



U.S. NUCLEAR REGULATORY COMMISSION
STANDARD REVIEW PLAN

14.3.5 INSTRUMENTATION AND CONTROLS - INSPECTIONS, TESTS, ANALYSES, AND ACCEPTANCE CRITERIA

REVIEW RESPONSIBILITIES

Primary - Organization responsible for the review of instrumentation and controls

Secondary - None

I. AREAS OF REVIEW

This SRP section addresses inspections, tests, analyses, and acceptance criteria (ITAAC) related to the instrumentation and control (I&C) systems. ITAAC information is contained in the final safety analysis report (FSAR) of a combined operating license (COL) application or Tier 1 information from the design control document of a design certification (DC) application.

The ITAAC review includes a review of the design commitments to be verified by ITAAC inspection. For DC applications, these design commitments also define the scope of the certified design. The design commitments are identified in Design Descriptions that establish the scope of ITAAC. For DC applications and for COL applications that reference a DC, these Design Descriptions and ITAAC are contained in the Tier 1 portion of the DC Document. For COL applications that do not reference a DC, these design commitments may be described in ITAAC Design Descriptions, or identified by ITAAC references to the FSAR.

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USNRC STANDARD REVIEW PLAN

This Standard Review Plan, NUREG-0800, has been prepared to establish criteria that the U.S. Nuclear Regulatory Commission staff responsible for the review of applications to construct and operate nuclear power plants intends to use in evaluating whether an applicant/licensee meets the NRC's regulations. The Standard Review Plan is not a substitute for the NRC's regulations, and compliance with it is not required. However, an applicant is required to identify differences between the design features, analytical techniques, and procedural measures proposed for its facility and the SRP acceptance criteria and evaluate how the proposed alternatives to the SRP acceptance criteria provide an acceptable method of complying with the NRC regulations.

The standard review plan sections are numbered in accordance with corresponding sections in Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)." Not all sections of Regulatory Guide 1.70 have a corresponding review plan section. The SRP sections applicable to a combined license application for a new light-water reactor (LWR) are based on Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)."

These documents are made available to the public as part of the NRC's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Individual sections of NUREG-0800 will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience. Comments may be submitted electronically by email to NRR_SRP@nrc.gov.

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The review of I&C ITAAC should be coordinated with the review of the applicant's I&C systems design as described in Chapter 7 of the SRP. It is recognized that the review of ITAAC is performed after review of the application against acceptance criteria contained in Chapter 7 of the SRP. Furthermore, the ITAAC are reviewed to assure that all systems, structures, and components (SSCs) in this area of review are identified and addressed as appropriate.

The specific areas of review are as follows:

1. Tier 1 information on I&C systems involving reactor protection and control, engineered safety features actuation, and other systems using I&C equipment.
2. Tier 1 information related to design process of digital computers in I&C systems.
3. Selected interface requirements related to I&C issues.
4. Functional requirements of IEEE Std. 603 -1991 and the General Design Criteria when implementing the safety system.
5. For a DC application:
 - A. The staff reviews 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 design certification is built and will operate in accordance with the design certification, the Atomic Energy Act, and the NRC's regulations.
 - B. The staff reviews the justification that compliance with the interface requirements is verifiable through ITAAC. The staff also reviews the method that is to be used for verification of the interface requirements.
6. For a COL application:
 - A. The staff reviews 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, the facility has been constructed and will operate in conformity with the combined license, the Atomic Energy Act, and the NRC's regulations.
 - B. If the application references a standard design certification, the staff verifies that the ITAAC contained in the certified design apply to those portions of the facility design that are approved in the design certification.
7. 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 listed SRP sections interface with this section as follows:

