



## U.S. NUCLEAR REGULATORY COMMISSION

# STANDARD REVIEW PLAN

### 2.4.1 HYDROLOGIC DESCRIPTION

#### REVIEW RESPONSIBILITIES

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

**Secondary** - None

#### I. AREAS OF REVIEW

Chapter 2 of the Standard Review Plan (SRP) discusses the site characteristics that could affect the safe design and siting of the plant. The staff reviews information presented by the applicant for a construction permit (CP), operating license (OL), design certification (DC), early site permit (ESP), or combined license (COL) concerning the hydrological setting of the site as it relates to safety-related structures, systems, and components (SSC). This SRP section applies to reviews performed for each of these types of applications. The staff's review and findings are described in the appropriate section of the safety evaluation report (SER).

The hydrological setting is described in this section of the applicant's safety analysis report (SAR). The applicant also describes in this section, the data that are used in its safety conclusions in the SAR.

Revision 3 -March 2007

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### USNRC STANDARD REVIEW PLAN

This Standard Review Plan, NUREG-0800, has been prepared to establish criteria that the U.S. Nuclear Regulatory Commission staff responsible for the review of applications to construct and operate nuclear power plants intends to use in evaluating whether an applicant/licensee meets the NRC's regulations. The Standard Review Plan is not a substitute for the NRC's regulations, and compliance with it is not required. However, an applicant is required to identify differences between the design features, analytical techniques, and procedural measures proposed for its facility and the SRP acceptance criteria and evaluate how the proposed alternatives to the SRP acceptance criteria provide an acceptable method of complying with the NRC regulations.

The standard review plan sections are numbered in accordance with corresponding sections in Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)." Not all sections of Regulatory Guide 1.70 have a corresponding review plan section. The SRP sections applicable to a combined license application for a new light-water reactor (LWR) are based on Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)."

These documents are made available to the public as part of the NRC's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Individual sections of NUREG-0800 will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience. Comments may be submitted electronically by email to [NRR\\_SRP@nrc.gov](mailto:NRR_SRP@nrc.gov).

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The review covers the following specific areas:

1. Interface of the Plant with the Hydrosphere: The interface of the plant with the hydrosphere includes descriptions of site location, major hydrological features in site vicinity, surface and ground water-related characteristics, and the proposed water supply to the plant. The staff's review establishes how the safety of the plant is affected by hydrology in the vicinity of the site. The descriptions in this section should include summarized quantitative information on the major hydrologic features such as record high and low flows and other hydrologic anomalies from record.
2. Hydrological Causal Mechanisms: The staff's review addresses identification of hydrological causal mechanisms that may require special plant design bases or operating limitations with regard to floods and water supply requirements.
3. Surface and Ground Water Uses: The staff's review identifies current and likely future surface and ground water uses by the plant and water users in the vicinity of the site that may impact 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 SAR are reviewed in this section of the SER.
5. Alternate Conceptual Models: The staff reviews alternate conceptual models of the hydrology of the site that reasonably bound hydrological conditions at the site. The set of alternate conceptual models of site hydrology reflects uncertainty in hydrological processes and hydrological characteristics.
6. Consideration of Other Site-Related Evaluation Criteria: The staff considers the potential effects of seismic 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 SRP sections interface with this section as follows:

1. The identification of safety-related structures and equipment that should be protected against the effects of flooding is performed under SRP Section 3.4.1, "Flood Protection."
2. The review of the design of seismic Category I structures to design for the effects of flooding is performed under SRP Section 3.4.2, "Analysis Procedures."
3. The review to ensure that adverse environmental conditions will not preclude the safety function of the ultimate heat sink is performed under SRP Section 9.2.5, "Ultimate Heat Sink."

4. The data, including spatial and temporal data used by the applicant in support of its safety conclusions in the SAR, are reviewed in this SRP section. However, specific use of these data items in the staff's review may be addressed in later SER sections and described in the corresponding SRP sections.
5. 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>1</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 Section 2.0.

The specific acceptance criteria and review procedures are contained in the referenced SRP sections.

## II. ACCEPTANCE CRITERIA

### Requirements

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

1. 10 CFR Part 100, as it relates to identifying and evaluating hydrologic features of the site. The requirements to consider physical site characteristics in site evaluations are specified in 10 CFR 100.10(c) for applications before January 10, 1997, and 10 CFR 100.20(c) for applications on or after January 10, 1997.
2. 10 CFR Part 50, Appendix A, General Design Criterion (GDC) 2, for CP and OL applications, as it relates to consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area, with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated.
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.

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

## SRP Acceptance Criteria

Specific SRP acceptance criteria acceptable to meet the relevant requirements of the NRC's regulations identified above are as follows for the review described in this SRP section. The SRP is not a substitute for the NRC's regulations, and compliance with it is not required. However, an applicant is required to identify differences between the design features, analytical techniques, and procedural measures proposed for its facility and the SRP acceptance criteria and evaluate how the proposed alternatives to the SRP acceptance criteria provide acceptable methods of compliance with the NRC regulations.

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

Regulatory Guide 1.27 describes the applicable ultimate heat sink capabilities.

Regulatory Guide 1.29 identifies seismic design bases for safety-related SSC.

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

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

1. Interface of the Plant with the Hydrosphere: The application should provide a description of hydrology in the vicinity of the site and site regions and of how the plant interfaces with the hydrosphere. The description and elevations of safety-related structures, facilities, and accesses thereto should be sufficiently complete to allow evaluation of the impact 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 difference magnitude and recurrence interval should be of appropriate scale and quality. 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.

