



U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

2.4.11 LOW WATER CONSIDERATIONS

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 a 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 they relate 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 applicant's safety analysis report (SAR), natural events that may reduce or limit the available safety-related cooling water supply, are identified and the applicant ensures that an adequate water supply will exist to shut down the plant under conditions requiring safety-related cooling.

The specific areas of review are as follows:

1. Low Water from Drought: The staff reviews the worst drought considered reasonably possible in the region.

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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 Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)." Not all sections of Regulatory Guide 1.70 have a corresponding review plan section. The SRP sections applicable to a combined license application for a new light-water reactor (LWR) are based on Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)."

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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2. Low Water from Other Phenomena: The staff reviews the effects of low water surface elevations caused by various hydrometeorological events and potential blockage of intakes by sediment, debris, littoral drift, and ice inasmuch as they affect safety-related water supply. The review of low water effect of existing and proposed water control structures (including those due to dam failures) is described in SRP Section 2.4.4. The review of low water setdown resulting from surges, seiches, or tsunami events is described in SRP Sections 2.4.5 (Surge or Seiche) and 2.4.6 (Tsunami). The review of low water resulting from icing events is described in SRP Section 2.4.7 (Icing).
3. Effect of Low Water on Safety-Related Water Supply: The staff reviews the effects on the intake structure and pump design bases in relation to the events described in SAR Sections 2.4.7, 2.4.8, 2.4.9, and 2.4.11 considering the range of water supply required by the plant (including minimum operating and shutdown flows, during anticipated operational occurrences and emergency conditions) compared with availability (considering the capability of the ultimate heat sink to provide adequate cooling water under conditions requiring safety-related cooling).
4. Water Use Limits: The staff reviews the use limitations imposed or under discussion by Federal, State, or local agencies authorizing the use of the water.
5. Consideration of Other Site-Related Evaluation Criteria: The potential effects of seismic and non-seismic information on the postulated worst-case low water scenario for the proposed plant site.
6. Additional Information for 10 CFR Part 52 Applications: Additional information will be presented dependent on the type of application. For a COL application, the additional information is dependent 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

Other SRP sections interface with this section as follows:

1. For DC applications and COL applications referencing a DC rule or DC application, 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 2.0, "Site Characteristics and Site Parameters."
2. The review to ensure that adverse environmental conditions due to low water will not preclude the safety function of the ultimate heat sink is performed under SRP Section 9.2.5, "Ultimate Heat Sink."
3. The staff's review of low water events resulting from dam failures or failures of other water control structures is described in SRP Section 2.4.4, of those resulting from surges and seiches is described in SRP Section 2.4.5, of those resulting from tsunami is described in SRP Section 2.4.6, and of those resulting from ice effects is described in SRP Section 2.4.7.

4. The staff is responsible for providing site characteristics and other hydrometeorologic parameters related to low water considerations at or near the site to the organization responsible for review of the SSC potentially affected by the low water to ascertain whether these effects are properly considered in the mechanical or structural design basis for the plant.
5. 10 CFR 50, Appendix A, General Design Criterion (GDC) 44, for CP and OL applications, as it relates to providing an ultimate heat sink for normal operating and accident conditions.

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 at 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 hydrologic 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.
5. 10 CFR 50, Appendix A, General Design Criterion (GDC) 44, for CP and OL applications, as it relates to providing an ultimate heat sink for normal operating and accident conditions.

SRP Acceptance Criteria

Specific SRP acceptance criteria acceptable to meet the relevant requirements of the NRC's regulations identified above are as follows for the review described in 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 evaluate how the proposed alternatives to the SRP acceptance criteria provide acceptable methods of compliance with the NRC regulations.

Appropriate sections of the following documents 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 SSC important to safety.

