

Proposed - For Interim Use and Comment



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

2.4.9 CHANNEL DIVERSIONS

REVIEW RESPONSIBILITIES

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

Secondary - None

I. AREAS OF REVIEW

In this section of the Design-Specific Review Standard (DSRS), the hydrologic, geophysical, and hydraulic phenomena are reviewed to ensure that any potential hazard to the structures, systems, and components (SSCs) important to safety from the effects of channel diversion is considered in plant design. This review includes stream channel diversions away from the site (which may lead to loss of water supply to SSCs important to safety) and stream channel diversions towards the site (which may lead to flooding). Additionally, if such an event were to occur, the applicant needs to show that alternative water supplies are available to SSCs important to safety.

This section is part of Chapter 2 of the DSRS, which discusses the site characteristics that could affect the safe design and siting of a plant. The staff reviews information presented by the applicant for a design certification (DC), early site permit (ESP), or combined license (COL) concerning hydrologic setting of the site as they relate to safety-related or risk-significant SSCs. 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 final safety evaluation report (FSER).

The specific areas of review are as follows:

1. Historical Channel Diversions: The staff reviews historical channel migration phenomena including meandering, cutoffs, subsidence, and uplift.
2. Regional Topographic Evidence: The staff reviews regional topographic evidence which suggests that future channel diversion may or may not occur (used in conjunction with evidence of historical diversions).
3. Ice Causes: The staff reviews thermal causes of channel diversion such as ice jams (coordinate review with that of FSAR Section 2.4.7). These diversions may result from downstream ice blockages that may lead to flooding from backwater, or they can be upstream ice blockages that can divert the channel away from an intake.

4. Permafrost Hydrology: For sites located in the permafrost region staff will review information related to gas hydrates, freezing, thawing and thermal gradients in the subsurface and the impacts these processes have on channel diversion and migration at the site.
5. Flooding of Site Due to Channel Diversion: The staff reviews the potential effects of flooding or blockage of water supplies to SSCs important to safety resulting from channel migration (flooding not addressed by hydrometeorologically-induced flooding scenarios in other sections).
6. Human-Induced Causes of Channel Diversion: The staff reviews the potential of channel diversion from human-induced causes (i.e., land-use changes, instream hydraulic structures, diking, channel modification, armoring, or failure of structures).
7. Alternative Water Sources: The staff reviews alternative water sources and operating procedures if applicable.
8. Consideration of Other Site-Related Evaluation Criteria: The staff reviews the potential effects of seismic (including the effects of potential land subsidence) and non-seismic information on the postulated worst-case channel diversion scenario for the proposed plant site.
9. 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 or Standard Review Plan (SRP) sections interface with this section as follows:

1. Sections 2.4.0 and 2.4.2 – 2.4.8 address the flood-producing phenomena individually and in combination to determine the design basis flood.
2. The identification of structures and equipment important to safety that should be protected against the effects of flooding is performed under DSRS Section 3.4.1, "Internal Flood Protection for Onsite Equipment Failure."
3. The review of the design of seismic Category I structures to design for the effects of flooding forces, including that which could result from channel diversions, is performed under DSRS Section 3.4.2, "Analysis Procedures."
4. The review to ensure that adverse environmental conditions, including freezing, will not preclude the safety function of the ultimate heat sink is performed under DSRS Section 9.2.5, "Ultimate Heat Sink."
5. The staff is responsible for providing the site characteristics and other geomorphological parameters related to channel diversions at or near the site to the organization

responsible for review of the SSCs important to safety that may potentially be affected by the channel diversion to ascertain whether these effects are properly considered in the hydrologic and hydraulic design basis for the plant.

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 Commission regulations:

1. 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).
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 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, GDC 44 as it relates to providing an ultimate heat sink for normal operating and accident conditions.

DSRS Acceptance Criteria

Specific DSRS acceptance criteria acceptable to meet the relevant requirements of the NRC's regulations identified above are set forth below. The 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

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

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 U.S. Nuclear Regulatory Commission (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 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 SSCs important to safety from being adversely affected.

