U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

2.4.11 ~~COOLING WATER SUPPLY~~LOW WATER CONSIDERATIONS[1]

REVIEW RESPONSIBILITIES

Primary - ~~Hydrologic & Geotechnical Engineering Branch (HGEB)~~Civil Engineering and Geosciences Branch (ECGB)[2]

Secondary - None

I. AREAS OF REVIEW

The purpose of this section of the applicant's safety analysis report (SAR) is to identify natural events that may reduce or limit the available cooling water supply, and to ~~assure~~ensure[3] that an adequate water supply will exist to operate or shut down the plant under normal operations, anticipated operational occurrences,[4] and emergency conditions.

Depending on the site, the areas of review include:

1. The worst drought considered reasonably possible in the region.

2. Low water (setdown) resulting from surges, seiches, or tsunami.

3. Low water resulting from icing in relation to the events described in Standard Review Plan (SRP) Section 2.4.7.[5]

4. The effect of existing and proposed water control structures (dams, diversions, dam failures, etc.).

5. The intake structure and pump design basis in relation to the events described in SAR Subsections 2.4.11.1, 2.4.11.2, 2.4.11.3, 2.4.11.4 and SRP Sections 2.4.7, 2.4.8, and 2.4.9.[6]
6. The use limitations imposed or under discussion by Federal, state, or local agencies authorizing the use of the water.

7. The range of water supply required by the plant, including minimum operating and shutdown flows, during anticipated operational occurrences and emergency conditions,[7] compared ~~to~~with availability.

8. The effects of potential blockage of intakes by sediment, ~~and~~ littoral drift and ice.[8]

9. The capability of the ultimate heat sink to provide adequate cooling water under normal operations, anticipated operational occurrences,[9] and emergency conditions.

10. Potential structural effects and their proper consideration in the structural design bases for the plant.[10]

For standard design certification applications, the cooling water inlet and air temperatures are specified in the site parameter envelope that must be met by the plant design.[11]

Review Interfaces[12]

1. The ECGB also performs reviews under:

    a. SRP Section 9.2.5 for analysis of the dependability of the ultimate heat sink.

    b. SRP Section 2.4.7 to ensure that safety-related facilities and water supplies are not affected by ice, flooding, or blockage.

    c. SRP Sections 2.4.8 and 2.4.9 for dependability of the cooling water supply.

    d. SRP Section 2.3.6 (proposed) for the adequacy of the site parameter envelope specified in standard design certification applications.[13]

2. The ECGB coordinates other branch evaluations that interface with the overall review, as follows:

    a. The Plant Systems Branch (SPLB):

        i. Reviews the ultimate heat sink to avoid any duplication with ECGB's system analysis of water supply structures and conveyance systems to ensure that failure of one component will not cause failure of the entire system.

ii. Consults with ECGB when design criteria are not firmly established for the structural or mechanical design bases of the plant regarding the cooling water supply.

iii. Obtains conclusions from ECGB on the analysis of the dependability of the ultimate heat sink.

iv. Reviews emergency procedures that, in the event of an accident, may be required to obtain the use of alternate water supplies and (if the independently estimated water supply appears to be less than 30 days) to determine that there is continuity of the water supply.

v. Determines and supplies ECGB with the design maximum temperature and heat load of the design basis accident.

vi. Determines the adequacy of any required alternative water supply sources to ensure the continuity of the water supply.

b. The Mechanical Engineering Branch (EMEB) ascertains, on request by ECGB, whether mechanical effects are properly considered in the mechanical design bases of the plant. (Such requests are based on evidence of potential mechanical effects.)

c. The Emergency Preparedness and Radiation Protection Branch (PERB) is consulted whenever design criteria are not firmly established.

d. The Human Factors Assessment Branch (HHFB) ascertains whether emergency procedures required for conversion to an alternate water source are adequate.[14]

For those areas of review identified as part of the primary responsibility of other branches, the acceptance criteria and methods of application are contained in the referenced SRP section.[15]

II. ACCEPTANCE CRITERIA

Acceptance criteria for this SRP section relate to the following regulations:

1. General Design Criterion 2 (GDC 2) requires that structures, systems, and components important to safety be designed to withstand the effects of natural phenomena.

2. General Design Criterion 44 (GDC 44) requires an ultimate heat sink capable of accepting the plant's heat load under normal and accident conditions.

