

# Proposed - For Interim Use and Comment



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

### 2.4.1 HYDROLOGIC DESCRIPTION

#### REVIEW RESPONSIBILITIES

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

**Secondary** - None

#### I. AREAS OF REVIEW

This section<sup>1</sup> provides guidance for the U.S. Nuclear Regulatory Commission (NRC) staff's review of a general description of hydrologic conditions at and near a proposed nuclear power plant site. This general description is typically presented in Section 2.4.1 of the applicant's final safety analysis report (FSAR). This section serves as an introduction to subsequent sections of the hydrologic review. It describes the site as it relates to the hydrosphere including surface water and groundwater hydrologic features and conditions that are relevant to water supply for the plant or to safety hazards. It also describes the principal forms and sources of data used to support the staff's review of specific hydrologic topics such as flooding. Guidance on the review of specific topics is presented below in Design-Specific Review Standard (DSRS) Sections 2.4.2 through 2.4.14.

This section is part of Chapter 2 of the DSRS, which provides guidance for the staff's review of 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 it relates to structures, systems, and components (SSCs) important to safety. This DSRS section applies to reviews performed for each of these types of applications. The staff's review and findings are described in the corresponding section (normally Section 2.4.1) of the safety evaluation report (SER).

The review covers the following specific areas:

1. Interface of the Plant with the Hydrosphere. A proposed plant's SSCs can be directly or indirectly exposed to the effects from hydrologic and geophysical phenomena. For example, door openings or access penetrations into buildings could allow flood waters to enter, an intake could be exposed to floods and low water events, and building foundations and walls could experience hydrostatic forces from rising groundwater. These exposures of the plant's SSCs are referred to as the interfaces to the hydrosphere. The plant's interface with the hydrosphere is unique for each site and supports the development of alternative conceptual models for hydrologic and geophysical phenomena that could affect the safety of the plant. To perform its safety analyses (that are subject of subsequent sections of this DSRS), the staff reviews

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<sup>1</sup> Unless otherwise specified, in this section the term "this section" refers to DSRS Section 2.4.1.

descriptions of site location, major hydrologic and geophysical features and phenomena that may pose hazards to the proposed plant, surface and groundwater-related characteristics, and the proposed water supply to the plant. The descriptions in this section should include summarized quantitative information on the major hydrologic features such as record high and low flows, subsurface hydraulic heads, and any unusual existing or historical hydrologic and geophysical conditions from the record. It should be noted that the various site characteristics (flood water surface elevation, flow velocity, erosion and deposition patterns, forces on structures, etc.) can result from design basis events caused by different phenomena or different realizations or scenarios of the same phenomenon for each characteristic. The staff's review covers all plausible phenomena and all plausible scenarios of each phenomenon that may affect the safety of the plant.

2. Hydrologic and Geophysical Phenomena. The staff's review addresses identification of hydrologic and geophysical phenomena that may require special plant design bases or operating limitations with regard to floods, subsurface hydraulic head, and water supply requirements.
3. Surface and Groundwater Uses. The staff's review identifies current and likely future surface and groundwater uses by the plant and water users in the vicinity of the site that may affect safety of the plant.
4. Data: The staff reviews available spatial and temporal data relevant for the site review. The data that form the basis of applicant's analysis and safety conclusions in the FSAR are reviewed in this section of the SER. The staff reviews historical records, location-specific data (maps and geographical information system (GIS) data), and the hydrologic and geophysical setting (river basins, stream network, dam locations, coastal and estuarine configurations, tsunamigenic sources, subsurface features) to adequately review interface of the plant with the hydrosphere. The period and length of record for the data should be sufficient enough to provide adequate characterization of the hydrologic and geophysical description, and demonstrate possible limitations in characterization of the site and phenomena that are relevant for safety of the plant. A detailed review of the available data is made in the following sections that address specific topics, such as flooding or ice effects.
5. Alternative Conceptual Models. The staff reviews alternative conceptual models of the hydrologic and geophysical phenomena that reasonably bound post-construction hydrologic conditions at the site during plant operations. During construction at multi-unit sites, consideration of Title 10 of the *Code of Federal Regulations* (10 CFR), Section 52.79(a)(31) requires an evaluation of potential hazards to SSCs important to safety of existing operating units resulting from construction activities and a description of managerial and administrative controls to be used to provide assurance that the limiting conditions for operation are not exceeded as a result of construction activities at the multi-unit site.. The set of alternative conceptual models of hydrologic and geophysical phenomena reflects the uncertainty in the hydrologic processes and characterization. Details of alternative conceptual models of specific site features, such as contaminant flowpaths, are discussed in later sections for specific topics.
6. Consideration of Other Site-Related Evaluation Criteria. The staff considers the potential effects of seismic (including the effects of possible land subsidence) and non-seismic information on the postulated design bases and how they relate to the hydrology in the vicinity of the site and the site region.

