U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

18.0 HUMAN FACTORS ENGINEERING

REVIEW RESPONSIBILITIES

Primary - Human Factors Assessment Branch (HHFB)

Secondary - None

I. AREAS OF REVIEW[1]

The Human Factors Assessment Branch reviews applicant (e.g., for construction permit (CP); operating license (OL); standard design certification (DC); and combined license (COL)) human factors engineering (HFE) programs. The programs include human system interface (HSI) design and supporting elements such as staffing, training, and procedures. The purpose of these reviews is to improve safety by verifying that accepted human factors engineering practices and guidelines are incorporated into the program design. The HHFB reviews plant designs and conducts audits in support of these reviews.

This chapter describes a comprehensive process for evaluating (1) designs, (2) design processes, and (3) design reviews, submitted by applicants for the broad range of NRC review responsibilities. The chapter identifies 10 specific areas of review that are prerequisites for successful integration of human characteristics and capabilities into nuclear power plant design. These areas of review include:

- HFE Program Management
- Operating Experience Review
- Functional Requirements Analysis and Function Allocation
- Task Analysis
- Staffing

- Human Reliability Analysis
- Procedure Development
- Training Program Development
- Human-System Interface Design
- Human Factors Verification and Validation[2]

While this review process defines 10 areas of review, not all may be applicable to reviewing an applicant's human factors engineering program. Judgement regarding the areas of review to be given attention for an applicant's submittal should be based on evaluation of the information provided by the applicant, the similarity of the associated HFE issues to those recently reviewed for other plants, and the determination of whether items of special or unique safety significance are involved. Also, the relevance of each area of review and the appropriate level of detail of evidence should be considered with respect to such factors as the purpose of the review, the nature of the HFE concerns, the status of the applicant's design process, the scope of the design, and the goal of the review (e.g., design certification, licensing).

Based on the detail provided, the applicant submittals may be reviewed at three levels: program description level, implementation plan level, and completed-area-of-review level, as described below.

1. Program Description Level. For a review at the program description level, it is not necessary that the applicant's submittals include details of the design or analysis methodology because detailed evaluations using the staff's review criteria are beyond the scope of the review. Instead, the review criteria are used to determine whether the program description addresses all relevant topics in sufficient detail to provide an acceptable framework for the development of a detailed implementation plan. The value of the program description level review is that it provides assurance that the implementation plan will address all the staff's review criteria.

2. Implementation Plan Level. This is a review of submittals that describe the methodology proposed by the applicant for addressing HFE in the design. Acceptance at this level provides assurance that the proposed methodology is consistent with the criteria of the applicable area(s) of review. While some implementation plans can be reviewed on their own merits, the staff may request sample analyses that demonstrate the application of the methodology and its results.

3. Completed-Area-of-Review Level. This is a review of finished products of areas of review (e.g., a completed operating experience review, task analysis, or HSI design). Acceptance at this level indicates that all review criteria have been satisfied and that staff concerns have been resolved.

Individual areas of review may be found acceptable at any of the three levels of review described above. For example, for reviews associated with designs that are planned, the review may focus on the adequacy of the plans to incorporate HFE into the design progress. For design efforts that are in progress, the review may focus upon acceptability of specific plans for addressing specific review areas. For the review of a completed design, the review will focus on the acceptability of

completed areas of review, including acceptability of the design and whether or not the work was completed in a manner that was consistent with the staff's criteria.

Review Interfaces[3]

The reviews conducted in this section should be coordinated with those of other Standard Review Plan (SRP) chapters and sections. Important review interfaces are described below.

1. Chapter 7, "Instrumentation and Controls." The Instrumentation and Control Branch (HICB) has primary responsibility for the review activities associated with Chapter 7. Descriptions of HSI components and characteristics addressed by the Chapters 7 and 18 reviews should be consistent. In addition, the results of the Chapter 18 review should be considered, as appropriate, in the conduct of Chapter 7 review activities.

2. Section 13.1.1, "Management and Technical Support Organization." The HHFB has primary responsibility for reviewing the corporate-level management and technical organizations of the applicant and its major contractors under Section 13.1.1. This section addresses the need for clearly defined management and organizational responsibilities with regard to HFE considerations in plant design. Chapter 18, under Acceptance Criteria, includes a comprehensive summary of management's role in ensuring that HFE has been adequately considered in new plant design or in the upgrade/modification of an existing plant. Thus, the reviews of Section 13.1.1 and Chapter 18 should be conducted in a coordinated manner.

3. Section 13.1.2-13.1.3, "Operating Organization." The HHFB has primary responsibility for reviewing specific staffing requirements under Section 13.1.2-13.1.3. In addition, Chapter 18 specifies a systematic analysis of staffing requirements that includes a thorough understanding of task requirements and applicable regulatory requirements. This analysis addresses the requirements from Section 13.1.2-13.1.3 as an input. Reviewers should ensure that staffing requirements addressed under Section 13.1.2-13.1.3, are properly considered in the Chapter 18 analysis.

4. Section 13.2, "Training." The HHFB has primary responsibility for the review of Section 13.2, which provides specific criteria for reviewing training programs for reactor operators in Section 13.2.1 and non-licensed plant staff in Section 13.2.2. Chapter 18 contains an area of review titled "Training Program Development," which provides criteria for the review of the process by which training programs are developed. It addresses the relationship between training development and the overall HFE design process. Thus, these reviews should be conducted in a coordinated manner. Topics from the SRP Chapter 18 area of review that are related to the review of Section 13.2 are cross-referenced.

5. Section 13.5, "Plant Procedures." The HHFB has primary responsibility for the review of general administrative procedures under Section 13.5.1.1, and operating and emergency operating procedures under Section 13.5.2.1. The Quality Assurance and Maintenance Branch (HQMB) has primary responsibility for initial test program procedures under Section 13.5.1.2 and maintenance procedures under Section 13.5.2.2.[4]

Chapter 18 contains an area of review titled "Procedure Development," which provides criteria for the review of a program for procedure development. It emphasizes the procedure development process rather than the actual procedures. Thus, these reviews should be conducted in a coordinated manner. Topics from the Chapter 18 area of review that are related to the review of Section 13.5 are cross-referenced.

6. Chapter 15, "Accident Analysis." Many branches have responsibility for the review of Chapter 15, which addresses anticipated operational occurrences and postulated accidents. Information from analyses conducted to address the criteria of Chapter 15 should be incorporated as an input to the HFE design process, including the development of HSI design and test requirements.

7. The Probabilistic Safety Assessment Branch (SPSB) has primary responsibility for the review of probabilistic risk assessments for site-specific safety risks. The Chapter 18 review area "Human Reliability Analysis" addresses the relationship between HFE activities and probabilistic risk analysis/human reliability analysis (PRA/HRA) activities. Thus, these reviews should be conducted in a coordinated manner.

II. ACCEPTANCE CRITERIA[5]

Acceptance is based upon conformance to the review criteria associated with the following areas of review.