The description of hydrologic characteristics should correspond to those of the United States Geological Survey (USGS), National Oceanic and Atmospheric Administration (NOAA), Natural Resources Conservation Service (NRCS), U.S. Army Corps of Engineers (USACE), 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. These descriptions may be obtained from reports of the USGS, United States Bureau of Reclamation (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.

2. Hydrological Causal Mechanisms: The application should provide a description of hydrological causal mechanisms that affect the safety of the plant. Mechanisms that can result in flooding at or in the vicinity of the site should be described. Mechanisms and climate in the vicinity of the site that affect low-water or drought conditions should be described.
3. Surface and Ground Water Uses: The application should provide a description of surface and ground water uses in the vicinity of the site that affect the safety-related water supply to the plant. The description should include all current and future known and likely surface and ground water use that may affect safety-related water supply to the plant. 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 safety-related SSC.

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

5. Alternate Conceptual Models: The application should provide a description of alternate conceptual models of site hydrology. These alternate conceptual models should be sufficiently detailed to reasonably bound hydrological conditions at 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 and non-seismic information as they relate to hydrologic description in the vicinity of the proposed plant site and site regions are appropriately taken into account.

### Technical Rationale

The technical rationale for application of these acceptance criteria to the areas of review addressed by this SRP section is discussed in the following paragraphs:

1. Pursuant to GDC 2, nuclear power plant SSC important to safety be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunamis, and seiches without loss of capability to perform their safety functions. The GDC further specifies that the design bases for these SSC 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.

This criterion is relevant to SRP Section 2.4.1 in that it specifies the hydrological 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 structures, systems, and components important to safety. This is a similar standard as that applied in reviewing ESPs or COLs for hydrologic site characteristics.

2. Sections 100.10(c) and 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 ground water.

To satisfy the hydrologic requirements of 10 CFR Part 100, the applicant's SAR 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 SSC 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 from either normal operations or as the result of a reactor accident.

### III. REVIEW PROCEDURES

The reviewer will select material from the procedures described below, as may be appropriate for a particular case.

The procedures outlined below are used to review CP applications, ESP applications, and COL applications that do not reference an ESP to determine whether data and analyses for the proposed site meet the acceptance criteria given in Subsection II of this SRP section. For reviews of OL applications, these procedures are used to verify that the data and analyses remain valid and that the facility's design specifications are consistent with these data. As applicable, reviews of OLs and COLs include a determination on whether the content of technical specifications related to hydrologic site characteristics is acceptable and whether the technical specifications reflect consideration of any identified unique conditions.

These review procedures are based on identified SRP acceptance criteria. For deviations from these acceptance criteria, the staff should review the applicant's evaluation of how the proposed alternatives provide an acceptable method of complying with the relevant NRC requirements identified in Subsection II.

1. 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 ground water environments, and existing or proposed water control structures (located both upstream and downstream; characteristics such as location, size, capacity, type, seismic design criteria, and operational details).

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

2. Hydrological Causal Mechanisms: The staff reviews hydrology in the vicinity of the site and site regions to identify various feasible flooding mechanisms. Subsequent sections of the SRP review these mechanisms with respect to specification of site characteristics related to flood water elevation and specification of design bases of safety-related SSC. Historical flooding conditions can be ascertained using streamflow data available from the USGS.

The description and elevations of safety-related structures, facilities, and accesses thereto should be sufficiently complete to allow evaluation of the impact of flood design bases.

The staff reviews historical hydrometeorological data to determine the frequency of low-water conditions, such as those during droughts. Streamflow data for rivers and streams in the vicinity of the site may be obtained from the USGS. Meteorological data included in the SAR 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 these hydrological mechanisms.

3. Surface and Ground Water Uses: The staff reviews data on surface and ground water users, location with respect to the site, type of use, and quantity of water used to review the availability and reliability of safety-related water supply to 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.
4. Data: The staff reviews the identification and description of all spatial and temporal data that are used in the review of subsequent SRP 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 SAR 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 ground water users
- viii. Maps of soil types and subsurface characteristics identifying aquifers and ground water pathways
- ix. Detailed topographic and bathymetric maps of the site area
- x. Aerial photographs
- xii. Geologic maps

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 meteorological (air temperature, dewpoint, and rainfall) records near the site
- iv. Historical records of hurricanes, surges, seiches, and tsunamis
- v. Any relevant pre-historical records, e.g., paleo-tsunami evidence
- vi. Lake-water surface elevation and downstream discharge, if applicable
- vii. Historical records of sedimentation, littoral drift, hillslope failure, ice jams, ice-sheet formation on water bodies, channel diversions, etc., where applicable

5. Alternate Conceptual Models: The staff reviews a variety of alternate conceptual models of the site, each based on the geological and hydrological characteristics of the site. These conceptual models need to be envisioned as part of the complete understanding of the surface and subsurface water movement. The most adverse of these conceptual models, in terms of contaminant movement, should be used to derive a conservative bounding estimate of travel time. Consideration should be given to surface and ground water pathways, preferential flow in the subsurface, chemistry of the subsurface media, and other relevant physiographic conditions to evaluate the most severe impact on people and the environment.
6. 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 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.

