safety functions to be performed.

   The first specification was adopted in recognition of the relatively short history available for severe natural phenomena (e.g., tsunami) on the North American continent and, when based on probabilistic considerations only, the potential for underestimating the severity of such events. This problem can be avoided by using a deterministic approach to assess design basis events. Such an approach will account for the practical physical limitations of natural phenomena at a proposed site that contribute to the severity of a given event.

   This criterion is relevant to SRP Section 2.4.6 in that it specifies the hydrologic phenomenon (i.e., tsunami) addressed in this section for the particular site. In general terms, it also specifies the level of conservatism that should be used to assess the severity of tsunami hazards for the purpose of determining the design bases for SSC important to safety. This is a similar standard to that applied in reviewing ESP or COL applications for hydrologic site characteristics.

For applications pursuant to 10 CFR Part 50, meeting the applicable requirements of GDC 2 provides a level of assurance that the design bases of SSC important to safety will reflect appropriate consideration of the most severe hazards likely to occur as a result of tsunamis; the adequacy of these design bases will be evaluated pursuant to other SRP sections.

For applications pursuant to 10 CFR Part 52, meeting the applicable requirements of 10 CFR 52.17 and 10 CFR 52.79 that correspond to GDC 2 provides a level of assurance that the most severe hazards likely to occur as a result of tsunamis have been identified; whether GDC 2 is met with respect to the adequacy of the associated design bases will be evaluated pursuant to other SRP sections.

2. Sections 100.10(c) and 100.20(c) of 10 CFR Part 100 requires that physical characteristics of a site (including seismology, meteorology, geology, and hydrology) be taken into account when determining its acceptability for a nuclear power reactor.

   To satisfy the hydrologic requirements of 10 CFR Part 100, the applicant's SAR should contain a description of the hydrogeologic and seismic characteristics of the region and an analysis of the potential hazard due to tsunami. This description should be sufficient to assess the acceptability of the site and the potential for a tsunami to influence the design of plant SSC important to safety.

   Meeting the requirements of Section 100.10(c) provides a level of assurance that plant SSC important to safety have been designed to withstand the most severe hazards likely to occur as a result of a tsunami. Meeting the requirements of Section 100.20(c) provides a level of assurance that physical characteristics of the site with respect to seismology and hydrology have been considered appropriately in determining the acceptability of the site; the adequacy of the associated plant design bases will be evaluated pursuant to other SRP sections.

III. REVIEW PROCEDURES

The reviewer will select and emphasize material from the procedures described below, as may be appropriate for a particular case.

The procedures outlined below are used to review CP applications, ESP applications, and COL applications that do not reference an ESP to determine whether data and analyses for the proposed site meet the acceptance criteria given in Subsection II of this SRP section. For reviews of OL applications, these procedures are used to verify that the data and analyses remain valid and that the facility's design specifications are consistent with these data. Reviews of OLs and COLs include a determination that the content of technical specifications related to hydrology-related site characteristics acceptable and considers any identified unique conditions.

For deviations from these specific acceptance criteria, the staff should review the applicant's evaluation of how the proposed alternatives to the SRP criteria provide an acceptable method of complying with the relevant NRC requirements identified in Subsection II of this SRP section.

1. Historical Tsunami Data. The staff reviews historical tsunami data, including paleotsunami data, to determine the vulnerability of a proposed site to this phenomenon. Historical data may help in establishing the frequency of occurrence and other useful indicators such as the maximum observed runup height.

   The National Oceanic and Atmospheric Administration (NOAA) National Geophysical Data Center (NGDC) collects and archives information on tsunami sources and effects to support tsunami modeling and engineering. The NGDC database contains historical as well as paleotsunami data. The NGDC data, relevant to the proposed plant site, should be used to describe the history of tsunamis at the site. Paleotsunami data should also be included in this description. Other sources of historical data, especially international sources that are relevant for proposed plant sites exposed to far-field trans-oceanic tsunamis, should also be investigated.

   The staff reviews the historical and paleotsunami data for their completeness and relevance to the proposed plant site.

2. Probable Maximum Tsunami. The staff reviews the PMT with respect to the source mechanisms, the characteristics of these source mechanisms, and the simulation of the wave propagating towards the proposed plant site.