A. HFE Program Management

The objective of this review is to confirm that the applicant has adequately considered the role of HFE and the means by which HFE activities are accomplished. The review should verify that (1) the applicant has identified plans to oversee design and construction of the nuclear facility in accordance with the requirements of 10 CFR 50.34(f)(3)(vii), and 10 CFR 50.34(f)(2)(iii) as described in SRP Section 13.1.1 "Management and Technical Support Organization";[6] (2) the applicant has an HFE design team with the responsibility, authority, placement within the organization, and composition to ensure that the design commitment to HFE is achieved; and (3) the team is guided by an HFE program plan to ensure the proper development, execution, oversight, and documentation of the HFE program. This plan should describe the technical program in sufficient detail to ensure that all aspects of the HSI are developed, designed, and evaluated on the basis of a structured top-down systems analysis using accepted HFE principles.

The HFE program plan should address the following areas as described in Section 2 of NUREG-0711.[7]

1. General HFE Program Goals and Scope. A description of the goals and scope of the HFE program should be provided that addresses the following topics described by Section 2.4.1: HFE program goals, assumptions and constraints, applicable facilities, applicable HSI components, applicable plant personnel, and

the technical basis of the proposed program. The defined scope should be consistent with the goals of the program.

2. HFE Team and Organization. A description of the HFE team and organization should be provided that is consistent with the review criteria for the following topics described by Section 2.4.2: responsibility, organizational placement and authority, composition, and team staffing. The HFE design team should include the expertise described in Appendix A of NUREG-0711.[8] Team staffing should be described in terms of job descriptions and assignments of team personnel.

3. HFE Process and Procedures. A description of the HFE process and procedures should be provided that is consistent with the review criteria for the following topics described by Section 2.4.3: general process procedures, process management tools, integration of HFE and other plant design activities, HFE program milestones, HFE documentation, and HFE subcontractor efforts.

4. HFE Issues Tracking. A tracking system should be available to record and track the status of human factors issues identified during the HFE review, including issues that are (a) known to the industry and defined in the operating experience review and (b) identified throughout the life cycle of the HFE/HSI design, development, and evaluation. A description of the HFE issues tracking system should be provided that is consistent with the review criteria for the following topics described by Section 2.4.4: availability, method, documentation, and responsibility. The tracking system need not be a stand-alone system but may be integrated with other applicant tracking systems.

5. Technical Program. A description of the technical aspects of the HFE program should be provided that is consistent with the review criteria of Section 2.4.5. The description should identify and describe (a) implementation plans, analyses, and evaluation of the areas of review; (b) HFE requirements imposed on the design process including standards and specifications that are sources of HFE requirements; and (c) HFE facilities, equipment, tools, and techniques to be utilized in the HFE program.

B. Operating Experience Review

The objective of this review is to verify that the applicant has identified and analyzed HFE-related problems and issues encountered in previous designs that are similar to the proposed design under review so that these problems and issues may be avoided in the development of the new design. This review should also ensure that positive features of previous designs are retained. The operating experience review (OER) should be conducted in accordance with the review criteria of Sections 3.4.1 and 3.4.2 of NUREG-0711 and Section 3.1.2 of Part 1 of NUREG-0700, Revision 1, and should satisfy requirements of 10 CFR 50.34(f)(3)(i). The scope of this review should address the following:[9]

1. Predecessor/Related Plants and Systems. The review should include information pertaining to human factors issues related to the predecessor plant(s) or highly similar plants and plant systems, as described in criterion 1 of Section 3.4.1 of NUREG-0711.[10]

2. Recognized Industry HFE Issues. The review should address recognized HFE issues of the nuclear power industry. These should include, but not be limited to, the following categories, which are discussed in Appendix B of NUREG-0711[11] and Higgins (1995): unresolved safety issue/generic safety issues, TMI issues, NRC generic letters and information notices, Office for Analysis and Evaluation of Operational Data studies, low power and shutdown issues, and operating plant event reports.

3. Related HSI Technology. The review should address the operating experience of related HSI technology, as described in criterion 3 of Section 3.4.1 of NUREG-0711.[12] For example, if the use of touch screen interfaces is planned, then HFE issues associated with their use should be reviewed.

4. Operator Interviews/Surveys. Operator interviews/surveys should be conducted to determine operating experience for related plants and systems, as described in criterion 4 of Section 3.4.1 of NUREG-0711 and criterion 2 of NUREG-0700, Revision 1.[13]

HFE issues identified from the OER should be analyzed and documented as described in Section 3.4.2 of NUREG-0711 and criteria 3 and 4 of NUREG-0700, Revision 1.[14] This analysis should include identification of (1) human performance issues, problems, and sources of human error and (2) design elements that support and enhance human performance. The analysis of operating experience should be documented in an evaluation report. Each operating experience issue determined to be appropriate for incorporation in the design, but not already addressed in the design, should be documented in the HFE issue tracking system.

C. Functional Requirements Analysis and Function Allocation Analysis

The objective of this review is to verify that (1) functions that are important to plant safety have been defined and (2) the allocation of functions between personnel and plant system elements takes advantage of human strengths and avoids demands that are not compatible with human capabilities. This review area involves two distinct review activities: (1) functional requirements analysis and (2) function allocation.
These analyses should be performed using a structured process reflecting HFE principles, including those described in NUREG/CR-2623, NUREG/CR-3331, and other documents described in criterion 2 of Section 4.4.1 of NUREG-0711.[15]

Functional requirements analysis is the identification and analysis of those functions that must be performed to satisfy plant safety objectives; that is, to prevent or mitigate the consequences of postulated accidents that could cause undue risk to the health and safety of the public. Acceptability of the functional requirements analysis should be based on

the conformance with the review criteria of Section 4.4.2 of NUREG-0711,[16] including the following: identification of safety functions and processes, identification of those processes and functions that have been changed from those of the predecessor plant, documentation of the technical basis for changed processes, a summary description of plant processes, and detailed narrative descriptions of changed processes. An alternative functional requirements analysis method is described in 3.2.2 of NUREG-0700, Revision 1,[17] which includes the following: identification of plant safety functions and systems, identification and selection of operational events, and function description.

