



U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

3.5.1.4 MISSILES GENERATED BY TORNADOES AND EXTREME WINDS

REVIEW RESPONSIBILITIES

Primary - Organization responsible for the review of the protection of structures, systems and components from missiles

Secondary - None.

I. AREAS OF REVIEW

The specific areas of review are as follows:

1. The staff reviews and evaluates the applicant's assessment of possible hazards attributable to missiles generated by high-speed winds, such as tornado, hurricane, and any other extreme winds identified in Section 3.5 of the safety analysis report (SAR), to ensure that the applicant has chosen and properly characterized appropriate design-basis missiles, and to ensure that the effects caused by those missiles are acceptable. Currently, missiles generated by design-basis tornadoes are considered in the plant design bases for all plants. Missiles from hurricane and extreme winds are considered on a case-by-case basis when they are identified.
2. Inspection, Test, Analysis, and Acceptance Criteria (ITAAC). For design certification (DC) and combined license (COL) reviews, the applicant's proposed information on the ITAAC associated with the systems, structures, and components (SSCs) related to this Standard Review Plan (SRP) section is reviewed in accordance with SRP Section 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria - Design Certification." The staff recognizes that the review of ITAAC is performed after review of the rest of this portion of the application against acceptance criteria contained in this SRP section.

Rev. 3 - [Month] 2007

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 the Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)." Not all sections of the standard format have a corresponding review plan section. The SRP sections applicable to a combined license application for a new light-water reactor (LWR) will be based on Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," until the SRP itself is updated.

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.

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Furthermore, the ITAAC are reviewed to assure that all SSCs in this area of review are identified and addressed as appropriate in accordance with SRP Section 14.3.

3. COL Action Items and Certification Requirements and Restrictions. COL action items may be identified in the NRC staff's final safety evaluation report (FSER) for each certified design to identify information that COL applicants must address in the application. Additionally, DCs contain requirements and restrictions (e.g., interface requirements) that COL applicants must address in the application. For COL applications referencing a DC, the review performed under this SRP section includes information provided in response to COL action items and certification requirements and restrictions pertaining to this SRP section, as identified in the FSER for the referenced certified design.

Review Interfaces

The listed SRP sections interface with this section as follows:

1. Reviews of those SSCs that should be protected against missile impact is performed under Standard Review Plan (SRP) Section 3.5.2.
2. The acceptability of the design analysis, procedures, and criteria used to establish the ability of seismic Category I structures and/or missile barriers to withstand the effects of tornado missiles is reviewed under SRP Section 3.5.3.
3. The acceptability of the design-basis tornado parameters, including maximum wind speed is reviewed under SRP Section 2.3.1.

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 52.47(a)(1)(vi), as it relates to ITAAC (for design certification) sufficient to assure that the SSCs in this area of review will operate in accordance with the certification.
2. 10 CFR 52.97(b)(1), as it relates to ITAAC (for combined licenses) sufficient to assure that the SSCs in this area of review have been constructed and will be operated in conformity with the license and the Commission's regulations.

The acceptability of the assessment as described in the applicant's SAR is based on compliance with 10 CFR Part 50 Appendix A General Design Criteria (GDC) 2 and 4, as they relate to the capability of SSCs important to safety to withstand the effects of tornadoes and other natural phenomena. Acceptance is based on meeting the guidelines in Regulatory Guides 1.76 and 1.117.

The method of identifying appropriate design-basis missiles generated by natural phenomena shall be consistent with the acceptance criteria defined for the evaluation of potential accidents from external sources in SRP Section 2.2.3. Other methodologies used by licensees and applicants with appropriate rationale may be acceptable on a case-by-case basis.

SRP Acceptance Criteria

Specific SRP acceptance criteria acceptable to meet the relevant requirements of the NRC's regulations identified above are described below. The SRP is not a substitute for the NRC's regulations, and compliance with it is not mandatory. 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. Regulatory Guide 1.76 describes acceptable parameters for the design-basis tornado.
2. The design-basis tornado-generated missile spectrum in Regulatory Guide 1.76 is acceptable for the design of nuclear power plants.

