



## U.S. NUCLEAR REGULATORY COMMISSION

# STANDARD REVIEW PLAN

## 2.2.3 EVALUATION OF POTENTIAL ACCIDENTS

### REVIEW RESPONSIBILITIES

**Primary** - Organization responsible for the review of man-made site hazards

**Secondary** - None

### I. AREAS OF REVIEW

Chapter 2 of the 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 applicant's identification and evaluation of potential accident situations in the vicinity of the plant to determine the completeness of the applicant's submittal and the bases upon which the design did or did not accommodate these potential accidents. The review considers the applicant's probability analyses of potential accidents involving hazardous materials or activities on site and in the vicinity of the proposed site to confirm that appropriate data and analytical models have been used.

This SRP section applies to reviews performed for each of the above mentioned types of applications. The review covers the following specific areas:

1. Hazards associated with nearby industrial activities, such as manufacturing, processing, or storage facilities.
2. Hazards associated with nearby military activities, such as military bases, training areas, or aircraft flights.
3. Hazards associated with nearby transportation routes (aircraft routes, highways, railways, navigable waters, and pipelines).
4. The following principal types of hazards will be considered with respect to each of the above areas of review:

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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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- i. Toxic vapors or gases and their potential for incapacitating nuclear plant control room operators
  - ii. Overpressure resulting from explosions or detonations involving materials such as munitions, industrial explosives, or explosive vapor clouds resulting from the atmospheric release of gases (such as propane and natural gas or any other gas) with a potential for ignition and explosion
  - iii. Missile effects attributable to mechanical impacts, such as aircraft impacts, explosion debris, and impacts from waterborne items such as barges
  - iv. Thermal effects attributable to fires
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.

For an early site permit (ESP) application, the scope of the review of identified potential accidents includes the evaluation of the need to consider them in the design of a nuclear power plant or plants of a specified type or, falling within a plant parameter envelope (PPE) that might be constructed on the proposed site (see SRP Section 2.2.1-2.2.2). For construction permit (CP) or combined license (COL) applications, the scope of the review includes the evaluation of man-made site hazards that have been identified as design-basis accidents with respect to safety-related structures, systems, and components (SSCs) of a specific plant design to be constructed and/or operated on the site. For design certification (DC) applications, the scope of the review includes the evaluation of man-made site hazards that have been identified as design-basis events and their effects on specific SSCs.

### Review Interfaces

Other SRP sections interface with this section as follows:

1. For CP, ESP, COL, and DC applications potential offsite accidents on, or in the vicinity of, the site which could affect control room habitability (e.g., release of toxic gases, asphyxiants) and will be accommodated on a design basis, as determined in the SRP Section 2.2.3 review, will be addressed as part of the SRP Section 6.4 review in accordance with TMI-Related Requirement III.D.3.4 of NUREG-0694.
2. For CP, ESP, COL applications, the identification and characterization of industrial, military, and transportation for application facilities and routes in the vicinity of the site will be reviewed under SRP Section 2.2.1-2.2.2.
3. For CP, ESP, COL applications, the aircraft hazards will be addressed under SRP Section 3.5.1.6.
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 an ESP or in COL applications referencing an ESP is also performed under Section 2.0.

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

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. For CP applications the acceptance criteria are based on 10 CFR 100.20(b)<sup>2</sup> which states as they relate to the factors to be considered in the evaluation of sites, which indicate the nature and proximity of man related hazards (e.g. airports, dams, transportation routes, military and chemical facilities) that must be evaluated to establish whether the plant design can accommodate commonly occurring hazards, and whether the risk of other hazards is very low. The acceptance criteria are also based on 10 CFR 50.34(a)(1)(i) as it relates to the site evaluation factors identified in 10 CFR Part 100.
2. For ESP applications, the acceptance criteria are based on meeting the relevant requirements of 10 CFR 52.17(a)(vii) as they relate to the factors to be considered in the evaluation of sites which require the location and description of any industrial, military, or transportation facilities and routes, and the requirements of 10 CFR 52.17(a)(ix) as they relate to compliance with 10 CFR Part 100.
3. For COL applications, the acceptance criteria are based on meeting the relevant requirements of CFR 52.79(a)(1)(iv) as they relate to the factors to be considered in the evaluation of sites, which require the location and description of industrial, military, or transportation facilities and routes, and the requirements of 10 CFR 52.79(a)(1)(vi) as they relate to compliance with 10 CFR Part 100.