3. 10 CFR Part 100 requires that hydrologic characteristics be considered in the evaluation of the site.

4. 10 CFR Part 100, Appendix A requires, in part, that consideration of river blockages or diversion or other failures which may block the flow of cooling water, tsunami runup and

drawdown, and dam failures be included in the evaluation of the adequacy of the emergency cooling water supply.

To meet the requirements of the hydrologic aspects of the above regulations, the following specific criteria are used:

Acceptance is based principally on the adequacy of the ultimate heat sink to supply cooling water for normal operations, anticipated operational occurrences,[16] and for safe shutdown, cooldown (first 30 days), and long-term cooldown (periods in excess of 30 days) during adverse natural conditions. In addition, the design basis of the intake system must be adequate to enable delivery of the necessary cooling water to the plant during adverse hydrologic conditions. Where the specific design bases preclude plant operation during severe hydrologically related events, sufficient warning time must 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. In cases where sufficient warning time to permit advance shutdown is considered necessary to protect safety-related components, an item in the plant Technical Specifications will be required.

SAR Section 2.4.11.1 (Low Flow in Rivers and Streams): For essential water supplies the low-flow/low-level design for the primary water supply source must 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.

SAR Section 2.4.11.2 (Low Water Resulting from Surges, Seiches, or Tsunami):[17] 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 must be higher than the intake design basis for essential water supplies. For coastal sites, the appropriate probable maximum hurricane(PMH) wind fields must 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 must be estimated from probable maximum winds oriented away from the plant site. The same general analysis methods discussed in Standard Review Plan Sections 2.4.3, 2.4.5 and 2.4.6 are applicable to low water estimates due to the various phenomena discussed.

SAR Section 2.4.11.3 (Historical Low Water): If historical flows and levels are used to estimate design values by inference from frequency distribution plots, the data used must be presented so that an independent determination can be made. The data and methods of the National Oceanic and Atmospheric Administration, United States Geologic Survey, Soil Conservation Service, Bureau of Reclamation, and the Corps of Engineers are acceptable.

SAR Section 2.4.11.4 (Future Controls): This section is acceptable if 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 have been

considered and are substantiated by reference to reports of the appropriate agencies. The most adverse possible effects of these controls must be shown and taken into account in the design basis to ~~assure~~ensure[18] that essential water supplies are not likely to be affected adversely in the future.

SAR Section 2.4.11.5 (Plant Requirements): Acceptance is based on the following required information:

1. Minimum essential cooling water flow rates and levels must be presented (or cross-referenced) and shown to be less than the probable minimum low flows and levels from the applicable sources of supply.

2. Maximum water requirements for normal operations must be presented and (if applicable) shown to be less than the water available under all likely conditions from the sources of supply.

SAR Section 2.4.11.6 (Heat Sink Dependability Requirements): The required data and information are those necessary to determine that the facility meets the criteria of GDC 44 as described in Regulatory Guide 1.27. The analyses will be considered complete and acceptable if the following are adequately addressed:

1. The initial water inventory must be sufficient for shutdown and cooldown of the plant.

2. Water losses (such as seepage, drift, and evaporation) must be conservatively estimated, as suggested in Regulatory Guide 1.27.

3. The design basis hydrometeorology (temperature, dewpoint, etc.) must be as conservative as the criteria of the guide (see SRP Section 2.3).

4. The limit on the heat sink return water temperature must be less than the maximum allowable cooling water inlet design temperature.

5. The heat sink intakes are located such that no potential exists for blockage by littoral drift and/or sediment, and/or ice, and/or channel diversions[19] that would decrease water supply below minimum required levels.

Technical Rationale[20]

The technical rationale for application of these acceptance criteria to reviewing low water considerations is discussed in the following paragraphs:[21]

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 criterion further specifies that the design bases for these structures, systems, and components shall reflect the following:

a. Appropriate consideration for 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.

GDC 2 applies to this SRP section because the reviewer addresses natural hydrologic phenomenon that may reduce or limit the available cooling water supply and, in general terms, the amount of conservatism that must be used in assessing these natural phenomenon in order to determine the design bases for structures, systems, and components important to safety. Regulatory Guide 1.27 provides additional guidance for meeting these requirements.

