



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

## 2.4.9 CHANNEL DIVERSIONS

### REVIEW RESPONSIBILITIES

Primary - ~~Hydrologic & Geotechnical Engineering Branch (HGEB)~~Civil Engineering and Geosciences Branch (ECGB)<sup>1</sup>

Secondary - None

### I. AREAS OF REVIEW

In this section of the applicant's safety analysis report (SAR), the geohydrologic design basis is developed to ~~assure~~ ensure<sup>2</sup> that the plant and essential water supplies will not be adversely affected by natural stream channel diversion or that, in such an event, alternate water supplies are available to safety-related equipment.

The review includes:

1. Historical channel diversions, including cutoffs and subsidence.
2. Regional topographic evidence which suggests that future channel diversion may or may not occur (used in conjunction with evidence of historical diversions).
3. Alternate water sources and operating procedures (coordinate review with that of SAR Section 2.4.11.6).

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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.

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## II. ACCEPTANCE CRITERIA

Acceptance criteria for this ~~SRP~~ Standard Review Plan (SRP)<sup>3</sup> 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 floods.
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 hydrological characteristics be considered in the evaluation of the site.

To meet the requirements of GDC 2, GDC 44, and 10 CFR Part 100 as they relate to channel diversions, the following specific criteria are used:

1. A description of the applicability (potential adverse effects) of stream channel diversions is required.
2. Historical diversions and realignments must be discussed.
3. The topography and geology of the basin and its applicability to natural stream channel diversions must be addressed.
4. If applicable, the safety consequences of diversion and the potential for high or low water levels caused by upstream or downstream diversion adversely to affect safety-related facilities, water supply, or ultimate heat sink must be addressed. Regulatory Guide 1.27 provides guidance on acceptable criteria for ultimate heat sinks.

### Technical Rationale<sup>4</sup>

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:<sup>5</sup>

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.

Channel diversion has the potential for causing flooding or low surface water level at certain nuclear power plant sites, thus adversely affecting 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.

Meeting the requirements of this criterion provides a level of assurance that the plant is not susceptible to flooding due to channel diversion or realignment. Further, it assures the staff and the public that, given the most severe natural phenomena capable of causing channel diversions, an adequate and dependable source of cooling water can be maintained.<sup>6</sup>

- 2. Compliance with GDC 44 requires that a system be provided to transfer heat from structures, systems, and components important to safety. The system is to function under normal and accident conditions, assuming a single failure.

GDC 44 applies to SRP Section 2.4.9 because the ultimate heat sink for the plant can consist of complex water sources, including necessary retaining structures (e.g., ponds or rivers with dams) and the associated canals and conduits connecting these sources with the nuclear power plant. The earthwork, consisting of dams and canals, must be constructed in a manner that ensures the integrity of the cooling water system and its safety function. In addition, it must be shown that channel diversion caused by severe natural phenomena cannot cause loss of the heat sink or result in flooding in excess of the design basis.

Meeting these requirements provide a level of assurance that, given the most severe natural phenomena capable of causing channel diversions or realignment, an adequate and dependable source of cooling water can be maintained.<sup>7</sup>

- 3. Section 10(c) of 10 CFR Part 100 requires that physical characteristics of the site, including seismology, meteorology, geology, and hydrology, be taken into account to determine the acceptability of a site for a nuclear power reactor.

Channel diversion or realignment, posing the potential for flooding or adversely affecting the supply of cooling water for the plant, is one of the many natural phenomena specified in 10 CFR 100.10(c) that must be considered in designing the plant to accommodate the characteristics of a proposed site.

Meeting this requirement provides a level of assurance that the plant is not vulnerable to flooding or to loss of cooling water that could be caused by channel diversion resulting from severe natural phenomena.<sup>8</sup>

### III. REVIEW PROCEDURES

Site-specific publications and maps are reviewed to identify historical channel diversions and to evaluate (by independent conservative calculations and professional judgment) the potential for future diversions. Where an alternate safety-related cooling water supply is provided, the criteria for SAR Section 2.4.11.6 apply and are checked for consistency.

The above reviews are performed only when applicable to the site or site region. Some items of review may be done on a generic basis.