Function allocation analysis is the analysis of requirements for plant control and the assignment of control functions to (1) personnel (e.g., manual control), (2) system elements (e.g., automatic control and passive, self-controlling phenomena), and (3) combinations of personnel and system elements (e.g., shared control and automatic systems with manual backup). Function allocation seeks to ensure overall plant safety and reliability by exploiting the strengths of personnel and system elements. Acceptability of the function allocation analysis should be based on conformance with the review criteria of Section 4.4.3 of NUREG-0711 and criterion 6 of Section 3.2.2 of Part 1 of NUREG-0700, Revision 1.[18] In addition, the functional requirements analysis and function allocation analysis should be documented as described in criterion 8 of Section 3.2.2 of Part 1 of NUREG-0700, Revision 1.[19]

D. Task Analysis

Task analysis is the analysis of human performance demands that result from the allocation of functions to personnel and the identification of HSI characteristics needed to support personnel task accomplishment. The objective of this review is to confirm that the applicant's task analysis methods, results, and applications of the results to the HSI design process are all acceptable. The task analysis method should be consistent with criteria 1 to 5 of Section 5.4 of NUREG-0711 and criterion 7 of Section 3.2.2 of Part 1 of NUREG-0700, Revision 1,[20] with respect to the following: task analysis scope, identification and analysis of critical tasks, detailed description of personnel demands (e.g., input, processing, and output), iterative nature of the analysis, and the incorporation of job design issues. The task analysis scope should address the full range of plant operating modes defined in criterion 1 of Section 5.4 of NUREG-0711.[21] The task analysis results should provide evidence that human performance requirements do not exceed human capabilities. The review should indicate that the task analysis results are incorporated into the HSI design process as described in criteria 6 and 7 of Section 5.4 of NUREG-0711,[22] including their use as input to HSI design, procedure development, and personnel training programs. The task analysis should be documented as described in criterion 8 of Section 3.2.2 of Part 1 of NUREG-0700, Revision 1.[23]

E. Staffing

The objective of this review is to verify that the applicant has analyzed the requirements for the number and qualifications of personnel in a systematic manner that includes a thorough understanding of task requirements and applicable regulatory requirements. Acceptability of the staffing analysis should be based on consistency with the review

criteria of Section 6.4 of NUREG-0711.[24] The staffing analysis should address the range of applicable plant conditions and personnel tasks, as described in criterion 1 of NUREG-0711.[25]

The categories of personnel that should be considered should be consistent with the scope defined by the HFE program management plan. Staffing levels should be based on an analysis of (1) staffing requirements described in SRP Section 13.1.2-13.1.3, "Operating Organization," and 10 CFR 50.54;[26] (2) personnel actions required by 10 CFR 50.47 and NUREG-0654 to meet an initial accident response in key functional areas; and (3) other considerations described in criterion 2 of NUREG-0711[27] and Information Notice 95-48.

The staffing analysis should be iterative, as described in criterion 3 of NUREG-0711. It should consider staffing issues identified in other review areas, as described in criterion 4 of NUREG-0711, including operating experience review, functional requirements analysis and function allocation, task analysis, human reliability assessment, HSI design, procedures, and verification and validation. The review should confirm that an analysis has been conducted to identify resulting changes in the demands placed upon plant personnel and determine whether staffing changes are required to address these demands. For the case of regulatory inspections, the review should verify that the applicant has considered staffing issues in a systematic way and has addressed relevant review topics described above.[28]

F. Human Reliability Analysis

Human reliability analysis (HRA) is an evaluation of the potential for and mechanisms of human error that may affect plant safety. The objective of this review is to confirm that the applicant's HRA is performed using acceptable assumptions, data, and methods and that the HRA is integrated with the rest of the HFE design process. In addition, the review should ensure that HRA activities performed in support of the HFE design are coordinated with PRA/HRA analyses required by 10 CFR 50.34(f)(1)(i) and addressed in Section 19.2 and other sections of the SRP.[29]

The HRA method should be consistent with accepted principles and practices of HFE and HRA/PRA, as indicated by the review criteria of Section 7.4.1 of NUREG-0711, including use of a structured, systematic process; performance of HRA early in the design effort and later when the detailed design is available; establishment of a thorough documentation system; use of PRA event/fault trees to support determination of risk-significant human actions; identification of performance shaping factors; use of a screening analysis to identify human actions that are important to plant risk and plant safety; use of human-system analyses and evaluations to provide understanding of task requirements; selection of human error quantification approaches based upon their appropriateness to the types of actions to be analyzed; and the use of sensitivity and uncertainty analyses. In addition, the HRA method should be consistent with the goals and requirements for risk analysis described in NUREG/CR-2300, NUREG/CR-2815, NUREG/CR-3485.

The integration of HRA with the HFE design should be consistent with review criteria 1 to 5 of Section 7.4.2 of NUREG-0711[30] with respect to the following topics. Critical or risk-significant human actions should be identified from the PRA/HRA and should be used as input to the HFE design effort. The human actions that are identified through the initial PRA/HRA should be specifically addressed during task analysis to examine task details and confirm that these tasks are within human performance capabilities. Human actions that are identified as posing serious challenges to plant safety and reliability should be re-examined by function allocation analysis, task analysis, HSI design, or procedure development to change either the operator task or the control and display environment to reduce or eliminate undesirable sources of error. The adequacy of human performance associated with these human actions should be evaluated through verification and validation. Also, HRA assumptions such as decision-making and diagnosis strategies for dominant sequences should be validated by walkthrough analyses with personnel with operational experience using a plant-specific control room mockup, prototype, or simulator.

G. Human-System Interface Design

The objective of this review is to evaluate the HSI design process and the detailed HSI design that is a product of that process. The review should verify that the applicant has appropriately translated function and task requirements to the detailed designs of HSI components, such as alarms, displays, controls, and operator aids, through the systematic application of HFE principles and criteria. This review should verify that the control room design reflects state-of-the-art human factor principles as required by 10 CFR 50.34(f)(2)(iii). Acceptability of the HSI design activity should be based upon review findings that are consistent with the review criteria of Section 8.4 of NUREG-0711.[31]

The scope of HSI design should be consistent with the scope defined in the HFE program plan. For a new plant design, the scope of the HSI design is described in criterion 2 of NUREG-0711[32] and should include the following: overall work environment, workspace layout (e.g., control room and remote shutdown facility layouts), control panel and console design, control and display device layout, and information and control interface design details.

The HSI design process should be organized and documented to support its standardized and consistent use, as described in criterion 1 of NUREG-0711. The definition of HSI requirements, such as display range, accuracy, and precision, should be derived from analyses addressed by earlier review areas, as described in criterion 3 of NUREG-0711. Characteristics of the HSI components should be developed to support human performance and usability, as described in criterion 4 of NUREG-0711. The selection of general HSI design features, such as types of display devices and user input devices, should be based upon evaluations of design alternatives, as described in criterion 5 of NUREG-0711.[33]

The process by which the detailed design is developed for selected general HSI features, layout, and environment should incorporate HFE guidelines, as described in criterion 6

of NUREG-0711. Generic HFE guidance documents should be tailored to the applicant's specific HSI design and documented in a guidance or specification document. Design details, problems and issues that are not well defined by guidelines should be resolved through analyses, as described in criterion 7 of NUREG-0711.[34]

The HSI design should be evaluated in an ongoing fashion to ensure its acceptability for task performance and conformance to HFE criteria, standards, and guidelines, as described in criterion 8 of NUREG-0711. Aspects of the HSI that are at variance with design guidance or for which HFE guidance is lacking should be analyzed to determine that human performance is adequately supported. Evaluations should also be conducted to ensure that the HSI includes all information and controls required to perform operator tasks and that extraneous controls and displays, not required for the accomplishment of any tasks, are excluded. The outcomes of these evaluations and rationale for resulting design decisions should be documented and available for review. The HSI design documentation should also include a detailed HSI description and the basis for the HSI design characteristics, as described in criterion 9 of NUREG-0711.[35]

In addition to the general HFE considerations discussed above, the following specific HSI design guidance should be addressed:

1. Safety parameter display system requirements, as described in 10 CFR 50.34(f)(2)(iv)[36], NUREG-1342, and Supplement 1 of NUREG-0737.