Meeting the requirements of GDC 2 provides assurance that an adequate water supply will be available for normal operations; anticipated operational occurrences; or safe shutdown of the plant after normal operations, anticipated operational occurrences, or emergency conditions.[22]

2. 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 under 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 must 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.[23]

3. Compliance with 10 CFR Part 100 requires, in part, that hydrologic characteristics be considered in the evaluation of a nuclear power plant site.

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.[24]

4. Compliance with Appendix A to 10 CFR Part 100 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.

Appendix A to 10 CFR Part 100 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 must 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 Appendix A to 10 CFR Part 100 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.[25]

III. REVIEW PROCEDURES

Minimum plant requirements (water level and flow) that are identified in SAR subsection 2.4.11.5 or 9.2.5 are compared ~~to~~with the estimated minimum water levels and flows given in ~~section~~ subsection[26] 2.4.11.1. If normal operation is not ~~assured~~ensured[27] at the minimum water supply conditions, and loss of normal operation capability can adversely affect safety-related components, estimates of warning time are reviewed to ~~assure~~ensure[28] 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 ~~assure~~ensure[29] 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 ~~Auxiliary Systems Branch (ASB) and Power Systems Branch (PSB)~~SPLB.[30] Determination of the dependability of the ultimate heat sink is accomplished by using Regulatory Guide 1.27 as a standard of comparison.

Each source of water for normal operations, anticipated operational occurrences,[31] or emergency shutdown and cooldown, and the natural phenomena and site-related accident design criteria for each should be identified.

First,[32] a systems analysis is ~~first~~ undertaken of all water supply sources to determine the likelihood that at least one source would survive:

1. The most severe of each of the natural phenomena,

2. Site-related accident phenomena, and

3. 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 repeated, to ~~assure~~ensure[33] that the failure of one component will not cause failure of the entire system. These analyses are coordinated with the ~~ASB and PSB~~SPLB[34] review of the ultimate heat sink and related cooling systems, to avoid duplication. Operating rules for each portion of the system are ascertained to determine the amount of water that can be assumed available in the event of normal operations, anticipated operational occurrences,[35] or ~~accidental shutdown~~emergency shutdown and cooldown.[36] If there is evidence of potential ~~structural or~~[37] mechanical effects, the ~~Structural Engineering Branch (SEB) or~~[38] ~~Mechanical Engineering Branch (MEB)~~EMEB[39] will be requested by ~~HGEB~~ECGB[40] to ascertain whether the effects are properly considered in the ~~structural or~~ [41]mechanical design bases for the plant. If there is evidence of potential structural effects, ECGB will ascertain whether the effects are properly considered in the structural design bases for the plant.[42] Consultations with the ~~Geosciences Branch (GB), Accident Evaluation Branch (AEB) Emergency Preparedness and Radiation Protection Branch~~PERB[43]~~, SEB, ASB,~~ and ~~PSB~~SPLB[44] are undertaken where design criteria are not firmly established.

The potential for surges in intake sumps (i.e., seiching in intake structures and surges in intake pipes) that could cause adverse effects are reviewed to ~~assure~~ensure[45] that the effects have been properly incorporated for 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.

For multiple purpose (normal operations, anticipated operational occurrences,[46] ~~normal shutdown, and emergency shutdown~~and emergency shutdown and cooldown[47]) water supply systems, the primary portion of the system is first reviewed to determine that the water supply will be maintained at minimum volume requirements at all times. The secondary portion of the system is then 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 must be adjusted for historical and potential future effects). If not available,[48] the applicant is requested to provide a technical specification requiring plant shutdown at the point where an adequate shutdown water supply is still ~~assured~~ensured.[49]

Institutional restraints on water use, such as limitations in water use and discharge permits, are reviewed to ~~assure~~ensure[50] the plant will have an adequate supply and not exceed limitations imposed upon operation. If a conflict is foreseen, the applicant is requested to either obtain a variance or make a design change to accommodate the limitation.

The potential for blockage of the intakes by littoral drift, sediment, and/or ice[51] is reviewed to ~~assure~~ensure[52] 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 mitigative measures are required to protect safety- related facilities. Independent estimates of "worst-case" buildups will be made using statistical or deterministic techniques.

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. For ocean 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.