1. Low Water from Drought: To meet the requirements of GDC 2, GDC 44, 10 CFR 52.17, and 10 CFR Part 100, a complete history of low water conditions at and in the vicinity of the site is needed. A thorough listing of types of phenomena, locations and durations of these events, and descriptions of hydrometeorological characteristics accompanying these events should be included. These listings and descriptions should be sufficient to establish the history of droughts in the vicinity of the site. The staff will evaluate the applicant's evidence as it relates to low water considerations. If the staff disagrees with the applicant's conclusions, they will request additional information. The applicant should fully document and justify its estimates or accept the staff's estimates and redesign SSC important to safety affected by low water levels. The suggested criteria of Regulatory Guide 1.27 apply when the water supply comprises part of the ultimate heat sink.
2. Low Water from Other Phenomena: To meet the requirements of GDC 2, GDC 44, 10 CFR 52.17, and 10 CFR Part 100, a complete history of low water conditions, caused by phenomena other than a drought, at and in the vicinity of the site is needed. A thorough listing of types of phenomena, locations and durations of these events, and descriptions of hydrometeorological and hydrogeological characteristics accompanying these events should be included. These listings and descriptions should be sufficient to establish the most severe low water event due to these phenomena reasonably possible in the vicinity of the site. These estimates of low water events caused by other phenomena should be consistent with the estimates in the respective SAR sections where review of these individual phenomena is carried out. In case of disagreement between the staff's and the applicant's conclusions, the applicant should fully document and justify its conclusions or accept the staff's conclusions and redesign any SSC important to safety that may be affected by low water events.
3. Effect of Low Water on Safety-Related Water Supply: To meet the requirements of GDC 2, GDC 44, 10 CFR 52.17, and 10 CFR Part 100, a thorough description of all safety-related water supply requirements and the effects of the most severe low water event reasonably possible at or in the vicinity of the site is needed. The staff will review the proposed requirements of the plant with respect to the available water during the most severe low water event to assess the reliability of the proposed safety-related water supply. In case of disagreement between the staff's and the applicant's conclusions, the applicant should fully document and justify its conclusions or accept the staff's conclusions and redesign the safety-related water supply.
4. Water Use Limits: To meet the requirements of GDC 2, GDC 44, 10 CFR 52.17, and 10 CFR Part 100, a thorough description of water use and discharge limitations (both

physical and legal), already in effect or under discussion by responsible Federal, regional, State, or local authorities, that may affect water supply at the plant that have been considered and are substantiated by reference to reports of the appropriate agencies is needed. The staff will review these water uses and use limitations to determine the reliability of the proposed safety-related water supply to the plant. In case of disagreement between the staff's and the applicant's conclusions, the applicant should fully document and justify its conclusions or accept the staff's conclusions and redesign the safety-related water supply.

5. **Consideration of Other Site-Related Evaluation Criteria:** To meet the requirements of GDC 2, 10 CFR 52.17, and 10 CFR Part 100, the applicant should provide an assessment of the potential effects of site-related proximity, seismic, and non-seismic information on the postulated worst-case low-flow scenario for the proposed plant site. 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 acceptance criteria to the areas of review addressed by this SRP section is discussed in the following paragraphs:

1. Compliance with GDC 2 requires that nuclear power plant structures, systems, and components important to safety 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 GDC further specifies that the design bases for these structures, systems, and components shall reflect the following:
 - A. Appropriate 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 time period in which the historical data have been accumulated;
 - B. Appropriate combinations of the effects of normal and accident conditions with those of the natural phenomena; and
 - C. The importance of the safety functions to be performed.

Low water conditions could adversely affect sources of water required for cooling the proposed plant. Accordingly, GDC 2 requirements are imposed to ensure that components and structures associated with the ultimate heat sink will continue to function, thereby keeping the plant in a safe condition.

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 hydrologic site characteristics 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.

3. Compliance with GDC 44 requires that a system be provided to transfer heat from structures, systems, and components important to safety to an ultimate heat sink during normal operations, anticipated operational occurrences, and accident conditions.