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.<sup>9</sup>

### IV. EVALUATION FINDINGS

For construction permit (CP) and early site permit<sup>10</sup> reviews and when applicable, findings will consist of a brief general description of historical channel diversions. If the staff concurs with the applicant that channel diversion is unlikely or that the plant is protected from potential flood effects and that alternate essential water supplies meet the criteria of Regulatory Guide 1.27, the findings will so indicate. If the staff evaluation does not support the applicant's contention of channel stability or the effects of channel diversions, flood protection and/or an alternate source of water may be required.

For operating license or combined license<sup>11</sup> reviews, findings will consist of the same material, updated as required to reflect new information available since preparation of the CP or early site permit<sup>12</sup> findings.

A sample CP-stage statement follows:

Diversions of the A River are well documented in historical and topographic data. Oxbow lakes, low-lying swamps, and bars and chutes provide eloquent evidence of historical diversion. Others organizations<sup>13</sup> are planning further bank protection measures, additional to the existing levee system, in the vicinity of the plant intake structure. However, the diversion of the main channel by degradation/aggradation within the confines of the levee system, or by breaching the west levee during major floods, cannot be discounted. The staff concludes that the plant's ultimate heat sink will not be endangered by potential channel diversions and thus meets this aspect of GDC 44. This conclusion is based upon the fact that the ultimate heat sink (as discussed in SAR Section 2.4.11) is not directly dependent on the river intake.

The staff concludes that the plant meets the requirements of GDC 2 with respect to floods caused by channel diversions. This conclusion is based on the fact that the plant is

well away from the path of any potential diversion of the A River and well above the level of any resultant flood.

Based upon the above evaluation, we conclude that channel diversions present no safety-related hazard to the plant and that the requirements to 10 CFR Part 100 relative to channel diversions have been met.

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.<sup>14</sup>

## 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.<sup>15</sup> 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.<sup>16</sup>

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

## VI. REFERENCES

No specific publications can be cited for general use; however, site-specific publications and maps can be obtained from the United States Geologic Survey, Soil Conservation Service, National Oceanic and Atmospheric Administration, Corps of Engineers, and State and other agencies and organizations to identify historical and potential future channel diversions.

1. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."
2. 10 CFR Part 50, Appendix A, General Design Criterion 44, "Cooling Water."
3. 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."<sup>17</sup>
4. 10 CFR Part 100, "Reactor Site Criteria."

5. Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants."
6. Regulatory Guide 1.27, "Ultimate Heat Sink for Nuclear Power Plants."

### SRP Draft Section 2.4.9

#### 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 to reflect current PRB name, Civil Engineering and Geosciences Branch (ECGB).
2.	Editorial correction	Changed "assure" to "ensure."
3.	Editorial correction	Provided definition for "SRP."
4.	SRP-UDP format item, develop technical rationale	"Technical Rationale" added to ACCEPTANCE CRITERIA and put in paragraph form to describe the bases for referencing the GDC.
5.	SRP-UDP format item - Develop technical rationale	Added lead-in sentence for "Technical Rationale."
6.	SRP-UDP format item - Develop technical rationale	Added technical rationale for GDC 2.
7.	SRP-UDP format item - Develop technical rationale	Added technical rationale for GDC 44.
8.	SRP-UDP format item - Develop technical rationale	Added technical rationale for 10 CFR Part 100.
9.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard paragraph to address application of Review Procedures in design certification reviews.
10.	SRP-UDP format item	Added reference to early site reviews.
11.	SRP-UDP format item	Added reference to combined license permits.
12.	SRP-UDP format item	Added reference to early site permits.
13.	Editorial modification	Added "organizations" to improve clarity.

**SRP Draft Section 2.4.9**

Attachment A - Proposed Changes in Order of Occurrence

<b>Item</b>	<b>Source</b>	<b>Description</b>
14.	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.
15.	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.
16.	SRP-UDP Guidance	Added standard paragraph to indicate applicability of this section to reviews of future applications.
17.	SRP-UDP format item	Added reference to 10 CFR Part 52.



**SRP Draft Section 2.4.9**  
Attachment B - Cross Reference of Integrated Impacts

<b>Integrated Impact No.</b>	<b>Issue</b>	<b>SRP Subsections Affected</b>
	No Integrated Impacts were incorporated in this SRP Section.	