7. 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 DSRS and Standard Review Plan (SRP) sections interface with this section as follows:

1. Sections 2.4.0 and 2.4.2 - 2.4.9 address effects of specific flood-producing phenomena. DSRS Section 2.4.12 addresses effects of groundwater. DSRS Section 2.4.13 addresses effects of releases of radionuclides. DSRS Section 2.4.10 addresses flooding protection measures to be implemented to protect SSCs from flooding and high hydraulic heads that affects subsurface safety-related or risk-significant SSCs. DSRS Section 2.4.14 addresses technical specifications and emergency operations. Hydrologic, geophysical, and subsurface descriptions for the types of phenomena considered in DSRS Sections 2.4.2-2.4.9, 2.4.13, and 2.4.14 are described in this section.
2. The seismic design basis review that includes seismically-induced land subsidence information is performed under SRP Section 2.5.1, "Basic Geologic and Seismic Information."
3. 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."
4. The review of the design of seismic Category I structures for the effects of controlling hydrologic events such as flooding or high subsurface hydraulic head is performed under DSRS Section 3.4.2, "Analysis Procedures."
5. The review to ensure that adverse environmental conditions will not preclude the safety function of the ultimate heat sink is performed under DSRS Section 9.2.5, "Ultimate Heat Sink."
6. The data, including spatial and temporal data used by the applicant in support of its safety conclusions in the FSAR, are reviewed in this DSRS section. Specific use of these data items in the staff's review is presented in detail in later SER sections and described in the corresponding DSRS sections.
7. 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 2<sup>2</sup> 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.

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<sup>2</sup> Additional supporting information on prior DC rules may be found in DCD Tier 2 Section 14.3.

## II. ACCEPTANCE CRITERIA

### Requirements

Acceptance criteria are based on meeting the relevant requirements of the following NRC 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 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.
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 the hydrologic characteristics of the proposed site 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 Part 52.79(a)(31), for COL applications, as it relates to the effect of construction activities (including hydrologic modifications of the site) on SSCs important to safety of operating units at multi-unit sites.

### 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 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 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.

RG 1.113, as supplemented by best current practices, provides guidance on evaluating the effect of the dispersion of accidental releases on resulting concentrations of radionuclides in surface water.

1. Interface of the Plant with the Hydrosphere. The application should provide a description of hydrologic and geophysical phenomena and how the plant interfaces with the hydrosphere.

The description of hydrologic and geophysical characteristics should correspond to those of the United States Geological Survey (USGS), National Oceanic and Atmospheric Administration (NOAA), Natural Resources Conservation Service (NRCS), United States Bureau of Reclamation (USBR), U.S. Army Corps of Engineers (USACE), Federal Emergency Management Agency (FEMA), or appropriate State and river basin agencies. Descriptions of all existing or proposed reservoirs and dams (both upstream and downstream) that could influence conditions at the site should be provided. The inclusion of proposed dams is equally as important as existing dams because one or more dams may be constructed within the licensing period and may affect the safety of the plant. These descriptions may be obtained from reports of the USGS, USBR, USACE, and others. Generally, reservoir descriptions of a quality similar to those contained in pertinent data sheets of a standard USACE Hydrology Design Memorandum are adequate.

