



U.S. NUCLEAR REGULATORY COMMISSION  
**STANDARD REVIEW PLAN**  
OFFICE OF NUCLEAR REACTOR REGULATION

14.3.9<sup>1</sup> HUMAN FACTORS ENGINEERING (Tier 1)

REVIEW RESPONSIBILITIES

Primary - Human Factors Assessment Branch (HHFB)

Secondary - None

I. AREAS OF REVIEW

HHFB reviews the Design Control Document (DCD) submitted by the applicant. HHFB has primary review responsibility for the main control room panels, remote shutdown panel, and local control panels described in Tier 1. HHFB also has primary review responsibility for additional material applicable to multiple systems of the standard design in Tier 1 pertaining to human factors engineering, if such material is provided by the applicant. HHFB is responsible for providing input to other review branches regarding the minimum inventory of alarms, controls, and indications appropriate for the main control room and the remote shutdown station.

Review Interfaces

SRP Section 14.3 provides general guidance on review interfaces. HHFB performs related reviews and coordination activities, as requested by other branches, for issues in Tier 1 related to human factors engineering. In addition, HHFB will coordinate other branches' evaluations that interface with the overall review of the control room and remote shutdown room, as follows:

1. The Electrical Engineering Branch (EELB) determines the acceptability of Tier 1 information regarding electrical SSCs in SRP Section 14.3.6.

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**USNRC STANDARD REVIEW PLAN**

Standard review plans are prepared for the guidance of the Office of Nuclear Reactor Regulation staff responsible for the review of applications to construct and operate nuclear power plants. These documents are made available to the public as part of the Commission's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Standard review plans are not substitutes for regulatory guides or the Commission's regulations and compliance with them is not required. The standard review plan sections are keyed to the Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants. Not all sections of the Standard Format have a corresponding review plan.

Published standard review plans will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience.

Comments and suggestions for improvement will be considered and should be sent to the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, D.C. 20555.

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2. The Civil Engineering and Geosciences Branch (ECGB) determines the acceptability of Tier 1 information regarding the ability of SSCs to withstand various natural phenomena in SRP Sections 14.3.1 and 14.3.2.
3. The Instrumentation and Controls Branch (HICB) determines the acceptability of Tier 1 information regarding the I&C aspects of the standard design in SRP Section 14.3.5.
4. The Plant Systems Branch (SPLB) determines the acceptability of Tier 1 information regarding the HVAC design in SRP Section 14.3.7.
5. The Reactor Systems Branch (SRXB) determines the acceptability of Tier 1 information regarding the reactor systems and core cooling systems in SRP Section 14.3.4.

## II. ACCEPTANCE CRITERIA

The acceptance criteria for ITAAC are based on meeting 10 CFR 52.97(b)(1), which sets forth the comprehensive requirements for ITAAC. For design certification reviews, the scope of ITAAC is limited to the scope of the certified design as required by 10 CFR 52.47(b). See also the acceptance criteria in SRP Chapter 18 regarding the requirements for an effective human factors engineering (HFE) design. The acceptance criteria can be met by meeting the requirements of the following:

The reviewer should determine the top-level design features and requirements appropriate for treatment in Tier 1 based on several sources. The basis for the review in this area is NUREG-0711, "Human Factors Engineering Program Review Model" developed by the staff. The staff's certification review in the control room design area is based on a design and implementation process plan. The reviewer should also utilize SRP Chapter 18 and applicable sections of SRP Chapter 13. Other sources should include applicable rules and regulations, Regulatory Guides, USIs and GSIs, and operating experience.

The staff developed NUREG-0711 to serve as a technical basis for the review of the design process and design acceptance criteria (DAC) for certification of the standard plant control room and remote shutdown station design. The NUREG-0711 is (1) based upon currently accepted HFE practices, (2) well-defined, and (3) validated through experience with the development of complex, high-reliability systems in other industrial and military applications. The review model identifies the important HFE elements in a system development, design, and evaluation process that are necessary and sufficient requisites to successful integration of human factors in complex systems. The review model also identifies aspects of each HFE element that are key to a safety review, and describes acceptance criteria by which the HFE elements can be evaluated. NUREG-0711 has ten program elements, each of which contain both general and more specific acceptance criteria.

