



U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

2.4.4 POTENTIAL DAM FAILURES

REVIEW RESPONSIBILITIES

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

Secondary - Organization responsible for the review of issues related to geoscience and geotechnical engineering

I. AREAS OF REVIEW

Chapter 2 of the Standard Review Plan (SRP) discusses the site characteristics that could affect the safe design and siting of the plant. The staff reviews information presented by the applicant for a construction permit (CP), operating license (OL), design certification (DC), early site permit (ESP), or combined license (COL) concerning the 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 safety analysis report (SAR), the hydrological design basis is developed to ensure that any potential hazard to the safety-related facilities due to the failure of onsite, upstream, and downstream water control structures are considered in plant design.

The specific areas of review are as follows:

1. Flood Waves from Severe Breaching of an Upstream Dam: Flood waves resulting from a dam breach or failure, including those due to hydrologic failure as a result of

Revision 3 - March 2007

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 NRN_SRP@nrc.gov.

Requests for single copies of SRP sections (which may be reproduced) should be made to the U.S. Nuclear Regulatory Commission, Washington, DC 20555, Attention: Reproduction and Distribution Services Section, or by fax to (301) 415-2289; or by email to DISTRIBUTION@nrc.gov. Electronic copies of this section are available through the NRC's public Web site at <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0800/>, or in the NRC's Agencywide Documents Access and Management System (ADAMS), at <http://www.nrc.gov/reading-rm/adams.html>, under Accession # ML070730417.

overtopping for any reason, routed to the site and the resulting highest water surface elevation that may result in flooding of SSC important to safety.

2. Domino-Type or Cascading Dam Failures: Successive failures of several dams in the path to the plant site caused by failure of an upstream dam due to plausible reasons, such as probable maximum flood, landslide-induced severe flood, earthquakes, or volcanic activity and the effect of highest water surface elevation at the site under the cascading failure conditions.
3. Dynamic Effects on Structures: Dynamic effects of dam failure-induced flood waves on SSC important to safety.
4. Loss of Water Supply Due to Failure of a Downstream Dam: Failure of a dam downstream of the plant site that may affect the availability of safety-related water supply to the plant.
5. Effects of Sediment Deposition and Erosion: Effects of sediment deposition or erosion during dam failure-induced flood waves that may result in blockage or loss of function of SSC important to safety.
6. Failure of Onsite Water Control or Storage Structures: Failure of onsite water control or storage structures, such as levees, dikes, and any engineered water storage facilities, that are located above site grade and may induce flooding at the site.
7. Consideration of Other Site-Related Evaluation Criteria: The potential effects of seismic and non-seismic information on the postulated design bases and how they relate to dam failures in the vicinity of the site and the site region.
8. 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. Flooding protection measures, including dynamic effects (hydrodynamic forces and impact forces from debris and projectiles), if required for SSC important to safety, are reviewed in SRP Section 2.4.10.
2. The review to ensure that adverse environmental conditions, including those from loss of water due to dam failure, will not preclude the safety function of the ultimate heat sink is performed under SRP Section 9.2.5, "Ultimate Heat Sink."
3. The organization responsible for issues related to geoscience and geotechnical engineering reviews data necessary to justify seismic Category I classification of relevant dams and water control structures to verify that these structures will survive a local equivalent of the safe shutdown earthquake.

4. 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 and Chapter 2 of the DCD Tier 2¹ submitted by the applicant is performed under SRP Section 2.0, "Site Characteristics and Site Parameters." Review of site characteristics and site-related design parameters in ESP applications or in COL applications referencing an ESP is also performed under Section 2.0.

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

¹ Additional supporting information of prior DC rules may be found in DCD Tier 2 Section 14.3.

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 Regulatory Guides are used by the staff for the identified acceptance criteria:

Regulatory Guide 1.27 describes the applicable ultimate heat sink capabilities.

Regulatory Guide 1.29 identifies seismic design bases for SSC important to safety.

Regulatory Guide 1.59, as supplemented by best current practices, provides guidance for developing the hydrometeorological design bases.

Regulatory Guide 1.102 describes acceptable flood protection to prevent the safety-related facilities from being adversely affected.

