



# U.S. NUCLEAR REGULATORY COMMISSION

## STANDARD REVIEW PLAN

### 19.5 ADEQUACY OF DESIGN FEATURES AND FUNCTIONAL CAPABILITIES IDENTIFIED AND DESCRIBED FOR WITHSTANDING AIRCRAFT IMPACTS

#### REVIEW RESPONSIBILITIES

- Primary-** Organization responsible for the review of fire protection  
Organization responsible for the review of structures
- Secondary-** Organization responsible for the review of reactor systems  
Organization responsible for the review of spent fuel cooling  
Organization responsible for the review of Balance of Plant Systems

#### I. AREA OF REVIEW

Under Title 10 of the *Code of Federal Regulations* (10 CFR) 50.150, the Aircraft Impact Assessment (AIA) rule, applicants for new nuclear power reactors are required to perform a design specific assessment of the effects on the facility of the impact of a large, commercial aircraft.

The aircraft impact rule does not require applicants to submit the AIA to the U.S. Nuclear Regulatory Commission (NRC) in their applications. Applicants subject to the AIA rule are only required to submit a description of the key design features and functional capabilities identified as a result of the AIA and a description of how those features and capabilities show, with reduced use of operator action, that the assessment requirements in 10 CFR 50.150(a)(1) are met.

Draft Revision 0-July 2012

---

#### USNRC STANDARD REVIEW PLAN

This Standard Review Plan (SRP), NUREG-0800, has been prepared to establish criteria that the U.S. Nuclear Regulatory Commission (NRC) 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 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 an acceptable method of complying with the NRC regulations.

The SRP sections are numbered in accordance with corresponding sections in Regulatory Guide (RG) 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)." Not all sections of RG 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 RG 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 # ML12138A468.

---

Pursuant to 10 CFR 50.150(a)(3), the AIA rule applies to the following new reactor applicants: (1) construction permit applications; (2) operating license applications for which a construction permit was issued after July 13, 2009; (3) design certification applications; (4) design certification renewal applications for design certifications in effect on July 13, 2009, which have not been amended to comply with the AIA rule; (5) design approval applications; (6) combined license applications that either (a) do not reference a design certification, design approval, or manufactured reactor, or (b) reference a design certification issued before July 13, 2009, which has not been amended to address the AIA rule; and (7) manufacturing license applications that either (a) do not reference a design certification or design approval, or (b) reference a certification issued before July 13, 2009, which has not been amended to address the requirements of this section.

Using realistic analyses, applicants shall identify and incorporate into the design those design features and functional capabilities to show, with reduced use of operator action, that the reactor core remains cooled or the containment remains intact and spent fuel cooling or spent fuel pool integrity is maintained (the acceptance criteria). Applicants are required to describe how such design features and functional capabilities meet the acceptance criteria of the rule. The impact of a large, commercial aircraft is a beyond design basis event (BDBE). Consequently, the NRC requirements that apply to the design, construction, testing, operation, and maintenance of design features and functional capabilities for design basis events do not apply to design features or functional capabilities selected by the applicant solely to meet the requirements of the aircraft impact rule. The objective of the aircraft impact rule is to require nuclear power plant designers to perform a rigorous assessment of the design to identify design features and functional capabilities that could provide additional inherent protection to withstand the effects of an aircraft impact (i.e., meet the rule's acceptance criteria with reduced use of operator actions).

Applicants may identify either safety-related or non-safety-related features or capabilities to satisfy the rule. There is no requirement that the features or capabilities identified solely for complying with the AIA rule be classified as safety-related. The design features relied upon to satisfy the AIA rule may be structures or features: (1) whose sole purpose is to address the requirements of the AIA rule, or (2) which have a dual purpose of addressing the aircraft impact required by the AIA rule, as well as other NRC requirements (safety, security, etc).

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 Standard Review Plan (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.

Combined License (COL) Action Items and Design 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.