GDC 44 applies to this SRP section because the ultimate heat sink for the cooling water system consists of water sources that are subject to natural events, which in turn may reduce or limit the available cooling water supply. These natural events should be conservatively estimated to provide an adequate supply of cooling water from the ultimate heat sink to ensure that safety-related structures, systems, and components will be capable of performing their intended safety functions. Regulatory Guide 1.27 provides additional guidance for meeting these requirements.

Meeting the requirements of GDC 44 provides assurance that the cooling water system will be capable of performing its intended safety functions by providing an adequate supply of cooling water to safety-related structures, systems, and components.

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

10 CFR Part 100 applies to this SRP section because the reviewer verifies that the applicant's SAR contains a description of surface and subsurface hydrological characteristics of the site and region. The ultimate heat sink for the cooling water system consists of water sources affected by, among other things, site hydrological characteristics that may reduce or limit the available supply of cooling water for safety-related structures, systems, and components.

Meeting the requirements of 10 CFR Part 100 provides assurance that plant structures, systems, or components important to safety are designed to withstand appropriately severe hydrologic phenomena and are capable of performing their intended safety functions.

5. Compliance with 10 CFR 100.23 requires, in part, that consideration of river blockages or diversion or of other failures that may block the flow of cooling water, tsunami runup and drawdown, and dam failures be included in the evaluation of the emergency cooling water supply.

10 CFR 100.23 applies to this SRP section because the ultimate heat sink for the cooling water system consists of water sources that are subject to natural events that may reduce or limit the available supply of cooling water (i.e., the heat sink). Natural events such as river blockages or diversion or other failures that may block the flow of cooling water, tsunami runup and drawdown, and dam failures should be conservatively estimated to assess the potential for these characteristics to influence the design of plant structures, systems, and components important to safety.

Meeting the requirements of 10 CFR 100.23 provides assurance that plant structures, systems, and components important to safety are designed to withstand appropriately severe hydrologic phenomena and be capable of performing their intended safety functions.

III. REVIEW PROCEDURES

The reviewer will select 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. As applicable, reviews of OLs and COLs include a determination on whether the content of technical specifications related to hydrology-related site characteristics are acceptable and whether the technical specifications reflect consideration of any identified unique conditions.

These review procedures are based on the identified SRP acceptance criteria. For deviations from these acceptance criteria, the staff should review the applicant's evaluation of how the proposed alternatives provide an acceptable method of complying with the relevant NRC requirements identified in Subsection II.

1. Low Water from Drought: The worst drought considered reasonably possible in the region is reviewed along with a complete history of low water conditions at and in the vicinity of the site, including initiating phenomena, locations and durations of these events, and descriptions of hydrometeorological characteristics accompanying these events that are sufficient to establish the history of droughts in the vicinity of the site. The applicable literature describing historical occurrences of low water in the region is reviewed to determine if additional protection should be considered in the design of safety-related facilities. Publications of the United States Geologic Survey (USGS), the U.S. Army Corps of Engineers (USACE), National Oceanic and Atmospheric Administration (NOAA), and other hydrometeorological sources are used to identify the history and potential for low water in the region. For any extreme low water events, historical water flow variations should be quantified using USGS streamflow data, where possible.

For essential water supplies the low-flow/low-level design for the primary water supply source should be based on the probable minimum low flow and level resulting from the most severe drought that can reasonably be considered possible for the region. The low flow and level design bases for operation (if different than the design bases for essential water requirements) should be such that shutdowns caused by inadequate water supply will not cause frequent use of emergency systems. In cases where a common source of cooling water for operation and safety is provided, and where operation can affect minimum levels required for safety, the system will be acceptable if technical specifications are provided for shutdown before the ultimate heat sink can be adversely affected.

The staff will evaluate the applicant's evidence as it relates to low water considerations. If the staff disagrees with the applicant's conclusions, they will request additional information. The applicant should fully document and justify its estimates or accept the staff's estimates and redesign the SSC important to safety affected by low water levels. The staff should use the suggested criteria of Regulatory Guide 1.27 when the water supply comprises part of the ultimate heat sink.

