



U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

3.5.2 STRUCTURES, SYSTEMS, AND COMPONENTS TO BE PROTECTED FROM EXTERNALLY-GENERATED MISSILES

REVIEW RESPONSIBILITIES

Primary - Organization responsible for the review of plant design for protection of structures, systems, and components from internal and external hazards

Secondary - None

I. AREAS OF REVIEW

The review of the structures, systems, and components (SSCs) to be protected from externally-generated missiles includes all plant site safety-related SSCs supporting the reactor facility, such elements as essential service water intakes, buried components (e.g., essential service water piping, storage tanks), and structure access openings and penetrations.

The specific areas of review are as follow:

1. The functional operations or performance requirements for SSCs are reviewed for compliance with 10 CFR 50, Appendix A, General Design Criteria (GDCs) 2 and 4 requirements and SSCs necessary for the safe shutdown of the reactor facility and SSCs, the failure of which could result in a significant release of radioactivity, are identified.

Revision 3 - March 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 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.

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2. Safety-related SSCs are reviewed for their capability to perform functions required to attain and maintain safe shutdown conditions during normal or accident conditions, mitigating the consequences of an accident, or preventing the occurrence of an accident, assuming impact from externally-generated missiles.
3. If the turbine is not properly oriented, the protection of SSCs from the effects of turbine missiles is reviewed. Based on their relation to safety, structures or areas of structures, systems or portions of systems, and components require protection from externally-generated missiles if they could prevent an intended safety function or if, as a result of missile impact on a nonsafety-related SSC, its failure could affect the intended safety function of a safety-related SSC.
4. Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC). For design certification (DC) and combined license (COL) reviews, the staff reviews the applicant's proposed ITAAC associated with the structures, systems, and components (SSCs) related to this SRP section in accordance with SRP Section 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria." The staff recognizes that the review of ITAAC cannot be completed until after the rest of this portion of the application has been reviewed against acceptance criteria contained in this SRP section. Furthermore, the staff reviews the ITAAC to ensure that all SSCs in this area of review are identified and addressed as appropriate in accordance with SRP Section 14.3.
5. COL Action Items and Certification Requirements and Restrictions. For a DC application, the review will also address COL action items and requirements and restrictions (e.g., interface requirements and site parameters).

For a COL application referencing a DC, a COL applicant must address COL action items (referred to as COL license information in certain DCs) included in the referenced DC. Additionally, a COL applicant must address requirements and restrictions (e.g., interface requirements and site parameters) included in the referenced DC.

Review Interfaces

Other SRP sections interface with this section as follows:

1. Review of specific missile sources and the protection needed is performed under SRP sections 3.5.1.4, 3.5.1.5, and 3.5.1.6.
2. Review of the acceptability of barriers and structures designed to withstand externally-generated missiles is performed under SRP section 3.5.3.

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. General Design Criterion (GDC) 2, "Design bases for protection against natural phenomena," of Appendix A to 10 CFR Part 50, requires structures, systems, and components (SSCs) important to safety shall be designed to withstand the effects of natural phenomena such as tornadoes and hurricanes without loss of capability to perform their safety functions.
2. GDC 4, "Environmental and dynamic effects design bases," of Appendix A to 10 CFR Part 50, requires that SSCs important to safety be appropriately protected against the effects of missiles that may result from events and conditions outside the nuclear power unit.
3. 10 CFR 52.47(b)(1), which requires that a DC application contain the proposed inspections, tests, analyses, and acceptance criteria (ITAAC) that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a plant that incorporates the design certification is built and will operate in accordance with the design certification, the provisions of the Atomic Energy Act, and the NRC's regulations.
4. 10 CFR 52.80(a), which requires that a COL application contain the proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the combined license, the provisions of the Atomic Energy Act, and the NRC's regulations.

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.

Acceptance is based on the design meeting the guidelines of Regulatory Guide (RG) 1.13 as to the capability of spent fuel pool systems and structures to withstand the effects of externally-generated missiles and to prevent missiles from contacting stored fuel assemblies; RG 1.27 as to the capability of the ultimate heat sink and connecting conduits to withstand the effects of externally-generated missiles; RG 1.115 as to the protection of important

safety-related SSCs from the effects of turbine missiles; and RG 1.117 as to the protection of important safety-related SSCs from the effects of tornado missiles.