   A regional assessment of tsunamigenic sources should be carried out to determine the sources that may generate a PMT at the proposed plant site. The source mechanisms considered in this assessment should include earthquakes, submarine and subaerial landslides, and volcanoes. The characteristics of the sources that are used for the specification of the PMT should be conservative, e.g., supplemented by a larger regional or global earthquake size distribution to account for the limited period of historical records. The landslide sources should be characterized using the maximum volume parameter determined from seafloor mappings or geologic age dating of the historical landslides. A slope-stability analysis should be performed to assess the potential tsunami generation efficiency of the candidate landslides. The tsunamigenic source types caused by volcanic activity considered in the PMT assessment should include pyroclastic flows, submarine caldera collapse, explosions, and debris avalanches or flank failures.

   The staff reviews the initial displacement of the water surface that subsequently causes the radiating tsunami waves. The initial displacement of the water surface should be estimated conservatively.

   The staff reviews propagation of the PMT waves from the source towards the proposed site. If appropriate, the shallow water wave approximation should be used to simulate propagation of the PMT waves in deep waters. The simulation of the propagation of the PMT waves in shallower waters, where the shallow water wave approximation is not valid, should use nonlinear wave dynamics approaches.

3. Tsunami Propagation Models. The staff reviews the computational models used in the PMT hazard analysis. Tsunami propagation models should be used, such as those used by NOAA that are published in peer-reviewed literature and are verified using extensive testing.

The staff reviews the model parameters and the input data used to simulate the propagation of the PMT waves towards the site. The model parameters should be described and their conservative values should be chosen. All other data used for model input should be described and their respective sources noted. Usually bathymetry and topography data archived and maintained by NOAA/NGDC, the USGS, and the U.S. Army Corps of Engineers are sufficient.

4. Wave Runup, Inundation, and Drawdown. The staff reviews the wave runup caused by the PMT. An appropriate initial water surface elevation for the body of water under consideration, before the arrival of the tsunami waves, should be assumed, similar to that recommended for storm surges and seiches by ANSI/ANS-2.8-1992. For example, to estimate the highest tsunami wave runup at a coastal site, the 90th percentile of high tides may be used as the initial water surface elevation near the site; to estimate the lowest drawdown caused by receding tsunami waves at the same site, the 10th percentile of the low tides may be used as the initial water surface elevation.

   The staff reviews the extent of the inundation caused by the tsunami waves at the proposed plant site. The inundation may lead to flooding and should be considered in flooding design bases for the plant SSC. The flooding due to the inundation caused by the tsunami waves may also necessitate flooding protection for some safety-related SSC. The staff also reviews the duration of the inundation caused by the tsunami waves to estimate the time during which the plant safety-related SSC may be affected.

   The staff reviews the effect of the drawdown caused by the tsunami waves and how it may affect the safety-related intakes, if they are used in the plant design and are exposed to the effects of the tsunami. The staff also reviews the duration of the drawdown caused by the tsunami waves to estimate the time during which a safety-related intake may be affected. The suggested criteria of Regulatory Guide 1.27 apply when the water supply comprises part of the ultimate heat sink.

   It should be demonstrated that the extent and the duration of the inundation and the drawdown caused by the tsunami waves are adequately established for the purposes of the plant design bases.

5. Hydrostatic and Hydrodynamic Forces. The staff reviews the hydrostatic and the hydrodynamic forces on the safety-related SSC caused by the tsunami waves. Since the tsunami occurs as a train of waves, several incoming and receding wave cycles should be considered. Local geometry and bathymetry can significantly affect the height, velocity, and momentum flux near the locations of the safety-related SSC. The suggested criteria of Regulatory Guide 1.27 apply when the water supply comprises part of the ultimate heat sink.

   It should be demonstrated that hydrostatic and the hydrodynamic forces caused by the tsunami waves are adequately established for the purposes of the plant design bases.

6. Debris and Water-Borne Projectiles. The staff reviews the likelihood of debris and water-borne projectiles carried along with the tsunami currents and their ability to cause damage to the safety-related SSC. The suggested criteria of Regulatory Guide 1.27

apply when the water supply comprises part of the ultimate heat sink. It should be demonstrated that any possibility of damage to the safety-related SSC from debris and water-borne projectiles is adequately established for the purposes of the plant design bases.

