

Proposed - For Interim Use and Comment



U.S. NUCLEAR REGULATORY COMMISSION **DESIGN-SPECIFIC REVIEW STANDARD FOR mPOWER™ iPWR DESIGN**

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 geosciences and geotechnical engineering

I. AREAS OF REVIEW

In this section of the Design-Specific Review Standard (DSRS), the hydrologic and hydraulic design basis is developed to ensure that any potential hazard to the structures, systems and components (SSCs) important to safety from the failure of onsite, upstream, and downstream water control structures are considered in plant design.

This section is part of Chapter 2 of the DSRS, which 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 design certification (DC), early site permit (ESP), or combined license (COL) concerning the hydrologic setting of the site as they relate to SSCs Important to safety. This DSRS section applies to reviews performed for each of these types of applications. These reviews are based on information and analysis presented in the applicant's final safety analysis report (FSAR). The staff's review and findings are described in the appropriate section of the safety evaluation report (SER).

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 overtopping for any reason, routed to the site and the resulting highest water surface elevation that may result in flooding of SSCs important to safety. Flooding from the potential rupture of onsite and offsite water storage tanks is also reviewed.
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. As identified in section 2.4.1 of the DSRS, dams to be included in the domino-type or cascading failure should include existing and proposed dams and other significant water retaining structures.
3. Dynamic Effects on Structures: Dynamic effects of dam failure-induced flood waves on SSCs 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 water supply to the SSCs important to safety, if applicable..
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 SSCs important to safety. The potential effects of sediment erosion and deposition on the site drainage system and its conveyance capacity should be considered. Effects of erosion on local groundwater recharge properties need to be addressed depending on the duration and extent of flooding and erosion.
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 (including the effects of potential land subsidence) 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 Title 10 of the Code of Federal Regulations (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 DSRS and Standard Review Plan (SRP) sections interface with this section as follows:

1. Sections 2.4.0, 2.4.2, 2.4.3 and 2.4.5-2.4.9 address the flood-producing phenomena individually and in combination to determine the design basis flood.
2. DSRS Section 2.4.12 "Groundwater" considers the effects of design basis flood elevation and erosion/deposition on subsurface hydraulic heads.
2. Flooding protection measures, including dynamic effects (hydrodynamic forces and impact forces from debris and projectiles) and minimum emergency response time (flood wave travel time), if required for SSCs important to safety, are reviewed in DSRS Section 2.4.10.
3. The seismic design basis that includes seismically-induced land subsidence information is performed under SRP Section 2.5.1, "Basic Geologic and Seismic Information."
4. 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 DSRS Section 9.2.5, "Ultimate Heat Sink."
5. The organization responsible for issues related to geosciences 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.

6. 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 SRP Section 2.0.

II. ACCEPTANCE CRITERIA

Requirements

Acceptance criteria are based on meeting the relevant requirements of the following NRC regulations:

1. 10 CFR Part 50, Appendix A, General Design Criterion (GDC) 2 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.
2. 10 CFR Part 50, Appendix A, GDC 4 as it relates to the effect of events and conditions outside the nuclear power unit on SSCs important to safety. For mPower™ reactors, GDC 4 is also assumed to include risk-significant SSCs as identified in DSRS Section 3.2.2.
3. 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.
4. 10 CFR 50, Appendix A, GDC 44 as it relates to providing an ultimate heat sink for normal operating and accident conditions.
5. 10 CFR Part 100, as it relates to identifying and evaluating hydrologic features of the site. The requirements to consider physical site characteristics in site evaluations are specified in 10 CFR 100.20(c).
6. 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.

DSRS Acceptance Criteria

Specific DSRS acceptance criteria acceptable to meet the relevant requirements of the U.S Nuclear Regulatory Commission's (NRC's) regulations identified above are set forth below. The

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

DSRS is not a substitute for the NRC's regulations, and compliance with it is not required. Identifying the differences between this DSRS section and the design features, analytical techniques, and procedural measures proposed for the facility, and discussing how the proposed alternative provides an acceptable method of complying with the regulations that underlie the DSRS acceptance criteria, is sufficient to meet the intent of 10 CFR 52.47(a)(9), "Contents of applications; technical information." The same approach may be used to meet the requirements of 10 CFR 52.17(a)(1)(xii) and 10 CFR 52.79(a)(41), for ESP and COL applications, respectively.

Appropriate sections of the following Regulatory Guides (RGs) are used by the NRC staff for the identified acceptance criteria:

RG 1.27 describes the applicable ultimate heat sink capabilities.