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. GDC 2 establishes requirements for the capability of important safety-related SSCs to withstand natural phenomena without the loss of their safety functions. This criterion applies directly to the assessment of SSCs as to external missiles generated by natural phenomena. Application of GDC 2 determines whether the chosen design basis reflects the importance of the safety functions to be performed. RG 1.13 describes a method acceptable to the NRC staff for protecting spent fuel pool systems and structures from externally-generated missiles and preventing mechanical damage to the spent fuel by designing the facility to prevent externally-generated missiles from contacting the spent fuel within the pool. Identification of systems and structures that prevent mechanical damage to the spent fuel properly designates SSCs to be protected from externally-generated missiles. RG 1.27 describes a method acceptable to the NRC staff for protecting the ultimate heat sink and its conduits from the effects of externally-generated missiles. The ultimate heat sink constitutes the source of water supply necessary to safely operate, shut down, and cool down a nuclear plant. Because the ultimate heat sink is important to safety, its important safety-related SSCs should be identified and their safety functions secured. Protecting the ultimate heat sink SSCs important to safety from externally-generated missiles ensures that the system can perform its safety functions. Protecting important safety-related SSCs from externally-generated missiles secures such safety functions of those SSCs as maintenance of the integrity of the spent fuel pool, mitigation of the potential release of fission products, and preservation of the capability of the ultimate heat sink to maintain the plant in a safe condition.
2. GDC 4 establishes requirements for the protection of important safety-related SSCs from dynamic effects, including the effects of missiles from events and conditions outside the nuclear unit. Dynamic events originating outside the nuclear unit have the potential to generate missiles; therefore, this criterion applies directly to the assessment of important safety-related SSCs that may be affected. RG 1.115 describes methods acceptable to the NRC staff for identification and protection of important safety-related SSCs from the effects of missiles generated by turbine failure. Cumulative failure data for conventional plants indicate that the protection of important safety-related SSCs from the effects of missiles is an appropriate safety consideration. RG 1.117 describes a method acceptable to the NRC staff for determining which SSC should be protected from external missiles generated by tornados. The selection of SSCs to be protected is made to keep offsite exposures from exceeding an appropriate fraction of 10 CFR Part 100 offsite dose guidelines. Limits based upon an appropriate fraction ensures protection for events not as severe as design-basis events but with a higher probability of occurrence. Protecting important safety-related SSCs from externally-generated missiles secures the integrity of the reactor coolant pressure boundary, the capability to shut down the reactor and maintain it in a shutdown condition, and the capability to prevent significant uncontrolled release of radioactivity.

III. REVIEW PROCEDURES

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

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.

The procedures set forth below are used during the construction permit review in determining whether the applicant's list of SSCs that require protection from externally-generated missiles is complete and meets the acceptance criteria in subsection II of this SRP section. For operating license applications, the procedures are used to verify whether the construction permit stage list continues to be complete and applicable or has been supplemented appropriately.

1. The first step in the review is to verify the identification of the safety-related SSCs and whether they are safety-related in their entirety or only in portions. The safety category is determined by evaluation of the facility SSCs as to their necessity in achieving and maintaining safe reactor shutdown or for performing accident prevention or mitigation functions. The safety analysis report information on SSC design bases, design criteria, descriptions and safety evaluations together with the system and component characteristic tables and safety classification tables are reviewed for SSC safety functions. Generally, the safety functions of the SSCs in various designs remain essentially the same; however, the location or arrangement of the SSCs and the methods used vary from plant to plant depending upon individual designers.
2. The second step in the review is to determine which SSCs or SSC portions require protection against externally-generated missiles. The reviewer uses engineering judgment and the results of failure modes and effects analyses in conjunction with the results of reviews under other SRP sections for specific SSCs in this determination. Most safety-related systems are located within structures resistant to external missiles by design for other purposes (e.g., primary containment) or because of specific construction to withstand missiles. Systems and components within such structures are considered adequately protected. The reviewer concentrates attention on safety-related SSCs outside such structures and on penetrations and access openings in them. Essential service water piping and components, storage tanks, and ultimate heat sink components are examples of SSCs typically outside missile-resistant structures. Such site-specific systems as the ultimate heat sink may be excepted from the DC scope. Detailed review of the site-specific systems for a standardized design to be protected from missiles is therefore typically deferred until review of applications referring to the site specific systems. Depending on the nature and source of the externally-generated missiles, protection may be by missile barriers for individual components, by location of independent redundant subsystems in compartments in missile-protected structures, or by subgrade location at sufficient depth. Physical separation alone is not normally an acceptable method of missile protection for redundant safety-related systems and components.