7. Effects of Sediment Erosion and Deposition. The staff reviews the sediment deposition during the tsunami, as well as the erosion caused by the high velocity of flood waters or wave action during the tsunami and its effect on foundations of the safety-related SSC, to ensure that these are adequately established for the purposes of the plant design bases. Any potential erosion and sediment deposition should not affect safety-related functioning of the exposed SSC. The suggested criteria of Regulatory Guide 1.27 apply when the water supply comprises part of the ultimate heat sink.

8. Consideration of Other Site-Related Evaluation Criteria. 10 CFR Part 100 describes site-related proximity, seismic, and non-seismic evaluation criteria for power reactor applications. Subpart A to 10 CFR Part 100 addresses the requirements for applications before January 10, 1997, and Subpart B is for applications on or after January 10, 1997. The staff's review will include evaluation of pertinent information to determine if these criteria are appropriately used in postulation of worst-case tsunami scenarios.

9. Review Procedures Specific to 10 CFR Part 52 Application Types

A. Construction Permit and Early Site Permit Reviews. Subpart A to 10 CFR Part 52 specifies the requirements and procedures applicable to the Commission's issuance of ESPs for approval of a proposed site. Information required for an ESP includes a description of the characteristics of the proposed site. For an ESP, the scope and level of detail for reviewing data parallel those used for a CP review. The applicant should identify postulated values of design parameters that provide design details to support the NRC staff's review of an ESP application. This set of bounding parameter values defines the plant parameter envelope (PPE).

In the absence of certain circumstances, such as a compliance or adequate protection issue, 10 CFR 52.39 precludes the staff at the COL stage from changing or imposing new site characteristics, design parameters, or terms and conditions for the ESP.

B. Standard Design Certification Reviews. Applications for design certification do not contain general descriptions of site characteristics because this information is site-specific and will be addressed by the COL applicant. However, the DC applicant must provide site parameters postulated for the design. The reviewer verifies that:

i. The parameters in the site parameter envelope are consistent with the acceptance criteria given in Subsection II of this SRP section;

ii. The appropriate site parameters are included as Tier 1 information per SRP Section 14.3.1; and

iii. Pertinent parameters are captured in a site parameters summary table.

C. Combined License Reviews. For a COL application referencing a certified standard design, the NRC staff reviews that application to ensure sufficient information was presented to demonstrate that the characteristics of the site fall within the site parameters specified in the DC rule. Should the actual site characteristics not fall within the certified standard design site parameters, the COL applicant will need to demonstrate by some other means that the proposed facility is acceptable at the proposed site. This might be done by re-analyzing or designing the proposed facility.

For a COL application referencing an ESP, the NRC staff reviews the application to ensure the application provided sufficient information to demonstrate that the design of the facility falls within the site characteristics and design parameters specified in the ESP as applicable to this SRP section. Should the design of the facility not fall within the site characteristics and design parameters, the application should include a request for a variance from the ESP that complies with the requirements of 10 CFR 52.39 and 52.93.

In addition, long-term environmental changes and changes to the region resulting from human or natural causes may have introduced changes to the site characteristics that could be relevant to the design basis. The requirements of 10 CFR 52.39 preclude the Commission from changing or imposing new site characteristics, design parameters, or terms and conditions on the ESP, unless the change is necessary to assure adequate protection of the public health and safety or to bring the permit or site into compliance with the Commission's regulatory requirements in effect when the permit was issued. Consequently, the staff's review of a COL application referencing an ESP should not include a re-investigation of the site characteristics that have previously been accepted in the referenced ESP. However, in accordance with 10 CFR 52.6, "Completeness and Accuracy of Information," the applicant or licensee is responsible for identifying changes of which it is aware that would satisfy the criteria specified in 10 CFR 52.39. Information provided by the applicant in accordance with 10 CFR 52.6(b) will be addressed by the staff during the review of a COL application referencing an ESP or DC.

For a COL application referencing either an ESP or DC or both, the staff should review the corresponding sections of the ESP and DC FSERs to ensure that any unresolved items, commitments, assumptions, and deferred items identified in the FSERs are appropriately handled in the COL application.

IV. EVALUATION FINDINGS

The review should document the staff's evaluation of site characteristics with regard to the relevant regulatory criteria. The evaluation should support the staff's conclusions as to whether the regulations are met. The reviewer should state what was done to evaluate the applicant's safety analysis report. The staff's evaluation may include verification that the applicant followed applicable regulatory guidance, performance of independent calculations, and/or validation of appropriate assumptions. The reviewer may state that certain information provided by the

applicant was not considered essential to the staff's review and was not reviewed by the staff. While the reviewer may summarize or quote the information offered by the applicant in support of its application, the reviewer should clearly articulate the bases for the staff's conclusions.