1. Historical Channel Diversions. To meet the requirements of GDC 2, GDC 44, 10 CFR 52.17, and 10 CFR Part 100, a complete history of channel diversions at and in the vicinity of the site is needed. A thorough listing of types of phenomena (landslides, channel erosion and deposition, meandering, cutoff, breached dikes, etc.), locations, spatial and time scales of these events, and descriptions of geomorphologic and hydrologic characteristics accompanying these events should be included. This description should be sufficient to establish the history of channel diversion in the vicinity of the site (this review includes the site and adjacent watersheds displaying similar channel characteristics).
2. Regional Topographic Evidence. To meet the requirements of GDC 2, GDC 44, 10 CFR 52.17, and 10 CFR Part 100, a description of regional topographic evidence as it relates to channel diversions is needed. This should include information related to paleo-flooding if available, which can indicate possible routes taken by large floods. This description should be supported by data and should be sufficient to make an assessment of the possibility of channel diversion near the site that may affect SSCs important to safety.
3. Ice Causes. To meet the requirements of GDC 2, GDC 44, 10 CFR 52.17, and 10 CFR Part 100, estimates of the most severe ice-induced channel diversion are needed. These estimates should be consistent with the estimates in the applicant's corresponding FSAR Section.
4. Permafrost Hydrology. To meet the requirements of GDC 2, GDC 44, 10 CFR 52.17, and 10 CFR Part 100, for sites located in the permafrost region, the staff will review information related to gas hydrates, freezing, thawing and thermal gradients in the subsurface and the impacts these processes have on channel diversion and migration at the site.
5. Flooding of Site Due to Channel Diversions. To meet the requirements of GDC 2, GDC 44, 10 CFR 52.17, and 10 CFR Part 100, estimates of the most severe flooding induced by channel diversion on SSCs important to safety are needed. These estimates

should be sufficient to demonstrate that SSCs important to safety can withstand these floods without loss of their functionality. A description of mitigation measures for flooding from channel diversions should be provided, and it should be demonstrated that these measures are consistent with the Commission's regulations regarding performance of SSCs important to safety.

6. Human-Induced Causes of Channel Diversion. To meet the requirements of GDC 2, GDC 44, 10 CFR 52.17, and 10 CFR Part 100, an assessment of the potential for human-induced channel diversions, in the vicinity of the site (e.g., land-use changes, instream hydraulic structures, diking, channel modification, armoring or failure of such structures) is needed. An assessment of high and low water levels during channel diversion should be provided.
7. Alternative Water Sources. To meet the requirements of GDC 2, GDC 44, 10 CFR 52.17, and 10 CFR Part 100, assessments of alternative water sources and operating procedures are needed if applicable. These assessments should be consistent with those in the corresponding FSAR Sections (Low Water Considerations and Technical Specifications and Emergency Operation Requirements).
8. Consideration of Other Site-Related Evaluation Criteria. To meet the requirements of GDC 1, GDC 2, 10 CFR 52.17, and 10 CFR Part 100, a description of the potential effects of site-related proximity, seismic (including the effects of potential land subsidence), and non-seismic information on the postulated worst-case channel diversion scenario for the proposed plant site is needed. This description should be sufficient to demonstrate that the applicant's design bases appropriately account for these effects.

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 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.

The first specification was adopted in recognition of the relatively short history available for severe natural phenomena on the North American continent and, as a result, the

potential for underestimating the severity of such events, based on probabilistic considerations only. This problem can be avoided by using a deterministic approach to assess design basis events. Such an approach will account for the practical physical limitations of natural phenomena to contribute to the severity of a given event.

This criterion is relevant to this DSRS section in that it addresses the potential effects of channel diversion on the hydrologic characteristics of the plant site. In general terms, it also specifies the amount of conservatism that should be used to determine the severity of channel diversion phenomena for the purpose of assessing the adequacy of the design bases used or SSCs important to safety. This is a similar standard as that applied in reviewing ESPs or COL applications.

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

GDC 44 can apply to DSRS Section 2.4.9 if the ultimate heat sink for the plant consists 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, should be constructed in a manner that ensures the integrity of the cooling water system and its safety function. In addition, it should 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.