For plants using rivers, minimum design service water levels are compared with asymptotic extrapolations of low-flow frequency curves which have been corrected for historical and potential future effects. Conservative estimates of low flow using statistical methodologies as used by the USGS provide magnitudes of low flow of specified recurrence interval and need to be used as indicators of low streamflow under

hydrological drought conditions. For coastal or estuary plants, design low water levels are compared with probable maximum hurricane and tsunami-induced low water levels. For Great Lakes plants, design low water levels are compared with minimum historical levels coincident with probable maximum surge or seiche-induced low water levels.

If historical flows and levels are used to estimate design values by inference from frequency distribution plots, the data used should be presented so that the staff can make an independent determination. The data and methods of NOAA, USGS, the Natural Resources Conservation Service, the Bureau of Reclamation, and the Corps of Engineers are used by the staff in its independent review.

2. Low Water from Other Phenomena: The effects to low water from other phenomena (including potential blockage of intakes by sediment, debris, littoral drift, and ice) are reviewed along with a complete history of low water conditions in the vicinity of the site and a thorough listing of types of phenomena, locations and durations of these events, and descriptions of hydrometeorological and hydrogeological characteristics accompanying these events that are sufficient to establish the history of low water phenomena in the vicinity of the site.

Estimates of the most severe low water condition caused by failures of water control structures should be consistent with the analysis presented in SAR Section 2.4.4. Estimates of the most severe surge or seiche induced low water condition should be consistent with SAR Section 2.4.5. Estimates of the most severe tsunami induced low water condition should be consistent with SAR Section 2.4.6. Estimates of the most severe ice-induced low water condition should be consistent with SAR Section 2.4.7.

If the site is susceptible to such phenomena, minimum water levels resulting from setdown (sometimes called runout or rundown) from hurricane surges, seiches, and tsunami should be higher than the intake design basis for essential water supplies. For coastal sites, the appropriate probable maximum hurricane (PMH) wind fields should be postulated to give maximum winds blowing offshore, thus creating a probable minimum surge level. Low water levels on inland ponds, lakes, and rivers due to surges should be estimated from probable maximum winds oriented away from the plant site. The same general analysis methods discussed in SRP Sections 2.4.5 and 2.4.6 are applicable to low water estimates due to the phenomena discussed.

The potential for surges in intake sumps (i.e., seicheing in intake structures and surges in intake pipes) that could cause adverse effects are reviewed to ensure that the effects have been properly accounted for in the intake design. The potential for adverse hydrodynamic effects of a trip of the intake pumps is evaluated based on potential surges in intake sumps.

The potential for blockage of the intakes by littoral drift, sediment, debris, and ice is reviewed to ensure that the intakes are located and sized to prevent blockage which would preclude use of the safety-related water supply. Applicable literature describing historic sediment accumulations in the site region is reviewed to determine if mitigation measures are required to protect safety-related facilities. Independent estimates of "worst-case" buildups are made using statistical or deterministic techniques.

The staff evaluates the applicant's evidence as it relates to low water considerations. If the staff disagrees with the applicant's conclusions, they will request additional

information. The applicant should fully document and justify its estimates or accept the staff's estimates and redesign the SSC important to safety affected by low water levels. The staff should use the suggested criteria of Regulatory Guide 1.27 when the water supply comprises part of the ultimate heat sink.

3. Effect of Low Water on Safety-Related Water Supply: The staff reviews the adequacy of the ultimate heat sink to supply cooling water for conditions requiring safety-related cooling. In addition, the design basis of the intake system should be adequate to enable delivery of the necessary cooling water to the plant during adverse hydrological conditions. Where the specific design bases preclude plant operation during severe hydrologically-related events, availability of sufficient warning time should be demonstrated so that the plant may be shut down during or in advance of adverse events without causing potential damage to safety-related facilities.