The reviewer verifies that the applicant has provided sufficient information and that the review and calculations (if applicable) support conclusions of the following type to be included in the staff's safety evaluation report. The reviewer also states the bases for those conclusions.

1. Construction Permit, Operating License, and Combined License Reviews

The following statements should be preceded by a summary of the site characteristics and parameters used for the plant:

> As set forth above, the applicant has presented and substantiated information relative to the effects of probable maximum tsunami hazards important to the design and siting of this plant. The staff has reviewed the available information provided and, for the reasons given above, concludes that the identification and consideration of the effects of probable maximum tsunami hazards at the site and in the surrounding area are acceptable and meet the relevant requirements of 10 CFR Part 100 [10 CFR Part 100.10(c) or 10 CFR Part 100.20(c), as applicable] and [10 CFR Part 50, Appendix A, General Design Criterion 2] [or] 10 CFR 52.79]], with respect to determining the acceptability of the site.
>
> The staff finds that the applicant has considered the appropriate site phenomena for establishing the design bases for SSCs important to safety. The staff has generally accepted the methodologies used to determine the effects of probable maximum tsunami hazards reflected in these site characteristics, as documented in safety evaluation reports for previous licensing actions. Accordingly, the staff concludes that the use of these methodologies results in site characteristics containing margin sufficient for the limited accuracy, quantity, and period of time in which the data have been accumulated. The staff concludes that the identified site characteristics meet the relevant requirement(s) of 10 CFR Part 100.10(c) [or 10 CFR Part 100.20(c)] and [10 CFR Part 50, Appendix A, General Design Criterion 2] [or] 10 CFR 52.79]], with respect to establishing the design basis for SSCs important to safety.

2. Early Site Permit Reviews

The following statements should be preceded by a summary of the site characteristics to be included in any ESP that might be issued for the proposed site:

> As set forth above, the applicant has presented and substantiated sufficient information pertaining to the effects of probable maximum tsunami hazards at the proposed site. Section 2.4.6, "Probable Maximum Tsunami Hazards," of NUREG-0800, Standard Review Plan, provides that the site safety analysis report should address the requirements of 10 CFR Parts 52 and 100 as they relate to identifying and evaluating the effects of probable maximum tsunami hazards. Further, the applicant considered the most severe natural phenomena that have been historically reported for the site and surrounding area while

describing the probable maximum tsunami hazards, with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated. The staff has generally accepted the methodologies used to determine the severity of the phenomena reflected in these site characteristics, as documented in safety evaluation reports for previous licensing actions. Accordingly, the staff concludes that the use of these methodologies results in site characteristics containing sufficient margin for the limited accuracy, quantity, and period of time in which the data have been accumulated. In view of the above, the site characteristics previously identified are acceptable for use in establishing the design bases for SSCs important to safety, as may be proposed in a COL or CP application.

Therefore, the staff concludes that the identification and consideration of the probable maximum tsunami hazards site characteristics set forth above are acceptable and meet the requirements of 10 CFR 52.17(a)(1)(vi), 10 CFR 100.20(c), and 10 CFR 100.21(d).

In view of the above, the staff finds the applicant's proposed site characteristics related to probable maximum tsunami hazards for inclusion in an ESP for the applicant's site, should one be issued, to be acceptable.

3. Design Certification Reviews

The following statement should be preceded by a list of the applicable site parameters used for the plant:

The NRC staff acknowledges that the applicant has selected the site parameters referenced above for plant design inputs (a subset of which is included as Tier 1 information), but does not claim that they are representative of any particular percentile of possible sites in the United States, and does not assert the acceptability of the basis for the choice of values with respect to siting. Probable maximum tsunami hazards are site-specific and will be addressed by the COL applicant. This should include the provision of information sufficient to demonstrate that the design of the plant falls within the site parameters specified by the siting review.

V. IMPLEMENTATION

The staff will use this SRP section in performing safety evaluations of design certifications and license applications submitted by applicants pursuant to 10 CFR Parts 50 or 52. Except when the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the staff will use the method described herein to evaluate conformance with Commission regulations.

The provisions of this SRP section apply to reviews of applications docketed six months or more after the date of issuance of this SRP section, unless superceded by a later revision.