10 CFR Part 100 describes site-related proximity, seismic, and non-seismic evaluation criteria for power reactor applications. Subpart A to 10 CFR Part 100 addresses the requirements for applications before January 10, 1997, and Subpart B is for applications on or after January 10, 1997. The staff's review will include evaluation of pertinent information to determine if these criteria are appropriately used in the hydrological description of the proposed plant site.

## 7. Review Procedures Specific to 10 CFR Part 52 Application Type

A. Early Site Permit Reviews: Subpart A to 10 CFR Part 52 specifies the requirements and procedures applicable to the Commission's review of an ESP application for approval of a proposed site. Information required in an ESP application includes a description of the site characteristics and design parameters of the proposed site. The scope and level of detail of review of data parallel that used for a CP review.

In the absence of certain circumstances, such as a compliance or adequate protection issue, 10 CFR 52.39 precludes the staff from imposing new site characteristics, design parameters, or terms and conditions on the ESP at the COL stage. Accordingly, the reviewer should ensure that all physical attributes of the site that could affect the design basis of SSCs important to safety are reflected in the site characteristics, design parameters, or terms and conditions of the early site permit.

B. Standard Design Certification Reviews: DC applications do not contain general descriptions of site characteristics because this information is site-specific and will be addressed by the COL applicant. However, pursuant to 10 CFR 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 SRP Section 2.0;
- iii. Pertinent parameters are stated in a site parameters summary table; and
- iv. The applicant has provided a basis for each of the site parameters.

C. Combined License Reviews: For a COL application referencing a certified standard design, the NRC staff reviews that application to ensure sufficient information was presented to demonstrate that the characteristics of the site fall within the site parameters specified in the DC rule. 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 early site permit as applicable to this SRP section. In accordance with 10 CFR 52.79(b)(2), should the design of the facility not fall within the site characteristics and design parameters, the application shall include a request for a variance from the ESP that complies with the requirements of 10 CFR 52.39 and 10 CFR 52.93.

In addition, long-term environmental changes and changes to the region resulting from human or natural causes may have introduced changes to the site characteristics that could be relevant to the design basis. In the absence of certain circumstances, such as a compliance or adequate protection issue, 10 CFR 52.39 precludes the staff from imposing new site characteristics, design parameters, or terms and conditions on the early site permit at the COL stage. Consequently, a COL application referencing an ESP need not include a re-investigation of the site characteristics that have previously been accepted in the referenced ESP. However, in accordance with 10 CFR 52.6, "Completeness and Accuracy of Information," the applicant or licensee is responsible for identifying changes of which it is aware, that would satisfy the criteria specified in 10 CFR 52.39. Information provided by the applicant in accordance with 10 CFR 52.6(b) will be addressed by the staff during the review of a COL application referencing an ESP or a DC.

For a COL application referencing either an ESP or DC or both, the staff should review the corresponding sections of the ESP and DC FSEER to ensure that any early site permit conditions, restrictions to the DC, or COL action items identified in the FSEERs are appropriately handled in the COL application.

#### 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 safety analysis report. The staff's evaluation may include verification that the applicant followed applicable regulatory guidance, performance of independent calculations, and/or validation of appropriate assumptions. The reviewer may state that certain information provided by the applicant was not considered essential to the staff's review and was not reviewed by the staff. While the reviewer may summarize or quote the information offered by the applicant in support of its application, the reviewer should clearly articulate the bases for the staff's conclusions.

The reviewer verifies that the applicant has provided sufficient information and that the review and calculations (if applicable) support conclusions of the following type to be included in the staff's safety evaluation report. The reviewer also states the bases for those conclusions.

1. Construction Permit, Operating License, and Combined License Reviews

The following statements should be preceded by a summary of the site characteristics and parameters used for the plant:

As set forth above, the applicant has presented and substantiated information relative to the 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 [10 CFR Part 100.10(c) or 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 safety evaluation reports 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 100.10(c) [or 10 CFR Part 100.20(c)], with respect to establishing the design basis for SSCs important to safety.

2. Early Site Permit Reviews

The following statements should be preceded by a summary of the site characteristics and design parameters to be included in any ESP that might be issued for the proposed site:

As set forth above, the applicant has presented and substantiated sufficient information pertaining to the hydrologic description at the proposed site. Section 2.4.1, "Hydrologic Description," of NUREG-0800, Standard Review Plan, provides that the site safety analysis report should address the requirements of 10 CFR Parts 52 and 100 as they relate to identifying and evaluating the hydrology in the vicinity of the site and site regions, including interface of the plant with the hydrosphere, hydrological causing mechanisms, surface and ground water 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 safety evaluation reports for previous licensing actions. Accordingly, the staff concludes that the use of these methodologies results in site characteristics containing sufficient margin

for the limited accuracy, quantity, and period of time in which the data have been accumulated. In view of the above, the site characteristics previously identified are acceptable for use in establishing the design bases for SSCs important to safety, as may be proposed in a COL or CP application.

Therefore, the staff concludes that the identification and consideration of the hydrological 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 hydrological setting for inclusion in an ESP for the applicant's site, should one be issued, to be acceptable.

### 3. Design Certification Reviews

The following statement should be preceded by a list of the applicable site parameters used for the plant:

The NRC staff acknowledges that the applicant has selected the site parameters referenced above for plant design inputs (a subset of which is included as Tier 1 information), 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 SRP section in performing safety evaluations of DC applications and license applications submitted by applicants pursuant to 10 CFR Part 50 or 10 CFR Part 52. Except when the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the staff will use the method described herein to evaluate conformance with Commission regulations.