3. The reviewer determines whether the failure of nonsafety-related SSCs as result of a missile could prevent a safety-related SSCs identified as requiring protection from externally-generated missiles from completing its safety function. The reviewer also verifies for applicants referring to certified designs whether SSCs outside the design scope might generate external missiles that would prevent safety-related SSCs from performing their intended safety function.
4. For review of a DC application, the reviewer should follow the above procedures to verify that the design, including requirements and restrictions (e.g., interface requirements and site parameters), set forth in the final safety analysis report (FSAR) meets the acceptance criteria. DCs have referred to the FSAR as the design control document (DCD). The reviewer should also consider the appropriateness of identified COL action items. The reviewer may identify additional COL action items; however, to ensure these COL action items are addressed during a COL application, they should be added to the DC FSAR.

For review of a COL application, the scope of the review is dependent on whether the COL applicant references a DC, an early site permit (ESP) or other NRC approvals (e.g., manufacturing license, site suitability report or topical report).

For review of both DC and COL applications, SRP Section 14.3 should be followed for the review of ITAAC. The review of ITAAC cannot be completed until after the completion of this section.

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.

The review of SSCs to be protected from externally-generated missiles included all safety-related SSCs supporting the reactor facility. After review of the applicant's proposed design criteria, design bases, and safety classifications for SSCs necessary for safe reactor shutdown, the staff concludes that the SSCs to be protected from externally-generated missiles are in compliance with GDCs 2 and 4. This conclusion is based on the following findings:

The applicant has met the requirements of GDCs 2 and 4 for protection of important safety-related SSCs against the effects of externally-generated missiles by:

1. Meeting RG 1.13, Position C.2, "Spent Fuel Storage Facility Design Basis," by preventing missiles generated by tornado winds from causing significant loss of watertight integrity of the fuel storage pool and from contacting fuel within the pool.;
2. Meeting RG 1.27, Positions C.2 and C.3, "Ultimate Heat Sink for Nuclear Power Plants," so that the ultimate heat sink is capable of withstanding the effects of external missiles generated by natural phenomena;

3. Meeting RG 1.115, Position C.2, "Protection Against Low Trajectory Turbine Missiles," so that essential systems are protected from low-trajectory turbine missiles by either proper turbine orientation or missile barriers;
4. Meeting regulatory Positions C.1, C.2, and C.3 and the Appendix to RG 1.117, "Tornado Design Classification," so that important safety-related SSCs are protected from the effects of missiles generated by the design basis tornado by missile barriers for individual components, by location of independent redundant systems or components in missile-protected structures, or by underground locations at depth sufficient to protect against missiles; and
5. Identifying all SSCs requiring protection against the effects of externally-generated missiles, including those nonsafety-related SSCs, the failure of which as a result of missiles, may prevent safety-related SSCs from performing their safety-related functions.

For those applicants referring to a certified design, the reviewer finds that SSCs outside of the DC scope that may cause external missile generation will not prevent safety-related SSCs from performing intended safety functions.

For DC and COL reviews, the findings will also summarize the staff's evaluation of requirements and restrictions (e.g., interface requirements and site parameters) and COL action items relevant to this SRP section.

In addition, to the extent that the review is not discussed in other SER sections, the findings will summarize the staff's evaluation of the ITAAC, including design acceptance criteria, as applicable.

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, Appendix A, GDC 2, "Design Bases for Protection Against Natural Phenomena."
2. 10 CFR Part 50, Appendix A, GDC 4, "Environmental and Dynamic Effects Design Bases."
3. 10 CFR 52.47, "Contents of Application."

4. 10 CFR 52.80, "Contents of Applications; Additional Technical Information."
5. 10 CFR 100.11, "Determination of Exclusion Area, Low Population Zone, and Population Center Distance."
6. 10 CFR Part 100, "Reactor Site Criteria."
7. Regulatory Guide 1.13, "Spent Fuel Storage Facility Design Basis."
8. Regulatory Guide 1.27, "Ultimate Heat Sink for Nuclear Power Plants."
9. Regulatory Guide 1.115, "Protection Against Low-Trajectory Turbine Missiles."
10. Regulatory Guide 1.117, "Tornado Design Classification."

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.

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