



U.S. NUCLEAR REGULATORY COMMISSION
STANDARD REVIEW PLAN
OFFICE OF NUCLEAR REACTOR REGULATION

2.4.1 HYDROLOGIC DESCRIPTION

Primary - Hydrologic & Geotechnical Engineering Branch (HGEB) Civil Engineering and Geosciences Branch (ECGB)¹

Secondary - None

I. AREAS OF REVIEW

The areas of review under this SRP section are:

1. Identification of the interface of the plant with the hydrosphere.
2. Identification of hydrologic causal mechanisms that may require special plant design bases or operating limitations with regard to floods and water supply requirements.
3. Identification of surface and ground water uses that may be affected by plant operation.

The review of Section 2.4.1.1 (Site and Facilities) of safety analysis reports (SARs) for a construction permit (CP), operating license (OL), or early site permit² consists of comparing the independently verified or derived hydrologic design bases (see subsequent sections of 2.4) with the critical elevations of safety-related structures and facilities. The review of SAR Section 2.4.1.2 (Hydrosphere) requires identification of the hydrologic characteristics of streams, lakes (e.g., location, size, shape, drainage area), shore regions, the regional and local groundwater environments, and existing or proposed water control structures (upstream and downstream) influencing the type of flooding mechanisms which may adversely effect safety aspects of plant siting and operation.

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USNRC STANDARD REVIEW PLAN

Standard review plans are prepared for the guidance of the Office of Nuclear Reactor Regulation staff responsible for the review of applications to construct and operate nuclear power plants. These documents are made available to the public as part of the Commission's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Standard review plans are not substitutes for regulatory guides or the Commission's regulations and compliance with them is not required. The standard review plan sections are keyed to the Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants. Not all sections of the Standard Format have a corresponding review plan.

Published standard review plans will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience.

Comments and suggestions for improvement will be considered and should be sent to the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, D.C. 20555.

II. ACCEPTANCE CRITERIA

Acceptance criteria for this ~~SRP~~ Standard Review Plan (SRP)³ section relate to the following regulations:

- A. General Design Criterion 2 (GDC 2) as it relates to structures, systems, and components important to safety being designed to withstand the effects of hurricanes, floods, tsunami, and seiches.
- B. 10 CFR Part 100 as it relates to identifying and evaluating hydrologic features of the site.

To meet the requirements of the hydrologic aspects of GDC 2 and 10 CFR Part 100, the following specific criteria are used:

- 1. The description and elevations of safety-related structures, facilities, and accesses thereto should be sufficiently complete to allow evaluation of the impact of flood design bases. Site topographic maps must be of good quality and of sufficient scale to allow independent analysis of pre- and post-construction drainage patterns. All external plant structures and components should be identified on site maps. Data on surface water users, location with respect to the site, type of use, and quantity of surface water used are required.

The information presented in SAR Section 2.4.1.2 forms the basis for subsequent hydrologic engineering analysis with respect to applications for a CP, OL, combined license (COL), or early site permit.⁴ Therefore, completeness and clarity are of paramount importance. Maps must be legible and adequate in coverage to substantiate applicable data. Inventories of surface water users must be consistent with regional hydrologic inventories reported by applicable State and Federal agencies. The description of the hydrologic characteristics of streams, lakes, and shore regions must correspond to those of the United States Geological Survey (USGS), National Oceanic and Atmospheric Administration (NOAA), Soil Conservation Service (SCS), Corps of Engineers, or appropriate State and river basin agencies. Descriptions of all existing or proposed reservoirs and dams (both upstream and downstream) that could influence conditions at the site must be provided. Descriptions may be obtained from reports of the USGS, United States Bureau of Reclamation (USBR), Corps of Engineers, and others. Generally, reservoir descriptions of a quality similar to those contained in pertinent data sheets of a standard Corps of Engineers Hydrology Design Memorandum are adequate. Tabulations of drainage areas, types of structures, appurtenances, ownership, seismic and spillway design criteria, elevation-storage relationships, and short- and long-term storage allocations must be provided.

- 2. Appendix A, "Hydrologic Engineering Site Visits," to this SRP section details the purposes and procedures of the site visit. The site visit serves to acquaint the reviewer with the site and to provide an independent confirmation of the hydrologic characteristics of the site and adjacent environs.

Technical Rationale⁵

The technical rationale for application of the above acceptance criteria to the review of a hydrologic description of a nuclear power plant site is discussed in the following paragraphs:⁶

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 the effects of the natural phenomena; and
 - c. The importance of the safety functions to be performed.

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

This criterion is applicable to SRP Section 2.4.1 in that it specifies the hydrologic phenomena that must be described in the section. In general terms, it also specifies the level of conservatism that must be used to assess the severity of these phenomena when determining the appropriate design bases for structures, systems, and components important to safety. The latter controls the degree of completeness required in the hydrologic description of the site and region.