2. Periodic testing of diesel generator units used as onsite electrical power systems at NPPs, as described in Regulatory Guide 1.9.

3. Periodic testing of protection systems actuation functions, as described in Regulatory Guide 1.22.

4. Bypassed and inoperable status indication for NPP safety systems, as described in Regulatory Guide 1.47.

5. Manual initiation of protective actions, as described in Regulatory Guide 1.62.

6. Shared emergency and shutdown electrical systems for multi-unit NPPs, as described in Regulatory Guide 1.81.

7. Instrumentation for light-water-cooled nuclear power plants to access plant and environmental conditions during and following an accident, as described in Regulatory Guide 1.97.

8. Instrumentation setpoints, as described in Regulatory Guide 1.105.

9. Functional criteria for emergency response facilities, as described in NUREG-0696.

10. Guidelines for human factors engineering reviews, as described in Part 2 of NUREG-0700, Revision 1.[37]

H. Procedure Development

The objective of this review is to confirm that the applicant's procedure development program incorporates HFE principles and criteria, along with all other design requirements, to develop procedures that are technically accurate, comprehensive, explicit, easy to utilize, validated, and in conformance with 10 CFR 50.34(f)(2)(ii). Because procedures are considered an essential component of the HSI design, they should be a derivative of the same design process and analyses as the other components of the HSI (e.g., displays, controls, operator aids) and subject to the same evaluation processes. This review addresses the scope of procedures, the development of procedure content, and the integration of procedure development with other HFE design activities.

The scope of procedures should be consistent with the scope of the overall review, as defined by the HFE program plan. The scope of procedures should include the following, as described in criterion 1 of Section 9.4 of NUREG-0711:[38] generic technical guidance, plant and system operations, abnormal and emergency operations, tests (e.g., preoperational, startup, and surveillance), and alarm response. It should also be consistent with the scope described in SRP Sections 13.5.1.1, 13.5.1.2, 13.5.2.1, and 13.5.2.2.[39]

The development of procedure content should be consistent with the guidance provided in SRP Sections 13.5.1.1, 13.5.1.2, 13.5.2.1, and 13.5.2.2.[40] It should also be consistent with criteria 3, 4, and 8 of Section 9.4 of NUREG-0711,[41] which address: (1) the content and use of a procedure writer's guide, (2) the elements of procedure content (e.g., title, statement of applicability), and (3) procedure maintenance and control of updates.

The procedure development process should be integrated with the rest of the HFE design process, as described in criteria 2, 6, 7, and 9 of Section 9.4 of NUREG-0711. In particular, the technical bases of procedures should be based on task analyses, critical or risk-significant actions identified through PRA/HRA, and other sources described in criterion 2 of Section 9.4 of NUREG-0711. All procedures should be evaluated through verification and validation.[42]

I. Training Program Development[43]

The objective of this review is to ensure that the applicant establishes an acceptable process for the development of personnel training that (1) incorporates the elements of a systems approach to training, (2) evaluates the knowledge and skill requirements of personnel, (3) coordinates training program development with the other activities of the HFE design process, and (4) implements training in an effective manner that is consistent with human factors principles and practices. The training program should be developed in accordance with 10 CFR 50.120 and 10 CFR Part 55 to ensure that personnel have the qualifications commensurate with the performance requirements of their jobs and should

address criteria 1 to 15 of Section 10.4 of NUREG-0711 and applicable guidance provided in SRP Section 13.2, "Training."

The overall scope of training should be defined including categories of personnel to be trained, specific plant conditions, specific operational activities, and HSI components, as described in criterion 6 of NUREG-0711. The scope should include personnel participating in the verification and validation of the design. In addition, the roles and qualifications of organizations and personnel involved in the development and conduct of training should be defined, as described in criteria 4 and 5 of NUREG-0711.

A systems approach to training as defined in 10 CFR 55.4 and criterion 3 of NUREG-0711 should be used. Learning objectives should be derived from an analysis that describes desired performance after training. This analysis should include, but not be limited to, training issues identified in the following review areas, as described in criterion 7 of NUREG-0711: operating experience review, function analysis and allocation, task analysis, human reliability assessment, HSI design, plant procedures, and verification and validation. Learning objectives should also be derived from knowledge and skill requirements that are derived from safety analysis reports, system description manuals and operating procedures, facility license and license amendments, licensee event reports, and other documents identified by the staff as being important to training, as described in criterion 8 of NUREG-0711.

The design of the training program should specify procedures and/or methods for the following, as described in criteria 9, 11, 12, 13, and 14 of NUREG-0711: conveying learning objectives to the trainees, evaluating trainee mastery of training objectives, verifying the accuracy and completeness of training course materials, evaluating the overall effectiveness of the training programs, and refining and updating the content and conduct of training. In addition, the design of the training program should define training facilities and resources such as plant-referenced simulators, as described in criterion 10 of NUREG-0711.

J. Verification and Validation

Verification and validation (V&V) evaluations seek to comprehensively determine that the design conforms to HFE design principles and that it enables plant personnel to successfully perform their tasks to achieve plant safety and other operational goals. This element comprises five V&V activities, which should be addressed by the applicant:

1. HSI task support verification is defined as an evaluation to ensure that HSI components are provided to address all identified personnel tasks.

2. HFE design verification is an evaluation to determine whether the design of each HSI component reflects HFE principles, standards, and guidelines.

3. Integrated system validation is a performance-based evaluation of the integrated design to ensure that the HFE/HSI supports safe operation of the plant.

4. Human factors issue resolution verification is an evaluation to ensure that the HFE issues identified during the design process have been acceptably addressed and resolved.

5. Final plant HFE/HSI design verification is intended to ensure that the implementation of the final design of the HSI and supporting systems (e.g., procedures and training programs) conform to the verified and validated design that resulted from the HFE design process.

Requirements related to these V&V activities are provided in Section 11 of NUREG-0711 and Sections 4 and 5 of NUREG-0700, Revision 1,[44] and are discussed below.

The scope of V&V should be consistent with the purpose of the overall review. V&V should address all HSI design requirements defined in the review area for HSI design, including the specific requirements listed in subsection G, above. The general scope of V&V should be consistent with criterion 1 of Section 11.4.1 of NUREG-0711. It should include the following features for all applicable HSI facilities (e.g., main control room, remote shutdown room) defined in the HFE program plan: HSI hardware, HSI software, communications, procedures, workstation and console configurations, design of the overall work environment, and trained personnel. The scope of integrated system validation may be limited to those applicable facilities required for the evaluation of integrated system validation scenarios.

