



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

SECTION 9.5.6

EMERGENCY DIESEL ENGINE STARTING SYSTEM

REVIEW RESPONSIBILITIES

Primary - Auxiliary and Power Conversion Systems Branch (APCSB)

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

I. AREAS OF REVIEW

The APCSB review of the emergency diesel engine starting system EDESS includes those system features necessary to assure reliable starting of the emergency diesel engine following a loss of offsite power. The review includes the system air compressors, air receivers, devices to crank the diesel engine, valves, piping, filters, and associated ancillary instrumentation and control systems.

1. The APCSB reviews the EDESS to verify that:
 - a. Each emergency diesel engine has reliable, redundant starting systems of adequate starting capacity.
 - b. The system complies with appropriate seismic requirements and quality standards, and has been properly designed, fabricated, erected, and tested.
 - c. Essential portions of the system are housed within seismic Category I structures capable of protecting the system from extreme natural phenomena, missiles, and the effects of pipe whip or jet impingement from high and moderate energy pipe breaks.
 - d. A single failure in an emergency engine air starting system will not lead to a loss of function of more than one diesel engine.
2. The applicant's proposed technical specifications are reviewed for operating license applications as they relate to areas covered in this plan.

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 Revision 2 of the Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants. Not all sections of the Standard Format have a corresponding review plan.

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

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

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Secondary reviews are performed by other branches and the results used by the APCSB to complete the overall evaluation of the system. The evaluation performed by others are as follows. The SEB determines the acceptability of the design analyses, procedures, and criteria used to establish the ability of structures housing the system to withstand the effects of natural phenomena such as the safe shutdown earthquake (SSE), the probable maximum flood (PMF), and tornado missiles. The MEB reviews the seismic qualification testing of components and confirms that components, piping, and structures are designed in accordance with applicable codes and standards. The RSB determines that the assigned seismic and quality group classifications for system components are acceptable. The MTEB verifies that inservice inspection requirements are met for system components and, upon request, will verify the compatibility of the materials of construction with service conditions. The EICSB determines the adequacy of the design, installation, inspection, and testing of all essential electrical components (sensing, control and power).

II. ACCEPTANCE CRITERIA

Acceptability of the diesel engine starting system, as described in the applicant's safety analysis report (SAR), is based on specific general design criteria and regulatory guides. An additional basis for acceptability is the similarity of the EDESS design with that of previously reviewed plants having satisfactory operating experience.

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

1. General Design Criterion No. 2, as related to the ability of structures housing the system to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, and floods, as established in Chapters 2 and 3 of the SAR.
2. General Design Criterion No. 4, with respect to structures housing the systems and the system itself being capable of withstanding the effects of external missiles and internally generated missiles, pipe whip, and jet impingement forces associated with pipe breaks.
3. General Design Criterion No. 5, as related to the capability of shared systems and components important to safety to perform required safety functions.
4. Regulatory Guide 1.26 as related to quality group classification of the system components.
5. Regulatory Guide No. 1.29, as related to the system seismic design classification.
6. Branch Technical Positions APCSB 3-1 and MEB 3-1, as related to breaks in high and moderate energy piping systems outside containment.
7. Branch Technical Position EICSB-17, Diesel Generator Protective Trip Circuit Bypasses.
8. The EDESS should also meet the following specific criteria:
 - a. Each diesel engine should be provided with an air compressor and with independent and redundant starting systems, each consisting of an air receiver, injection lines and valves, and devices to crank the engine.

- b. As a minimum, each of the redundant starting systems should be capable of cranking a cold diesel engine five times without recharging the receiver. Each cranking cycle duration should be approximately 3 seconds, or consist of 2 to 3 engine revolutions.
- c. Alarms should be provided which alert operating personnel if the air receiver pressure falls below the minimum allowable value.
- d. Provisions should be made for the periodic or automatic blowdown of accumulated moisture and foreign material in the air receivers.

II. 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 used 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 review 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 during the review. The reviewer will select and emphasize material from the paragraphs below, as may be appropriate for a particular case.

1. The reviewer establishes that the EDESS description and piping and instrumentation drawings (P&IDs) clearly delineate all modes of operation and include the means for monitoring, indicating, and controlling receiver air pressure as required by the engine starting service. The P&IDs are reviewed to determine that each receiver has been provided with a pressure gauge, relief valve, drain valve, an automatic means of maintaining the receiver pressure within an allowable range, and suitable low pressure alarms. If there are piping interconnections between shared systems, they are reviewed to verify that failure could not lead to the loss of starting of more than one diesel engine. The building layout drawings are examined to ascertain that sufficient space has been provided around the components to permit inspection. The reviewer verifies that essential portions of the EDESS are classified seismic Category I.
2. The SAR is reviewed to assure that each diesel engine has its own compressor and that the compressor capacity is adequate with respect to the air receiver capacities of the redundant starting systems.
3. The reviewer verifies that the system has been designed to be operated and maintained in the event of adverse environmental conditions such as hurricanes, tornadoes, or floods, and is protected against the effects of internally or externally generated missiles.
4. The reviewer determines that the failure of non-seismic Category I systems, structures, or components located close to the EDESS will not preclude operation of the system.

5. The reviewer determines that essential portions of the EDESS are protected from the effects of high and moderate energy line breaks. Layout drawings are reviewed to assure that no high or moderate energy piping systems are close to the system, or that protection from the effects of failure are provided. The means of providing such protection are discussed in Section 3.6 of the SAR and the procedures for reviewing this information are given in the corresponding review plans.
6. The SAR information, P&IDs, related system drawings, and failure modes and effects analyses are reviewed to assure that minimum requirements of the system will be met following design bases accidents, assuming a concurrent single active failure and loss of offsite power. The analyses presented in the SAR are reviewed to assure function of required components following postulated accidents. Utilizing the descriptions, related drawings, and analyses, the reviewer verifies that minimum system requirements are met for each degraded situation over the required time spans. For each case the design is considered acceptable if minimum system requirements are met.

IV. EVALUATION FINDINGS

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

"The emergency diesel engine starting system includes the features necessary to assure that the system will be available and capable of starting the diesel engine following a loss of offsite power. The scope of review of the system for the _____ plant included layout drawings, flow diagrams, piping and instrumentation diagrams, and descriptive information for the emergency diesel engine starting system and supporting systems essential to its operation. [The review has determined the adequacy of the applicant's proposed design criteria and design bases for the system, and the provisions necessary for diesel engine starting during all conditions of plant operation. (CP)] [The review has determined that the design of the emergency diesel engine starting system and supporting systems is in conformance with the design criteria and bases. (OL)]

"The basis for acceptance in the review has been conformance of the applicant's designs and design criteria for the emergency diesel engine starting system and necessary 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 emergency diesel engine starting 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 4, "Environmental and Missile Design Bases."
3. 10 CFR Part 50, Appendix A, General Design Criterion 5, "Sharing of Structures, Systems, and Components."
4. Regulatory Guide 1.26, "Quality Group Classifications and Standards For Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," Revision 1.
5. Regulatory Guide 1.29, "Seismic Design Classification," Revision 1.
6. Branch Technical Positions APCSB 3-1, "Protection Against Postulated Piping Failures in Fluid Systems Outside Containment," attached to Standard Review Plan 3.6.1, and MEB 3-1, "Postulated Break and Leakage Locations in Fluid System Piping Outside Containment," attached to Standard Review Plan 3.6.2.

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