In addition to providing a description of the plant's interface with the hydrosphere, application should provide a discussion that supports the development of alternative conceptual models of the hydrologic and geophysical phenomena that could plausibly affect the safety of the plant.

2. Hydrologic and Geophysical Phenomena. The application should provide a description of hydrologic and geophysical phenomena that affect the safety of the plant. Phenomena that can result in flooding at or in the vicinity of the site should be described. Phenomena and climate in the vicinity of the site that affect low-water or drought conditions should be described. The applicant should describe all plausible hydrologic and geophysical phenomena and all plausible scenarios of each phenomenon that may affect the safety of the plant.
3. Surface and Groundwater Uses. The application should provide a description of surface and groundwater uses in the vicinity of the site that affect the water supply to SSCs important to safety. The description should include all current and future known and likely surface and groundwater use that may affect water supply to SSCs important to safety. This description should include both upstream and downstream uses of water in the vicinity of the site.
4. Data. The application should provide a complete description of all spatial and temporal datasets used by the applicant in support of its conclusions regarding safety of the plant. Data and descriptions should be sufficiently detailed to allow the staff to review the applicant's conclusions regarding the safety of the plant and to determine of the design bases of SSCs important to safety. Temporal data should be of sufficient length to provide a description of the site characteristic being reviewed.

The description and elevations of SSCs important to safety, and accesses thereto should be sufficiently complete to allow evaluation of the effect of flood design bases.

Site topographic maps should be of good quality and of sufficient scale to allow independent analysis of pre- and post-construction drainage patterns. Flood maps that show the areas to be inundated by floods of different magnitude and recurrence interval should be of appropriate scale and quality for their intended purpose. All external plant structures and components should be identified on site maps. Data should be provided on surface water users, location with respect to the site, type of use, and quantity of surface water used.

Tabulations of drainage areas, types of structures, appurtenances, ownership, seismic and spillway design criteria, elevation-storage relationships, and short and long-term storage allocations should be provided.

Data collected, maintained, and distributed by Federal and State agencies, such as USGS, NOAA, NRCS, USACE, FEMA, and various State water resources departments, are adequate for safety evaluation of the plant.

5. Alternative Conceptual Models. The application should provide a description of alternative conceptual models of hydrologic and geophysical phenomena. These alternative conceptual models should be sufficiently detailed to reasonably bound hydrologic and geophysical conditions that affect the site.
6. Consideration of Other Site-Related Evaluation Criteria. The application should demonstrate that the potential effects of site-related proximity and of seismic (including the effects of possible land subsidence) and non-seismic information as they relate to hydrologic and geophysical description in the vicinity of the proposed plant site and site regions are appropriately taken into account.
7. Permafrost Hydrology. Permafrost hydrology is of special interest because of the unique hydrologic, geologic, geochemical and climatic patterns that prevail in the region. Current research also indicates that the permafrost region is undergoing environmental changes characterized by accelerated thawing. Permafrost is defined as land and subsurface soil that remains below the freezing point of water for two or more consecutive years. In addition to accelerated thawing which results in changes in water pathways, land subsidence and formation of cracks, environmental changes in the permafrost region are also characterized by biogeochemical processes that result in release of gas hydrates.

Review areas will include information on the following:

- A. Description of the hydrologic processes in the permafrost region: The staff reviews information on the major hydrologic processes that govern the hydrologic processes at the site.
- B. Presence and extent of thawing at the site and in the vicinity of the site: The staff reviews information related to evidence of thawing and its extent as presented in regional data obtained from a variety of sources.
- C. Presence of gas hydrates at the site and in the vicinity of the site: The staff reviews information related to the prevalence of gas hydrates at the site and in the vicinity of the site and their role in the local hydrologic processes. The review will also include the ability of gas hydrates to impact safe operation of SSCs important to safety.

- D. Thermal gradient in the subsurface at the site and in the vicinity of the site: The staff reviews information related to the subsurface thermal gradient and its impact on site hydrologic processes and safe operation of SSCs important to safety.