## II. ACCEPTANCE CRITERIA

### Requirements

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

1. 10 CFR 50.150(a)(1) requires that each applicant perform a design-specific assessment of the effects on the facility of the impact of a large commercial aircraft. Using realistic analysis, the applicant shall identify and incorporate into the design those design features and functional capabilities to show that, with reduced use of operator actions: (1) The reactor core remains cooled, or the containment remains intact; and (2) spent fuel cooling or spent fuel pool integrity is maintained.
2. 10 CFR 52.47(b)(1), which requires that a DC application contain the proposed 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 DC has been constructed and will be operated in accordance with the DC, the provisions of the Atomic Energy Act (AEA), 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 be operated in conformity with the COL, the provisions of the AEA, and the NRC's regulations.

### Standard Review Plan 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. Regulatory Guide (RG) 1.217, Revision 0, "Guidance for the Assessment of Beyond-Design-Basis Aircraft Impacts," endorses the guidance in Nuclear Energy Institute (NEI) 07-13, Revision 8, "Methodology for Performing Aircraft Impact Assessments for New Plant Designs (Reference 1)," as an acceptable method for use in satisfying the NRC's requirements in 10 CFR 50.150(a) regarding the assessment of aircraft impacts for new nuclear power reactors.

The NRC will review the information contained in the application and reach conclusions as to whether the applicant has: (1) Adequately described design features and functional capabilities in

accordance with the aircraft impact rule; and (2) conducted an assessment reasonably formulated to identify design features and functional capabilities to show, with reduced use of operator action, that the facility can withstand the effects of an aircraft impact.<sup>1</sup>

### III. REVIEW PROCEDURES

For the purpose of evaluating whether or not the above criteria have been met, the staff shall consider:

1. An AIA performed by qualified personnel using a method that conforms to the guidance in NEI 07-13, Revision 8, to be a method which is reasonably formulated to identify design features and functional capabilities to show, with reduced use of operator action, that the facility can withstand the effects of an aircraft impact;
2. Qualified personnel to be: (1) applicants who are the designer of the facility for which the AIA applies; and/or (2) an applicant's primary contractor for the AIA who has designed a nuclear power reactor facility either already licensed by the NRC or currently under review by the NRC;
3. Use of operator action to be reduced when (1) all necessary actions to control the nuclear facility can be performed in the control room, or at an alternate station containing equipment specifically designed for control purposes, and (2) a reduced amount of active operator intervention, if any, is required to meet the assessment criteria in 10 CFR 50.150(a)(1). Reduction in the use of operator action is measured relative to the actions required to address aircraft impact without the AIA rule in place (e.g., similar actions contained in operational programs in place at current operating reactor sites).<sup>2</sup>
4. The "design features" or functional capabilities that provide reactor core cooling or spent fuel pool cooling criterion to be satisfied if the design features or functional capabilities have been included in the design of the plant to perform that cooling function and can be operated with reduced use of operator action (i.e., they are not features that serve a different function in the design but could be used in an ad hoc fashion to perform the cooling function);
5. The "intact containment structure" criterion to be satisfied if the containment: (1) will not be perforated by the impact of a large commercial airliner and, (2) maintains ultimate pressure capability, given a core damage event, until effective mitigation strategies can be implemented. Effective mitigation strategies are those that provide, for an indefinite period of time, sufficient cooling to the damaged core or containment to limit temperature and pressure challenges below the ultimate pressure capability of the containment as

---

<sup>1</sup> Consideration of Aircraft Impacts for New Nuclear Power Reactors, 74 FR 28120 (June 12, 2009).