VI. REFERENCES

1. 10 CFR Part 50, Appendix A, General Design Criterion 2, “Design Bases for Protection Against Natural Phenomena.”

2. 10 CFR Part 50, Appendix A, General Design Criterion 44, “Cooling Water.”

3. 10 CFR Part 52, “Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants.”

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

5. ANSI/ANS-2.8-1992, “Determining Design Basis Flooding at Power Reactor Sites.” Historical Technical Reference.

6. B. F. Atwater, S. Musumi-Rokkaku, K. Satake, Y. Tsuji, K. Ueda, and D.K. Yamaguchi, “The Orphan Tsunami of 1700: Japanese Clues to a Parent Earthquake in North America,” the United States Geological Survey and the University of Washington Press, 2005.

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PAPERWORK REDUCTION ACT STATEMENT

The information collections contained in the draft Standard Review Plan are covered by the requirements of 10 CFR Part 50 and 10 CFR Part 52, and were approved by the Office of Management and Budget, approval number 3150-0011 and 3150-0151.

PUBLIC PROTECTION NOTIFICATION

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

SRP Section 2.4.6
Description of Changes

This SRP section affirms the technical accuracy and adequacy of the guidance previously provided in Draft Revision 3 of this SRP, dated April 1996, with the following exception, as applicable. See ADAMS accession number ML052070246.

The title of this section was changed from "Probable Maximum Tsunami Flooding" to "Probable Maximum Tsunami Hazards." This modification is intended to better convey that staff's review in this section also includes tsunami hazards other than flooding.

In addition, this SRP section was administratively updated in accordance with NRR Office Instruction, LIC-200, Revision 1, "Standard Review Plan (SRP) Process." The revision also adds standard paragraphs to extend application of the updated SRP section to prospective submittals by applicants pursuant to 10 CFR Part 52.

The technical changes are incorporated in Revision 3, dated [Month] 2007:

REVIEW RESPONSIBILITIES - Reflects changes in review branches resulting from reorganization and branch consolidation. Change is reflected throughout the SRP.

I. AREAS OF REVIEW

1. An introductory paragraph was added at the beginning of this section.

2. This section was updated to add review of historical tsunami data.

3. This section was updated to add review of hydrostatic and hydrodynamic forces associated with the tsunami waves.

4. This section was updated to add review of debris and water-borne projectiles carried along with the tsunami waves.

5. This section was updated to add review of sediment erosion and deposition caused by the tsunami currents and waves.

6. This section was updated to add review of consideration of seismic and non-seismic criteria on the worst-case icing scenario.

7. The Review Interfaces subsection in this section was rewritten to provide a list of other SRP sections which interface with the review in this section.

8. A statement that review of site parameters for DC applications and COL applications that reference a DC is performed in SRP Section 14.3 was added to the Review Interfaces subsection.

9. A statement to indicate the interface with SRP Section 2.4.10, where flooding protection requirements are reviewed based on the design-basis flooding scenario described in this section, was added to the Review Interfaces subsection.

10. A statement to indicate interface with SRP Section 9.2.5, where review of the effects of dam failures on the safety function of the ultimate heat sink is performed, was added to the Review Interfaces subsection.

11. A statement to indicate that the organization responsible for issues related to geoscience and geotechnical engineering, which provides information regarding the seismic displacement that may result in a tsunami or a tsunami-like wave, was added to the Review Interfaces subsection.

II. ACCEPTANCE CRITERIA

1. Specific acceptance criteria for each item in an area of review were rewritten to realign with the Commission's regulations.

2. This section was updated to include requirements of 10 CFR Part 100.23(d).

3. This section was updated to include requirements of 10 CFR Part 100 as it relates to site evaluations in 10 CFR 100.10(c) for applications before January 10, 1997, and 10 CFR 100.20(c) for applications on or after January 10, 1997, in the Acceptance Criteria.

4. This section was updated to include currently available best practices to supplement recommendations of Regulatory Guide 1.59.

III. REVIEW PROCEDURES

1. This section was expanded to describe the review approach for each area of review.

IV. EVALUATION FINDINGS

1. This section was rewritten to provide specific guidance related to each type of application. Sample statements addressing evaluation findings for each application type were also rewritten.

V. IMPLEMENTATION

1. This section was revised to indicate that this SRP section will also be used in reviews of design certification applications.

VI. REFERENCES

1. The References list was updated.