Effects to the intake structure and pump design basis in relation to the events described in SAR Sections 2.4.7, 2.4.8, 2.4.9, and 2.4.11 are evaluated considering the range of water supply required by the plant (including minimum operating and shutdown flows during anticipated operational occurrences and emergency conditions) and compared to availability of water. This evaluation includes assessment of the capability of the ultimate heat sink to provide adequate cooling water under conditions requiring safety-related cooling.

Minimum plant requirements (water level and flow) that are identified in this section (or Section 9.2.5) are compared with the estimated minimum water levels and flows identified in this section. If normal operation is not ensured at the minimum water supply conditions and loss of normal operation capability can adversely affect safety-related components, the estimates of warning time are reviewed to ensure that shutdown or conversion to alternate water sources can be accomplished prior to the trip. For such cases, emergency operating procedures are required and are reviewed to ensure that they are consistent with the postulated conditions. The analysis of the dependability of the ultimate heat sink is reviewed and the conclusions are provided to the SPLB. The dependability of the ultimate heat sink should be reviewed using Regulatory Guide 1.27 as a standard of comparison.

The sources of water for normal operations, anticipated operational occurrences, or emergency shutdown and cooldown, and the natural phenomena and site-related accident design criteria for each should be identified.

First, a systems analysis is undertaken of all water supply sources to determine the likelihood that at least one source would survive the following:

- A. the most severe of each of the natural phenomena,
- B. site-related accident phenomena, or
- C. reasonable combinations of less severe natural and accident phenomena.

Second, arbitrarily assumed mechanistic failures of water supply structures and conveyance systems are postulated and the systems analysis is repeated to ensure that the failure of one component will not cause failure of the entire system. To avoid duplication, these analyses should be coordinated with the review of the ultimate heat

sink and related cooling systems carried out by the organization responsible for the review of cooling water systems associated with the balance of the plant. Operating rules for each portion of the system are ascertained to determine the amount of water that can be assumed to be available in the event of normal operations, anticipated operational occurrences, or emergency shutdown and cooldown. If there is evidence of potential mechanical effects, the organization responsible for review of the SSC should be asked by the staff to ascertain whether the effects are properly considered in the mechanical design bases for the plant. If there is evidence of potential structural effects, the organization responsible for review of the SSC should ascertain whether the effects are properly considered in the structural design bases for the plant. Consultations with the organization responsible for review of the SSC should be undertaken where design criteria are not firmly established. If the possibility exists that low water could affect forces on the safety-related structures, this should be coordinated with the organization responsible for review of the structural design bases.

For multiple purpose (normal operations, anticipated operational occurrences, and emergency shutdown and cooldown) water supply systems, the primary portion of the system should be reviewed first to determine that the water supply will be maintained at minimum volume requirements at all times. The secondary portion of the system should then be reviewed to determine whether an adequate emergency water supply can be expected to be available during operating conditions such as the regional drought of record (flows should be adjusted for historical and potential future effects). If not available, the applicant should be asked to provide a technical specification requiring plant shutdown at the point that an adequate shutdown water supply is still ensured.

The ability of the ultimate heat sink to provide a 30-day supply of cooling water, as specified in Regulatory Guide 1.27, should be independently evaluated. For those cases where makeup water cannot be ensured (e.g., an onsite cooling pond supplied from a nearby river through nonseismic piping), estimates of water loss due to drift, evaporation, blowdown, and seepage should be made. Techniques described in NUREG-0693 and NUREG-0733 should be used to evaluate the adequacy of the initial water inventory under meteorological conditions of the severity discussed in Regulatory Guide 1.27.

If the ultimate heat sink system is not capable of continued long-term water supply under the criteria in Regulatory Guide 1.27 or the above considerations, the system should be reviewed in two parts: short-term capability and long-term capability. For short-term capability, the organization responsible for the review of cooling water systems and the Licensing Project Manager (LPM) should be informed if the independently estimated supply appears to be less than 30 days. The applicant should be asked to determine whether sufficient personnel and equipment can safely be made available to switch water supply sources in the event of an accident. If emergency procedures are required to obtain the use of alternate water supplies, the applicant's water supply sources and procedures should be reviewed with the organization responsible for the review of cooling water systems and the LPM to determine that there is continuity of water supply. The time period for which a highly dependable water supply would be available should be compared with the time required to obtain water from an alternative supply, and the natural or accident environmental conditions which could prevail.