<sup>2</sup> Each design feature and functional capability incorporated into the design does not have to involve reduced use of operator actions; the overall reduction in use of operator actions must be judged for the complete set of design features and functional capabilities identified by the applicant to show that the acceptance criteria have been met. In this context, "operator action" includes actions of operators in the control room or at alternative control panels or control areas to control the reactor and the nuclear facility. This means that active operator intervention and initiation of responsive action to maintain core cooling or an intact containment, and spent fuel cooling or spent fuel pool integrity should be reduced. The designer need not strive to achieve the absolute minimum in operator action. In some cases, there may be countervailing considerations that weigh against reducing to the absolute minimum the use of operator action to show that the acceptance criteria are met.

defined in Chapter 19 of the Design Certification Document (DCD) or Final Safety Analysis Report (FSAR), as applicable;

6. The “spent fuel pool integrity maintained” criterion to be satisfied if the impact of a large commercial aircraft on the spent fuel pool wall or support structures does not result in leakage through the spent fuel pool liner below the required minimum water level of the pool;
7. The exterior wall of a structure to be unable to prevent penetration of the aircraft into the structure unless an analysis of an already existing design verifies that penetration is prevented, or the wall is specifically designed to prevent such penetration;
8. An intervening structure having the following features to be able to protect a building wall from aircraft impact:
  - A. The location of the structure is fixed and not subject to plant-specific location changes without re-verifying that the AIA rule is satisfied.
  - B. The exterior walls of the structure are made of reinforced concrete,
  - C. The structure has multiple interior walls in the flight path that are made of reinforced concrete and,
  - D. The height, width and location of the intervening structure relative to the building wall being protected satisfy criteria in Sections 3.2.2.1 and 3.2.2.2 of NEI 07-13, Revision 8;
9. The following design features to be capable of limiting the spread of a jet fuel fire caused by the crash of a large commercial aircraft:
  - A. Two standard listed 3-hour fire-rated doors in series or one door rated at greater than 5 psid (e.g. watertight door);
  - B. Floor, ceiling and wall plugs installed to fill open penetrations that are fire-rated for at least 3-hours; and will withstand any over pressure.
  - C. Boundary walls enclosing the fire damage footprint that are fire-rated for at least 3 hours and have masonry construction to ensure overpressure survival.

The Statement of Considerations for the AIA rule regarding consideration of aircraft impacts for new nuclear power reactors<sup>1</sup> states that: “The NRC’s decision on an application subject to 10 CFR 50.150 will be separate from any NRC determination that may be made with respect to the adequacy of the impact assessment which the rule does not require be submitted to the NRC.” Since the impact assessment is not submitted to the NRC for its review, the staff shall conduct its review of the FSAR or DCD, as applicable, to determine whether or not descriptions of the design features and functional capabilities are complete enough such that, assuming the design features and functional capabilities perform their intended functions, there is reasonable assurance that

<sup>1</sup>

Consideration of Aircraft Impacts for New Nuclear Power Reactors, 74 FR 28120 (June 12, 2009).

the acceptance criteria in 10 CFR 50.150(a)(1) can be met. The AIA reviewers will not make any determinations of adverse impacts the AIA features may have on the rest of the plant design and operations. Other reviewers under other SRP sections will make this determination.

#### Reasonably Formulated Aircraft Impact Assessment

The AIA reviewer shall examine the summary description of the AIA and use review procedures III.1 and III.2 of this SRP to determine if it has been reasonably formulated.

#### Review of Design Features for Core Cooling

The AIA reviewer shall consider the design features credited by the applicant for core cooling, including front line systems and support systems. The AIA reviewer shall examine the description provided by the applicant and confirm that it describes all equipment in the heat removal path. Features shall be provided that are capable of removing heat immediately following shutdown from full power operation and when the plant is shutdown with the reactor in a cold shutdown (non-flooded) condition with a large vent in the primary system. The AIA reviewer shall apply review procedure III.4 of this SRP. The AIA reviewer should not attempt to verify whether or not design features for core cooling satisfy core cooling success criteria for beyond design-basis events (documented in the PRA). Applicants must demonstrate this as part of the AIA, which is subject to inspection by the staff.

Using information provided by the applicant, the AIA reviewer shall determine if the features identified are designed to cool the reactor core in the presence of a breach of the reactor coolant system. If not, the AIA reviewer shall initiate a review, as described below, to confirm that design features or functional capabilities that protect reactor coolant system pressure boundary from structural damage have been identified and described in the application. The AIA reviewer also shall determine if the features credited for core cooling are designed to accomplish this function with the reactor critical and producing power. If not, the AIA reviewer shall initiate a review, as described below, to confirm that design features are in place to protect equipment relied upon for reactor scram.