Technical Rationale

The technical rationale for application of these requirements to reviewing this SRP section is discussed in the following paragraphs:

1. GDC 2 establishes requirements regarding the ability of SSCs important to safety to withstand a tornado without the loss of capability to perform their safety functions. Application of GDC 2 ensures that the chosen design basis reflects the most severe tornadoes historically reported for the site and surrounding region. A nuclear power plant must remain in a safe condition in the event of the most severe tornadoes that can reasonably be predicted. Designing a nuclear power plant to withstand the design-basis maximum tornado wind speed and tornado missiles discussed in Regulatory Guide 1.76 ensures that SSCs important to safety will be capable of performing their safety function, and there will be no undue risk to the health and safety of the public in the event of the most severe tornado conditions. Evolutionary reactors should be designed based on regional wind speeds corresponding to strike probability of 10^{-7} per year, as defined in Regulatory Guide 1.76.

2. GDC 4 establishes requirements regarding the ability of SSCs important to safety to be protected from dynamic effects, including the effects of missiles, from events and conditions outside the nuclear unit. Tornadoes are dynamic events originating outside the nuclear unit; therefore, this criterion is applicable to the assessment of any missiles generated by tornadoes. For safety considerations, nuclear power plant design must consider the impact of direct action of tornado wind and the moving ambient pressure field, as well as the impact of tornado-generated missiles. Protection from a spectrum of missiles exemplified by missiles with critical characteristics provides assurance that the necessary SSCs will be available to mitigate the potential effects of a tornado on plant safety. The selection of SSCs to be protected is based upon the methods in Regulatory Guide 1.117 and maintaining offsite exposures below an appropriate fraction of the offsite dose guidelines of 10 CFR Part 100.

III. REVIEW PROCEDURES

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

For each area of review specified in subsection I of this SRP section, the review procedure is identified below. These review procedures are based on the identified SRP acceptance criteria. For deviations from these specific acceptance criteria, the staff should review the applicant's evaluation of how the proposed alternatives to the SRP criteria provide an acceptable method of complying with the relevant NRC requirements identified in subsection II.

1. For reviews of construction permits (CP), the following procedures are used to determine that the design criteria and bases and the preliminary design, as set forth in the preliminary safety analysis report, meet the acceptance criteria given in Subsection II.
2. For reviews of operating licenses (OL) applications, the following procedures are utilized to verify that the initial design criteria and bases have been appropriately implemented in the final design, as set forth in the final safety analysis report.
3. For reviews of DC and COL under 10 CFR Part 52, the reviewer should follow the above procedures to verify that the design set forth in the safety analysis report, and if applicable, site interface requirements meet the acceptance criteria. For DC applications, the reviewer should identify necessary COL action items. With respect to COL applications, the scope of the review is dependent on whether the COL applicant references a DC, an ESP or other NRC-approved material, applications, and/or reports.

After this review, SRP Section 14.3 should be followed for the review of Tier 1 information for the design, including the postulated site parameters, interface criteria, and ITAAC.

Upon request from the primary reviewer, the interface review branch will provide input for the areas of review stated in Subsection I. The primary reviewer obtains and uses such input as required to ensure that this review procedure is complete.

The judgment on areas to be given attention and emphasis in the review is to be based on an inspection of the material presented to see whether it is similar to that recently reviewed on other plants and whether items of special safety significance are involved.

1. The SAR is reviewed for the identification of the design-basis natural phenomena that could possibly generate missiles. Postulated missiles are reviewed for proper characterization.
2. Regulatory Guide 1.76 provides guidance on the definition and characterization of the design-basis tornado as discussed in Subsection II.
3. The design-basis natural phenomena for the site are reviewed with respect to the potential for missile generation. For phenomena with greater potential for missile generation than the design-basis tornado (i.e., the probability per year of damage to the total of all SSCs important to safety is 10^{-7} per year or greater), appropriate design-basis missiles are proposed.
4. All plants are required to be designed to protect safety-related equipment against damage from missiles which might be generated by the design-basis tornado for that plant. The reviewer verifies that the applicant has postulated missiles that include at least (1) a massive high-kinetic-energy missile that deforms on impact, (2) a rigid missile to test penetration resistance, and (3) a small rigid missile of a size sufficient to just pass through any openings in protective barriers. Acceptable missiles and their associated wind speeds are identified in Table 2 of Regulatory Guide 1.76.