RG 1.29 identifies seismic design bases for SSCs that are safety-related and/or important to safety. In the case of mPowerTM, risk-significant SSCs would be included under the review of SSCs important to safety.

RG 1.59, as supplemented by best current practices, provides guidance for developing the flood design bases.

RG 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 and travel time that may affect SSCs important to safety and preparedness for emergency response.
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 hydrologic 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 and travel time that may affect SSCs important to safety and preparedness for emergency response.
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 SSCs important to safety is needed. If a potential hazard to SSCs 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 water supply to the SSCs important to safety caused by failure of a downstream dam is needed. If the possibility of loss of water supply SSCs important to safety exists, it should be documented and the design of water supply to SSCs important to safety 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 SSCs important to safety caused by blockages or damage 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 SSCs important to safety, it should be documented and the design of all SSCs important to safety should be reassessed. The effects of erosion on local groundwater recharge properties may also need to be addressed depending on the duration and extent of flooding and erosion.
6. Effects of Permafrost Freezing and Thawing: For sites located in permafrost regions, in order to meet the requirements of GDC 2, 10 CFR 52.17, 10 CFR Part 100, and 10 CFR 100.23(d), it is necessary to assess loss of functionality of SSCs important to safety caused by blockages or damage due to permafrost thawing during the dam and other water retaining structures failure-induced flood event. If a hazard exists that may lead to loss of functionality of SSCs important to safety, it should be documented and the design of all SSCs important to safety should be reassessed.
7. 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 SSCs important to safety. If a hazard exists that may lead to flooding of SSCs important to safety, it should be documented and included in the design bases of affected facilities.
8. Consideration of Other Site-Related Evaluation Criteria: The potential effects of site-related proximity, seismic (including the effects of potential land subsidence), and non-seismic information as they relate to flooding due to upstream dam failures and loss of water supply to SSCs important to safety 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 DSRS section is discussed in the following paragraphs:

1. Compliance with GDC 2 requires that nuclear power plant SSCs 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 SSCs 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 DSRS Section 2.4.4 because it specifies the hydrologic 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 SSCs 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 DSRS 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 and potential land subsidence.

These requirements are applicable to DSRS Section 2.4.4 because it requires investigation of seismically induced floods or low water levels that guide the NRC 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 RG 1.70 and American National Standard Institute/American Nuclear Society (ANSI/ANS)-2.8-1992², including results for seismically induced dam failures and antecedent flood flows coincident with the flood peak³.

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

- 3. Section 100.20(c) of 10 CFR Part 100 requires 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 DSRS Section 2.4.4 because it addresses the physical characteristics, including hydrology, considered by the NRC when determining the acceptability of a site for a power reactor. To satisfy the hydrologic requirements of 10 CFR Part 100, the applicant's FSAR should contain a description of the hydrologic 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 SSCs important to safety.

² As and when it becomes available, the latest revision of this document is to be used.

³ As and when it becomes available, additional guidance related to dam breach analysis is to be used.

Meeting this requirement provides a level of assurance that SSCs 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 procedures outlined below are used to review 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 DSRS section. As applicable, reviews of COLs include a determination on whether the content of technical specifications related to hydrologic site characteristics are acceptable and whether the technical specifications reflect consideration of any identified unique conditions.

These review procedures are based on the identified DSRS 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. In accordance with 10 CFR 52.47(a)(8),(21), and (22), for new reactor license applications submitted under Part 52, the applicant is required to (1) address the proposed technical resolution of unresolved safety issues (USIs) and medium- and high-priority generic safety issues (GSIs) that are identified in the version of NUREG-0933 current on the date 6 months before application and that are technically relevant to the design; (2) demonstrate how the operating experience insights have been incorporated into the plant design; and, (3) provide information necessary to demonstrate compliance with any technically relevant portions of the Three Mile Island requirements set forth in 10 CFR 50.34(f), except paragraphs (f)(1)(xii), (f)(2)(ix), and (f)(3)(v). These cross-cutting review areas should be addressed by the reviewer for each technical subsection and relevant conclusions documented in the corresponding SER section.
2. 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, water surface elevation, and wave travel time 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 confirm 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.

3. 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, water surface elevation, and wave travel time. A description and bases of all coefficients, parameters, and methods are presented.

Instead of an independent analysis, the staff's review may confirm 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.