Meeting the requirements of this criterion provides a level of assurance that structures, systems, and components important to safety have been designed to withstand the most severe natural phenomena likely to occur.⁷

2. Section 100.10(c) of 10 CFR Part 100 requires 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. In addition, 10 CFR 100.10(c) addresses the hydrologic characteristics of a proposed site that may affect the consequences of an escape of radioactive material from the facility. Special precautions are required if a reactor is to be located on a site where significant quantities of radioactive effluent might accidentally flow into nearby streams or rivers or might find ready access to ground water.

To satisfy the hydrologic requirements of 10 CFR Part 100, the applicant's SAR must contain a description of the surface and subsurface hydrologic characteristics of the site and region. This description must be sufficient to assess the acceptability of the site and the potential for those characteristics to influence the design of plant structures, systems, or components.

Meeting this requirement provides a level of assurance that the nuclear power plant is designed to withstand appropriately severe hydrologic phenomena. Further, it assures the staff and the public that the plant will pose no undue risk of radioactive contamination to surface or subsurface water from either normal operations or as the result of a reactor accident.⁸

III. REVIEW PROCEDURES

The information presented in SAR Section 2.4.1.1 is generally amenable to independent verification through cross-checks with other SAR sections and chapters, available publications relating to hydrologic characteristics of the site region, and by site visits. The review procedure consists of evaluating the completeness of the information and data by sequential comparison with information available from references. Based on the description of the hydrosphere (e.g., geographic location and regional hydrologic features) potential site flood mechanisms are identified. Subsequent SAR sections addressing the mechanisms are cross-checked to ~~assure~~ ensure⁹ that data and information required therein for review and substantiation are available.

An important facet of the review procedure for this and other SRP sections in hydrologic areas is the site visit. The site visit provides the principal technical reviewer with independent confirmation of hydrologic characteristics of the site and adjacent environs. The site visit is discussed in Appendix A to this SRP section.

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.¹⁰

IV. EVALUATION FINDINGS

For ~~construction permit (CP)~~ or early site permit¹¹ reviews, findings will consist of a brief general description of the site with respect to the general hydrosphere as required by 10 CFR Part 100 and GDC 2, and of the offsite uses of surface water. For ~~operating license (OL)~~ or COL¹² reviews, findings will consist of the same material, updated as required for new information available since preparation of the CP findings. The hydrologic description for each plant site is unique. The review verifies that sufficient information has been provided and will support conclusions of the following type, to be included in the staff's safety evaluation report:

The proposed site for the ABC Nuclear Plant is located about 42 kilometers (26 miles)¹³ SSE of XYZ City on the southwest bank of the DEF River at about river kilometer 245 (mile 152).¹⁴ Plant grade will be at about elevation 67 m (220 feet)¹⁵ above mean sea level (MSL).

Significant hydrologically related plant features include the river intake structure, the natural draft cooling towers, mechanical draft nuclear service cooling towers (these are redundant towers and serve as the ultimate heat sink), and various groundwater wells.

The staff concludes that the requirements of General Design Criterion 2 and 10 CFR Part 100, with respect to general hydrologic descriptions, have been met. This conclusion is based upon the following:

The applicant has provided sufficient information pertaining to the general hydrologic characteristics of the site including descriptions of water bodies, water control structures, and water users.

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.¹⁶

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 52.¹⁷ Except in those cases in which the applicant proposes 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.¹⁸

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

VI. REFERENCES

Because of the geographic diversity of plant sites and the large number of hydrologic references, no specific tabulation is given here. In general, maps and charts by the USGS, NOAA, Army Map Service (AMS), and Federal Aviation Administration (FAA); water-supply papers of the USGS; River Basin Reports of the Corps of Engineers; and other publications of State, Federal, and other regulatory bodies, describing hydrologic characteristics and water utilization in the

plant vicinity and region, are referred to on an "as-available" basis. Other SRP sections in the hydrology area (2.4.2 through 2.4.14) contain references that are to be used in evaluating the hydrologic description of the site.

1. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."
2. 10 CFR Part 100, "Reactor Site Criteria."
3. Appendix A, SRP Section 2.4.1, "Hydrologic Engineering Site Visits," attached.
4. Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants."

APPENDIX A

STANDARD REVIEW PLAN SECTION 2.4.1 HYDROLOGIC ENGINEERING SITE VISITS

I. PURPOSES

The purposes of hydrologic engineering site visits are as follows:

1. Acquaint the reviewer with general site and regional hydrologic characteristics and topography.
2. Confirm the applicant's general appraisal of the site/plant hydrologic interfaces.
3. Review specific hydrologic engineering problem areas with the applicant, his engineers, and his consultants.