The ability of the ultimate heat sink to provide a 30-day supply of cooling water, as specified in Regulatory Guide 1.27, will be independently evaluated. For those cases where makeup water cannot be ~~assured~~ensured[53] (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 are made. Techniques described in NUREG-0693 and NUREG-0733[54] ~~References 24 and 25~~ are 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 will be reviewed in two parts: short-term capability and long-term capability. For short-term capability,the ~~AEB~~PERB,[55] ~~PSB~~SPLB,[56] and the Licensing Project Manager (LPM) will be informed if the independently estimated supply appears to be less than 30 days. The applicant will 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 will be reviewed with ~~AEB~~PERB,[57] ~~PSB~~SPLB,[58] 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 is 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 ~~assure~~ensure[59] 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 will 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 will be evaluated. The design maximum temperature and the heat load of the design basis accident, as specified in Regulatory Guide 1.27, will be provided by ~~ASB~~SPLB.[60] Techniques for selecting the meteorologic 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[61] ~~References 24 and 25~~, respectively.

Requirements and procedures governing issuance of early site permits for approval of proposed sites for nuclear power facilities are specified in 10 CFR Part 52. Information required for such

a permit includes a description of the site's hydrological and meteorological characteristics. For this type of permit, the procedures above should be followed.

For an application referencing a certified standard design, the reviewer verifies that historical data related to cooling water supplies are consistent with the temperatures specified in the site parameter envelope for the certified design.[62]

For standard design certification reviews under 10 CFR Part 52, the procedures above should be followed, as modified by the procedures in SRP Section 14.3 (proposed), to verify that the design set forth in the standard safety analysis report, including inspections, tests, analysis, and acceptance criteria (ITAAC), site interface requirements and combined license action items, meet the acceptance criteria given in subsection II. SRP Section 14.3 (proposed) contains procedures for the review of certified design material (CDM) for the standard design, including the site parameters, interface criteria, and ITAAC.[63]

IV. EVALUATION FINDINGS

The findings will indicate the degree of compliance with GDC 2, GDC 44, 10 CFR Part 100, and 10 CFR Part 100, Appendix A.

For construction permit (CP) or early site permit (ESP)[64] reviews the findings will summarize the applicant's and staff's estimates of the design basis minimum water flows and levels. If the applicant's estimates are no more than 5% less conservative than the staff's estimates, staff concurrence in the applicant's estimates will be stated. If the applicant's estimates are more than 5% less conservative and if the proposed plant may be adversely affected, a statement of the staff's position (bases) will be made. A similar finding on the design bases for the ultimate heat sink will be made. If technical specification requirements are needed to ~~assure~~ensure[65] an adequate supply, they will be indicated in the CP, ~~statement~~ESP, or COL safety evaluation report (SER)[66] and required for operation.

For operating license (OL) reviews of plants for which detailed low water reviews were done at the CP stage, the CP conclusions will be referenced. For review of a plant proposed for a site that has been granted an early site permit, the early site permit's conclusions regarding low water reviews will be referenced.[67] In addition, the results of a review to reaffirm the low water design bases will be noted. If no changes have been made to the ultimate heat sink design since the CP review, the conclusions of the CP will be referenced. However, for both the low water considerations and the ultimate heat sink, an evaluation will be made during the OL review to ~~assure~~ensure[68] that the design bases have been properly implemented. The availability of long-term water supply will be noted. If no low water and ultimate heat sink review was undertaken at the CP or ESP[69] stage (of the scope described), this fact will be noted also.

A sample CP-stage statement follows:

> The normal water supply for the station will be obtained from Lake A. Emergency cooling water will be furnished by the ultimate heat sink reservoir which is not dependent upon the water level in Lake A for its safety function.

The minimum lake elevation needed for operation of the pumps supplying makeup water for the circulating and the service water systems is 169.0 meters (554.6 feet)[70] above International Great Lakes Datum 172.5 meters [(566.1 feet)[71] above mean sea level]. The lowest lake level observed at B City during the 70 years of record was 172.4 meters (565.7 feet)[72] above International Great Lakes Datum 172.9 meters [(567.2 feet),[73] above mean sea level] on February 4, 1936. Recurrence of this low lake level would not affect the plant's ability to obtain water.

The applicants calculated the probable minimum lake setdown during a postulated probable maximum windstorm using a one-dimension numerical surge model. The minimum calculated lake level, including an antecedent level equal to the minimum monthly lake level of record, is 167.3 meters (549.0 feet)[74] above International Great Lakes Datum 167.8 meters [(550.4 feet)[75] above mean sea level]. Since this level is below the minimum necessary for pump submergence, the plant would have to be shut down using water from the ultimate heat sink reservoir, which would not be affected by the postulated low lake level.