4. Dynamic Effects on Structures: Locations of SSCs 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 mean and turbulent velocities and momentum fluxes near or at SSCs important to safety.
5. Loss of Water Supply Due to Failure of a Downstream Dam: The water supply to SSCs important to safety that may be impacted by failure of a downstream dam should be identified. The reduction in capacity of the 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 function of SSCs important to safety, or that an alternative source of water supply to SSCs important to safety exists that is also not similarly affected.
6. Effects of Sediment Deposition and Erosion: Sediment deposition during the flood resulting from dam failure should be estimated to ensure that functioning of all SSCs important to safety 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 and the subsurface SSCs important to safety should be examined. Any potential erosion should not affect the functioning of SSCs important to safety. The potential effects of sediment erosion and deposition on the site drainage system and its conveyance capacity should be considered. The effects of erosion on local groundwater recharge properties may also need to be addressed depending on the duration and extent of flooding and erosion.
7. Effects of Permafrost Freezing and Thawing: For sites located in the permafrost region the potential of failure of dams and other water retaining structures from accelerated thawing needs to be considered and the subsequent flooding analyzed. The effects of subsidence and changes to land surface as a result of thawing need to be considered.
8. 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 SSCs important to safety and doors and openings identified. It should be shown that this mode of flooding does not compromise the functioning of SSCs important to safety or other exposed plant systems.

9. Consideration of Other Site-Related Evaluation Criteria: Subpart B of 10 CFR Part 100 describes site-related proximity, seismic (including the effects of potential land subsidence) and non-seismic evaluation criteria for power reactor applications. 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.
10. Review Procedures Specific to 10 CFR Part 52 Application Type
- A. ESP Reviews: Subpart A to 10 CFR Part 52 specifies the requirements and procedures applicable to the NRC'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 for reviewing data parallel those used for a COL 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 ESP.
- B. Standard DC 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 DSRS 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. COL 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 DSRS section and if the above condition for these parameters has not been met (i.e. 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 ESP as applicable to this DSRS 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 ESP 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 ESP conditions, restrictions to the DC, or COL action items identified in the FSERs are appropriately handled in the COL application.

For a COL application referencing either an ESP or DC or both, the staff has issued additional guidance for review of COL items that cannot be resolved prior to issuance of the license in Interim Staff Guidance 015 (ISG-015). A COL applicant must provide all information in the COL application that is necessary for the staff to make the findings required to issue the license. Therefore, it may be necessary for the staff to partially close certain COL action or information items noted in an ESP or a DC, or both. The staff should identify the remaining portion of the COL items associated with information that is not necessary to issue the license as post-licensing commitments.

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 FSAR. 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 SER. The reviewer also states the bases for those conclusions.

1. COL Reviews

The following statements in the SER 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, GDC 2, 10 CFR 100.23(d), and 10 CFR 100.20(c), 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, GDC 2, 10 CFR 100.23(d), and 10 CFR 100.20(c), with respect to establishing the design basis for SSCs important to safety.

2. ESP Reviews

The following statements in the SER 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 the Design-Specific Review Standard for mPower™ Integral Pressurized Water Reactor (iPWR) Design, provides that the site FSAR 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 water supply to SSCs important to safety, 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 SERs 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 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. DC Reviews

The following statement in the SER 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 DSRS section in performing safety evaluations of mPower™-specific DC, COL, or ESP applications submitted by applicants pursuant to 10 CFR Part 52. The staff will use the method described herein to evaluate conformance with Commission regulations.

Because of the numerous design differences between the mPower™ and large light-water nuclear reactor power plants, and in accordance with the direction given by the Commission in SRM- COMGBJ-10-0004/COMGEA-10-0001, "Use of Risk Insights to Enhance the Safety Focus of Small Modular Reactor Reviews," dated August 31, 2010 (Agencywide Documents Access and Management System Accession (ADAMS) ML102510405), to develop risk-informed licensing review plans for each of the small modular reactor (SMR) reviews including the associated pre-application activities, the staff has developed the content of this DSRS section as an alternative method for mPower™-specific DC, COL, or ESP applications submitted pursuant to 10 CFR Part 52 to comply with 10 CFR 52.47(a)(9), "Contents of applications; technical information."

This regulation states, in part, that the application must contain "an evaluation of the standard plant design against the SRP revision in effect 6 months before the docket date of the application." The content of this DSRS section has been accepted as an alternative method for complying with 10 CFR 52.47(a)(9) as long as the mPower™ DCD FSAR does not deviate significantly from the design assumptions made by the NRC staff while preparing this DSRS section. The application must identify and describe all differences between the standard plant design and this DSRS section, and discuss how the proposed alternative provides an acceptable method of complying with the regulations that underlie the DSRS acceptance criteria. If the design assumptions in the DC application deviate significantly from the DSRS, the staff will use the SRP as specified in 10 CFR 52.47 (a)(9). Alternatively, the staff may supplement the DSRS section by adding appropriate criteria in order to address new design

assumptions. The same approach may be used to meet the requirements of 10 CFR 52.17 (a)(1)(xii) and 10 CFR 52.79 (a)(41), for ESP and COL applications, respectively.