The AIA reviewer shall consider the design features credited by the applicant for protection of core cooling design features from structural damage caused by aircraft impact. Based on the applicant's description of the location of equipment credited for core cooling, including necessary support systems, the AIA reviewer shall confirm that the applicant has identified design features or functional capabilities that protect these locations. Based on the applicant's descriptions of design features or functional capabilities, the AIA reviewer shall confirm that they satisfy review procedures III.5, III.7 and III.8 of this SRP. The AIA reviewer shall ensure that the applicant has addressed all potential impact locations around the perimeter of the structure housing the protected core cooling design features. The AIA reviewer shall confirm that equipment credited for core cooling, including support systems, are not attached to the walls or ceiling of any structure credited as a protective barrier. The adequacy of the design features in protecting equipment from structural and shock damage should not be evaluated by the AIA reviewer. That is determined as part of the AIA, which is subject to inspection by the staff.

The AIA reviewer shall consider design features credited for the purpose of protecting core cooling design features from fire damage caused by the dispersal of jet fuel following an aircraft impact. Based on the applicant's description of the location of equipment credited for core

cooling, including necessary support systems, the AIA reviewer shall confirm that the applicant has identified design features or functional capabilities that keep fire from spreading to these locations. Based on the applicant's descriptions of design features or functional capabilities, the AIA reviewer shall confirm that they satisfy review procedure III.9 of this SRP. The adequacy of the design features in protecting equipment from fire damage should not be evaluated by the AIA reviewer. That is determined as part of the AIA, which is subject to inspection by the staff.

#### Review of Design Features for Maintaining the Containment Intact

If the applicant has not identified design features or functional capabilities to maintain core cooling under all aircraft impact scenarios, the AIA reviewer shall confirm that the applicant has identified design features or functional capabilities for maintaining an intact containment, i.e., that satisfy review procedure III.5 of this SRP. The AIA reviewer shall verify that the applicant has credited the containment structure as a feature specifically designed such that it will not be perforated by the impact of a large commercial airliner. The applicant's assessment of the ability of the containment to withstand perforation is not required to be submitted for review by the NRC. However, it is subject to inspection by the NRC staff. The AIA reviewer shall examine the description provided by the applicant of features relied upon to maintain the containment intact following a core damage event and confirm that it describes all equipment needed to maintain ultimate pressure capability until effective mitigation strategies can be implemented. The adequacy of the design features for maintaining an intact containment should not be evaluated by the AIA reviewer. That is determined as part of the AIA, which is subject to inspection by the staff. The AIA reviewer shall examine the description of any associated mitigating strategy for assuring indefinite containment heat removal, if required, and confirm that all actions necessary to accomplish heat removal have been described. The ability of operators to carry out this strategy with procedures, including the timing of such actions, should not be evaluated by the AIA reviewer. That is determined as part of the AIA, which is subject to inspection by the staff, and also subject to review and inspection by the staff in accordance with the requirements in paragraphs 10 CFR 50.54(hh)(2) and 10 CFR 52.80(d) of the Commission's regulations, respectively.

#### Review of Design Features for Maintaining Spent Fuel Pool Integrity

The AIA reviewer shall examine the applicant's description of design features or functional capabilities for maintaining spent fuel integrity and confirm that either: (1) the applicant has stated that the walls, liner and the support structure for the fuel pool are designed such that there will be no leakage from the pool following impact of the aircraft, or (2) the applicant has identified sufficient intervening structures to protect the pool walls and support structure which meet review procedure III.6 of this SRP. The adequacy of the design features for maintaining spent fuel pool integrity should not be evaluated by the AIA reviewer. That is determined as part of the AIA, which is subject to inspection by the staff.