For long-term water supply capability, different sources and means of obtaining water may be required because of the limited capability of a “short-term” supply. In those cases where different sources are necessary to ensure the long-term plant heat removal capability, the alternative sources and the means of supplying water from the sources to the plant should be identified. Any plant design provisions necessary for such situations should also be described or a reference provided to other SAR sections for the descriptions.

Emergency means for obtaining long-term water supplies should be judged on the basis of the time required to obtain such supplies, natural or accident phenomena likely to prevail or to have caused the need for such supplies, and the dependability of the supply itself.

The ability of the ultimate heat sink to provide the plant with cooling water below the design maximum temperature should be evaluated. The design maximum temperature and the heat load of the design basis accident, as specified in Regulatory Guide 1.27, should be provided by the organization responsible for the review of cooling water systems. Techniques for selecting the meteorological conditions for minimum heat transfer and for performing the transient analysis for cooling ponds and spray ponds are provided in NUREG-0693 and NUREG-0733, respectively.

4. Water Use Limits: In addition to natural hydrometeorologic or hydrogeologic causes of low water, the potential exists that other anthropogenic water uses could exacerbate the natural causes of low water. The potential for human-induced causes of low water in the vicinity of the site is qualitatively evaluated. The use limitations imposed or under discussion by Federal, State, or local agencies authorizing the use of the water should be reviewed. Institutional restraints on water use, such as limitations in water use and discharge permits, should be reviewed to ensure the plant will have an adequate supply and not exceed limitations imposed upon operation. If a conflict is foreseen, the applicant should be asked either to obtain a variance or make a design change to accommodate the limitation.
5. 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 should include evaluation of pertinent information to determine if these criteria are appropriately used in postulation of worst-case low flow scenarios at the proposed plant site.
6. Review Procedures Specific to 10 CFR Part 52 Application Types
 - A. Early Site Permit Reviews: Subpart A to 10 CFR Part 52 specifies the requirements and procedures applicable to the Commission's review of an ESP application for approval of a proposed site. Information required in an ESP application includes a description of the site characteristics and design parameters of the proposed site. The scope and level of detail of review of data parallel that used for a CP review.

In the absence of a compliance or adequate protection issue, a modification necessary based on updating early site permit-emergency preparedness

information, or a variance, 10 CFR 52.39 precludes the staff from imposing new site characteristics, design parameters, or terms and conditions on the early site permit at the COL stage. Accordingly, the reviewer should ensure that all physical attributes of the site that could affect the design basis of SSCs important to safety are reflected in the site characteristics, design parameters, or terms and conditions on the early site permit.

- B. Standard Design Certification Reviews: DC applications do not contain general descriptions of site characteristics because this information is site-specific and will be addressed by the COL applicant. However, pursuant to 10 CFR 52.47(a)(1), a DC applicant must provide site parameters postulated for the design. The reviewer verifies that:
- i. The postulated site parameters should be representative of a reasonable number of sites that may be considered within a COL application;
 - ii. The appropriate site parameters are included as Tier 1 information per SRP Section 14.3.1; and
 - iii. Pertinent parameters are stated in a site parameters summary table.
- C. Combined License Reviews: For a COL application referencing a certified standard design, 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 redesigning the proposed facility.