3. Section 100.20(c) of 10 CFR Part 100 requires that physical characteristics of a site (including seismology, meteorology, geology, and hydrology) be taken into account to determine 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 SSCs important to safety, is one of the many natural phenomena specified in and 10 CFR 100.20(c) that should 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.

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 FSER section.
2. Historical Channel Diversions: The staff reviews applicable literature or information describing historical occurrences of channel diversions in the region to determine if additional protection should be considered in the design of SSCs important to safety. This information should include historical maps, photographs, and documentary records. Publications of the United States Geologic Survey (USGS), the U.S. Army Corps of Engineers (USACE), USACE Engineer Research, National Cooperative Highway Research Program (NCHRP) of the Transportation Research Board, State highway departments and other sources are used to identify the history and potential for channel diversions in the region. For any channel diversion events, historical hydrograph data and potential causes should be noted, as well as the volume of any blocking materials with respect to the channel geometry.

The phrase "channel diversions" is not commonly used in the literature, so the reviewer should also search for "channel migration," "channel geomorphology," "physical hydrology," and initiating events such as "landslides" and "levee breaks" or "breaches."

Channel history and potential for diversions is reviewed for the following areas:

- A. Upstream, and generally above-bank, due to geologic, seismic, or topographic change, e.g., caused by hillslope failure or earthquakes
- B. Upstream (or downstream) and within the bank, due to erosion, deposition, channel cutoff, or avulsion caused by episodic flood events, e.g., loss of a revetment or dike, or alluvial channel meander changes

- C. Upstream (or downstream) and within the bank due to thermal causes such as ice-jams
 - D. Upstream (or downstream) and within the bank, due to human activities such as land use changes.
3. Regional Topographic Evidence: The staff reviews regional topographic evidence which suggests that future channel diversion may or may not occur in conjunction with evidence of historical diversions. The reviewer studies elevation relief of topographic maps along with geologic maps to qualitatively determine potential locations where geologic or human-induced events increase the likelihood of channel diversions. The staff's review should ensure that the SSCs important to safety are not adversely affected by channel diversion.

Evaluate the channel types including planform (meanders, point bars, and braided), cross-section (width and depth), profile (bed slope), discharge (velocity and energy grade line), and material (bed, bank, and suspended sediments).

If considered necessary, the staff identifies the most likely types of channel diversion conditions and the potential impact on plant design of each type. For each type of condition, preliminary independent conservative estimates of the "worst case" should be made qualitatively.

The USACE and the NCHRP have provided methods of predicting channel migration. USGS and state departments of natural resources provide databases of landslide mapping. The Federal Emergency Management Agency (FEMA) has completed a riverine erosion hazard area mapping study. The reviewer needs to consider the possibility the channel could divert by blockage or as a result of uplift or subsidence. The reviewer needs to consider potential diversions that can result from long-term gradual progressive causes, or from short-term quick catastrophic change.

If the applicant's assessment of channel diversion effects is comparable to the staff's preliminary bounding analysis, the staff should concur with the applicant's assessment. If the preliminary bounding analysis indicates the two are not comparable, the staff's analysis should be repeated using more realistic techniques. If the two remain non-comparable then the staff should analyze data and methods used by the applicant and use alternative techniques of analysis.

4. Ice Causes: The staff reviews estimates of the most severe ice-induced channel diversion consistent with the applicant's estimates in the corresponding FSAR Section (Ice Effects). Flow available under the most severe channel diversion should be sufficient to meet water supply requirements for SSCs important to safety.

If ice blockage of the river or estuary is possible, it should be demonstrated that the resulting water level in the vicinity of the site has been considered in establishing the flood (e.g., from diverted channel of an ice dam) and water supply design bases (e.g., low water downstream of ice jams). If this water level could adversely affect the intake structure or other SSCs important to safety, it should be demonstrated that an alternative water supply will not also be adversely affected.