The provisions of this SRP section apply to reviews of applications submitted six months or more after the date of issuance of this SRP section, unless superseded by a later revision.

### VI. REFERENCES

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

5. ANSI/ANS-2.8-1992, "Determining Design Basis Flooding at Power Reactor Sites." Historical Technical Reference.
6. "Engineering and Design - Ice Engineering," EM 1110-2-1612, U.S. Army Corps of Engineers, Washington, DC, 2002 or later edition.
7. Regulatory Guide 1.27, "Ultimate Heat Sink for Nuclear Power Plants."
8. Regulatory Guide 1.29, "Seismic Design Classification."
9. Regulatory Guide 1.59, "Flood Design Basis for Nuclear Power Plants."
10. Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)."
11. Regulatory Guide 1.102, "Flood Protection for Nuclear Power Plants."
12. Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants." (LWR Edition)

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**PAPERWORK REDUCTION ACT STATEMENT**

The information collections contained in the Standard Review Plan are covered by the requirements of 10 CFR Part 50 and 10 CFR Part 52, and were approved by the Office of Management and Budget, approval number 3150-0011 and 3150-0151.

**PUBLIC PROTECTION NOTIFICATION**

The NRC may not conduct or sponsor, and a person is not required to respond to, a request for information or an information collection requirement unless the requesting document displays a currently valid OMB control number.

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## APPENDIX A

### STANDARD REVIEW PLAN SECTION 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 concerns with the applicant's hydrologic engineers and it is ensured that the questions and concerns are understood. In addition, generally acceptable techniques and procedures necessary to respond to staff concerns should be discussed.

#### II. PROCEDURES

Questions or items of staff concern 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 questions or items of staff concern 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 questions or items of staff concern are finalized.

The staff reviewers for Hydrologic Description will discuss any unusual or potentially controversial areas of concern with the Chief of the organization responsible for the review of issues related to hydrology prior to transmittal of the questions or items of staff concern to the Project Manager. Transmittal will be forwarded by memo route slip through the Branch Chief.

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 concern), 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 project manager (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.



U.S. NUCLEAR REGULATORY COMMISSION  
**STANDARD REVIEW PLAN**

### 2.4.13 ACCIDENTAL RELEASES OF RADIOACTIVE LIQUID EFFLUENTS IN GROUND AND SURFACE WATERS

#### REVIEW RESPONSIBILITIES

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

**Secondary** - Organization responsible for review of solid waste and liquid and gaseous effluents

Organization responsible for review of radiation protection

#### I. AREAS OF REVIEW

Chapter 2 of the Standard Review Plan (SRP) discusses the site characteristics that could affect the safe design and siting of a plant. The staff reviews information presented by the applicant for a construction permit (CP), operating license (OL), design certification (DC), early site permit (ESP), or combined license (COL) concerning hydrological setting of the site as they relate to safety-related structures, systems, and components (SSC). This SRP section applies to reviews performed for each of these types of applications. The staff's review and findings are described in the appropriate section of the safety evaluation report (SER).

The hydrogeological characteristics of the site are evaluated in this section of the applicant's safety analysis report (SAR) to describe the effects of accidental releases of radioactive liquid effluents in ground and surface waters on existing uses and known and likely future uses of ground and surface water resources. The source term from a postulated accidental release is reviewed under SRP 11.2 following the guidance provided in Branch Technical Position (BTP) 11-6, "Postulated Radioactive Releases Due to Liquid-containing Tank Failures." The

Revision 3 - March 2007

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#### USNRC STANDARD REVIEW PLAN

This Standard Review Plan, NUREG-0800, has been prepared to establish criteria that the U.S. Nuclear Regulatory Commission staff responsible for the review of applications to construct and operate nuclear power plants intends to use in evaluating whether an applicant/licensee meets the NRC's regulations. The Standard Review Plan is not a substitute for the NRC's regulations, and compliance with it is not required. However, an applicant is required to identify differences between the design features, analytical techniques, and procedural measures proposed for its facility and the SRP acceptance criteria and evaluate how the proposed alternatives to the SRP acceptance criteria provide an acceptable method of complying with the NRC regulations.

The standard review plan sections are numbered in accordance with corresponding sections in Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)." Not all sections of Regulatory Guide 1.70 have a corresponding review plan section. The SRP sections applicable to a combined license application for a new light-water reactor (LWR) are based on Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)."

These documents are made available to the public as part of the NRC's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Individual sections of NUREG-0800 will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience. Comments may be submitted electronically by email to [NRR\\_SRP@nrc.gov](mailto:NRR_SRP@nrc.gov).

Requests for single copies of SRP sections (which may be reproduced) should be made to the U.S. Nuclear Regulatory Commission, Washington, DC 20555, Attention: Reproduction and Distribution Services Section, or by fax to (301) 415-2289; or by email to [DISTRIBUTION@nrc.gov](mailto:DISTRIBUTION@nrc.gov). Electronic copies of this section are available through the NRC's public Web site at <http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0800/>, or in the NRC's Agencywide Documents Access and Management System (ADAMS), at <http://www.nrc.gov/reading-rm/adams.html>, under Accession # ML070730449.

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source term is determined from a postulated release from a single tank outside of containment. Normal and accidental releases are also considered in the applicant's environmental report.