The proposed ultimate heat sink will be comprised of Lake A and a rectangular cooling pond located on the site. Normal operation and shutdown will utilize cooling water from the natural draft cooling towers; the makeup for the cooling towers comes from Lake A. If, for any reason, the natural draft cooling towers are unavailable, the onsite pond will be used to shut down the units. The pond will be 603.5 meters (1980 feet)[76] long and 286.5 meters (940 feet)[77] wide. The depth of the water will be 3.4 meters (11 feet),[78] and the pond's embankment will have a freeboard of 1.5 meters (5 feet).[79] The submerged intake and discharge pipes will be located at the same end of the pond but separated by a dike running almost the entire length of the pond to prevent short-circuiting between the intake and discharge. The pond must be capable of providing cooling water below the design temperature of 43.3 °C (110 °F)[80] under normal operation[81] or emergency conditions.

The applicants analyzed the pond's thermal performance assuming a loss-of-coolant accident in one unit, a simultaneous normal operation[82] shutdown in the other, and meteorological conditions of the severity specified in Regulatory Guide 1.27, "Ultimate Heat Sink for Nuclear Power Plants." The maximum pond temperature calculated was 42.9 °C (109.3 °F).[83]

~~We~~The staff[84] independently modeled the thermal performance of the pond and conclude that it is capable of providing cooling water below the design temperature of 43.3 °C (110 °F).[85] ~~We~~The staff[86] conservatively estimated maximum water losses from the pond, assuming meteorological conditions of the severity specified in Regulatory Guide 1.27, and conclude that the initial pond inventory will be sufficient to provide at least a 30-day cooling water supply without makeup.

~~We~~The staff[87] evaluated the potential effects of freezing events on the pond's capability of providing emergency cooling water to the plant. Our analysis showed that the intake and discharge pipes will be below the maximum depth of pond freezing that could occur under meteorological conditions of the severity suggested in Regulatory Guide 1.27. In

addition, to prevent freezing around the intake and discharge pipes, the intake pumphouse will be heated and the discharge piping will be buried below the frost line, heat traced or the discharge structure will be heated.

~~We have~~The staff has[88] evaluated the performance of the proposed cooling pond and conclude that, under meteorological conditions of the severity described in Regulatory Guide 1.27, (1) the design will provide sufficient water in the pond to cool the plant for at least 30 days without any makeup and (2) the maximum temperature of the water supplied to the plant will be below the design temperature of 43.3 °C (110 °F).[89]

Based upon the evaluations described above, ~~we~~the staff[90] concludes that the cooling water supply for the plant meets the requirements of General Design Criterion 2, 10 CFR Part 100, and 10 CFR Part 100, Appendix A with respect to hydrologic characteristics and that it meets the requirements of General Design Criterion 44 with respect to thermal aspects of the heat transfer system.

For an application referencing a certified plant design, the reviewer's findings should include a concluding statement similar to the following:

Historical data for the proposed site are consistent with the cooling water temperatures and levels identified in the site parameter envelope specified in the certified plant design documents.[91]

For design certification reviews, the findings will also summarize, to the extent that the review is not discussed in other safety evaluation report sections, the staff’s evaluation of inspections, tests, analyses, and acceptance criteria (ITAAC), including design acceptance criteria (DAC), site interface requirements, and combined license action items that are relevant to this SRP section.[92]

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this SRP section.

This SRP section will be used by the staff when performing safety evaluations of license applications submitted by applicants pursuant to 10 CFR 50 or 10 CFR 52.[93] Except in those cases in which the applicant proposed an acceptable alternative method for complying with specified portions of the Commission's regulations, the method described herein will be used by the staff in its evaluation of 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.[94]

Implementation schedules for conformance to parts of the method discussed herein are contained in the referenced regulatory guides and NUREGs.

VI. REFERENCES[95]

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 100, "Reactor Site Criteria."

4. 10 CFR Part 100, Appendix A, "Seismic and Geologic Siting Criteria for Nuclear Power Plants."

5. L. R. Beard, "Methods for Determination of Safe Yield and Compensation Water from Storage," Seventh International Water Supply Congress, Barcelona, Spain (1966).