### 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. Pursuant to GDC 2, nuclear power plant SSCs important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions. The GDC further specifies that the design bases for these SSCs shall reflect the following:
  - A. Appropriate consideration of the most severe of the natural phenomena that have been historically reported and the use of geological and physical data for the site and surrounding area, with sufficient margin for the limited accuracy, quantity, and time period in which the historical data have been accumulated;
  - B. Appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena; and
  - C. The importance of the safety functions to be performed.

The first specification was adopted in recognition of the relatively short history available for severe natural phenomena on the North American continent and, as a result, the potential for underestimating the severity of such events, based on probabilistic considerations only. This problem can be avoided by using a deterministic approach to assess design basis events. Such an approach will account for the practical physical limitations of natural phenomena to contribute to the severity of a given event. The application should evaluate the various site characteristics (flood, erosion and deposition, forces on structures, etc.) in Section 2.4 of the application with the understanding that these can result from different design basis events.

This criterion is relevant to DSRS Section 2.4.1 in that it specifies the hydrologic phenomena that should be considered in the section. In general terms, it also specifies the level of conservatism that should be used to assess the severity of these phenomena when determining the appropriate design bases for SSCs important to safety. This is a similar standard as that applied in reviewing ESPs or COLs for hydrologic site characteristics.

2. Sections 100.20(c) of 10 CFR Part 100 require that physical characteristics of a site (including seismology, meteorology, geology, and hydrology) be taken into account to determine its acceptability for a nuclear power reactor. In addition, these sections address the hydrologic characteristics of a proposed site that may affect the consequences of an escape of radioactive material from the facility. Special precautions are required if a reactor is to be located on a site where significant quantities of radioactive effluent might accidentally flow into nearby streams or rivers or might find ready access to groundwater.

To satisfy the hydrologic requirements of 10 CFR Part 100, the applicant's FSAR should contain a description of the surface and subsurface hydrologic characteristics of the site and region. This description should be sufficient to assess the acceptability of the site and the potential for those characteristics to influence the design of the plant SSCs that are important to safety.

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

### 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 is acceptable and whether the technical specifications reflect consideration of any identified unique conditions.

These review procedures are based on 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. Interface of the Plant with the Hydrosphere. The staff reviews hydrologic and hydraulic characteristics of watersheds, streams, lakes (e.g., location, size, shape, drainage area), shore regions, the regional and local groundwater environments, and existing or proposed water control structures (located both upstream and downstream from the proposed site including characteristics such as location, size, capacity, type, seismic design criteria, and operational details). The staff will review the description of the plant's interface with the hydrosphere, to ascertain that it supports the development of alternative conceptual models of the hydrologic and geophysical phenomena that could affect the safety of the plant.

The review procedure consists of evaluating the completeness of the information and data by sequential comparison with information available from references. An important facet of the review procedure for this and other DSRS sections in hydrologic areas is the



site visit. The site visit provides the technical reviewers with independent confirmation of hydrologic characteristics of the site and adjacent environs. The site visit is discussed in Appendix A to this DSRS section. A site audit may also be scheduled during the site visit to support the staff's review through detailed discussions with the applicant regarding of the applicant's data, methods, and conclusions with the applicant.

3. Hydrologic and Geophysical Phenomena. The staff reviews hydrologic and geophysical characteristics in the vicinity of the site and site regions to identify all feasible flooding mechanisms (Subsequent sections of the DSRS review these phenomena with respect to specification of site characteristics related to flood water elevation or subsurface hydraulic head, as related to the design bases of SSCs important to safety.). Historical conditions can be ascertained using data available from the USGS and other government agencies. The description and elevations of structures and facilities important to safety and accesses thereto should be sufficiently complete to allow evaluation of the effect of flood design bases in their respective sections.

The staff reviews historical hydrometeorological data to determine the hydrologic characteristics of the site regions. Streamflow data for rivers and streams in the vicinity of the site may be obtained from the USGS. Meteorological data included in the FSAR may be obtained from NOAA's National Climatic Data Center, Regional Climate Centers, or State Climate Offices. The USACE Cold Regions Research and Engineering Laboratory holds accumulated freezing degree-days data that is sufficient to evaluate icing on lakes and storage reservoirs. Historical data related to hurricanes, storm surges, seiches, and tsunamis, collected and maintained by NOAA, are also used in staff's review of the plausible hydrologic and geophysical phenomena. The USGS and state and local agencies may have relevant local information on groundwater levels and quality, and on hydrogeological conditions that affect them.