V&V activities should be performed in the order listed above. However, iteration of some steps may be necessary to address design corrections and modifications that occur during V&V. The methods used by the applicant for reviewing and assessing HFE issues and problems and identifying design solutions should be consistent with the guidance of Sections 5.1.2 and 5.2.2 of NUREG-0700, Revision 1.[45]

1. HSI Task Support Verification. This review addresses the method and the results of the HSI task support verification. Acceptance should be based upon review findings that are consistent with the review criteria 1 and 2 of Section 11.4.2 of NUREG-0711. It should be verified that all aspects of the HSI (e.g., alarms, controls, displays, procedures, and data processing) that are required to accomplish human tasks and actions — as defined by the task analysis, emergency operating procedures, and the critical or risk-significant actions of the PRA/HRA — are available through the HSI. It should also be verified that the HSI does not include information, displays, controls, and decorative features that do not support personnel performance. The process by which the HSI task support verification is conducted should be consistent with the review criteria of Section 4.1 of NUREG-0700, Revision 1,[46] with respect to the identification and documentation of unsupported personnel tasks, partially supported personnel tasks, and HSI components that are not justified by personnel task requirements.

2. HFE Design Verification. This review addresses both the method and the results of the HFE design verification. Acceptance should be based upon review

findings that are consistent with the review criteria 1 and 2 of Section 11.4.3 of NUREG-0711. It should be verified that all aspects of the HSI have been designed to be (a) appropriate to personnel task requirements and operational considerations as defined by design specifications and (b) consistent with accepted HFE guidelines, standards, and principles. Deviations from accepted HFE guidelines, standards, and principles should be (a) acceptably justified on the basis of a documented rationale such as trade study results, literature-based evaluations, demonstrated operational experience, or tests and experiments, or (b) documented for resolution/correction. The process by which the HSI is compared against accepted HFE guidelines, standards, and principles should be consistent with Section 4.2.2 of NUREG-0700, Revision 1.[47] Review considerations should include:

a. HSI Sampling. If all HSI components are not addressed individually by HFE design verification, then a multidimensional sampling methodology should be used to assure comprehensive consideration of the safety significance of HSI components, as described in criterion 2 of NUREG-0700, Revision 1.[48] The sampling methodology should select HSI components that reflect a range of: plant conditions, operator functions (e.g., status monitoring, fault detection), task structure (e.g., procedure supported, knowledge-based tasks), interactions between plant personnel (e.g., with the Technical Support Center), critical and risk-significant human actions as defined by the PRA/HRA, and types of HSI components and user-system interaction tasks. In addition the sample should include all HSI components and associated personnel tasks that were identified as problematic during the OER. The sample size should be sufficient to identify all significant safety issues.

b. Guideline Selection. Design-specific HFE guideline documents that are to be used for HFE design verification should be reviewed by the NRC staff for acceptability, as described in criterion 3 of NUREG-0700, Revision 1.[49] If HFE design verification is to be conducted using the HFE guidelines of Part 2 of NUREG-0700, Revision 1, then the individual guidelines should be selected to address the specific characteristics of the HSI by using a selection process similar to that described in criterion 3 of NUREG-0700, Revision 1.[50]

c. HSI Evaluation. The HFE design verification should address: global features, standardized features, and detailed features, as described in criterion 4 of NUREG-0700, Revision 1.[51] For the case of an upgrade or modification of the HSI, consideration should be given to: verifying that all functional uses of the former design have been addressed, evaluating the integration of the design upgrade/modification with the rest of the HSI, and evaluating the integration of the design upgrade/modification with procedures and training.

d. Documentation. Deviations of HSI characteristics from HFE guidance should be documented in terms of the HSI component involved and how its characteristics depart from a particular guideline, as described in criterion 5 of NUREG-0700, Revision 1.[52]

3. Integrated System Validation. Acceptance of integrated system validation should be based upon review findings that are consistent with the review criteria of Section 11.4.4 of NUREG-0711 and Section 4.3 of Part 1 of NUREG-0700, Revision 1.[53] Integrated system validation should be performed after HFE problems identified in earlier review activities have been resolved or corrected because these may negatively affect performance and, therefore, validation results. The methodology for integrated system validation should address the areas identified in criterion 1 of NUREG-0711. Validation should be performed by evaluating dynamic task performance using tools that are appropriate to the accomplishment of this objective, as described in criterion 2 of NUREG-0711. The primary tool for this purpose is a simulator; that is, a facility that physically represents the HSI configuration and that dynamically represents the operating characteristics and responses of the plant design in real time. The requirement to validate performance at HSI components located outside of the main control room, such as remote shutdown panels and local control stations, will be dependent on the applicant's design. Human actions at facilities outside of the main control room may be evaluated using mockups, prototypes, or similar tools. Review considerations for conducting limited-scope evaluations using walk-through evaluations are described in criterion 4 of NUREG-0700, Revision 1.[54]

The objectives of validation evaluations should be consistent with criterion 3 of NUREG-0711 and criterion 1 of NUREG-0700, Revision 1.[55] All critical or risk-significant human actions as defined by the task analysis and the PRA/HRA should be tested and found to be adequately supported in the design, including the performance of such actions outside the control room. The design of tests and evaluations to be performed as part of HFE V&V activities should specifically examine these actions. The validation should evaluate selected activities based on procedures that are developed to address requirements of Appendix A of Regulatory Guide 1.33. Relevant categories of procedures are described in criterion 5 of NUREG-0711. The HSI should be dynamically evaluated under a range of operational conditions and upsets, including those described in criterion 6 of NUREG-0711. Scenarios should address the criteria for realism described in item 7 of NUREG-0711. Performance measures for dynamic evaluations should be adequate to test the achievement of all objectives, design goals, and performance requirements and should include the specific measures described in criterion 8 of NUREG-0711 and criterion 5 of NUREG-0700, Revision 1. Deviations from the acceptance criteria for the performance measures should be identified and documented according to criteria 6 and 7 of NUREG-0700, Revision 1.[56]

4. Issue Resolution Verification. Acceptance of issue resolution verification should be based upon review findings that are consistent with review criteria 1 and 2 of Section 11.4.5 of NUREG-0711. All issues documented in the HFE issue tracking system should be verified as adequately addressed. Issues that can not be resolved until the HSI design is constructed, installed, and tested should be specifically identified and incorporated into the final plant HFE/HSI design verification.

5. Final Plant HFE/HSI Design Verification. Final plant HFE/HSI design verification is required if the V&V activities, described above, did not evaluate the actual installation of the final HSI design in the plant. Acceptance of the final plant HFE/HSI design verification should be based upon review findings that are consistent with review criteria 1, 2, and 3 of Section 11.4.6 of NUREG-0711. After completion of the four V&V activities described above, a design description should be developed that describes the detailed design and its performance criteria. Aspects of the design that were not fully addressed in HSI task support verification, HFE design verification, integrated system validation, or human factors issue resolution verification should be evaluated using appropriate V&V methods with the final installed design. These design aspects may include design characteristics such as (a) new or modified displays for plant-specific design features and (b) features that cannot be fully evaluated in a simulator such as control room lighting and noise. It should be verified that the in-plant implementation of the HFE design conforms to the design description that resulted from the HFE design process and V&V activities. In addition, it should be verified that the implemented design's static and dynamic characteristics are acceptably integrated with the rest of the HSI as described in criterion 3 of Section 5.3.2 of Part 1 of NUREG-0700, Revision 1. [57]

Technical Rationale[58]

The NRC bases its HFE review on current regulatory requirements established in 10 CFR 50.34(g), "Conformance with the Standard Review Plan (SRP)," and 10 CFR 50.34(f), "Additional TMI-Related Requirements." The NRC reviews HFE aspects of the HSI to verify that it reflects "state-of-the-art human factors principles" as required by 10 CFR 50.34(f)(2)(iii) and that personnel performance is appropriately supported. For plants licensed under 10 CFR Part 52, the requirements of 10 CFR 50.34 are incorporated under 10 CFR 52.47.