The site visit objectives will have been achieved if, in addition to viewing pertinent hydrologic features, the reviewer has had the opportunity to discuss specific questions and concerns with the applicant's hydrologic engineers and is assured that the questions and concerns are understood. In addition, generally acceptable techniques and procedures necessary to respond to staff concerns should be discussed.

II. PROCEDURES

Questions or items of staff concern are to be developed by the ~~Hydrologic Engineering Section~~ ~~ECGB~~¹⁹ reviewer and discussed in detail with the ~~Section Leader Branch Chief~~²⁰ 7-14 days before the scheduled site visit. For any unscheduled site visit (which may be necessary to resolve issues or prepare for hearings), similar questions or items of staff concern should be prepared at least 3 days prior to such site visit and also discussed in detail with the ~~Section Leader Branch Chief~~.²¹

Areas of overlap or interfaces with reviewers in other areas (such as geology, foundation engineering, auxiliary and power conversion systems, mechanical engineering, effluent treatment systems, and structural engineering) should be coordinated before questions or items of staff concern are finalized.

The ~~Section Leader~~ staff reviewer for Hydrologic Description²² will discuss any unusual or potentially controversial areas of concern with the Chief, ~~HGEB-ECGB~~,²³ prior to transmittal of the questions or items of staff concern to the Project Manager. Transmittal will be forwarded by memo route slip through the ~~Section Leader Branch Chief~~.²⁴

Site visits are generally to consist of a detailed reconnaissance of site areas and environs with the applicant and technical counterparts, discussions of questions (or items of staff concern), discussions of acceptable methods of analysis, and a general summarization of the areas discussed and conclusions reached.

Normally, a small group composed of the staff reviewer and ~~licensing~~ project manager (EPM)²⁵ should meet with an applicant representative responsible for responding to staff questions and the applicant's technical advisor. For verbal summarization during the site visit, the recommended method is to have the applicant or his technical advisor summarize the discussions to ~~assure~~ ensure²⁶ understanding.

III. TRIP REPORT

A trip report on a site visit should be prepared within 5 days of the reviewer's return. The report is to be as brief as possible and should summarize the trip and the areas of discussion and should list the participants in technical discussions.

SRP Draft Section 2.4.1
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.	Current PRB name and abbreviation	Changed PRB to ECGB.
2.	SRP-UDP format item	Identified different review types.
3.	Editorial modification	Defined "SRP" as "Standard Review Plan."
4.	SRP-UDP format item	Identified different review types.
5.	SRP-UDP format item, develop technical rationale	"Technical Rationale" added to ACCEPTANCE CRITERIA and put in paragraph form to describe the bases for referencing GDC 2.
6.	SRP-UDP format item - Develop technical rationale	Added lead-in sentence for "Technical Rationale."
7.	SRP-UDP format item - Develop technical rationale	Added technical rationale for GDC 2.
8.	SRP-UDP format item - Develop technical rationale	Added technical rationale for 10 CFR Part 100.
9.	Editorial correction	Changed "assure" to "ensure."
10.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard paragraph to address application of Review Procedures in design certification reviews.
11.	SRP-UDP format item	Identified different review types.
12.	SRP-UDP format item	Identified different review types.
13.	Conversion to SI units	Converted 26 miles to 42 kilometers.
14.	Conversion to SI units	Converted mile 152 to kilometer 245.
15.	Conversion to SI units	Converted 220 feet to 67 meters.
16.	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.
17.	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.
18.	SRP-UDP Guidance	Added standard paragraph to indicate applicability of this section to reviews of future applications.
19.	Current PRB abbreviation) Discussion with ECGB Chief	Changed to reflect current PRB reviewer, ECGB. The NRR no longer has a Hydrologic Engineering Section.
20.	Discussion with ECGB Chief	Changed to reflect current organizational structure of ECGB. The NRR no longer has a Hydrologic Engineering Section.

SRP Draft Section 2.4.1
Attachment A - Proposed Changes in Order of Occurrence

Item	Source	Description
21.	Discussion with ECGB Chief	Changed to reflect current organizational structure of ECGB. The NRR no longer has a Hydrologic Engineering Section.
22.	Discussion with ECGB Chief	Changed to reflect current organizational structure of ECGB. The NRR no longer has a Hydrologic Engineering Section.
23.	Current PRB abbreviation	Changed to reflect current PRB name, ECGB.
24.	Discussion with ECGB Chief	Editorial change made to reflect current organizational structure of ECGB. There is no longer a Hydrologic Engineering Section within NRR.
25.	Editorial modification	Changed "licensing project manager" to "project manager."
26.	Editorial modification	Changed "assure" to "ensure."

SRP Draft Section 2.4.1
Attachment B - Cross Reference of Integrated Impacts

Integrated Impact No.	Issue	SRP Subsections Affected
	No Integrated Impacts were incorporated in this SRP Section.	