6. L. R. Beard, "Statistical Methods in Hydrology," Corps of Engineers (1962).

7. D. K. Brady, et al., "Surface Heat Exchange at Power Plant Cooling Lakes," EEI Publication 69901 Edison Electric Institute, New York, November 1969.

8. V. T. Chow (ed.), "Handbook of Applied Hydrology," McGraw-Hill Book Company, New York (1964).

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. G. M. Fair, et al., "Water and Wastewater Engineering," Vol. 1, John Wiley & Son, Inc., New York (1966).

11. "Scientific Hydrology," Ad Hoc Panel on Hydrology, Federal Council for Science and Technology, Washington, D.C., June 1962.

12. M. B. Fiering and M. M. Hufschmidt, "Simulation Techniques for Design of Water-Resource Systems," Harvard University Press, Cambridge, Mass. (1966).

13. R. K. Linsley, et al., "Hydrology for Engineers," McGraw-Hill Book Company, New York (1958).

14. R. K. Linsley and J. B. Franzini, "Water-Resources Engineering," McGraw-Hill Book Company, New York (1964).

15. A. Maas, et al., "Design of Water-Resources Systems," Harvard University Press, Cambridge, Mass. (1962).

16. "Hydrologic Engineering Methods for Water Resources Development," Vol. 112, Corps of Engineers Hydrologic Engineering Center, Davis, California (1971).

17. "Reservoir Storage-Yield Procedures," Corps of Engineers Hydrologic Engineering Center, Davis, California (1967).

18. Regulatory Guide 1.27, "Ultimate Heat Sink for Nuclear Power Plants."

19. "Design of Small Dams," Second Edition, Bureau of Reclamation, U.S. Department of Interior (1973).

20. "Water Surface Profiles," HEC-2, Corps of Engineers Hydrologic Engineering Center (continuously updated).

21. "Reservoir System Analysis," HEC-3, Corps of Engineers Hydrologic Engineering Center (updated).

22. "Monthly Streamflow Simulation," HEC-4, Corps of Engineers Hydrologic Engineering Center (updated).

23. Regulatory Guide 4.4, "Reporting Procedure for Mathematical Models Selected to Predict Heated Effluent Dispersion in Natural Water Bodies."

24. R. B. Codell and W. K. Nuttle, "Analysis of Ultimate Heat Sink Cooling Ponds," NUREG-0693, USNRC (1980).

25. R. B. Codell, "The Analysis of Ultimate Heat Sink Spray Ponds," NUREG-0733, USNRC ~~(in preparation)~~1981.[96]

26. 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."[97]

SRP Draft Section 2.4.11
Attachment A - Proposed Changes in Order of Occurrence

Item numbers in the following table correspond to superscript numbers in the redline/strikeout copy of the draft SRP section.

Item	Source	Description
1.	Editorial	Changed title to agree with that of RG 1.70, "Low Water Considerations."
2.	Current PRB name and abbreviation	Changed PRB to Civil Engineering and Geosciences Branch (ECGB).
3.	Editorial	Replaced "assure" with "ensure."
4.	SRP-UDP format item	Changed to reflect implementation of Generic Issue B-3.
5.	SRP-UDP format item	Added reference to SRP Section 2.4.7, which considers the potential effects of ice-induced high or low flow levels on safety related facilities and water supplies.
6.	SRP-UDP format item	Added SRP Section 2.4.7 which considers the potential for ice-produced forces on, or blockage of safety-related facilities. Added SRP Sections 2.4.7 and 2.4.8 which refer to Cooling Water Canals and Reservoirs and Channel Diversions, respectively.
7.	SRP-UDP format item	Changed to reflect implementation of Generic Issue B-3.
8.	SRP-UDP format item	Added "and ice" because SRP Section 2.4.7 considers ice blockage of water intakes.
9.	SRP-UDP format item	Changed to reflect implementation of Generic Issue B-3.
10.	SRP-UDP format item	Excerpted from Section III, REVIEW PROCEDURES, third paragraph.
11.	Integrated Impact No. 518	Noted site parameter envelope for standard design certification.
12.	SRP-UDP format item	Added "Review Interfaces" to AREAS OF REVIEW and formatted into numbered paragraphs to describe how ECGB reviews aspects of the cooling water supply under other SRP sections and how other branches support the review of the cooling water supply. Except where noted otherwise, "Review Interfaces" were excerpted from subsection III, REVIEW PROCEDURES.
13.	Integrated Impact No. 518	Added a review interface to new SRP 2.3.6 for review of site parameter envelope.
14.	SRP-UDP format item	Added HHFB to reflect its review of all emergency procedures.