1. Flood Waves from Severe Breaching of an Upstream Dam: To meet the requirements of GDC 2, 10 CFR 52.17, 10 CFR Part 100, and 10 CFR 100.23(d), estimates of the following characteristics are needed, and should be based on conservative assumptions of hydrometeorological, geological, and seismic characteristics in the drainage area: (a) modes of assumed dam breaches or failures, (b) consideration of flood control reservoirs at full pool level, and (c) conservatism of coincident flow rates and water surface elevations. Flood waves produced by postulated dam failure scenarios should be routed to the proposed plant site to conservatively estimate the most severe flood water surface elevation that may affect SSC important to safety.
2. Domino-Type or Cascading Dam Failures: To meet the requirements of GDC 2, 10 CFR 52.17, 10 CFR Part 100, and 10 CFR 100.23(d), an appropriate configuration of the cascade of dam failures and its potential to produce the largest flood adjacent to the plant site is needed. Several possible cascading dam failures should be investigated, including those induced by seismic and hydrological failures. The failure modes should be conservatively chosen and the resulting flood waves should be conservatively routed to the proposed plant site to estimate the most severe flood water surface elevation that may affect SSC important to safety.
3. Dynamic Effects on Structures: To meet the requirements of GDC 2, 10 CFR 52.17, and 10 CFR Part 100, an estimate of dynamic effects of flood waves, such as velocities and momentum fluxes, on SSC important to safety is needed. If a potential hazard to SSC important to safety exists from dynamic effects of flood waves, it should be documented and included in the design bases of affected facilities.
4. Loss of Water Supply Due to Failure of a Downstream Dam: To meet the requirements of GDC 2, 10 CFR 52.17, 10 CFR Part 100, and 10 CFR 100.23(d), an assessment regarding loss of safety-related water supply to the plant caused by failure of a downstream dam is needed. If the possibility of loss of safety-related water supply exists, it should be documented and the design of safety-related water supply to the plant should be reassessed.
5. Effects of Sediment Deposition and Erosion: To meet the requirements of GDC 2, 10 CFR 52.17, 10 CFR Part 100, and 10 CFR 100.23(d), an assessment is needed

regarding loss of functionality of safety-related water supply to the plant caused by blockages due to sediment deposition or erosion during the dam failure-induced flood event. If a hazard exists that may lead to loss of functionality of safety-related water supply, it should be documented and the design of the safety-related water supply to the plant should be reassessed.

6. Failure of Onsite Water Control or Storage Structures: To meet the requirements of GDC 2, 10 CFR 52.17, and 10 CFR Part 100, an assessment is needed regarding the failure of any onsite water control or storage structures that may cause flooding of SSC important to safety. If a hazard exists that may lead to flooding of SSC important to safety, it should be documented and included in the design bases of affected facilities.
7. Consideration of Other Site-Related Evaluation Criteria: The potential effects of site-related proximity, seismic, and non-seismic information as they relate to flooding due to upstream dam failures and loss of safety-related water supply due to blockages and failures of downstream dam failures adjacent to and on the plant site and site regions are needed to meet the requirements of GDC 2, 10 CFR 52.17, and 10 CFR Part 100.

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 SSC important to safety be designed to withstand the effects of natural phenomena such as earthquakes, tornados, hurricanes, floods, tsunamis, and seiches without loss of capability to perform their safety functions. The criterion further specifies that the design bases for these SSC shall reflect the following:
 - A. Appropriate consideration of the most severe natural phenomena historically reported for the site and surrounding area, with sufficient margin for the limited accuracy, quantity, and time period in which the historical data have been accumulated;
 - B. Appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena; and
 - C. The importance of the safety functions to be performed.

This criterion is applicable to SRP Section 2.4.4 because it specifies the hydrological phenomenon (i.e., flooding associated with dam failure) addressed in this section. In general terms, it also specifies the level of conservatism that should be used to assess the severity of the flood for the purpose of determining the design bases for SSC important to safety.

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.

2. 10 CFR 100.23(d) and Appendix A to 10 CFR Part 100 require that geologic and seismic factors include a determination of site suitability and acceptability of the nuclear power plant design. Paragraph IV(c) in Appendix A describes the investigation required to obtain geologic and seismic data for evaluating seismically induced floods, including failure of an upstream dam during an earthquake.

These requirements are applicable to SRP Section 2.4.4 because it requires investigation of seismically induced floods or low water levels that guide the Commission in its consideration of the suitability of proposed sites for nuclear power plants. More detailed guidance on the investigation of seismically induced floods is provided by Regulatory Guide 1.70 and ANSI/ANS-2.8-1992, including results for seismically induced dam failures and antecedent flood flows coincident with the flood peak.

Meeting this requirement provides a level of assurance that SSC important to safety have been designed to withstand the effects of floods induced by seismic failure of upstream or downstream dams.