### Design Processes and Design Acceptance Criteria (DAC)

10 CFR Part 52 requires applicants for design certification to meet the TMI requirements in 10 CFR 50.34(f)(2)(iii) for providing a control room design that reflects state-of-the-art human factors principles. Applicants may not develop a final control room and remote shutdown

station design before design certification because this is an area of rapidly changing technology. Instead, applicants may provide the processes and acceptance criteria in Tier 1 and the detailed supporting information in DCD Tier 2 Chapter 18 by which the details of the design in this area would be developed, designed, and evaluated. In lieu of having a completed control room design for review, the reviewer must base his safety determination on an acceptable process for the design of the control room. In addition, applicants must submit a description of a minimum inventory of displays, controls, and alarms necessary to accomplish the Generic Technical Guidelines (e.g., EPGs, ERGs) and critical operator actions identified through PRA analysis.

If provided by the applicant, the processes and design acceptance criteria in Tier 1 regarding human factors engineering should apply to the human factors design of the main control room and the remote shutdown station of the standard design. The detailed supporting information for the human factors aspects of the main control room and remote shutdown station design should be provided in DCD Tier 2 Chapter 18, "Human Factors Engineering". The implementation of the processes in the final design is the responsibility of the COL applicant or licensee. Design processes and acceptance criteria are discussed further in Appendix A to SRP Section 14.3.

Tier 1 should describe the process to develop the Human-Systems Interface (HSI) design information for the main control room (MCR) and remote shutdown station (RSS) based on human factors systems analyses and human factors principles. A design effort should be directed by a multi-disciplinary HFE design team comprised of personnel with expertise in HFE and other technical areas relevant to the HSI design, evaluation and operations. The HSI design team shall develop a program plan to establish methods for implementing the HSI design through a process of human factors system analyses as discussed in Tier 1, and based on the HSI design implementation process in NUREG-0711. The details of implementation of each stage of the development process should be described in Tier 1, together with the related acceptance criteria. Detailed supporting information should be contained primarily in DCD Tier 2 Chapter 18.

The material in DCD Tier 2 Chapter 18 provides design information and defines design processes that are acceptable for use in meeting the acceptance criteria in Tier 1. However, Tier 2 information may be changed by a COL applicant or licensee referencing the certified design in accordance with a "50.59-like" process specified in the rule certifying the design. The staff bases its safety determinations on the design processes specified in Tier 2. Therefore, for the evolutionary designs, the staff designated selected information in DCD Tier 2 Chapter 18 that, if considered for a change, requires NRC approval prior to implementation. This information is known as Tier 2\* information (see Appendix A to SRP Section 14.3 for instructions on designating information in Tier 2 as Tier 2\*). Similar information should be considered on a design-specific basis for all standard designs. However, the staff allowed some of the Tier 2\* designation to expire after first full power operation of the facility, when the detailed design was complete and the facility performance characteristics were known from the startup and power ascension test programs. The NRC bears the final responsibility for designating which material in Tier 2 is Tier 2\*.

## Minimum Inventory of Displays, Alarms and Controls

The minimum inventory of displays, controls, and alarms should be developed through a task analysis of the operator actions necessary to carry out the Generic Technical Guidelines (e.g., ERGs, EPGs) and PRA critical actions. The staff's evaluation of the resulting minimum inventory encompasses a multi-disciplinary effort consisting of human factors, I&C, PRA, and plant, reactor, and electrical system engineering. The criteria used to determine acceptability of the inventory includes assuring that: (1) the scope of these items in the Generic Technical Guidelines and PRA effort are adequately considered, (2) the task analysis is detailed and comprehensive, (3) RG 1.97, category I variables for accident monitoring are included, and (4) important system displays and controls described in Tier 1 system design descriptions necessary for transient mitigation are included.

The minimum inventory list for the main control room and the controls, displays and alarms required on systems to remotely shutdown the reactor should be included in Tier 1. The items required for operation of the remote shutdown system may be designated on the figures for the individual systems, or listed in the remote shutdown system in Tier 1. Detailed supporting information is contained in Chapter 7 of Tier 2. The individual systems that contained the sensors for the displays, controls, and alarms should be reviewed to ensure that standard ITAAC entries were used to verify their function. The design processes and acceptance criteria specified in Tier 1 for I&C equipment, particularly the verification and validation aspects of the I&C design, will verify proper operation of the I&C aspects of the equipment. Similarly, the design processes and acceptance criteria for HFE contained in Tier 1, particularly the verification and validation aspects of the HFE design, will verify proper design and operation of the equipment for human factors aspects.