VI. REFERENCES

1. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."
2. 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."
3. 10 CFR Part 100, "Reactor Site Criteria."
4. ANSI/ANS-2.8-1992, "Determining Design Basis Flooding at Power Reactor Sites." Historical Technical Reference.
5. Final Interim Staff Guidance ESP/DC/COL-ISG-015, "Post-Combined License Commitments." January 21, 2010. Accession Number: ML093561416.
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).
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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.
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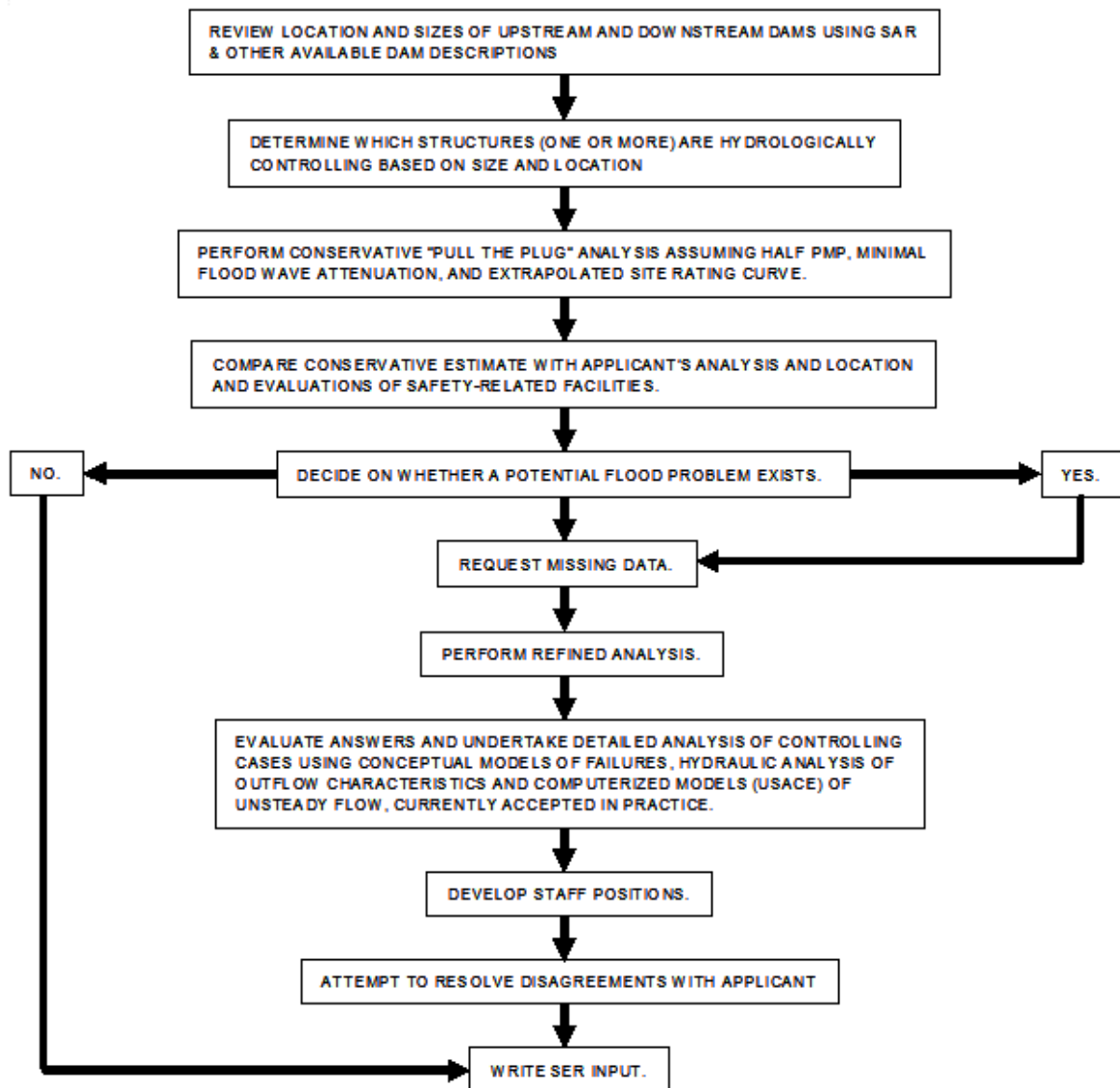


Figure 2.4.4-1. Standard Review Plan Section 2.4.4 Dam Failure-Induced Floods