3. Sections 100.10(c) and 100.20(c) of 10 CFR Part 100 require that the site's physical characteristics (including seismology, meteorology, geology, and hydrology) be taken into account when determining its acceptability for a nuclear power reactor. 10 CFR Part 100 is applicable to SRP Section 2.4.4 because it addresses the physical characteristics, including hydrology, considered by the Commission when determining the acceptability of a site for a power reactor. To satisfy the hydrologic requirements of 10 CFR Part 100, the applicant's SAR should contain a description of the hydrological and seismic characteristics of the region and an analysis of potential dam failures. The description should be sufficient to assess the acceptability of the site and the potential for those characteristics to influence the design of SSC important to safety.

Meeting this requirement provides a level of assurance that SSC important to safety have been designed to withstand the effects of high water levels resulting from failure of upstream dams, as well as those of low water levels resulting from failure of a downstream dam.

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. Flood Waves from Severe Breaching of an Upstream Dam: The location of dams and potentially “likely” or severe modes of failure are identified. Failure of a single upstream dam that has the most severe impact on the site should be evaluated using a conservative mode of dam failure, consideration of reservoir level at full pool, and appropriate combination of antecedent flows as described by ANSI/ANS-2.8-1992. Staff use currently accepted models of the U.S. Army Corps of Engineers (USACE) to route the flood wave resulting from the dam breach to the plant site. First-time use of another model will require complete model description and documentation. Acceptance of the model (and subsequent analyses) is based on the staff review of the model’s theory, available verification, and application. If other than instantaneous failure is assumed, the conservatism of the rate of failure and shape of the breach should be well documented. A determination of the peak flow rate and water surface elevation at the site should be presented, along with a description (and the bases) of all coefficients, parameters, and methods used.

Instead of an independent analysis, the staff’s review may verify the applicant’s assumptions and methodology or may require consultation with State and Federal agencies that have the authority and the responsibility to carry out similar analyses.

2. Domino-Type or Cascading Dam Failures: The potential for multiple, seismically or hydrologically induced dam failures and the domino failure of a series of dams should be discussed. Plausible permutations of cascading failures should be described. A summary analysis (that substantiates the selected condition as the critical permutation) is presented. Appropriate antecedent flow conditions as described by ANSI/ANS-2.8-1992 are considered, and the resulting flood is routed to the site using the currently accepted model of the USACE to estimate the peak flow rate and water surface elevation. A description and bases of all coefficients, parameters, and methods are presented.

Instead of an independent analysis, the staff’s review may verify the applicant’s assumptions and methodology or require consultation with State and Federal agencies that have the authority and the responsibility to carry out similar analyses.

3. Dynamic Effects on Structures: Locations of SSC important to safety with respect to the worst flood caused by dam failure should be documented. Hydraulic characteristics of the flood that may be used to estimate dynamic effects of the flood waves include hydrodynamic forces and impact forces of waterborne debris and projectiles. These hydraulic characteristics may include velocities and momentum fluxes near or at SSC important to safety.

4. Loss of Water Supply Due to Failure of a Downstream Dam: The safety-related water supply to the plant that may be impacted by failure of a downstream dam should be identified. The reduction in capacity of the safety-related source of water after failure of the downstream dam should be estimated. It should be demonstrated that the reduced capacity after failure of the downstream dam is sufficient to meet the safety function of the source, or that an alternate source of safety-related water supply exists that is also not similarly affected.

5. Effects of Sediment Deposition and Erosion: Sediment deposition during the flood resulting from dam failure should be estimated to ensure that safety-related functioning

of all SSC exposed to this flood is not impaired. Erosion caused by high velocity of flood waters should be estimated, and its effect on the foundations of SSC important to safety should be examined. Any potential erosion should not affect the safety-related functioning of SSC.

6. Failure of Onsite Water Control or Storage Structures: If any onsite water control or storage structures exist above the site grade, failures of these from any cause should be determined and the potential for flooding of SSC important to safety and doors and openings identified. It should be shown that this mode of flooding does not compromise the safety-related functioning of SSC or other exposed plant systems.
7. 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 flooding scenario from dam failures.

8. Review Procedures Specific to 10 CFR Part 52 Application Type

- 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 certain circumstances, such as a compliance or adequate protection issue, 10 CFR 52.39 precludes the staff from imposing new site characteristics, design parameters, or terms and conditions on the ESP 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 of 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. Site parameters associated with this SRP section are reviewed, as applicable, to verify that:
 - i. The postulated site parameters are representative of a reasonable number of sites that have been or may be considered for a COL application;
 - ii. The appropriate site parameters are included as Tier 1 information. This convention has been used by previous DC applicants. Additional guidance on site parameters is provided in SRP Section 2.0;

- iii. Pertinent parameters are stated in a site parameters summary table; and
- iv. The applicant has provided a basis for each of the site parameters.

