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

SECTION 9.5.1 FIRE PROTECTION SYSTEM

REVIEW RESPONSIBILITIES

Primary - Auxiliary and Power Conversion Systems Branch (APCSB)

Secondary - Reactor Systems Branch (RSB)
Structural Engineering Branch (SEB)
Mechanical Engineering Branch (MEB)
Materials Engineering Branch (MTEB)
Electrical, Instrumentation and Control Systems Branch (EICSB)

I. AREAS OF REVIEW

The fire protection system (FPS) provides essential protection to combat fires that may occur in the plant and safety-related components and systems. It provides for warning, alarm, and the initiation of automatic and manual systems for containment or control, suppression, and extinguishing of fires.

The APCSB review of the FPS includes an evaluation of the fire potential as described in the applicant's safety analysis report (SAR), and a review of the design layout of the FPS showing the system characteristics and locations which define the "fire prevention" and "fire protection" portions of the system. The review also includes the description, identification, and types of fire hazards that can exist and fire risk evaluations for each of the postulated hazards.

1. The APCSB reviews the total integrated FPS and its subsystems with regard to the following:

   a. The selection of fire fighting methods, manual or automatic equipment, and safety devices, including the detection, suppression, control, and extinguishing systems as described in the SAR.

   b. The selection of appraisal and trend evaluation systems to be used, and the design of the fire detection and alarm system.

   c. The general plan for performing inspection checks and the frequency of testing to maintain a reliable detection and alarm system.

d. Offsite fire station provisions and plans to provide assistance to the plant as necessary.

2. The APCSB reviews the building and facility arrangements and structural design features which control selection of the methods for fire prevention, control and extinguishing, and control of fire hazards. Fire barriers, use of fire retardant materials, egress routes, fire walls, and the isolation and containment features provided are included.

3. The APCSB determines from the SAR if appreciable amounts of combustibles are to be located on site, and reviews analyses of the effects of these hazards on safety-related equipment located nearby. APCSB verifies that these analyses include a conservative selection of design basis fires, as determined from the quantities of stored combustible materials.

4. The functional performance of extinguishing systems, as described in the SAR, is reviewed to verify the adequacy of the FPS to protect electrical equipment. On multiple unit applications, the additional fire protection and control provisions during construction of the remaining units are reviewed to verify that the integrity of the fire protection system is maintained.

5. The applicant's proposed technical specifications are reviewed for operating license applications as they relate to areas covered in this plan.

Secondary reviews are performed by other branches and the results used by the APCSB to complete the overall evaluation of the system. The secondary reviews are as follows. The KSB will identify essential facilities and systems associated with the reactor that are required to operate during both normal and accident conditions, and determine the appropriate seismic and quality classification for system components. The SEB will verify the acceptability of the design analyses, procedures, and criteria used for seismic Category I supporting structures for the FPS. The MEB will review the seismic qualification of components and confirm that system components, piping, and structures are designed in accordance with applicable codes and standards. The EICSB will evaluate the consequences of failure of the FPS on safety-related electrical equipment and cables and provide consultation on matters concerning the adequacy of instrumentation.

II. ACCEPTANCE CRITERIA

Acceptability of the design of the fire protection system, as described in the SAR, including appropriate sections of Chapters 2, 3, 6, 7, and 9, is based on specific general design criteria and regulatory guides, the use of consensus safety standards and engineering codes applicable to the FPS, and industrial standards and practices with respect to system functions and component selection. An additional basis for determining the acceptability of the FPS will be the compatability of design with the performance requirements.

The design of the fire protection system is acceptable if the integrated system design is in accordance with the following criteria:

1. General Design Criterion 2, as related to structures housing the system and the system itself being capable of withstanding the effects of natural phenomena.

2. General Design Criterion 3, as related to the design and operation of prevention, protection, and detection systems provided to protect the safety-related structures, systems, and components of the reactor facility.

3. General Design Criterion 5, as related to the capability of shared systems and components to perform required functions.

4. Regulatory Guide 1.22, as related to the FPS detection and actuation devices.

5. Regulatory Guide 1.29, as related to the system seismic design classification.

6. Regulatory Guide 1.58, as related to personnel qualifications for inspection and testing of the FPS.

7. Regulatory Guide 1.78, as related to habitable areas such as the control room and the use of specific extinguishing agents.

8. American National Standards Institute (ANSI) consensus standards, Underwriters Laboratories (UL) ratings, and National Fire Prevention Association (NFPA) consensus codes used to evaluate the selection of components and the system design and functions (Refs. 8 and 9).

III. REVIEW PROCEDURES

The procedures below are used during the construction permit (CP) review to determine that the design criteria and bases and the preliminary design as set forth in the preliminary safety analysis report meet the acceptance criteria given in Section II of this plan. For the review of operating license (OL) applications, the procedures are utilized to verify that the initial design criteria and bases have been appropriately implemented in the final design as set forth in the final safety analysis report. The procedures for OL applications include a determination that the content and intent of the technical specifications prepared by the applicant are in agreement with the requirements for system testing, minimum performance, and surveillance developed as a result of the staff's review.