The ability of these controls, displays and alarms to function should be checked during operation of the system for the functional tests required by the system ITAAC. Because the intent of the ITAAC is to verify the final as-built condition of the plant, the operation of the system during the completion of the functional tests required in the system ITAAC should be conducted from the MCR. Therefore, the verification that the system can be operated from the MCR need not be a separate ITAAC. Also, because the operation of the equipment from the control room demonstrates the control function, continuity checks between the RSS and the equipment demonstrates that the control signal will be received by the component and provides adequate assurance that the equipment can be operated by the RSS. The results of the pre-operational test program may be utilized to demonstrate the ability to operate plant equipment by the RSS.

### III. REVIEW PROCEDURES

1. Follow the general procedures for review of Tier 1 contained in the Review Procedures section of SRP Section 14.3. Ensure that the DCD is consistent with Appendix A to SRP Section 14.3. Review responsibilities may be consistent with those in Appendix B to SRP Section 14.3.
2. Ensure that all Tier 1 information is consistent with Tier 2 information. Figures and diagrams should be reviewed to ensure that they accurately depict the functional arrangement and requirements of the systems. Reviewers should use the Review

Checklists in Appendix C to SRP Section 14.3 as an aid in establishing consistent and comprehensive treatment of issues.

3. Ensure that the human factors engineering aspects of the design are clearly described in Tier 1, including the key performance characteristics and safety functions of SSCs based on their safety significance.
4. The reviewer should ensure that appropriate guidance is provided to other branches such that the minimum inventory of alarms, displays and controls in Tier 1 is treated in a consistent manner among branches.
5. Ensure that the standard ITAAC entries (see Appendix D to SRP Section 14.3) for main control room configuration and the remote shutdown station are included where appropriate in the systems of the standard design.
6. Ensure that design features from the resolutions of selected policy and technical issues are adequately addressed in Tier 1, based on safety significance. Ensure that the appropriate Commission guidance, requirements, bases and resolutions for these items are documented clearly in the SER.
7. Ensure that any Tier 2\* information is clearly designated in Tier 2, and consider expiration of these items at first full power, if appropriate. The staff's basis for designating the information as Tier 2\* and the rationale for its decision that it requires prior NRC approval to change should be specified in the SER (see also the discussion in Appendix A to SRP Section 14.3).

#### IV. EVALUATION FINDINGS

Each review branch verifies that sufficient information has been provided to satisfy the requirements of this SRP section, and concludes that Tier 1 is acceptable. A finding similar to that discussed in the Evaluation Findings section of SRP Section 14.3 should be included in a separate section of the SER.

If the applicant has provided additional material applicable to multiple systems of the design, typically the human factors engineering design processes and their related design acceptance criteria (DAC), then the reviewer should provide a separate evaluation similar to the above for that material.

#### V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this SRP section.

This SRP section will be used by the staff when performing safety evaluations of design certification and combined license applications submitted by applicants pursuant to 10 CFR 52. Except in those cases in which the applicant proposes an acceptable alternative method for

complying with specified portions of the Commission's regulations, the method described herein will be used by the staff in its evaluation of 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.

VI. REFERENCES

1. 10 CFR Part 52, §52.47 "Contents of Applications."
2. 10 CFR Part 52, §52.97 "Issuance of Combined Licenses."
3. NUREG-1503, "Final Safety Evaluation Report Related to the Certification of the Advanced Boiling Water Reactor", Volumes 1 and 2, July 1994.
4. NUREG-1462, "Final Safety Evaluation Report Related to the Certification of the System 80+ Design," Volumes 1 and 2, August 1994.
5. NUREG-0711, "Human Factors Engineering Program Review Model."

**SRP Draft Section 14.3.91**  
Attachment A - Proposed Changes in Order of Occurrence

Item numbers in the following table correspond to superscript numbers in the redline/strikeout copy of the draft SRP section.

Item	Source	Description
1.	<b>Integrated Impact 1542</b>	The scope and content of this proposed SRP section is derived from the requirements of 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants," as well as the guidance in staff SECY papers related to design certification and combined license reviews, and the staff positions established in the Final Safety Evaluation Reports (FSERs) for the evolutionary reactor designs. SRP Section 14.3.9 provides guidance specific to the review of human factors engineering information and related inspections, tests, analyses, and acceptance criteria (ITAAC) provided in applications submitted in accordance with the requirements of 10 CFR 52.

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**SRP Draft Section 14.3.91**  
Attachment B - Cross Reference of Integrated Impacts

<b>Integrated Impact No.</b>	<b>Issue</b>	<b>SRP Subsections Affected</b>
1542	Develop Acceptance Criteria and Review Procedures for review of Certified Design Material (CDM) including associated inspections, tests, analyses and acceptance criteria (ITAAC) for human factors engineering.	All