



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

18.2 Safety Parameter Display System (SPDS)

REVIEW RESPONSIBILITIES

- Primary - Human Factors Engineering Branch (HFEB)
- Secondary - Procedures and Systems Review Branch (PSRB)
 - Instrumentation and Control Systems Branch (ICSB)

I. AREAS OF REVIEW

The principal purpose and function of the Safety Parameter Display System (SPDS) is to aid control room personnel during abnormal and emergency conditions in determining the safety status of the plant and in assessing whether abnormal conditions warrant corrective action by operators to avoid a degraded core. During emergencies the SPDS serves as an aid to evaluating the current safety status of the plant, executing function-oriented emergency procedures, and monitoring the impact of engineered safeguards or mitigation activities. The SPDS also operates during normal operations, continuously displaying information from which the plant safety status can be readily and reliably assessed.

The scope of the staff's review is limited to the principal function of the SPDS. The review is bounded by the minimum set of plant variables, and whatever hardware, software processing algorithms and training are needed to achieve the principal SPDS functions. Secondary functions, such as presentation of data to assist operators with diagnosis of abnormal conditions, are not part of the scope of review under this SRP Section.

Rev. 0 - November 1984

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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.

Review of secondary SPDS functions will be performed by applicants and licensees in the course of the detailed Control Room Design Review (see SRP Section 18.1).

The HFEB has lead responsibility for coordinating the review of the SPDS and specific responsibility for reviewing the incorporation of good human engineering principles in the location and accessibility of the SPDS, formatting of displays, and operator interactive devices.

HFEB, PSRB and ICSB share responsibility for the review of the applicant's verification and validation (V&V) program, including the applicant's program for SPDS design, development and installation testing. HFEB reviews the V&V program for its human performance aspects including the adequacy of applications software characteristics, system response times, verification of the design of display formats, and the ease of understanding and acting on displayed data. ICSB reviews the V&V program for hardware and operating software aspects such as system reliability and sensor accuracy. PSRB reviews the V&V program with regard to the selection and validation of the SPDS parameter set.

ICSB, in addition to reviewing the V&V program, reviews the final design for reliability and availability of SPDS hardware, and the means used to isolate SPDS signals from safety systems and to avoid propagation of electrical faults.

PSRB reviews the adequacy and basis of the parameters selected for display by the applicant to represent the critical plant functions identified in Supplement 1 to NUREG-0737, and the SPDS's relationship to and consistency with emergency operating procedures.

II. ACCEPTANCE CRITERIA

The HFEB acceptance criteria are applied in the review of all ORs, OLs, and CPs in accordance with the following:

- A. The acceptance criteria for licensees and applicants for operating licenses are based on meeting the relevant requirements of Task Action Plan Item I.D.2 of NUREG-0660 as clarified in Supplement 1 to NUREG-0737. The purpose of the review is to determine that the SPDS meets the following requirements of Supplement 1 to NUREG-0737:
 1. An SPDS shall be provided that is located convenient to control room operators.
 2. The SPDS shall continuously display information from which the safety status of the plant can be readily and reliably assessed by control room personnel responsible for the avoidance of degraded and damaged core events.

3. The SPDS shall provide a concise display of critical plant variables which at a minimum shall be sufficient to provide information to plant operators about the following critical safety functions:
 - a. Reactivity control
 - b. Reactor core cooling and heat removal from the primary system
 - c. Reactor coolant system integrity
 - d. Radioactivity control
 - e. Containment conditions

The specific parameters to be displayed shall be determined by the applicant.

4. The SPDS shall be designed to incorporate accepted human factors principles so that the displayed information can be readily perceived and comprehended by SPDS users.

Information, recommendations and guidance that provide a basis acceptable to the staff for implementing the requirements identified above are contained in Appendix A to this SRP section. Examples of acceptable approaches to meeting the SPDS requirements are contained therein. NUREG-0700 contains guidance that will be useful to reviewers on the human engineering aspects of displays, printers, systems analysis and performance validation.

- B. The acceptance criteria for construction permit applicants are based on meeting the relevant requirements of General Design Criterion 19, as it relates to the control room being designed with appropriate human factors engineering design principles to assure that the operator-machine interfaces of the control room are adequate to support safe operations of the plant. Review of applicants' incorporation of the SPDS function will be included in the review performed under Section 18.1 of the Standard Review Plan.