Item	Source	Description
15.	SRP-UDP format item	Added reference to primary review responsibility of other branch reviews to reflect the added review interface section and for consistency with other SRP sections.
16.	SRP-UDP format item	Changed to reflect implementation of Generic Issue B-3.
17.	Editorial	Moved footnote from REFERENCES to this more appropriate location.
18.	Editorial	Replaced "assure" with "ensure."
19.	SRP-UDP format item	Added "and/or ice, and/or channel diversions" because icing has the potential to block the intakes and channel diversions have the potential to lower the water supply.
20.	SRP-UDP format item	Added "Technical Rationale" to ACCEPTANCE CRITERIA subsection and formatted into numbered paragraphs to describe the basis for referencing the General Design Criteria.
21.	SRP-UDP format item	Added lead-in sentence for "Technical Rationale."
22.	SRP-UDP format item	Added technical rationale for GDC 2.
23.	SRP-UDP format item	Added technical rationale for GDC 44.
24.	SRP-UDP format item	Added technical rationale for 10 CFR Part 100.
25.	SRP-UDP format item	Added technical rationale for Appendix A to 10 CFR Part 100.
26.	Editorial	Added "sub" to section 2.4.11.1 correcting it to its proper nomenclature.
27.	Editorial	Replaced "assured" with "ensured."
28.	Editorial	Replaced "assure" with "ensure."
29.	Editorial	Replaced "assure" with "ensure."
30.	Current PRB name	Changed review interface branch to SPLB.
31.	SRP-UDP format item	Changed to reflect implementation of Generic Issue B-3.
32.	SRP-UDP format item	Relocated the word "first" to the beginning of the sentence for consistency with the next paragraph and reformatted into numbered paragraphs for clarity.
33.	Editorial	Replaced "assure" with "ensure."
34.	Current PRB abbreviation	Changed review interface branch to SPLB.
35.	SRP-UDP format item	Changed to reflect implementation of Generic Issue B-3.

Item	Source	Description
36.	SRP-UDP format item	Replaced "accidental shutdown" with "emergency shutdown and cooldown" to be consistent with the second paragraph under subsection III.
37.	SRP-UDP format item	Changed to reflect EMEB as the interface reviewer in lieu of SEB. References to structural aspects deleted and added as a new paragraph under the review of the primary reviewer ECGB.
38.	SRP-UDP format item	Changed to reflect EMEB as the interface reviewer in lieu of SEB. References to structural aspects deleted and added as a new paragraph under the review of the primary reviewer ECGB.
39.	Current SRB abbreviation	Changed review branch to EMEB.
40.	SRP-UDP format item	Changed to reflect EMEB as the interface reviewer in lieu of SEB. References to structural aspects deleted and added as a new paragraph under the review of the primary reviewer ECGB.
41.	Current PRB abbreviation	Changed PRB to (ECGB).
42.	SRP-UDP format item	Added a sentence to reflect aspects of the structural review conducted by ECGB.
43.	Current PRB name and abbreviation	Changed review branch to PERB. The PRB name was deleted since it was given earlier. GB and SEB were deleted since they became ECGB.
44.	Current PRB abbreviation	Changed review interface branch to SPLB.
45.	Editorial	Replaced "assure" with "ensure."
46.	SRP-UDP format item	Changed to reflect implementation of Generic Issue B-3.
47.	SRP-UDP format item	Replaced "normal shutdown, and emergency shutdown" with "and emergency shutdown and cooldown." To be consistent with the second paragraph under subsection III of this SRP. Normal shutdown is part of normal operations.
48.	Editorial	Added the word "available" to reflect what "If not" refers to.
49.	Editorial	Replaced "assured" with "ensured."
50.	Editorial	Replaced "assure" with "ensure."
51.	SRP-UDP format item	Added "and\or ice" to ensure ice blockage is covered in accordance with SRP Section 2.4.7.
52.	Editorial	Replaced "assure" with "ensure."
53.	Editorial	Replaced "assured" with "ensured."