1. SRP Section 14.3 provides general guidance on review interfaces.
2. Acceptability of ITAAC information regarding the ability of SSCs to withstand various natural phenomena is reviewed under SRP Section 14.3.2.
3. Acceptability of ITAAC information for electrical systems and components is reviewed under SRP Section 14.3.6.
4. Acceptability of ITAAC information for plant systems including heating, ventilation, and air conditioning (HVAC) design, containment isolation, and selected aspects of the containment design is reviewed under SRP Section 14.3.7.
5. Acceptability of ITAAC information for reactor systems SRP Section 14.3.4.
6. Acceptability of ITAAC information for radiation protection is reviewed under SRP Section 14.3.8.
7. Acceptability of ITAAC information for human factors is reviewed under SRP Section 14.3.9.
8. Acceptability of ITAAC information for emergency preparedness is reviewed under SRP section 14.3.10.
9. Acceptability of ITAAC information for containment systems is reviewed under SRP Section 14.3.11.

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(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;
2. 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.

1. The methodology for selecting SSCs that will be subject to ITAAC as well as the criteria for establishing the necessary and sufficient ITAAC should be appropriate for and consistently applied to I&C systems.
2. Tier 1 Design Descriptions (for DC and for COL referencing DC) and ITAAC Design Descriptions or ITAAC references to the FSAR (for COL not referencing DC) should describe the top-level I&C design features and performance characteristics that are significant to safety. For safety systems, this should include a description of system purpose, safety functions, equipment quality (e.g., meet the functional requirements of IEEE Std. 603-1991 and the digital system life cycle design process), equipment qualification, automatic decision-making and trip logic functions, manual initiation functions, and design features (e.g., system architecture) provided to achieve high functional reliability.

The functions and characteristics of other I&C systems important to safety should also be discussed to the extent that the functions and characteristics are necessary to support remote shutdown, support required operator actions or assessment of plant conditions and safety system performance, maintain safety systems in a state that assures their availability during an accident, minimize or mitigate control system failures that would interfere with or cause unnecessary challenges to safety systems, or provide diverse back-up to protection systems.

SRP Section 14.3, Appendix A, Subsection B.1, provides additional guidance on the content of Tier 1 Design Descriptions, ITAAC Design Descriptions, or ITAAC references to the FSAR.

3. ITAAC should identify the significant features of the I&C systems on which the Staff is relying to assure compliance with each NRC requirement identified in SRP Appendix 7.1-A. Tests, analyses, and acceptance criteria associated with each design commitment should, when taken together, be sufficient to provide reasonable assurance that the final as-built I&C system fulfills NRC requirements.

SRP Appendix 7.1-C provides an expanded discussion of SRP acceptance criteria for safety system compliance with 10 CFR 50.55a(h).

SRP Appendix 7.1-D further discusses SRP acceptance criteria for safety and protection systems using digital computer-based technology.

SRP Section 14.3, Appendix A, Subsection B.2, provides additional guidance on the expected scope, content, and format of ITAAC.

4. For DC or for COL applications referencing a DC, Tier 1 Design Descriptions and ITAAC design commitments should be based on and consistent with the Tier 2 material. For a COL application not referencing a DC, the ITAAC Design Descriptions (if provided) and ITAAC design commitments should be based on and consistent with the FSAR portion of the application.
5. The applicant may provide design acceptance criteria (DAC) in lieu of detailed system design information. In this case, the DAC should be sufficiently detailed to provide an adequate basis for the Staff to make a final safety determination regarding the design, subject only to satisfactory design implementation and verification of the DAC by the COL applicant or licensee. Implementation of the DAC should be verified as part of the ITAAC performed to demonstrate that the as-built facility conforms to the certified design.

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. The relevance of the methodology for selecting SSCs that will be subject to ITAAC and the criteria for establishing the necessary and sufficient ITAAC should be considered from the perspective of each type of system within the scope of DC or COL applications. The accepted methodology should be applied consistently to all systems in the scope.
2. Key functions and performance requirements should be identified as a basis for identifying SSCs that should be within the scope of the ITAAC.
3. To confirm that I&C functions have been constructed in accordance with NRC rules and regulations, the ITAAC as a whole should address each regulatory requirement. The reviewer should understand the basis for any exceptions to this principle.
4. ITAAC should be consistent with the more complete description of the basis for plant safety.
5. I&C technology is continually changing. Consequently, specification of design details in a DC application (or even at the early stages of a COL application) risks committing to obsolete technology. DAC can compensate for the lack of design detail.