4. Surface and Groundwater Uses. The staff reviews data on surface and groundwater users, location with respect to the site, type of use, and quantity of water used to review the availability and reliability of water supply important to safety of the plant. Inventories of current and likely future water users, consistent with regional hydrologic inventories reported by applicable State and Federal agencies, are used in the staff's evaluation. The staff also reviews available projections of future water use, and if necessary of related projections of factors influencing water use, such as population.
5. Data. The staff reviews the identification and description of all spatial and temporal data that are used in the review of subsequent DSRS sections. Spatial data may be presented in a GIS format with a description of the computer software used to create the GIS layers. Temporal data may be presented electronically along with a description of the data format. The staff anticipates the use of the following data in the review of FSAR Section 2.4:

A. Spatially referenced data

- i. Topographic and bathymetric data including elevation contours
- ii. Location coordinates of the center of the powerblock and plant perimeter envelope
- iii. Locations of streamflow gauges

- iv. Locations of meteorological stations
- v. Locations of water control structures including dams and reservoirs
- vi. Locations of onsite or immediately adjacent water control, storage, or conveyance structures such as canals, dikes, levees, etc.
- vii. Locations of surface and groundwater users
- viii. Maps of soil types and subsurface characteristics identifying aquifers and confining units, and groundwater pathways
- ix. Detailed topographic and bathymetric maps of the site area
- x. Aerial photographs
- xi. Geologic maps
- xii. Locations of monitoring and pumping wells
- xiii. Locations of springs and seeps

B. Temporal data

- i. Observed streamflow records near the site, both upstream and downstream
- ii. Observed streamflow records in neighboring basins if only limited streamflow data are available for the basin where the site is located
- iii. Observed groundwater level records and subsurface hydraulic heads at the reactor site and vicinity
- iv. Observed meteorological (air temperature, dew point, and rainfall) records near the site
- v. Historical records of hurricanes, surges, seiches, and tsunamis
- vi. Any relevant prehistorical records, e.g., paleo-tsunami evidence
- vii. Lake-water surface elevation and downstream discharge, if applicable
- viii. Historical records of sedimentation, littoral drift, hillslope failure, ice jams, ice sheet formation on water bodies, channel diversions, etc., where applicable
- ix. Observed records of groundwater chemistry

6. Alternative Conceptual Models. The staff reviews a variety of alternative conceptual models of hydrologic and geophysical phenomena that are relevant for the site. These conceptual models need to be envisioned as part of the complete understanding of the surface and subsurface water movement. The conceptual model that presents the most

adverse case of contaminant transport should be used to derive a conservative bounding estimate of travel time. Consideration should be given to surface and groundwater pathways, preferential flow in the subsurface, chemistry of the subsurface media, and other relevant physiographic, hydrologic, and hydrogeologic conditions to evaluate the most severe effect on people and the environment.

7. Consideration of Other Site-Related Evaluation Criteria. The staff reviews the applicant's assertions regarding the potential effects of site-related proximity and of seismic and non-seismic information (including the effects of possible land subsidence and effects on groundwater levels) as they relate to the hydrologic description of the vicinity of the proposed plant site and site regions to be assured that the applicant's design bases appropriately account for these effects.

Subpart B of 10 CFR Part 100 describes site-related proximity, seismic, and non-seismic evaluation criteria for power reactor applications. The staff's review will include evaluation of pertinent information to determine if these criteria are appropriately used in the hydrologic description of the proposed plant site.

8. Review Procedures Specific to 10 CFR Part 52 Applications

- 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 Part 52.47(a)(1), a DC applicant must provide site parameters postulated for the design. The reviewer verifies 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 DSRS 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. Should the actual site characteristics 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 since the issuance of the ESP 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 safety evaluation report (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 (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 with regard to 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 should never copy text provided by the applicant except in a direct quotation that is properly attributed.