NRC guidance for the systematic, top-down evaluation of HFE was originally provided in NUREG-0700, Revision 0. This document provided a methodology for the review of existing control rooms. It recommended that for new control rooms, that additional analyses be conducted to optimize the allocation of functions to humans and machines and further examine advanced control system technologies. Appendix B of NUREG-0700, Revision 0, was provided as one source of guidance regarding these analyses. The guidance of NUREG-0700, Revision 0, was updated in NUREG-0700, Revision 1, to reflect changes in HFE review concerns and HSI technologies. NUREG-0711 addresses the integration of HFE in the design process and was originally developed to support NRC reviews of submittals for certification of new plant designs under 10 CFR Part 52. However, because it updates the guidance of Appendix B of NUREG-

0700, Revision 0, it should be used for HFE reviews of plant designs licensed under both 10 CFR Part 50 and 10 CFR Part 52. Portions of NUREG-0711 should also be used, as appropriate, to support the NRC in its reviews of re-designs and upgrades of current control rooms. Thus, the HFE review process presented in this SRP chapter incorporates guidance from both NUREG-0700, Revision 1, and NUREG-0711.[59]

Meeting the requirements of 10 CFR 50.34(f), 50.34(f)(2)(iii), and 50.34(g) ensures that plant design, staffing, and operating practices reflect "state-of-the-art human factors principles" thereby providing assurance that plant safety will not be compromised by human error or deficiencies in human interfaces with hardware and software.

III. REVIEW PROCEDURES[60]

Review materials should be submitted by the applicant for each review area. The types of reports that the applicant may submit are described in criterion 3 of Section 1.4.4 of NUREG-0711.[61] These include:

A.[62] Implementation Plan. A report that gives the applicant's proposed methodology for meeting the acceptance criteria of the area of review.

B. Analysis Results Report. A report that gives the results of the applicant's efforts in an area of review with respect to the review criteria. A reviewer will utilize the report as the main source of information for assessing the review criteria.

C. Design Team Review Report. A report from the applicant's design team that provides the independent evaluation of the activities addressed by the review area.

The implementation plan may be used as input for a review conducted at the implementation plan level. The analysis results report and the design team review report may be used as input for a review conducted at the completed-area-of-review level.

It is not intended that submittals necessarily be provided as three separate reports. Rather it is important that all three types of information be available to the reviewer; that is, methodology, results, and review. In some cases an applicant may choose to provide this information in a single report. It is also possible that, for more complex areas of review, such as HSI design or V&V, more than three reports may be submitted in order to address all review criteria. In addition to these reports, the reviewer may review sample work products (e.g., analyses and implemented designs).

The following are descriptions of special submittals and review considerations for specific areas of review:

1. HFE Program Management. The applicant should provide an HFE program plan instead of the implementation plan, analysis results report, and HFE design team evaluation report that are required for other review areas.

2. Human Reliability Analysis. The reviewers should review the PRA/HRA report(s) to gain a better understanding of the analysis method and results.

3. Human-System Interface Design. Other design-related HSI documents may be reviewed, such as applicant-developed guidance documents, detailed trade studies, technology assessments, or test/experiment reports developed to support the HSI design. In addition, a variety of mockups, prototypes, or similar physical representations of the HSI design may be available for preliminary review of the design implementation.

4. Verification and Validation. The HFE issues tracking system, described in Section 2.4.4 of NUREG-0711,[63] should be reviewed. The actual HSI design or a high-fidelity prototype or simulator of the HSI should be available for the staff to examine in conjunction with the verification reviews. In addition, the staff may witness the integrated system validation evaluations. A documented description of the final HSI design that resulted from the HSI task support verification, HFE design verification, integrated system validation, and issue resolution verification activities should be reviewed. Finally, the installation of completed design in the plant should be reviewed, if time and resources permit it.

For standard design certification reviews under 10 CFR Part 52, the procedures above should be followed, as modified by the procedures in SRP Section 14.3 (proposed), to verify that the design set forth in the standard safety analysis report, including inspections, tests, analysis, and acceptance criteria (ITAAC), site interface requirements and combined license action items, meet the acceptance criteria given in subsection II. SRP Section 14.3 (proposed) contains procedures for the review of certified design material (CDM) for the standard design, including the site parameters, interface criteria, and ITAAC.[64]

IV. EVALUATION FINDINGS

Acceptability of an individual area of review may be based on:

A.[65] Satisfying all associated review criteria.

B. Demonstrating by alternative means that all review criteria have been satisfied. Alternative analysis methods proposed by the applicant must be acceptable to the NRC. In addition, the required amount of evidence may be reduced for some areas of review if it can be shown that the new design does not significantly differ from an accepted predecessor design and that no unresolved human factors issues exist.

C. Providing an acceptable justification for deviations from review criteria. Depending upon the review area and the nature of the deviation from review criteria, these justifications may be based upon such evidence as analyses of recent literature, analyses of current practices and operational experience, tradeoff studies, and the results of engineering experiments and evaluations.

An overall review conclusion is determined by comparing the goals of the HFE review, which are based on the type and purpose of the HFE review, to the evidence provided by the review. Important considerations include:

1. Were all relevant areas of review examined?

2. Was each area of review reviewed at the appropriate level (e.g., program description level, implementation plan level, and completed-area-of-review level)?

3. Were the findings for each area of review acceptable?

If the evidence provided by the review does not satisfy the goal of the HFE review then additional analysis and design activities may be required of the applicant. These may include: (1) additional analysis and review for areas the have not been examined at the completed-area-of-review level and (2) completion of the design or correction of design deficiencies identified through the review.

V. IMPLEMENTATION

This section is intended to provide guidance to applicants 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 license applications submitted by applicants pursuant to 10 CFR 50 or 10 CFR 52.[66] Except in those cases in which the applicant proposes an acceptable alternative method for complying with specific 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.[67]

VI. REFERENCES

1. Higgins, J., "HFE Insights for Advanced Reactors Based Upon Operating Experience," BNL Technical Report E2090-T4-3-1/95, Brookhaven National Laboratory, Upton, New York, 1995.

2. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

3. 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

4. 10 CFR Part 55, "Operator's Licenses."