Since more than one designer will be responsible for the design and selection of the FPS, plant-to-plant variations in the design of the FPS and the selection of components will occur. The reviewer will select and emphasize material from the paragraphs below, appropriate to the particular design under review.

1. The information in the SAR is reviewed to determine if it adequately describes the design and operational performance for the total system and subsystems. The review includes system degradation evaluations and the procedures that are followed to detect and correct conditions when such degradation becomes intolerable. The results of a failure mode and effects analysis will be used to determine the capability of the total system and the subsystems of the FPS.

2. The performance specifications for the design of the FPS are reviewed to determine the acceptability of material and component selections, and detection and alarm devices. The review will verify that applicable consensus standards, engineering codes, and reference information have been used to select and develop the FPS.

3. The SAR analysis of the fire potential and the hazard of fires is reviewed to determine that:

   a. Potential fire characteristics for all individual plant areas containing combustible materials have been described and the design basis fires are in accordance with NFPA requirements. This includes maximum fire loading, hazards of flame spread, smoke generation, toxic contaminants, and explosions.

   b. Design characteristics for the suppression systems for smoke, heat, flame control, combustible and explosive gas control, and toxic material and contamination control are acceptable and provide adequate protection for safety-related structures, systems, and components. The reviewer determines that ventilating and exhaust system operations are consistent with these considerations.

   c. Performance requirements of detection systems, alarm systems, automatic suppression systems, manual systems, chemical systems, and gaseous systems for fire detection, confinement, control, and extinguishing are consistent with codes and standards requirements.

   d. Features of facility arrangements and buildings, and structural and containment features which affect the use's used for fire prevention, fire control, and control of hazards are acceptable for the protection of safety-related equipment.

   e. The essential electric circuit integrity needed to mitigate unacceptable consequences of fires corresponds with the standards established by the EICSB, and the protection systems are capable of maintaining the required integrity. Reference to established tests performed by standards organizations will be utilized during the review to determine acceptability.

   f. For multiple unit sites, protection is provided to operating units during concurrent construction of other units. This includes an evaluation of the total fire protection system for each plant or a total overall system for the site. The reviewer determines that the proposed methods for compliance with this arrangement are acceptable.

   g. The testing and inspection proposed during construction, installation and operation stages of the FPS will demonstrate the system is consistent and in compliance with code and standards appropriate for the safety function to be performed.

   h. A program is established for training, updating, and maintaining competence of the appointed station fire fighting staff, and is consistent with appropriate codes and standards.

i. Offsite fire control provisions are readily available if called upon for assistance.

IV. EVALUATION FINDINGS

The reviewer verifies that sufficient information has been provided and that his review supports conclusions of the following type, to be included in the staff's safety evaluation report:

"The fire protection system includes all piping, pumps, valves, manual and automatic controls, and safety devices associated with the system. The scope of the review of the fire protection system for the _____ plant included layout drawings, piping and instrumentation diagrams, and descriptive information for the system and the supporting systems that are essential to its safe operation. [The review has determined the adequacy of the applicant's proposed design criteria and bases for the fire protection system, and the requirements for system performance during all conditions of plant operation. (CP)] [The review has determined that the design of the fire protection system and supporting systems is in conformance with the design criteria and design bases. (OL)]

"The basis for acceptance in the staff review has been conformance of the applicant's designs, design criteria, and design bases for the fire protection system and its supporting systems to the Commission's regulations as set forth in the general design criteria, and to applicable regulatory guides, staff technical positions, and industry standards.

"The staff concludes that the design of the fire protection system conforms to all applicable regulations, guides, staff positions, and industry standards and is acceptable."

V. REFERENCES

1. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."

2. 10 CFR Part 50, Appendix A, General Design Criterion 3, "Fire Protection."

3. 10 CFR Part 50, Appendix A, General Design Criterion 5, "Sharing of Structures, Systems, and Components."

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

5. Regulatory Guide 1.29, "Seismic Design Classification," Revision 1.

6. Regulatory Guide 1.58, "Qualification of Nuclear Power Plant Inspection, Examination, and Testing Personnel."

7. Regulatory Guide 1.78, "Assumptions for Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release."

8. ANSI consensus standards, as applicable, A series, B series, E series, K series, and N series, American National Standards Institute.

9. Engineering society standards, codes, or guides as applicable, from, but not limited to the following: American Nuclear Society (ANS), American Society of Mechanical Engineers (ASME), American Society for Testing and Materials (ASTM), Institute of Electronics and Electrical Engineers (IEEE), National Fire Protection Association (NFPA), National Electrical Manufacturers Association (NEMA), Automatic Fire Alarm Association (AFAA), Underwriters Laboratories (UL), and American Water Works Association AWWA).

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