The specific areas of review are as follows:

1. Alternate Conceptual Models: The staff reviews alternate conceptual models of the hydrology at the site that reasonably bound hydrogeological conditions at the site inasmuch as these conditions affect transport of radioactive liquid effluent in the ground and surface water environment. The staff review examines whether the alternate conceptual models present a more realistic representation of the geometry of the hydrologic features and boundary conditions.
2. Pathways: The staff reviews the bounding set of plausible surface and subsurface pathways from potential points of accidental release to determine the critical pathways that may result in the most severe impact on existing uses and known and likely future uses of ground and surface water resources in the vicinity of the site.
3. Characteristics that Affect Transport: The staff reviews the ability of ground and surface water environment with respect to their ability to delay, disperse, dilute, or concentrate accidentally released radioactive liquid effluent during its transport. The staff review includes assessment of scenarios wherein accidental release of radioactive effluents is combined with hydrologic extreme events such as floods or low flows.
4. Consideration of Other Site-Related Evaluation Criteria: The staff review includes assessment of scenarios wherein accidental release of radioactive effluents is combined with potential effects of seismic and non-seismic events (e.g., assessing effects of hydraulic structures located upstream and downstream of the plant in the event of structural or operational failures and the ensuing sudden changes in the regime of flow).
5. Additional Information for 10 CFR Part 52 Applications: Additional information will be presented dependent on the type of application. For a COL application, the additional information is dependent on whether the application references an ESP, a DC, both, or neither. Information requirements are prescribed within the "Contents of Application" sections of the applicable Subparts to 10 CFR Part 52.

#### Review Interfaces

Other SRP sections interface with this section as follows:

1. The proposed radionuclide concentrations assumed for the postulated release from a tank that is to be considered for this evaluation is reviewed under SRP Section 11.2.
2. The staff obtains receptor locations to be analyzed from the organization responsible for the review of radiation protection.
3. The staff provides, to the organization responsible for review of the effectiveness of radwaste systems and to the organization responsible for review of radiation protection, the locations, dilutions, and travel times corresponding to the bounding set of plausible surface and subsurface pathways for radionuclides in the accident scenarios leading to the most adverse contamination.

4. For DC applications and COL applications referencing a DC rule or DC application, review of the site parameters in the Design Control Document (DCD) Tier 1 and Chapter 2 of the DCD Tier 2<sup>1</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 Section 2.0.

The specific acceptance criteria and review procedures are contained in the referenced SRP sections.

## II. ACCEPTANCE CRITERIA

### Requirements

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

1. 10 CFR Part 100, as it relates to identifying and evaluating hydrological features of the site. The requirements to consider physical site characteristics in site evaluations are specified in 10 CFR 100.10(c) for applications before January 10, 1997, and in 10 CFR 100.20(c) for applications on or after January 10, 1997.
2. 10 CFR 100.23(d) sets forth the criteria to determine the siting factors for plant design bases with respect to seismically induced floods and water waves at the site.
3. 10 CFR Part 50, Appendix A, General Design Criterion (GDC) 2, for CP and OL applications, as it relates to consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area, with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated.
4. 10 CFR 52.17(a)(1)(vi), for ESP applications, and 10 CFR 52.79(a)(1)(iii), for COL applications, as they relate to identifying hydrologic site characteristics with appropriate consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area and with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated.

### SRP Acceptance Criteria

Specific SRP acceptance criteria acceptable to meet the relevant requirements of the NRC's regulations identified above are as follows for the review described in this SRP section. The SRP is not a substitute for the NRC's regulations, and compliance with it is not required. However, an applicant is required to identify differences between the design features, analytical techniques, and procedural measures proposed for its facility and the SRP acceptance criteria and evaluate how the proposed alternatives to the SRP acceptance criteria provide acceptable methods of compliance with the NRC regulations.

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

Appropriate sections of the following Regulatory Guide are used by the staff for the identified acceptance criteria:

Regulatory Guide 1.113 as it relates to selection of surface water models.

The staff uses best current practices to analyze groundwater transport of radioactive liquid effluents.

1. Alternate Conceptual Models: Alternate conceptual models of hydrology in the vicinity of the site are reviewed. The description of these alternate conceptual models should be sufficient to bound the hydrogeological conditions at the site that define the transport of radioactive liquid effluent in ground and surface water environments.
2. Pathways: The bounding set of plausible surface and subsurface pathways from the points of release are reviewed. The description of these pathways should provide sufficient information including data to ensure that the bounding set of plausible pathways that may result in the worst-case contamination are adequately identified. Estimates of physical parameters necessary to calculate the transport of liquid effluent from the points of release to the site of existing or known and likely future users should be described.
3. Characteristics that Affect Transport: Radionuclide transport characteristics of the groundwater environment with respect to existing and known and likely future users should be described. Estimates and bases for coefficients of dispersion, adsorption, groundwater velocities, travel times, gradients, permeabilities, porosities and potentiometric map or piezometric levels between the site and existing or known and likely future surface and groundwater users should be described and should be consistent with site characteristics and conform to the stipulation of 10 CFR 100.20(c)(3).
4. Consideration of Other Site-Related Evaluation Criteria: The applicant's assessment of the potential effects of site-proximity hazards, seismic, and non-seismic events on the radioactive concentration from the postulated tank failure related to accidental release of radioactive liquid effluents to ground and surface waters for the proposed plant site is needed. This assessment should be sufficient to demonstrate that the applicant's design bases appropriately account for these effects.
5. Branch Technical Position BTP 11-6 provides guidance in assessing a potential release of radioactive liquids following the postulated failure of a tank and its components, located outside of containment, and impacts of the release of radioactive materials at the nearest potable water supply, located in an unrestricted area, for direct human consumption or indirectly through animals, crops, and food processing.