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 specific acceptance criteria, the staff should review the applicant's evaluation of how the proposed alternatives provide an acceptable method of complying with the relevant NRC requirements identified in Subsection II.

1. Follow the General Review Procedures of SRP Section 14.3. Assure that the Tier 1 material (for DC or COL referencing a DC), ITAAC Design Descriptions, or ITAAC references to the FSAR (for COL not referencing a DC) are consistent with SRP Section 14.3, Appendix A.
2. For DC or COL referencing a DC, assure that Tier 1 information is consistent with design control document (DCD) Tier 2 information. For COL not referencing a DC but providing ITAAC Design Descriptions, assure that the ITAAC Design Descriptions are consistent with the FSAR. Figures and diagrams should be reviewed to assure that they accurately depict the functional arrangement and requirements of the systems. The reviewer should use the requirements listed in SRP Appendix 7.1-A and the 10 CFR 50.55a(h) requirements found in SRP Appendices 7.1-C and the guidance found in SRP Appendix 7.1-D as an aid in establishing consistent and comprehensive treatment of issues.

In general, each design commitment made to fulfill the technical requirements of 10 CFR Part 50 identified in SRP Appendix 7.1-A should be included or provide justification with the technical basis for omission. It is permissible to develop general bases (e.g., selection criteria) that provide the basis for multiple omissions.

Note that it is not necessary that the ITAAC explicitly verify each regulatory requirement. In some cases, commitments to design features may address one or more regulatory requirements, and consequently the ITAAC verifies the associated requirement by verifying proper implementation of the design feature. For example, a DC application may commit to a specific protection system architecture and demonstrate that the architectural arrangement of functional blocks, channels, and divisions is sufficient to assure compliance with the single failure criterion. Thus, ITAAC that confirm that the functional arrangement of the as-built protection system is as described in the design description provides reasonable assurance that system meets the single-failure criterion. The reviewer should be certain to understand these relationships, but it is not necessary that the ITAAC or referenced Design Descriptions explicitly describe them.

3. Assure that the I&C systems are clearly described in Design Descriptions and ITAAC design commitments. For safety systems, this should include a description of system purpose, safety functions, equipment quality, equipment qualification, automatic decision-making and trip logic functions, manual initiation functions, and design features (e.g., system architecture) provided to achieve high functional reliability. The functions and characteristics of other I&C systems important to safety should also be discussed to the extent that the functions and characteristics are necessary to support remote shutdown, support required operator actions or assessment of plant conditions or safety system performance, maintain safety systems in a state that assures their availability during an accident, minimize or mitigate control system failures that would interfere with or cause unnecessary challenges to safety systems, or provide diverse back-up to protection systems.
4. The reviewer should assure that appropriate guidance is provided to other organizations such that I&C issues in the ITAAC and associated Design Descriptions are treated in a consistent manner among organizations.