IV. EVALUATION FINDINGS

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. The basis for acceptance in the staff review is the conformance of the applicants' design criteria for the protection from the effects of natural phenomena to the Commission's regulations as set forth in the General Design Criteria, and to applicable regulatory guides and national standards.
2. The staff concludes that the assessment of possible hazards attributable to missiles generated by the design-basis tornado and other extreme winds is acceptable and conforms to the requirements of GDC 2 and 4, as they relate to tornado-generated missiles. This conclusion is based on the applicant having met the requirements of GDC 2 and 4 by meeting the guidance of (1) Regulatory Guide 1.76, Positions C-1 through C-3, and (2) Regulatory Guide 1.117, Positions C-1 through C-3.

For DC and COL reviews, the findings will also summarize (to the extent that the review is not discussed in other SER sections) the staff's evaluation of the ITAAC, including design acceptance criteria, as applicable, and interface requirements and combined license action items relevant to this SRP section.

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 docketed six months or more after the date of issuance of this SRP section, unless superceded by a later revision.

VI. REFERENCES

1. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."
2. 10 CFR Part 50, Appendix A, General Design Criterion 4, "Environmental and Dynamic Effects Design Bases."
3. Regulatory Guide 1.76, "Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants."
4. Regulatory Guide 1.117, "Tornado Design Classification."

PAPERWORK REDUCTION ACT STATEMENT

The information collections contained in the draft 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.

SRP Section 3.5.1.4 Description of Changes

This SRP section affirms the technical accuracy and adequacy of the guidance previously provided in (Draft) Revision 3, April 1996 of this SRP. See ADAMS accession number ML051670296.

In addition this SRP section was administratively updated in accordance with NRR Office Instruction, LIC-200, Revision 1, "Standard Review Plan (SRP) Process." The revision also adds standard paragraphs to extend application of the updated SRP section to prospective submittals by applicants pursuant to 10 CFR Part 52.

The technical changes are incorporated in Revision 3, dated [Month] 2007:

Review Responsibilities - Reflects changes in review branches resulting from reorganization and branch consolidation. Change is reflected throughout the SRP.

I. AREAS OF REVIEW

1. Added references to Inspection, Testing, Analysis, and Acceptance Criteria (ITAAC) for DC and COL application review.
2. Added references to COL Action Items and Certification Requirements and Restrictions.
3. Deleted references to floods and other natural phenomena in order to conform with the revised title.

II. REVIEW INTERFACES

1. Revised the format of the review interfaces.

III. ACCEPTANCE CRITERIA

1. Added Acceptance Criteria for ITAAC for Design Certification and COL applications.
2. Added acceptable methods for compliance with the NRC regulations. Added that Regulatory Guide 1.76 provides guidance for the definition and characterization of the design-basis tornado that could potentially generate missiles.

IV. REVIEW PROCEDURES

1. Added reference to review procedures for reviewing DC and COL under Part 52.
2. Added that Regulatory Guide 1.76 provides guidance for the definition and characterization of the design-basis tornado that could potentially generate missiles.
3. Clarified that appropriate design-basis missiles should be proposed for phenomena with greater potential for missile generation than the design-basis tornado.

(i.e., the probability per year of damage to the total of all SSCs important to safety is 10^{-7} per year or greater).

4. Eliminated the listing of Spectrum I missiles, and referenced Table 2 of Regulatory Guide 1.76.
5. Eliminated reference to Spectrum II, Spectrum A, and Spectrum B missiles.
6. Eliminated the April 1996 draft version reference to inspections, tests, analysis, and acceptance criteria (ITAAC) for SDC application reviews. The ITAAC associated with this specific issue would be associated with plant design/construction, which is reviewed in other SRP sections.

IV. EVALUATION FINDINGS

1. Added reference to review procedures for reviewing DC and COL under Part 52.
2. Deleted references to floods and other natural phenomena in order to conform with the revised title.
3. Eliminated the April 1996 draft version reference to inspections, tests, analysis, and acceptance criteria (ITAAC) for SDC application reviews. The ITAAC associated with this specific issue would be associated with plant design/construction, which is reviewed in other SRP sections.

V. IMPLEMENTATION

1. Added that this SRP section applies to reviews under both 10 CFR Part 50 and 10 CFR Part 52.

VI. REFERENCES

1. Eliminated the references to NBSIR 76-1050 and WASH-1300 because Regulatory Guide 1.76 has been updated (Revision 1) to provide the basis for the staff's design-basis tornado wind speeds and missile spectra.
2. Added reference for 10 CFR Part 52.47(b)(1) and 52.80(a). [TO BE VERIFIED]