Item	Source	Description
54.	SRP-UDP format item	Deleted "References 24 and 25" and added NUREG-0693 and NUREG-0733.
55.	Current PRB abbreviation	Changed review interface branch to PERB.
56.	Current PRB abbreviation	Changed review branch to SPLB.
57.	Current PRB abbreviation	Changed review branch to PERB.
58.	Current PRB abbreviation	Changed review branch to SPLB.
59.	Editorial	Replaced "assure" with "ensure."
60.	Current PRB abbreviation	Changed review branch to SPLB.
61.	SRP-UDP format item	Deleted "References 24 and 25" and added NUREG-0693 and NUREG-0733.
62.	Integrated Impact No. 518	Added paragraphs to describe reviews for early site permits and applications referencing a certified design.
63.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard paragraph to address application of Review Procedures in design certification reviews.
64.	Integrated Impact No. 518	Added designation to indicate the review procedures to be applied at the early site permit (per 10 CFR Part 52).
65.	Editorial	Replaced "ensure" with "assure."
66.	Integrated Impact No. 518	Address application of the SRP findings to early site permits and combined license reviews.
67.	Integrated Impact No. 518	Added guidance for a review that references an early site permit.
68.	Editorial	Replaced "assure" with "ensure."
69.	Integrated Impact No. 518	Added reference to early site permit reviews.
70.	SRP-UDP format item	Converted feet to meters.
71.	SRP-UDP format item	Converted feet to meters.
72.	SRP-UDP format item	Converted feet to meters.
73.	SRP-UDP format item	Converted feet to meters.
74.	SRP-UDP format item	Converted feet to meters.
75.	SRP-UDP format item	Converted feet to meters.
76.	SRP-UDP format item	Converted feet to meters.
77.	SRP-UDP format item	Converted feet to meters.
78.	SRP-UDP format item	Converted feet to meters.
79.	SRP-UDP format item	Converted feet to meters.

Item	Source	Description
80.	SRP-UDP format item	Converted °F to °C.
81.	SRP-UDP format item	Implementation of Generic Issue B-3.
82.	SRP-UDP format item	Implementation of Generic Issue B-3.
83.	SRP-UDP format item	Converted °F to °C.
84.	SRP-UDP format item	Changed personal pronoun to "the staff."
85.	SRP-UDP format item	Converted °F to °C.
86.	SRP-UDP format item	Changed personal pronoun to "the staff."
87.	SRP-UDP format item	Changed personal pronoun to "the staff."
88.	SRP-UDP format item	Changed personal pronoun to "the staff."
89.	SRP-UDP format item	Converted °F to °C.
90.	SRP-UDP format item	Changed personal pronoun to "the staff."
91.	Integrated Impact No. 518	Added requirement for a statement regarding the site parameter envelope to EVALUATION FINDINGS.
92.	SRP-UDP Format Item, Implement 10 CFR 52 Related Changes	To address design certification reviews a new paragraph was added to the end of the Evaluation Findings. This paragraph addresses design certification specific items including ITAAC, DAC, site interface requirements, and combined license action items.
93.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard sentence to address application of the SRP section to reviews of applications filed under 10 CFR Part 52, as well as Part 50.
94.	SRP-UDP Guidance	Added standard paragraph to indicate applicability of this section to reviews of future applications.
95.	Editorial	Moved footnote from REFERENCES to a more appropriate location (see item 15 above).
96.	Integrated Impact No. 517	Added missing NUREG number (0733) and date to Reference 25.
97.	Integrated Impact No. 518	Added reference to 10 CFR Part 52.

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Integrated Impact No.	Issue	SRP Subsections Affected
517	Update a citation of an existing guidance document to reflect the approval and issuance of the document.	VI. REFERENCES, Reference 25
518	Consideration should be given to developing a new SRP Section for review of the site parameter envelope associated with standard plant applications, as a candidate for future work. Consideration should also be given to revising existing SRP Sections for review of site-specific parameters to reflect the site parameter-related requirements of 10 CFR 52, for applications referencing a standard plant design.	I. AREAS OF REVIEW, new paragraph I. REVIEW INTERFACES, Areas of Review, new paragraph III. REVIEW PROCEDURES, two new paragraphs IV. EVALUATION FINDINGS, introductory paragraphs and one new finding VI. REFERENCES, new item 26.
1211	Revise the SRP to incorporate the new and revised requirements from proposed rulemaking 59 FR 52255.	No changes to SRP, pending final action on proposed rule.