For a COL application referencing an ESP, NRC staff reviews the application to ensure the applicant provided sufficient information to demonstrate that the design of the facility falls within the site characteristics and design parameters specified in the early site permit 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 an ESP, unless the change is: necessary to assure adequate protection of the public health and safety; necessary to bring the permit or site into compliance with the Commission's regulatory requirements in effect when the permit was issued; is necessary based upon an update to early site permit-emergency preparedness information, or based on a variance. 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 a 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 FSER to ensure that any unresolved items, commitments, assumptions, and deferred issues 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 against 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 low water effects 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 potential for low water conditions is acceptable and meets the requirements of 10 CFR Part 50, Appendix A, General Design Criteria 2 and 44 and 10 CFR Part 100 [10 CFR 100.10(c) or 10 CFR 100.20(c), as applicable], with respect to determining the acceptability of the site.

The staff finds that the applicant has considered the appropriate site phenomena in establishing the design bases for SSCs important to safety. The staff has generally accepted the methodologies used to determine the potential for low water conditions is reflected in these design bases, as documented in safety evaluation reports for previous licensing actions. Accordingly, the staff concludes that the use of these methodologies results in design bases 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 design bases meet the requirement(s) of 10 CFR Part 50, Appendix A, General

Design Criteria 2 and 44 and 10 CFR 100.10(c) [or 10 CFR 100.20(c)], 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 identification and evaluation of low water conditions at the proposed site. Section 2.4.11, "Low Water Considerations," 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 low water conditions affecting the site. Further, the applicant considered the most severe natural phenomena that have been historically reported for the site and surrounding area while describing the hydrologic interface of the plant with the site, 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 climatic 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 hydrology for inclusion in an ESP for the applicant's site, should one be issued, 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. Low water effects 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 DC applications and license applications submitted by applicants pursuant to 10 CFR Part 50 or 10 CFR Part 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.

VI. REFERENCES

1. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."
2. 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."
3. 10 CFR Part 100, "Reactor Site Criteria."
4. 10 CFR 100.23, "Seismic and Geologic Siting Criteria for Nuclear Power Plants."
5. Regulatory Guide 1.27, "Ultimate Heat Sink for Nuclear Power Plants."
6. Regulatory Guide 1.29, "Seismic Design Classification."
7. Regulatory Guide 4.4, "Reporting Procedure for Mathematical Models Selected to Predict Heated Effluent Dispersion in Natural Water Bodies."
8. Regulatory Guide DG-1145, "Combined License Applications for Nuclear Power Plants (LWR Edition)."
9. J. E. Edinger and J. C. Geyer, "Heat Exchange in the Environment," EEI Publication 69-902, Edison Electric Institute, New York, June 1965.
10. R. B. Codell and W. K. Nuttle, "Analysis of Ultimate Heat Sink Cooling Ponds," NUREG-0693, USNRC (1980).
11. R. B. Codell, "The Analysis of Ultimate Heat Sink Spray Ponds," NUREG-0733, USNRC 1981.

PAPERWORK REDUCTION ACT STATEMENT

The information collections contained in the 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 2.4.11

Description of Changes

This SRP section affirms the technical accuracy and adequacy of the guidance previously provided in Draft Revision 3, dated April 1996 of this SRP. See ADAMS accession number ML052070256.

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 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. A review was added of consideration of seismic and non-seismic criteria on worst-case low water scenarios.
3. The Review Interfaces subsection was expanded to state that review of site parameters for DC applications and COL applications that reference a DC is performed in SRP Section 14.3.
4. The Review Interfaces subsection was expanded to state that review of the effects of freezing on the safety function of the ultimate heat sink is performed in SRP Section 9.2.5.
5. The Review Interfaces subsection was expanded to mention the interface of this SRP section with other SRP sections where low-water inducing natural phenomena are reviewed.
6. The Review Interfaces subsection was expanded to state that staff should provide site characteristics and other hydrometeorological parameters to the responsible organization to ascertain if low water effects are properly considered in mechanical and structural design bases.

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 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 Acceptance Criteria.

III. REVIEW PROCEDURES

1. Introductory paragraphs were added at the beginning of the Review Procedures section to provide guidance related to application of the procedures described therein to different types of applications.
2. This section was rewritten to provide specific guidance related to each area of review. The approach for evaluation of low water potential was updated to include methods of current practice.

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.