C. Combined License Reviews: For a COL application referencing a certified standard design, the NRC staff reviews that application to ensure sufficient information was presented to demonstrate that the characteristics of the site fall within the site parameters specified in the DC rule. If there are site parameters associated with this SRP section and if the above condition for these parameters has not been met (ie. the actual site characteristics do 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. In accordance with 10 CFR 52.79(b)(2), should the design of the facility not fall within the site characteristics and design parameters, the application shall include a request for a variance from the ESP that complies with the requirements of 10 CFR 52.39 and 10 CFR 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. In the absence of certain circumstances, such as a compliance or adequate protection issue, 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. Consequently, a COL application referencing an ESP need 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 early site permit conditions, restrictions to the DC, or COL action items identified in the FSERs are appropriately handled in the COL application.

IV. EVALUATION FINDINGS

The review should document the staff's evaluation of site characteristics 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 effects of dam failures important to the design and siting of this plant. The staff has reviewed the available information provided and, for the reasons given above, concludes that the identification and consideration of the effects of dam failures at the site and in the surrounding area are acceptable and meet the requirements of 10 CFR Part 50, Appendix A, General Design Criterion 2, 10 CFR 100.23(d), and 10 CFR Part 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 effects of dam failures 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 Criterion 2, 10 CFR 100.23(d), 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 and design parameters to be included in any ESP that might be issued for the proposed site:

As set forth above, the applicant has presented and substantiated sufficient information pertaining to the effects of dam failures at the proposed site. Section 2.4.4, "Potential Dam Failures," of NUREG-0800, Standard Review Plan, provides that the site safety analysis report should address the requirements of 10 CFR Parts 52 and 100 as they relate to identifying and evaluating the effects of dam failures. Further, the applicant considered dam failures in establishing design-basis information pertaining to flooding and safety-related water supply, 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 dam failures 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 the dam failures 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 agrees that they are representative of a reasonable number of sites that have been or may be considered for a COL application. Dam failures 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 submitted six months or more after the date of issuance of this SRP section, unless superseded by a later revision.

VI. REFERENCES

1. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."
2. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."
3. 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."
4. 10 CFR Part 100, "Reactor Site Criteria."

5. ANSI/ANS-2.8-1992, "Determining Design Basis Flooding at Power Reactor Sites." Historical Technical Reference.
6. "Floods Resulting From Suddenly Breached Dams, Conditions of High Resistance," Misc. Paper No. 2-374, Report 2, Corps of Engineers (1961).
7. "Flow Through a Breached Dam," Military Hydrology Bulletin No. 9, Corps of Engineers (1957).
8. "HEC-5 Simulation of Flood Control and Conservation Systems," User's Manual, Version 8.0, U.S. Army Corps of Engineers Hydrologic Engineering Center, Davis, California, October 1998.
9. "HEC-RAS River Analysis System," User's Manual, Version 3.1, U.S. Army Corps of Engineers Hydrologic Engineering Center, Davis, California, November 2002.
10. Hunter Rouse, ed., "Engineering Hydraulics," John Wiley & Sons, Inc., New York (1950).
11. "Hydrologic Engineering Requirements for Reservoirs," EM 1110-2-1420, U.S. Army Corps of Engineers, Washington, D.C., October 1997.
12. "Hydrologic Modeling System HEC-HMS," User's Manual, Version 3.0.1, U.S. Army Corps of Engineers Hydrologic Engineering Center, Davis, California, April 2006.
13. Regulatory Guide 1.27, "Ultimate Heat Sink for Nuclear Power Plants."
14. Regulatory Guide 1.29, "Seismic Design Classification."
15. Regulatory Guide 1.59, "Design Basis Floods for Nuclear Power Plants." Historical Technical Reference.
16. Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants."
17. Regulatory Guide 1.102, "Flood Protection for Nuclear Power Plants."
18. Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants." (LWR Edition)
19. "River Hydraulics," EM 1110-2-1416, U.S. Army Corps of Engineers, Washington, D.C., October 1993.
20. "Standard Project Flood Determinations," EM 1110-2-1411, U.S. Army Corps of Engineers, Washington, D.C., March 1952 (revised March 1965).
21. Ven Te Chow, "Open-Channel Hydraulics," McGraw-Hill Book Co., New York (1959).
22. Ven Te Chow, ed., "Handbook of Applied Hydrology," McGraw-Hill Book Co., New York (1964).