### 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.

#### 1. Event Probability

The identification of design-basis events resulting from the presence of hazardous materials or activities in the vicinity of the plant or plants of specified type (or, for ESP applications not referencing DC, falling within a PPE) is acceptable if all postulated types of accidents are included for which the expected rate of occurrence of potential exposures resulting radiological dose in excess of the 10 CFR 50.34(a)(1) as it relates to the requirements of 10 CFR Part 100 is estimated to exceed the NRC staff objective of an order of magnitude of  $10^{-7}$  per year.

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<sup>2</sup> For CP applications before January 10, 1997, the equivalent requirements are identified in 10 CFR 100.10.

If data are not available to make an accurate estimate of the event probability (see Technical Rationale 2 below), an expected rate of occurrence of potential exposures resulting radiological dose in excess of the 10 CFR 50.34(a)(1) as relates to the requirements of 10 CFR Part 100, by an order of magnitude of  $10^{-6}$  per year is acceptable if, when combined with reasonable qualitative arguments, the realistic probability can be shown to be lower.

## 2. Design-Basis Events

The effects of design-basis events have been adequately considered, in accordance with 10 CFR 100.20(b), if analyses of the effects of those accidents on the safety-related features of the plant or plants of specified type (or, for ESP applications, falling within a PPE) have been performed and measures have been taken (e.g., hardening, fire protection) to mitigate the consequences of such events.

## 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. Offsite hazards that have the potential to cause onsite accidents leading to the release of significant quantities of radioactive fission products, and thus pose an undue risk of public exposure, should have a sufficiently low probability of occurrence and should fall within the scope of the low-probability-of-occurrence required by 10 CFR 100.20(b) based on criterion of 10 CFR 50.34(a)(1) as it relates to the requirements of 10 CFR Part 100.
2. Data are often not available to enable the accurate calculation of probabilities because of the low probabilities associated with the events under consideration. Accordingly, the expected rate of occurrence of potential exposures in excess of the 10 CFR 50.34 (a)(1) requirements as they relate to the requirements of 10 CFR Part 100 guidelines by an order of magnitude of  $10^{-6}$  per year is acceptable if, when combined with reasonable qualitative arguments, the realistic probability can be shown to be lower.

## 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 is 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. The staff should estimate the probability of occurrence of the initiating events leading to potential consequences that exceed the 10 CFR 50.34(a)(1) exposure guidelines as it relates to the requirements of 10 CFR Part 100 exposure guidelines by using assumptions that are as representative of the specific site as is practicable. Because of the difficulty of assigning accurate numerical values to the expected rate of unprecedented potential hazards generally considered in this SRP section, judgment must be used to assess the acceptability of the overall risk presented. Chapter 2 of Regulatory Guide 1.70 offers specific guidance regarding offsite hazards.
2. The staff may need to consult with, obtain specific data from, or request other technical support from NRC organizations with expertise in areas such as mechanical, chemical, or civil engineering; statistical analyses; or plant systems.
3. The staff will review the applicant's probability calculations and perform an independent probability analysis if the potential hazard is considered sufficiently significant to affect the ability of the site to be licensed or is important to the identification of design-basis events.
4. The staff will identify and evaluate all stochastic variables that affect the occurrence or severity of the postulated event. The staff will determine if these variables are independent or conditioned by other variables.
5. The staff should test probabilistic models against all available information. If the model or any portion of it, by simple extension, can be used to predict an observable accident rate, this test should be performed.
6. The staff will review the design parameters (e.g., overpressure) and physical phenomena (e.g., gas concentration) selected by the applicant for each design-basis event to ascertain that the values are comparable to those used in previous analyses and found to be acceptable by the staff.
7. The staff will evaluate each design-basis event to confirm that the design adequately accommodates the effects of the event on the safety features of the plant.
8. The staff will review accidents involving the release of smoke, flammable or nonflammable gases, or toxic-chemical-bearing clouds if the accidents are considered to be design-basis events. Safety Analysis Report (SAR) Section 6.4 should evaluate the effects of these accidents on control room habitability, and SAR Chapter 9 should assess the effects on the operation of diesel generators and other safety-related equipment. If the design details necessary for these evaluations are not available at the ESP stage, the evaluations will need to be performed at the COL stage.
9. The staff should give special attention to the review of standardized designs that propose criteria involving individual numerical probability criteria for individual classes of external man-made hazards. In such instances, the reviewer should establish that the envelope also includes an overall criterion that limits the aggregate probability of exceeding design criteria associated with all of the identified external man-made hazards. Similarly, special attention should be given to the review of a site if several man-made hazards are identified, but none of them individually has a probability exceeding the acceptance criteria stated herein. The objective of this special review should be to ensure that the aggregate probability of an outcome that may lead to unacceptable plant damage meets the acceptance criteria of Subsection II of this SRP section.