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 hydrologic description in the vicinity of the site and site regions 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 hydrology in the vicinity of the site and site regions are acceptable and meet the requirements of [10 CFR Part 50, Appendix A, General Design Criterion 2 or 10 CFR 52.79, as applicable] and 10 CFR Part 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 for establishing the design bases for SSCs important to safety. The staff has generally accepted the methodologies used to determine the hydrologic description in the vicinity of the site and site regions 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 margin sufficient for the limited accuracy, quantity, and period of time in which the data have been accumulated. The staff concludes that the identified site characteristics meet the requirement(s) of [10 CFR Part 50, Appendix A, General Design Criterion 2 or 10 CFR 52.79, as applicable] and 10 CFR Part 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 hydrologic description at the proposed site. DSRS Section 2.4.1, "Hydrologic Description," of NUREG-0800, Standard Review Plan, provides that the site

FSAR should address the requirements of 10 CFR Parts 52 and 100 as they relate to identifying and evaluating the hydrology in the vicinity of the site and site regions, including interface of the plant with the hydrosphere, hydrologic, and geophysical phenomena, surface and groundwater uses, spatial and temporal data sets, and alternate conceptual models of site hydrology. 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 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 hydrologic setting of the site set forth above are acceptable and meet the requirements of 10 CFR Part 52.17(a)(1)(vi), 10 CFR Part 100.20(c), and 10 CFR Part 100.21(d).

In view of the above, the staff finds the applicant's proposed site characteristics related to hydrologic setting for inclusion in an ESP for the applicant's site, should one be issued, to be 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), and agrees that they are representative of a reasonable number of sites that have been or may be considered for a COL application. Site hydrology descriptions 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) 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, 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."
8. 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. "Engineering and Design - Ice Engineering," EM 1110-2-1612, U.S. Army Corps of Engineers, Washington, DC, 2002 or later edition.
6. Final Interim Staff Guidance ESP/DC/COL-ISG-015, "Post-Combined License Commitments." January 21, 2010. Accession Number: ML093561416.
7. RG 1.27, "Ultimate Heat Sink for Nuclear Power Plants."
8. RG 1.29, "Seismic Design Classification."
9. RG 1.59, "Flood Design Basis for Nuclear Power Plants."
10. RG 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)."
11. RG 1.102, "Flood Protection for Nuclear Power Plants."
12. RG 1.206, "Combined License Applications for Nuclear Power Plants. (LWR Edition)."
13. RG 1.113, "Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I."





## APPENDIX A

### DESIGN SPECIFIC REVIEW STANDARD 2.4.1 HYDROLOGIC ENGINEERING SITE VISITS

#### I. PURPOSES

The purposes of hydrologic engineering site visits are as follows:

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

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

#### II. PROCEDURES

List of discussion items are to be developed by the reviewers of the organization responsible for the review of issues related to hydrology and discussed in detail with the Branch Chief 7-14 days before the scheduled site visit. For any unscheduled site visit (which may be necessary to resolve issues or prepare for hearings), similar discussion items of from the staff should be prepared at least 3 days prior to such site visits and also discussed in detail with the Branch Chief.

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

The staff reviewers for Hydrologic Description will discuss any unusual or potentially controversial discussion items with the Chief of the organization responsible for the review of issues related to hydrology prior to transmittal of the staff's discussion items to the Project Manager (PM).

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

Normally, a group composed of the staff reviewers and PM should meet with an applicant representative responsible for responding to staff questions and the applicant's technical advisor. For verbal summarization during the site visit, the recommended method is to have the applicant or his technical advisor summarize the discussions to ensure understanding.

If determined to be necessary for the staff's review, a site audit may also be scheduled during the site visit. The site audit is expected to involve more detailed discussions of the applicant's data, methods, and conclusions. For this reason, the applicant's team of qualified engineers, consultants, and technical advisors should be available during the site audit.

### III. TRIP REPORT

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

If a site audit was conducted, the trip report should include a list of questions and items of staff interest discussed, together with a summary of responses and commitments to future actions provided by the applicant.