#### Technical Rationale

The technical rationale for application of these acceptance criteria to the areas of review addressed by this SRP section is discussed in the following paragraphs:

1. Compliance with 10 CFR 100.10(c) and 10 CFR 100.20 (c) 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.

To satisfy the hydrological requirements of 10 CFR Part 100, the applicant's SAR should consider local geological and hydrological characteristics when determining the

acceptability of a nuclear power plant site. The geological and hydrological characteristics of the site may have a bearing on the potential consequences of radioactive effluents accidentally released from the facility. Special precautions should be planned if a reactor will be located at a site where a significant quantity of radioactive effluent could accidentally flow into nearby streams or rivers or find ready access to aquifers.

These criteria apply to SRP Section 2.4.13 because the reviewer evaluates site hydrologic characteristics with respect to the potential consequences of radioactive materials escaping from the facility. Radionuclide transport characteristics of ground and surface water environments are reviewed with respect to accidental releases in order to ensure that current and known and likely future users of ground and surface water are not adversely affected. Regulatory Guide 1.113 provides guidance in selecting and using surface water models for analyzing the flow field and dispersion of contaminants in surface waters.

Meeting this requirement provides assurance that when accidental releases of radioactive liquid effluents to ground and surface waters occur, their adverse impact on public health and safety will be minimized.

### III. REVIEW PROCEDURES

The reviewer will select material from the procedures described below, as may be appropriate for a particular case.

The procedures outlined below are used to review CP applications, ESP applications, and COL applications that do not reference an ESP to determine whether data and analyses for the proposed site meet the acceptance criteria given in Subsection II of this SRP section. For reviews of OL applications, these procedures are used to verify that the data and analyses remain valid and that the facility's design specifications are consistent with these data. As applicable, reviews of OLs and COLs include a determination on whether the content of technical specifications related to hydrology-related site characteristics are acceptable and whether the technical specifications reflect consideration of any identified unique conditions.

These review procedures are based on the identified SRP acceptance criteria. For deviations from these acceptance criteria, the staff should review the applicant's evaluation of how the proposed alternatives provide an acceptable method of complying with the relevant NRC requirements identified in Subsection II.

1. Alternate Conceptual Models: Whether simple or highly complex multi-dimensional models are employed, conservative or bounding simulations are achieved by representing the existing ground and surface water systems with conservative conceptual models populated with conservative model parameters. Use of conservative model data in an inappropriate or non-conservative conceptual model will not provide a conservative analysis. For example, an aquifer in a karst geology with solution channels may not be conservatively represented by a porous medium continuum conceptual model. A variety of alternative conceptual models, each based on the geological and hydrological characteristics of the site, needs to be envisioned as part of the complete conceptual model for a site, and the combination of ground and surface water conceptual models yielding the most adverse contaminant concentrations should be used in conservative or bounding analyses. Consideration should be given to preferential flow in groundwater resulting from the geology (e.g., karst geology), or from spatial variability in sediment structure (e.g., impermeable strata forcing groundwater to perch or move laterally and form seeps or springs). Regarding the mobility of

contaminants, consideration should be given to the potential for the inclusion of organic or inorganic complexants in stored liquids that are also released during an accident. Complexants can greatly alter the sorption characteristics normally associated with radionuclides, in some cases making them freely mobile in the ground water system. In surface water conceptual models, consideration should be given to the potential for stratified flow to restrict a contaminant release to a fraction of the stream flow or lake volume, and more severely impact the ecology and people at select locations defined by the stratification.

2. Pathways: The staff should make independent calculations of the transport capabilities and potential contamination pathways of the groundwater environment under accidental conditions with respect to existing users and known and likely future users. Special attention should be directed to proposed facilities with permanent dewatering systems to ensure that pathways created by those systems have been identified. The staff should, in consultation with the organization responsible for review of solid waste and liquid and gaseous effluents, choose the accident scenarios leading to the most adverse contamination of the groundwater or the surface water.

Analysis of the contamination should commence with the simplest models, using demonstrably conservative assumptions and coefficients. Dilutions and travel times (or, alternatively, concentrations directly) resulting from the preliminary analyses should be provided to the organization responsible for review of solid waste and liquid and gaseous effluents and to the organization responsible for review of radiation protection to carry out further dose calculations. Further analyses using progressively more realistic and less conservative modeling techniques, should be undertaken if the preliminary results are not acceptable.

Independent calculations should be made of liquid effluent transport for the surface pathways identified. For preliminary analysis, the staff should employ simplified calculational procedures or models. The analysis should be performed using demonstrably conservative coefficients and assumptions, and the physical conditions (such as lowest recorded river flow) likely to give the most adverse dispersion of the liquid effluent. The applicant's model assumptions and results should be compared with the staff's results to ensure that the results are comparably conservative. The estimation of liquid effluent dispersion should reflect potential future changes that might result from variations in use by known and likely future surface and groundwater users.

Concentrations of radionuclides in the body of water under consideration should be calculated by the organization responsible for review of radiation protection based on the staff's dispersion computations and with initial concentrations corresponding to the most adverse contamination of surface waters. If the concentrations computed by conservative simplified methods are not acceptable, more precise and less conservative models, such as those used for hydrothermal prediction and coefficients, should be employed by the staff.