5. Permafrost Hydrology: For sites located in the permafrost region the staff reviews the potential for channel diversion as a result of gas hydrate activities, freezing, thawing, and thermal gradients in the subsurface.
6. Flooding of Site Due to Channel Diversions: If flooding to a degree greater than that described in the PMF section is possible, potential impact forces on the SSCs important to safety should be a consideration in the design bases. Also, the erosive forces and dynamic loading should be included in the structural design bases such as DSRS Section 3.4.2, "Analysis Procedures."
7. Human-Induced Causes of Channel Diversion: In addition to naturally migrating channels, the potential exists that human-induced reasons (e.g., land-use changes, instream hydraulic structures, diking, channel modification, armoring, or subsequent failure of such structures) could initiate or exacerbate geomorphologic channel changes. The staff qualitatively reviews the evaluation of potential for human-induced channel diversions in the vicinity of the site, as it relates to channel diversions. The staff uses a watershed approach that considers geomorphologic, hydrologic, and hydraulic processes affected by human activities within the watershed of channel. The USACE and the NCHRP have provided methods of predicting channel migration near structures when rivers are channelized.
8. Alternative Water Sources: The staff reviews availability of alternative sources of water supply to the SSCs important to safety according to recommendations of RG 1.27 if applicable. A detailed staff review for assessment of alternative water sources and operating procedures is carried out in FSER Section 2.4.11 (Low Water Considerations).
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 channel diversion scenario at the proposed plant site.
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 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 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, NRC staff reviews that application to ensure sufficient information is 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 provides 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 final 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 FSER. The reviewer also states the bases for those conclusions.

1. COL Reviews

The following statements in the FSER 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 channel diversion effects 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 potential for channel diversion is acceptable and meets the requirements of 10 CFR Part 50, Appendix A, GDC 2 and 44 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 potential for channel diversion is reflected in these design bases, as documented in FSERs 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 and 44 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 FSER 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 ESP site:

As set forth above, the applicant has presented and substantiated sufficient information pertaining to the identification and evaluation of channel diversions at the proposed site. Section 2.4.9, "Channel Diversions," of NUREG-0800, SRP, provides that the site FSAR should address the requirements of 10 CFR Parts 52 and 100 as they relate to identifying and evaluating channel diversions affecting the site. Further, the applicant considered the most severe natural phenomena that have been historically reported for the site and surrounding area while describing the hydrologic interface of the plant with the site, 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 FSERs 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 channel diversion site characteristics 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 channel diversions for inclusion in an ESP for the applicant's site, should one be issued, acceptable.

3. DC Reviews

The following statement in the FSER 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) and agrees that they are representative of a reasonable number of sites that have been or may be considered for a COL application. Channel diversion effects 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 React (ADAMS) or Reviews," dated August 31, 2010 (Agencywide Documents Access and Management System Accession No. 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, GDC 1, "Quality Standards and Records."
2. 10 CFR Part 50, Appendix A, GDC 2, "Design Bases for Protection Against Natural Phenomena."
3. 10 CFR Part 50, Appendix A, GDC 44, "Cooling Water."
4. 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."
5. 10 CFR Part 100, "Reactor Site Criteria."
6. EM 1110-2-1418 "Engineering and Design Channel Stability Assessment for Flood Control Projects", U.S. Army Corps of Engineers, CECW-EH-D Washington, DC 20314-1000, 31 October 1994.

7. FEMA Riverine Erosion Hazard Areas (REHA) Mapping Feasibility Study, 1999
<http://www.fema.gov/library/viewRecord.do?id=2209>
8. Final Interim Staff Guidance ESP/DC/COL-ISG-015, "Post-Combined License Commitments." January 21, 2010. Accession Number: ML093561416.
9. NCHRP Web-Only Document 67 (Project 24-16) Methodology for Predicting Channel Migration, National Cooperative Highway Research Program, Transportation Research Board, August 2004.
10. RG 1.27, "Ultimate Heat Sink for Nuclear Power Plants."
11. RG 1.29, "Seismic Design Classification."
12. RG 1.59, "Flood Design Basis for Nuclear Power Plants." Historical Technical Reference.
13. RG 1.102, "Flood Protection for Nuclear Power Plants."
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