III. REVIEW PROCEDURES

The staff evaluation of the SPDS consists of reviews of the applicant/licensee's documentation (i.e. safety analysis report and implementation plan) and audit meetings/site visits. The procedures below are used to verify that the SPDS meets the acceptance criteria of Subsection II for three categories of applicants/licensees: A) holders of operating licenses that request a pre-implementation review and applicants for operating licenses, B) holders of operating licenses that do not request a pre-implementation review, C) applicants for construction permits that are just starting the control room design process.

- A. Holders of Operating Licenses Requesting Pre-implementation Review and Applicants for Operating Licenses.

1. The HFEB reviewer assures that ICSB and PSRB are provided with copies of the implementation plan and safety analysis report and establishes a schedule with those branches for providing their input to the review.

2. The HFEB reviewer, in coordination with the ICSB and PSRB reviewers, evaluates the applicant/licensee's plan for verification and validation of the SPDS design (submitted as part of the SPDS implementation plan) to confirm that it is sufficient to provide reasonable assurance that the SPDS will meet the requirement that it provide a continuous display of valid and reliable information from which the plant safety status can be readily assessed. The reviewer verifies that the V&V program plan includes elements consistent with those described in Subsection 7 of Appendix A to this SRP section. Conformance with the guidance for a V&V program documented in NSAC-39 is acceptable, as are other V&V programs which the applicant/licensee demonstrates will accomplish the same goals.
3. The HFEB reviewer obtains written input from the PSRB reviewer on the safety analysis report. This input should include PSRB's evaluation of the applicant/licensee's basis on which the parameters selected for display are sufficient to assess the status of the critical safety functions identified in Supplement 1 to NUREG-0737 and are consistent with emergency operating procedures.
4. The HFEB reviewer obtains written input from the ICSB reviewer on ICSB's evaluation of the reliability and availability of the SPDS hardware and operating system software, and the means used to isolate SPDS signals from safety systems and avoid propagation of electrical faults (See Subsection 4.7 of Appendix B to SRP Section 7.1).
5. The HFEB reviewer evaluates the applicant/licensee's safety analysis report and available design documentation to confirm that means are provided to ensure that the data displayed are valid and that the display formats and operational interfaces of the SPDS have been designed to incorporate acceptable human engineering principles. Guidance for this evaluation is found in Subsections 5 and 6 of Appendix A to this SRP section. Additional human engineering guidelines are contained in Section 6 of NUREG-0700, especially Section 6.5, 6.6, 6.7, and 6.8.
6. Three separate audit meetings/site visits, as described below, may be arranged through the Division of Licensing Project Manager. As dictated by the comprehensiveness of the applicant/licensee's documentation and the schedule for design and implementation of the SPDS, the objectives of these audits may be met in fewer site visits.

Design Verification Audit. The purpose of this audit meeting is to obtain additional information required to resolve any outstanding questions about the V&V program, to confirm that the V&V program is being correctly implemented, and to audit the results of the V&V activities to date. At this meeting, the applicant should provide a thorough description of the SPDS design process. Emphasis should be placed on how the applicant is assuring that the implemented SPDS will: provide appropriate parameters, be isolated from safety systems, provide reliable and valid data, and incorporate good human engineering practice. To the extent dictated by the completeness of the V&V program plan, the HFEB reviewer will arrange for participation of PSRB and ICSB reviewers at this meeting.

Design Validation Audit: After review of all documentation, an audit may be conducted to review the as-built prototype or installed SPDS. The purpose of this audit is to assure that the results of the applicant/licensee's testing demonstrate that the SPDS meets the functional requirements of the design and to assure that the SPDS exhibits good human engineering practice.

Installation Audit. As necessary, a final audit may be conducted at the site to ascertain that the SPDS has been installed in accordance with the applicant/licensee's plan and is functioning properly. A specific concern is that the data displayed reflect the sensor signal which measures the variable displayed. This audit will be coordinated with and may be conducted by the NRC Resident Inspector.

- B. Holders of Operating Licenses That Do Not Request Pre-implementation Review
1. The HFEB reviewer assures that ICSB and PSRB are provided with copies of the licensee's SPDS implementation plan and safety analysis report and establishes a schedule with those branches for providing their input to the review.
 2. The licensee's implementation plan and safety analysis report are reviewed to determine if a serious safety question is posed by the proposed SPDS or if the analysis is seriously inadequate. To accomplish this, the review is directed at (a) confirming the adequacy of the variables selected for display to assess critical safety functions, (b) confirming that the SPDS will be suitably isolated from electrical and electronic interference with equipment and sensors that are used in safety systems, (c) confirming that means are provided to ensure that the data displayed are valid, and (d) confirming that the licensee has committed to a human factors engineering program to ensure that the displayed information can be readily perceived and comprehended so as not to mislead the operator. The HFEB reviewer obtains SER input from the PSRB reviewer on item (a) and from the ICSB reviewer on item (b). The HFEB reviewer is responsible for review of items (c) and (d). Guidelines that will be used to identify serious safety questions or inadequate analyses are specified in Subsection 5 of Appendix A to this SRP section.
 3. A post-implementation audit may be conducted at the site to ascertain that the SPDS fulfills the requirements of Supplement 1 to NUREG-0737, has been installed in accordance with the licensee's plan and is functioning properly. This audit will be coordinated with and may be conducted by the NRC Resident Inspector.