5. NUREG-0654, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants."

6. NUREG-0696, "Functional Criteria for Emergency Response Facilities."

7. NUREG-0700, Revision 1, "Human-System Interface Design Review Guideline."[68]

8. NUREG-0711, "Human Factors Engineering Program Review Model."[69]

9. NUREG-0737 and supplement 1, "Clarification of TMI Action Plan Requirements."

10. NUREG-1342, "A Status Report Regarding Industry Implementation of Safety Parameter Display Systems."

11. NUREG/CR-2300, "PRA Procedures Guide: A Guide to the Performance of Probabilistic Risk Assessments for Nuclear Power Plants."

12. NUREG/CR-2623, "The Allocation of Functions in Man-Machine Systems: A Perspective and Literature Review."

13. NUREG/CR-2815, "Probabilistic Safety Analysis Procedures Guide."

14. NUREG/CR-3331, "A Methodology for Allocation of Nuclear Power Plant Control Functions to Human and Automated Control."

15. NUREG/CR-3485, "PRA Review Manual."

16. Regulatory Guide 1.9, "Selection, Design, Qualification, and Testing of Emergency Diesel Generator Units Used as Class 1E Onsite Electric Power Systems at Nuclear Power Plants."

17. Regulatory Guide 1.22, "Periodic Testing of Protection System Actuation Functions."

18. Regulatory Guide 1.47, "Bypassed and Inoperable Status Indication for NPP Safety Systems."

19. Regulatory Guide 1.62, "Manual Initiation of Protective Actions."

20. Regulatory Guide 1.81, "Shared Emergency and Shutdown Electrical Systems for Multi-Unit NPPs."

21. Regulatory Guide 1.97, "Instrumentation for Light-Water-Cooled Nuclear Power Plants To Assess Plant and Environmental Conditions During and Following an Accident."

22. Regulatory Guide 1.105, "Instrumentation Setpoints."

23. Regulatory Guide 1.108, "Periodic Testing of Diesel Generator Units Used as Onsite Electric Power Systems at NPPs."

24. Information Notice 95-48, "Results of Shift Staffing Study".

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

Item	Source	Description
1.	SRP-UDP format item	Identified scope and appropriate level of detail for each stage of the human factors engineering review described in Chapter 18.
2.	Integrated Impact No.1545	The ten areas of review described in this subsection were taken directly from NUREG-0711, "Human Factors Engineering Program Review Model" and are described in greater detail in that document.The NRC considers the changes associated with NUREG-0711 to be Type I based, in part, on the following:The Human Factors Engineering Program Review Model that is cited in the evolutionary plant FSERs, and was provided to the Commission in SECY 92-299 and subsequently approved, was formalized as NUREG-0711. Although there are some differences between the documents, NUREG-0711 does not impose any new requirements or staff positions with regard to procedure development programs.
3.	SRP-UDP format item	Added "Review Interfaces" to identify related SRP section reviews that should be coordinated with the Chapter 18 review.
4.	Editorial	Existing SRP Sections 13.5.1 and 13.5.2 have been subdivided and renumbered. The changes to the Section numbers reflect this change.
5.	SRP-UDP format item	Developed acceptance criteria section based primarily on the requirements of 10 CFR 50.34(f), 50.34(f)(2)(iii), and 50.34(g) and human factors engineering (HFE) elements provided in NUREG-0711. For specific criteria, many of the criteria within NUREG-0700 and NUREG-0711 were adopted by reference.
6.	SRP-UDP format item	Referenced SRP Section 13.1.1, which addresses the applicant's plans for overseeing the design and construction of the plant, to ensure a coordinated review of Chapters 13 and 18
7.	Integrated Impact No.1545	Incorporated reference NUREG-0711 as it pertains to the HFE program plan
8.	Integrated Impact No.1545	Incorporated reference NUREG-0711 as it pertains to the HFE design team
9.	Integrated Impact Nos. 1544 and1545	Incorporated reference NUREG-0711 and NUREG-0700, Revision 1, as they relate to satisfying the requirements of 10 CFR 50.34(f)(3)(i)

Item	Source	Description
10.	Integrated Impact No.1545	Incorporated reference NUREG-0711 as it pertains to the human factors issues related to the predecessor plant(s) or highly similar plants and plant systems
11.	Integrated Impact No.1545	Incorporated reference NUREG-0711 as it pertains to unresolved safety issue/generic safety issues, TMI issues, NRC generic letters and information notices, Office for Analysis and Evaluation of Operational Data studies, low power and shutdown issues, and operating plant event reports
12.	Integrated Impact No.1545	Incorporated reference NUREG-0711 as it pertains to operating experience of related HSI technology
13.	Integrated Impact Nos. 1544 and1545	Incorporated reference NUREG-0711 and NUREG-0700, Revision 1, as they relate to operator interviews/surveys conducted to determine operating experience for related plants and systems
14.	Integrated Impact Nos. 1544 and1545	Incorporated reference to NUREG-0711 and NUREG-0700, Revision 1, as they relate to the documentation and analysis of HFE issues
15.	Integrated Impact No.1545	Incorporated reference NUREG-0711 as it pertains to analyses performed using a structured process reflecting HFE principles
16.	Integrated Impact No.1545	Incorporated reference NUREG-0711 as it pertains to the functional requirements analysis
17.	Integrated Impact No. 1544	Incorporated reference NUREG-0700, Revision 1, as it relates to the identification of plant safety functions and systems, identification and selection of operational events, and function description
18.	Integrated Impact Nos. 1544 and1545	Incorporated reference to NUREG-0711 and NUREG-0700, Revision 1, as they relate to function allocation analysis
19.	Integrated Impact No. 1544	Incorporated reference NUREG-0700, Revision 1, as it relates to the functional requirements analysis, function allocation analysis, and documentation of the analyses
20.	Integrated Impact Nos. 1544 and1545	Incorporated reference to NUREG-0711 and NUREG-0700, Revision 1, as they relate to task analysis methodology
21.	Integrated Impact No.1545	Incorporated reference NUREG-0711 as it pertains to the task analysis scope of a new plant design
22.	Integrated Impact No.1545	Incorporated reference NUREG-0711 as it pertains to the task analysis results being incorporated into the HSI design process
23.	Integrated Impact No. 1544	Incorporated reference NUREG-0700, Revision 1, as it relates to task analysis documentation