23. V. L. Streeter and E. B. Wylie, "Hydraulic Transients," McGraw Hill Book Co., New York, pp. 239-259 (1967).
24. W. A. Thomas, "A Method for Analyzing Effects of Dam Failures in Design Studies," Corps of Engineers Hydrologic Engineering Center, Davis California (for presentation at the ASCE Hydraulics Division Specialty Conference, Cornell University, August 1972).

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.

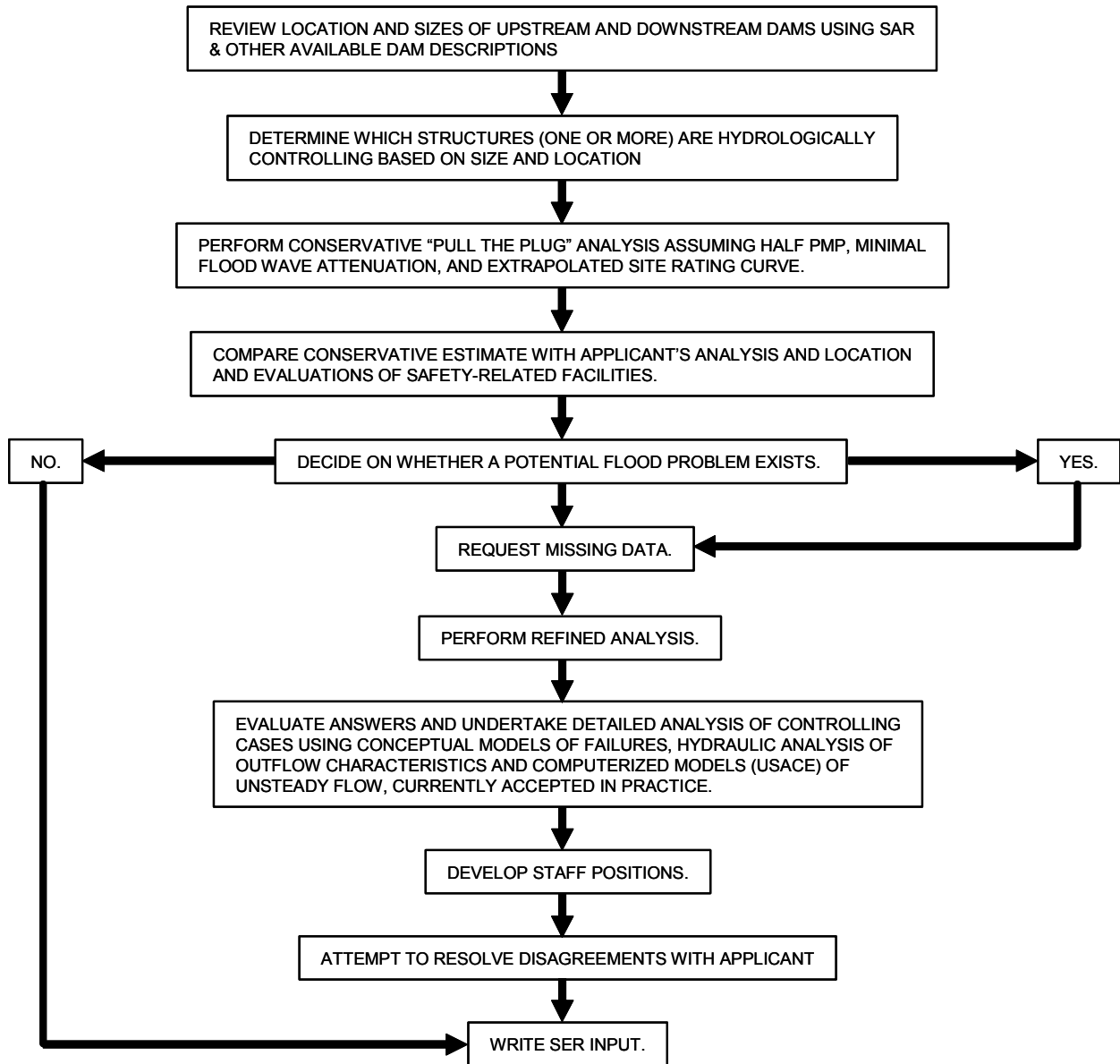


Figure 2.4.4-1. Standard Review Plan Section 2.4.4 Dam Failure-Induced Floods