The use of numerical models by the applicant should be reviewed with consideration given to whether standard and accepted practices have been followed. For example, there are ASTM publications on the simulation of subsurface fluid flow and contaminant transport that may be used as a guide (see ASTM references in the Reference section). In the performance of detailed model simulations, the review should determine if the applicant has followed a strategy such as that outlined in NUREG/CR-6805 and NUREG/CR-5621.

3. Characteristics that Affect Transport: Characteristics of both the surface and subsurface environments affect the mobility of contaminants. For instance, retardation of a subsurface contaminant is determined in part by the site-specific properties of the soil; the mixing of a contaminant in a lake can be limited by stratification. The properties used by the applicant to define the mobility and dilution of a contaminant need detailed consideration of site-specific properties unless the uncertainty in these properties is conservatively offset in the applicant's assessment. For instance, if the applicant finds any retardation of the contaminant relative to the velocity of water to be negligible, then detailed site-specific adsorption studies may not be necessary.
4. Consideration of Other Site-Related Evaluation Criteria: 10 CFR Part 100 describes site-proximity hazards, seismic, and non-seismic evaluation criteria for power reactor applications. Subpart A to 10 CFR Part 100 addresses the requirements for applications before January 10, 1997, and Subpart B is for applications on or after January 10, 1997. The staff's review should include evaluation of pertinent information to determine if these criteria are appropriately used in postulation of the release of radionuclides from a single tank for accidental releases of radioactive liquid effluent (see SRP Section 11.2 and BTP 11-6) in ground and surface waters at the proposed plant site.
5. Review Procedures Specific to 10 CFR Part 52 Application Type
  - A. Early Site Permit Reviews: Subpart A to 10 CFR Part 52 specifies the requirements and procedures applicable to the Commission's review of an ESP application for approval of a proposed site. Information required in an ESP application includes a description of the site characteristics and design parameters of the proposed site. The scope and level of detail of review of data parallel that used for a CP review.

In the absence of a compliance or adequate protection issue, a modification necessary based on updating early site permit-emergency preparedness information or a variance, 10 CFR 52.39 precludes the staff from imposing new site characteristics, design parameters, or terms and conditions on the early site permit at the COL stage. 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 on the early site permit.
  - B. Standard Design Certification Reviews: DC applications do not contain general descriptions of site characteristics because this information is site-specific and will be addressed by the COL applicant. However, pursuant to 10 CFR 52.47(a)(1), a DC applicant must provide site parameters postulated for the design. 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 SRP Section 2.0;

- iii. Pertinent parameters are stated in a site parameters summary table; and
  - iv. The applicant has provided a basis for each of the site parameters.
- C. Combined License Reviews: For a COL application referencing a certified standard design, NRC staff reviews that application to ensure that sufficient information is 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 provides sufficient information to demonstrate that the design of the facility falls within the site characteristics and design parameters specified in the early site permit as applicable to this SRP section. In accordance with 10 CFR 52.79(b)(2), should the design of the facility not fall within the site characteristics and design parameters, the application shall include a request for a variance from the ESP that complies with the requirements of 10 CFR 52.39 and 10 CFR 52.93.

In addition, long-term environmental changes and changes to the region resulting from human or natural causes may have introduced changes to the site characteristics that could be relevant to the design basis. In the absence of certain circumstances, such as a compliance or adequate protection issue, 10 CFR 52.39 precludes the staff from imposing new site characteristics, design parameters, or terms and conditions on the early site permit at the COL stage. Consequently, a COL application referencing an ESP need not include a re-investigation of the site characteristics that have previously been accepted in the referenced ESP. However, in accordance with 10 CFR 52.6, "Completeness and Accuracy of Information," the applicant or licensee is responsible for identifying changes of which it is aware, that would satisfy the criteria specified in 10 CFR 52.39. Information provided by the applicant in accordance with 10 CFR 52.6(b) will be addressed by the staff during the review of a COL application referencing an ESP or a DC.

For a COL application referencing either an ESP or DC or both, the staff should review the corresponding sections of the ESP and DC FSER to ensure that any early site permit conditions, restrictions to the DC, or COL action items identified in the FSERs are appropriately handled in the COL application.

#### IV. EVALUATION FINDINGS

The review should document the staff's evaluation of site characteristics against the relevant regulatory criteria. The evaluation should support the staff's conclusions as to whether the regulations are met. The reviewer should state what was done to evaluate the applicant's safety analysis report. The staff's evaluation may include verification that the applicant followed applicable regulatory guidance, performance of independent calculations, and/or validation of appropriate assumptions. The reviewer may state that certain information provided by the applicant was not considered essential to the staff's review and was not reviewed by the staff. While the reviewer may summarize or quote the information offered by the applicant in support of its application, the reviewer should clearly articulate the bases for the staff's conclusions.

The reviewer verifies that the applicant has provided sufficient information and that the review and calculations (if applicable) support conclusions of the following type to be included in the staff's SER.

1. Construction Permit, Operating License, and Combined License Reviews

The following statements should be preceded by a summary of the site characteristics and parameters used for the plant:

As set forth above, the applicant has presented and substantiated information relative to the accidental releases of radioactive liquid effluent in ground and surface waters 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 effects of accidental releases of radioactive liquid effluents in ground and surface waters on existing users and known and likely future users of ground and surface water resources in the vicinity of the site are acceptable and meet the requirements of 10 CFR Part 100 [10 CFR 100.10(c) or 10 CFR 100.20(c), as applicable], with respect to determining the acceptability of the site.