Item	Source	Description
24.	Integrated Impact No.1545	Incorporated reference NUREG-0711 as it pertains to the staffing analysis
25.	Integrated Impact No.1545	Incorporated reference NUREG-0711 as it pertains to the staffing analysis addressing the range of applicable plant conditions and personnel tasks
26.	SRP-UDP format item	Referenced SRP Section 13.1.2-13.1.3, which addresses the staffing requirements for the operating organization, to ensure a coordinated review of Chapters 13 and 18
27.	Integrated Impact No.1545	Incorporated reference NUREG-0711 as it pertains to the staffing considerations
28.	Integrated Impact No.1545	Incorporated reference NUREG-0711 as it pertains to the staffing considerations
29.	SRP-UDP format item	Referenced 10 CFR 50.34(f)(1)(i), addressed in Section 19.2 and other sections of the SRP, to ensure a coordinated review of Chapters 18 and 19
30.	Integrated Impact No.1545	Incorporated reference NUREG-0711 as it pertains to the integration of HRA with the HFE design
31.	Integrated Impact No.1545	Incorporated reference NUREG-0711 as it pertains to the acceptability of the HSI design activity
32.	Integrated Impact No.1545	Incorporated reference NUREG-0711 as it pertains to the scope of HSI design
33.	Integrated Impact No.1545	Incorporated four specific NUREG-0711 references pertaining to the scope of HSI design process
34.	Integrated Impact No.1545	Incorporated two specific NUREG-0711 references pertaining to the HSI design process
35.	Integrated Impact No.1545	Incorporated two specific NUREG-0711 references pertaining to the HSI design process performance and documentation
36.	Editorial	Added reference to 10 CFR 50.34(f)(2)(iv) which provides the regulatory requirement for implementation of TMI Action Item I.D.2 from NUREG-0737 related to SPDS. NUREG-0737 is already referenced in the text and thus this is not an addition of a new requirement and can be considered editorial.
37.	Integrated Impact No.1544	Incorporated reference to NUREG-0700, Revision 1, as it relates to HSI design requirements.
38.	Integrated Impact No.1545	Incorporated reference NUREG-0711 as it pertains to the scope of procedures

Item	Source	Description
39.	SRP-UDP format item	Referenced SRP Sections 13.5.1.1, 13.5.1.2, 13.5.2.1, and 13.5.2.2, which address the development of procedures, to ensure a coordinated review of Chapters 13 and 18.Note that the SRP numbers were changed during the SRP-UDP integration task to reflect the new structure and numbering for these sections.
40.	Editorial	Existing SRP Sections 13.5.1 and 13.5.2 have been subdivided and renumbered. The change reflects the new numbering.
41.	Integrated Impact No.1545	Incorporated reference NUREG-0711 as it pertains to the development of procedure content
42.	Integrated Impact No.1545	Incorporated two specific NUREG-0711 references pertaining to the procedure development process
43.	Integrated Impact No.1545	Incorporated numerous specific NUREG-0711 references pertaining to the training of staff
44.	Integrated Impact Nos. 1544 and 1544	Incorporated NUREG-0711 and NUREG-0700, Revision 1, as they relate to verification and validation (V&V) evaluations
45.	Integrated Impact No. 1544	Incorporated reference NUREG-0700, Revision 1, as it relates to methods for reviewing and assessing HFE issues and problems and identifying design solutions
46.	Integrated Impact No. 1544	Incorporated reference NUREG-0700, Revision 1, with respect to the identification and documentation of unsupported personnel tasks, partially supported personnel tasks, and HSI components that are not justified by personnel task requirements
47.	Integrated Impact No. 1544	Incorporated reference NUREG-0700, Revision 1, with respect to the process by which the HSI is compared against accepted HFE guidelines, standards, and principles
48.	Integrated Impact No. 1544	Incorporated reference NUREG-0700, Revision 1, with respect to a multidimensional sampling methodology for HFE design verification
49.	Integrated Impact No. 1544	Incorporated reference NUREG-0700, Revision 1, with respect to design-specific HFE guideline documents that are to be used for HFE design verification
50.	Integrated Impact No. 1544	Incorporated reference NUREG-0700, Revision 1, with respect to addressing the identification of specific characteristics of the HSI using an acceptable selection process
51.	Integrated Impact No. 1544	Incorporated reference NUREG-0700, Revision 1, with respect to global, standardized, and detailed features

Item	Source	Description
52.	Integrated Impact No. 1544	Incorporated reference NUREG-0700, Revision 1, with respect to the documentation of any deviations of HSI characteristics from HFE guidance
53.	Integrated Impact No. 1544	Incorporated reference NUREG-0700, Revision 1, with respect to review findings
54.	Integrated Impact No. 1544	Incorporated reference NUREG-0700, Revision 1, with respect to review findings
55.	Integrated Impact No. 1544	Incorporated reference NUREG-0700, Revision 1, with respect to the objectives of validation evaluations
56.	Integrated Impact No. 1544	Incorporated reference NUREG-0700, Revision 1, with respect to performance measures for dynamic evaluations and deviations from the acceptance criteria for the performance measures
57.	Integrated Impact No. 1544	Incorporated reference NUREG-0700, Revision 1, with respect to the integration of static and dynamic characteristics with the rest of the HSI
58.	SRP-UDP format item	Developed technical rationale for HFE acceptance criteria based on the requirements of 10 CFR 50.34(f), 50.34(f)(2)(iii), and 50.34(g).
59.	Integrated Impact Nos. 1544 and1545	Provided technical rationale for the use of NUREG-0700, Revisions 0 and 1, and NUREG-0711 in SRP Chapter 18
60.	SRP-UDP format item	Developed a review procedure subsection for HFE submittals described in sections 1 and 2 of NUREG-0711.
61.	Integrated Impact No.1545	Incorporated reference NUREG-0711 as it pertains to the types of material and reports to be submitted by the applicant or licensee
62.	Editorial, Format Item	Paragraphs 1. - 3. were redesignated A - C, during SRP-UDP integration task implementation, to eliminate repetitive numbering that could add confusion when citing paragraphs in Subsection III (i.e., under the current numbering system there would be two paragraphs III.1, III.2 and III.3)
63.	Integrated Impact No.1545	Incorporated reference NUREG-0711 as it pertains to the review of the HFE issues tracking system
64.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard paragraph to address application of Review Procedures in design certification reviews.

Item	Source	Description
65.	Editorial, Format Item	Paragraphs 1. - 3. were redesignated A - C, during SRP-UDP integration task implementation, to eliminate repetitive numbering that could add confusion when citing paragraphs in Subsection IV (i.e., under the current numbering system there would be two paragraphs IV.1, IV.2 and IV.3)
66.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard sentence to address application of the SRP section to reviews of applications filed under 10 CFR Part 52, as well as Part 50.
67.	SRP-UDP Guidance	Added standard paragraph to indicate applicability of this section to reviews of future applications.
68.	Integrated Impact No. 1544	Listed NUREG-0700, Revision 1, in REFERENCES subsection
69.	Integrated Impact No. 1545	Listed NUREG-0711 in the REFERENCES subsection.

Integrated Impact No.	Issue	SRP Subsections Affected
1544	Develop new SRP Chapter 18, Human Factors Engineering, incorporating guidance in NUREG-0700, Revision 0, "Guidelines for Control Room Design Reviews," and in NUREG-0700, Revision 1, "Human-System Interface Design Review Guideline."	Throughout subsection II, ACCEPTANCE CRITERIA Subsection VI, REFERENCES
1545	Develop new SRP Chapter 18, Human Factors Engineering, incorporating guidance on each of the elements described in NUREG-0711, "Human Factors Engineering Program Review Model."	Subsections I, second paragraph Throughout subsection II, ACCEPTANCE CRITERIA Throughout subsection III, REVIEW PROCEDURES Subsection VI, REFERENCES