C. Applicants for Construction Permits

Applicants which have not developed a control room design or are in the very early stages of control room design should incorporate the principal function of the SPDS in that design. In the course of the applicant's conduct and documentation of analyses to identify human/machine interface requirements and operator information needs, means for providing aid in determining the safety status of the plant and in assessing whether abnormal conditions warrant corrective action by operators should be established. Staff review of applicants' incorporation of this SPDS function will be included in the review performed under Section 18.1 of the Standard Review Plan.

IV. EVALUATION FINDINGS

The reviewers of an SPDS for holders of operating licenses that request pre-implementation review and reviewers of an SPDS for applicants for operating licenses confirm that sufficient information has been provided in the applicant/licensee's implementation plan, safety analysis report, and SPDS audit meetings, and that the review thereof supports conclusions of the following type to be used in the staff's safety evaluation report:

The safety parameter display system is acceptable and meets the applicable requirements of Supplement 1 to NUREG-0737. This conclusion is based on the following:

1. The variables displayed on the SPDS are sufficient to provide the minimum information required to assess the critical safety functions.
2. The SPDS is suitably isolated from electrical and electronic interference with equipment and sensors that are used in safety systems.
3. Means are provided to ensure that the data displayed are valid.
4. The applicant/licensee has demonstrated that the characteristics of the SPDS displays and other operational interfaces are sufficient to allow reasonable assurance that the information provided will be readily perceived and comprehended by its users.

The reviewers of an SPDS for holders of operating licenses that do not request a pre-implementation review confirm that sufficient information has been provided in the licensee's implementation plan and safety analysis report, and that the review thereof supports conclusions of the following type to be used in the staff's safety evaluation report:

No serious safety questions are posed by the proposed SPDS and implementation may continue. This conclusion is based on the following:

1. The variables selected for display are generally adequate to assess critical safety functions.
2. If implemented as designed, the SPDS will be suitably isolated from plant safety systems.
3. The licensee's design provides means to assure that displayed data are valid.
4. The licensee has committed to conduct a human factors engineering program which will allow reasonable assurance that the information provided will be readily perceived and comprehended by its users.

The conclusion that SPDS implementation may continue does not imply staff confirmation that the SPDS meets the requirements of Supplement 1 to NUREG-0737. Such confirmation can be made after a post-implementation audit or when the staff has otherwise obtained sufficient information.

For construction permit applicants', the SPDS function is reviewed in conjunction with the review performed under Section 18.1 of the Standard Review Plan. That review supports conclusions of the type specified in Section 18.1.

V. IMPLEMENTATION

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

Except in those cases in which the applicant/licensee proposes an acceptable alternative method for complying with specified portions of the Commission's requirements, the method described herein will be used by the staff in its evaluation of conformance with Commission requirements.

Implementation schedules for conformance to parts of the methods discussed herein are contained in the referenced NUREGs and will be applied in the review of all ORs, OLs, and CPs in accordance with the following:

1. Acceptance criteria for Operating Reactors (ORs) and Operating Licenses (OLs) are implemented in accordance with Subsection II A, of this SRP section.
2. Acceptance criteria contained in Subsection II B of this SRP section are applied to all future CP application reviews.

VI. REFERENCES

1. General Design Criteria 19, "Control Room."
2. NUREG-0660, "NRC Action Plan Developed as a Result of the TMI-2 Accident," August 1980.
3. NUREG-0737, "Clarification of TMI Action Plan Requirements," November 1980
4. Supplement 1 to NUREG-0737, "Requirements for Emergency Response Capability (Generic Letter 82-33)," December 1982.
5. NUREG-0700, "Guidelines for Control Room Design Reviews," September 1981.
6. NSAC-39, "Verification and Validation for Safety Parameter Display Systems," December 1981.
7. SRP Section 18.1.
8. Appendix A to SRP Section 18.2.

BIBLIOGRAPHIC DATA SHEET

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