5. The reviewer should assure that the standard ITAAC entries in SRP Section 14.3, Appendix D related to I&C items, are included in the appropriate systems of the standard design. In particular, the reviewer should assure consistent application and treatment of the standard ITAAC entries for basic configuration ITAAC (environmental qualification aspects) and independence for electrical and I&C systems.
6. The reviewer should assure that design features from the resolutions of selected technical and policy issues for the design are adequately addressed in Tier 1 material, ITAAC Design Descriptions, or ITAAC references to the FSAR, based on safety significance. Assure that the appropriate NRC guidance, requirements, bases, and resolutions for these items are documented clearly in the safety evaluation report (SER).
7. The reviewer of system implementation according to DAC should confirm via a sequence of audits that the ITAAC is appropriately implemented. For implementation of digital computer-based systems following DAC, SRP Appendix 7.0-A describes the review philosophy, Figure 7.0-A-5 of SRP Appendix 7.0-A identifies candidate topics for audit, and SRP Appendix 7.1-D and SRP Branch Technical Position 7-14 provide detailed technical guidance.
8. Identification of "Tier 2*" material. Tier 2 information for a COL referencing a DC or FSAR information for a plant not referencing a DC may be changed in accordance with a "50.59-like" process. The Staff may designate selected information in Tier 2 or the FSAR that, if considered for a change, requires NRC approval prior to implementation. This information is known as "Tier 2*." The reviewer should assure that Tier 2* material is identified and that appropriate expiration dates are set. These items should typically be restricted to rapidly changing technology where it is inappropriate to "lock in" a design process for the lifetime of the DC but would also be inappropriate to allow COL applicants or licensees to make unreviewed changes. The items included in Tier 2* should generally be the supporting material for the DAC.
9. Coordinate with the organization responsible for review of reactor systems to confirm that protective, control, display, and interlock functions are consistent with the accident analysis, the operating requirements of the I&C systems, and the requirements of 10 CFR 50, Appendix A, General Design Criteria (GDC) 10, 15, 28, 33, 34, and 35. I&C system ITAAC confirm that the accepted functions are implemented in the as-built design.
10. Coordinate with the organization responsible for the review of plant systems which evaluates the ITAAC for the auxiliary supporting features and other auxiliary features to demonstrate that they satisfy the applicable acceptance criteria including the operating requirements of the supported system and the requirements of GDC 41 and 44. These features include, for example, compressed (instrument) air, cooling water, boration, lighting, heating, and air conditioning.
11. Coordinate with the organization responsible for the review of containment systems which evaluates the ITAAC for the containment ventilation and atmospheric control systems provided to maintain required environmental conditions for I&C equipment located inside containment.

12. Coordinate with the organization responsible for the review of containment which confirms that protective, control, display, and interlock functions associated with containment systems and severe accidents are consistent with the accident analysis, operating requirements, and GDC 16 and 38. I&C system ITAAC confirm that the accepted functions are implemented in the as-built design.
13. Coordinate with the organization responsible for the review of electrical systems which evaluates the ITAAC demonstrating (1) physical separation for cabling and electrical power equipment, (2) that power is supplied to redundant systems by appropriate redundant sources, and (3) the adequacy of the I&C associated with the proper functioning of the onsite and offsite power systems.
14. Coordinate with the organization responsible for the review of environmental qualification which evaluates the ITAAC relating to environmental qualification of I&C equipment.
15. Coordinate with the organization responsible for the review of seismic qualification which reviews the ITAAC relating to seismic qualification demonstration for I&C equipment.
16. Coordinate with the organization responsible for the review of human-system interfaces which evaluates the ITAAC demonstrating the adequacy of the human factors aspects of the design, such as arrangement and location of I&C equipment, the capabilities of the I&C to support execution of the operating procedures and emergency response guides, and that qualified plant staff and training required to operate I&C equipment have been provided.
17. 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).

18. Implementation of ITAAC will be inspected in accordance with NRC Inspection Manual Chapter IMC-2503, "Construction Inspection Program - ITAAC Inspections."

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 reviewer verifies that sufficient information has been provided to satisfy SRP Section 14.3 and this SRP section, and concludes that the ITAAC is acceptable. A finding similar to that in the Evaluation Findings section of SRP Section 14.3 should be provided in a separate section of the SER.

2. 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.

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. NRC Inspection Manual Chapter IMC-2503, "Construction Inspection Program - ITAAC Inspections," April 25, 2006.
2. IEEE Std. 603-1991, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations."

PAPERWORK REDUCTION ACT STATEMENT

The information collections contained in the Standard Review Plan are covered by the requirements of 10 CFR Part 50 and 10 CFR Part 52, and were approved by the Office of Management and Budget, approval number 3150-0011 and 3150-0151.

PUBLIC PROTECTION NOTIFICATION

The NRC may not conduct or sponsor, and a person is not required to respond to, a request for information or an information collection requirement unless the requesting document displays a currently valid OMB control number.