#### Review of Design Features for Spent Fuel Pool Cooling

If the applicant has not identified design features or functional capabilities to maintain spent fuel pool integrity, the AIA reviewer shall consider design features credited by the applicant for the purpose of spent fuel pool cooling and confirm that they have been specifically designed to provide pool water make-up capability and the capability to spray water on fuel that is not submerged. The adequacy of the design features for providing spent fuel pool cooling should

not be evaluated by the AIA reviewer. That is determined as part of the AIA, which is subject to inspection by the staff.

The AIA reviewer shall consider design features credited by the applicant for protecting the spent fuel pool cooling design features from structural damage caused by aircraft impact. Based on the applicant's description of the location of equipment credited for spent fuel pool cooling, including necessary support systems, the AIA reviewer shall confirm that design features or functional capabilities have been identified that protect these locations. Based on the applicant's descriptions of design features or functional capabilities, the AIA reviewer shall confirm that they satisfy review procedures III.5, III.7 and III.8 of this SRP. The AIA reviewer shall ensure that the applicant has addressed all potential impact locations around the perimeter of the structure housing the protected spent fuel pool cooling design features. The AIA reviewer shall confirm that equipment credited for spent fuel pool cooling is not attached to the walls or ceiling of any structure credited as a protective barrier. The adequacy of the design features in protecting equipment from structural and shock damage should not be evaluated by the AIA reviewer. That is determined as part of the AIA, which is subject to inspection by the staff.

#### Review of the Use of Reduced Operator Action

In regards to meeting review procedure III.3, AIA reviewers should be cognizant of the fact that the designer need not achieve the absolute minimum in operator action. The NRC recognizes that there may be countervailing considerations that weigh against reducing to the absolute minimum the use of operator action to show that the acceptance criteria in the aircraft impact rule are met. The designer shall identify and consider in a reasonable process the goal of incorporating design features and functional capabilities which achieve the acceptance criteria in paragraph (a)(1)(i) and (ii) of 10 CFR 50.150 with reduced use of operator action.

For review of a DC application, the reviewer should follow the above procedures to verify that the design set forth in the FSAR meets the acceptance criteria. DCs have referred to the FSAR as the design control document. 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, or other NRC approvals (e.g., manufacturing license, 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 supports conclusions of the following type to be included in the staff's safety evaluation report (SER). The reviewer also states the basis for those conclusions.



Reviewers shall confirm that the evaluation supports the following conclusions, to be included in the staff's SER.

- The applicant has adequately described the design features and functional capabilities identified for inclusion in the design and how they show that the facility can withstand the effects of the aircraft impact, namely that:
  - (i) the reactor core remains cooled or the containment remains intact; and
  - (ii) spent fuel pool cooling or spent fuel pool integrity is maintained.
- The applicant has performed an AIA reasonably formulated to identify design features and functional capabilities to show, with reduced use of operator action, that the acceptance criteria in the rule are met.

For DC reviews, the findings will also summarize the staff's evaluation of the COL action/information items proposed by the DC applicant that are relevant to this SRP section.

For COL reviews, the findings will also summarize the staff's evaluation of how the COL applicant addressed those COL action/information items included in the DCD referenced in its application that are relevant to this SRP section.

## V. IMPLEMENTATION

The staff will use this SRP section in performing safety evaluations of license applications, design certifications, and design approvals 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. NEI 07-13, "Methodology for Performing Aircraft Impact Assessments for New Plant Designs", Revision 8, Nuclear Energy Institute, April 2011. (ML111440006)
2. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities"
3. 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants"
4. RG 1.217, Revision 0, "Guidance for the Assessment of Beyond-Design-Basis Aircraft Impacts"

---

#### **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 numbers 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 19.5**  
**“Adequacy of Design Features and Functional Capabilities**  
**Identified from Aircraft Impact Assessment”**  
**Description of Changes**

Section 19.5 is a new SRP section not previously included in NUREG-0800. It was developed to provide guidance for adequacy of design features and functional capabilities identified from the aircraft impact assessment.