



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 mechanical effects of missiles on structures, systems, and components

**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 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.

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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 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](mailto: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. **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 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. 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.
5. **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. Sections 3.5.1.4, 3.5.1.5, and 3.5.1.6: review of specific missile sources and the protection needed.
2. Section 3.5.3: review of the acceptability of barriers and structures designed to withstand externally-generated missiles.
3. For COL reviews of operational programs, the review of the applicant's implementation plan is performed under SRP Section 13.4, "Operational Review."

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. The list of SSCs to be protected against externally-generated missiles is acceptable if in accord with GDC 2 as to design of important safety-related SSCs to withstand the effects of natural phenomena; and GDC 4 as to appropriate protection of important safety-related SSCs against the effects of externally-generated missiles to maintain their essential safety functions.
2. 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;
3. 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 review described in Subsection I of 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 requirements to reviewing 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 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.

The reviewer will select and emphasize material from the procedures described below, as may be 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. 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 reviews of DC and COL applications 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 early site permit, or other NRC-approved material, applications, and/or reports.

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

#### 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 (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, 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 Part 52.47
4. 10 CFR Part 52.80
5. 10 CFR Part 100.11, "Determination of Exclusion Area, Low Population Zone, and Population Center Distance."
6. RG 1.13, "Spent Fuel Storage Facility Design Basis."
7. RG 1.27, "Ultimate Heat Sink for Nuclear Power Plants."
8. RG 1.115, "Protection Against Low-Trajectory Turbine Missiles."

9. RG 1.117, "Tornado Design Classification."
10. NRC Inspection Manual Chapter IMC-2504, "Construction Inspection Program - Non-ITAAC Inspections," issued April 25, 2006.

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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, which 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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**SRP Section 3.5.2**  
Description of Changes

This SRP section affirms the technical accuracy and adequacy of the guidance previously provided in Draft Revision 3, dated April 1996, of this SRP section. See ADAMS accession number ML052070307.

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 this updated SRP section to prospective applicant submissions pursuant to 10 CFR Part 52.

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

I. AREAS OF REVIEW

Provided guidance for ITAAC and COL action items.

II. ACCEPTANCE CRITERIA

Added Part 52 requirements as it relates to ITAAC for design certification and combined licenses.

III. REVIEW PROCEDURES

Added review procedures for the reviews of DC and COL applications under Part 52.

IV. EVALUATION FINDINGS

No significant changes were made to this section.

V. IMPLEMENTATION

No significant changes were made to this section.

VI. REFERENCES

Added 10 CFR 50, Appendix A, GDC 2, 10 CRF 52.47, and 10 CFR 52.80 to the list of references.