(A hypothetical example is a situation in which (1) the probability of shock wave overpressure greater than design overpressure is about  $10^{-7}$  per reactor year from accidents at a nearby industrial facility and (2) approximately equal probabilities exist of exceeding design pressure from railway accidents, highway accidents, and shipping accidents. Individually, each probability may be judged acceptably low. However, the aggregate probability may be assessed as sufficiently great that additional design features are warranted.)

10. 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 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 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 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. Pursuant to 10 CFR 52.47(a)(1), a DC applicant must provide postulated site parameters for the design. However, the evaluation of Potential Accidents in the site vicinity is not applicable for their area of review.

C. Combined License Reviews

For a COL application referencing a certified standard design, NRC staff reviews the 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. Since there are no site parameters included in the DC related to this SRP section, this demonstration is not applicable here.

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, the staff's review of a COL application referencing an ESP should 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 with respect 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 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 identified potential accidents related to the presence of hazardous materials or activities in the site vicinity that could affect a nuclear power plant or plants of the specified type that might be constructed on the proposed site, has appropriately determined those that should be considered as design-basis events, and has demonstrated that the plant is adequately protected and can be operated with an acceptable degree of safety with regard to the design-basis accidents. The staff has reviewed the information provided and, for the reasons given above, concludes that the applicant has established that the construction and operation of a nuclear power plant or plants of the specified type on the proposed site location is acceptable to meet the requirements of 10 CFR 100.20(b) and 10 CFR 50.34(a)(1)(i) for CPs, and 10 CFR 52.79(a)(1)(iv) and 10 CFR 2.79(a)(1)(vi) for COLs for compliance with respect to determining the acceptability of the site.

##### 2. Early Site Permit Reviews

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

As set forth above, the applicant has identified and evaluated potential accidents related to the presence of hazardous materials or activities in the site vicinity that could affect a nuclear power plant or plants that might be constructed on the

proposed site, and from these the applicant has selected those which should be considered as design-basis events at the combined license stage. The staff has reviewed the information provided and, for the reasons given above, concludes that the applicant has established site characteristics and design parameters acceptable to meet the requirements of 10 CFR 52.17(a)(vii) and 10 CFR 52.17(a)(ix) for compliance evaluation.

### 3. Design Certification Reviews

The evaluation of potential accidents is site-specific and will be addressed by the COL applicant.

## 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 100, "Reactor Site Criteria," Subpart A, "Evaluation Factors for Stationary Power Reactor Site Applications Before January 10, 1997 and for Testing Reactors," Section 100.10, "Factors To Be Considered When Evaluating Sites."
2. 10 CFR Part 100, "Reactor Site Criteria," Subpart B, "Evaluation Factors for Stationary Power Reactor Site Applications On or After January 10, 1997," Section 100.20, "Factors To Be Considered When Evaluating Sites."
3. 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants," Subpart A, "Early Site Permits," Section 52.17, "Contents of Applications."
4. 10 CFR Part 100, "Reactor Site Criteria," Subpart B, "Evaluation Factors for Stationary Power Reactor Site Applications On or After January 10, 1997," Section 100.21, "Non-Seismic Siting Criteria."
5. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."
6. 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."
7. Regulatory Guide 1.70, Revision 3, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants," November 1978.
8. Affidavit of Jacques B.J. Read before the Atomic Safety and Licensing Board in the Matter of Skagit Nuclear Power Project, Units 1 and 2, July 15, 1976, Dockets STN 50-522 and STN 50-523.
9. Atomic Safety and Licensing Board, Supplemental Initial Decision in the Matter of Hope Creek Generating Station, Units 1 and 2, March 28, 1977, Dockets 50-354 and 50-355.



10. Section 2, Supplement 2 to the Floating Nuclear Plant Safety Evaluation Report, September 1976, Docket STN 50-437.
11. NRC Staff Safety Evaluation Report (July 1987), in Electric Power Research Institute Report NP-5283-SR-A, "Guidelines for Permanent BWR Hydrogen Water Chemistry Installation—1987 Revision."
12. Safety Evaluation Relating to the Operation of a Mobile Volume Reduction System, Commonwealth Edison Company, Dresden Station, Unit Nos. 2 and 3, August 13, 1986, Dockets 50-237 and 50-249.

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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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