The staff finds that the applicant has considered the appropriate site phenomena in establishing the transport of radioactive liquid effluent in ground and surface waters that are important to safety of ground and surface water resources in the vicinity of the site. The staff has generally accepted the methodologies used to determine the potential effects of accidental releases of radioactive liquid effluents in ground and surface waters on existing users and known and likely future users of ground and surface water resources, as documented in safety evaluation reports for previous licensing actions. The staff concludes that the identified design bases meet the requirement(s) of 10 CFR 100.10(c) [or 10 CFR 100.20(c)], with respect to establishing the effects of accidental releases of radioactive liquid effluents in ground and surface waters.

2. Early Site Permit Reviews

The following statements should be preceded by a summary of the site characteristics and design parameters to be included in any ESP that might be issued for the proposed site:

As set forth above, the applicant has presented and substantiated sufficient information pertaining to the identification and evaluation of effects of accidental releases of radioactive liquid effluents in ground and surface waters on existing users and known and likely future users of ground and surface water resources in the vicinity of the proposed site. Section 2.4.13, "Accidental releases of Radioactive Liquid Effluents in Ground and Surface Waters," of NUREG-0800, Standard Review Plan, provides that the site safety analysis report should address the requirements of 10 CFR Part 100 as they relate to identifying and evaluating effects of accidental releases of radioactive liquid effluents in ground and surface waters on existing users and known and likely future users in the vicinity of 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 safety evaluation reports for



previous licensing actions. Accordingly, the staff concludes that the use of these methodologies results in site characteristics containing sufficient margin for the limited accuracy, quantity, and period of time in which the data have been accumulated. In view of the above, the site characteristics previously identified are acceptable for use in establishing the design bases for SSCs important to safety, as may be proposed in a COL or CP application.

Therefore, the staff concludes that the identification and consideration of the climatic 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 hydrology for inclusion in an ESP for the applicant's site, should one be issued, acceptable.

### 3. Design Certification Reviews

The following statement should be preceded by a list of the applicable site parameters used for the plant:

The NRC staff acknowledges that the applicant has selected the site parameters referenced above for plant design inputs (a subset of which is included as Tier 1 information) and agrees that they are representative of a reasonable number of sites that have been or may be considered for a COL application. Effects of accidental releases of radioactive liquid effluents in ground and surface waters on existing users and known and likely future users of ground and surface water resources in the vicinity of the site are site-specific and will be addressed by the COL applicant. This should include the provision of information sufficient to demonstrate that the design of the plant falls within the site parameters specified by the siting review.

## V. IMPLEMENTATION

The staff will use this SRP section in performing safety evaluations of DC applications and license applications submitted by applicants pursuant to 10 CFR Part 50 or 10 CFR Part 52. Except when the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the staff will use the method described herein to evaluate conformance with Commission regulations.

The provisions of this SRP section apply to reviews of applications submitted six months or more after the date of issuance of this SRP section, unless superseded by a later revision.

## VI. REFERENCES

In addition to the following references describing methods and techniques of evaluation, methods, techniques, and data published by Federal, State, and other agencies and organizations may be used as available.

1. 10 CFR Part 100, "Reactor Site Criteria."
2. ASTM 2004, "Standard Guide for Application of a Ground-Water Flow Model to a Site-Specific Problem," ASTM Designation: D 5447-04.

3. ASTM 2002, "Standard Guide for Conducting a Sensitivity Analysis of a Ground-Water Flow Model Application," ASTM Designation: D 5611-94.
4. ASTM 2003, "Standard Guide for Developing Conceptual Site Models for Contaminated Sites," ASTM Designation: D 1689-95.
5. ASTM 2000, "Standard Guide for Subsurface Flow and Transport Modeling," ASTM Designation: D 5880-95.
6. ASTM 2002, "Standard Guide for Comparing Ground-Water Flow Model Simulations to Site-Specific Information," ASTM Designation: D 5490-93.
7. ASTM 2002, "Standard Guide for Defining Boundary Conditions in Ground-Water Flow Modeling," ASTM Designation: D 5609-94.
8. ASTM 2002, "Standard Guide for Defining Initial Conditions in Ground-Water Flow Modeling," ASTM Designation: D 5610-94.
9. Neuman S.P. and P.J. Wierenga, 2003, "A Comprehensive Strategy of Hydrogeologic Modeling and Uncertainty Analysis for Nuclear Facilities and Sites," NUREG/CR-6805.
10. Cole, C.R. et. al., 1998, "Groundwater Models in Support of NUREG/CR-5512," NUREG/CR-5621.
11. U.S. EPA 1994, PB 94-205804 EPA 402-R-94-012, "A Technical Guide to Ground-Water Model Selection at Sites Contaminated with Radioactive Substances."

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#### **PAPERWORK REDUCTION ACT STATEMENT**

The information collections contained in the Standard Review Plan are covered by the requirements of 10 CFR Part 50 and 10 CFR Part 52, and were approved by the Office of Management and Budget, approval number 3150-0011 and 3150-0151.

#### **PUBLIC PROTECTION NOTIFICATION**

The NRC may not conduct or sponsor, and a person is not required to respond to, a request for information or an information collection requirement unless the requesting document displays a currently valid OMB control number.

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