



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

SECTION 9.5.7

EMERGENCY DIESEL ENGINE LUBRICATION SYSTEM

REVIEW RESPONSIBILITIES

Primary - Auxiliary and Power Conversion Systems Branch (APCSB)

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

The emergency diesel engine lubrication system (EDELS) provides essential lubrication to the components of the emergency diesel engines. The APCSB reviews the EDELS and associated auxiliary systems. The review includes system piping, pumps, components, and associated ancillary equipment essential for system operation up to the engine housing.

1. The APCSB reviews the characteristics of the EDELS and system components with respect to the effect on functional performance of adverse environmental occurrences, abnormal operational requirements, and accident conditions.
2. The APCSB determines that a malfunction or failure of a component, or the loss of a cooling source does not reduce the safety-related functional performance capabilities of the emergency powered systems. Further, the APCSB review assures that:
 - a. System components and piping have sufficient physical separation or barriers to protect the system from internally and externally generated missiles.
 - b. The system is protected from the effects of pipe cracks or breaks in high and moderate energy piping.
 - c. System components are designed in accordance with the design codes required by the assigned quality group and seismic category classifications.
 - d. The system is housed in structures designed to seismic Category I requirements.
 - e. Failure of non-seismic Category I structures or components will not affect the safety-related functions of the system.

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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3. The APCSB will also review the design of the EDELS with respect to the following:
 - a. Functional capability during abnormally high site water levels (probable maximum flood).
 - b. Capability for detection and control of system leakage.
 - c. Measures to assure the quality of the lubricating oil.
 - d. Capability for isolating portions of the system in the event of excessive leakage or component malfunction.
 - e. Instrumentation and control features provided to permit operational testing of the system and to assure that normal protective interlocks do not preclude engine operation during emergency conditions.

4. The APCSB will review the applicant's proposed technical specifications for operating license applications as they relate to areas covered in this plan.

Secondary reviews will be performed by other branches and the results of their reviews will be used by the APCSB to complete the overall evaluation of the system. The secondary reviews are as follows. The SEB will determine the acceptability of the design analyses, procedures, and criteria used to establish the ability of seismic Category I structures housing the system and supporting systems to withstand the effects of natural phenomena such as the safe shutdown earthquake (SSE), the probable maximum flood (PMF), and tornado missiles. The MEB will review the seismic qualification testing of components and will determine that the components, piping, and structures are designed in accordance with applicable codes and standards. The RSB will determine that the seismic and quality group classifications for system components are acceptable. The MTEB will verify 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 will determine the adequacy of the design, installation, inspection, and testing of all electrical components (sensing, control, and power) required for proper operation of the system.

II. ACCEPTANCE CRITERIA

Acceptability of the emergency diesel engine lubrication system, as described in the applicant's safety analysis report (SAR), is based on specific general design criteria and regulatory guides. The reviewer will also utilize information obtained from other sources such as other federal agencies, published reports, industry standards, military specifications, and technical literature on commercially available products. An additional basis for the acceptability of the system will be the degree of similarity with systems in previously reviewed plants with satisfactory operating experience.

The design of the EDELS is acceptable if the integrated design of the system 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 such as earthquakes, tornadoes, hurricanes, and floods, as established in Chapters 2 and 3 of the SAR.
2. General Design Criterion 4, with respect to structures housing the system 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 5, as related to shared systems and components important to safety being capable of performing required safety functions.
4. Regulatory Guide 1.26, as related to quality group classification of the system components.
5. Regulatory Guide 1.29, as related to the seismic design classification of system components.
6. Branch Technical Positions APCSB 3-1 and MEB 3-1, as related to breaks in high and moderate energy piping outside containment.
7. Branch Technical Position EI&CSB-17 Diesel-Generator Protective Trip Circuit Bypasses.
8. Specific design criteria as follows:
 - a. The operating pressure, temperature differentials, flow rate, and heat removal rate of the system external to the engine are in accordance with recommendations of the engine manufacturer.
 - b. The system has been provided with sufficient protective measures to maintain the required quality of the oil during engine operation.
 - c. Protective measures (such as relief ports) have been taken to prevent unacceptable crankcase explosions and to mitigate the consequences of such an event.
 - d. The temperature of the lubricating oil is automatically maintained above a minimum value by means of an independent recirculation loop including its own pump and heater, to enhance the "first try" starting reliability of the engine in the stand-by condition.

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 OL review includes 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.

The reviewer will select and emphasize material from this plan, as may be appropriate for a particular case.

1. The SAR is reviewed to establish that the EDELS description and related diagrams clearly delineate system operation, including the means provided for indicating and monitoring oil levels, temperatures, and pressures required for continuous operation of the system. The reviewer verifies the following:
 - a. Failure of a piping interconnection, as shown on the system piping and instrumentation diagrams (P&IDs) between subsystems will not cause total degradation of the lube oil system function. The results of failure modes and effects analyses will be used in this determination.
 - b. The system layout drawings are examined to ascertain that sufficient space has been provided to permit inspection of components.
 - c. The system has been designed to preclude the entry of deleterious material into the system due to operator error or extreme natural phenomena during recharging or normal operation. The system is acceptable if it is shown in the SAR that the system is locked closed, or if entry is administratively controlled.
 - d. The design contains an independent circulation loop to maintain the temperature of the crankcase oil above a minimum value during the standby mode.
 - e. The system P&IDs indicate the temperature, pressure, and level sensors which alert the operator when these parameters exceed the ranges recommended by the engine manufacturer.
 - f. Essential portions of the EDELS are classified seismic Category I.
2. The reviewer determines that the system is designed to maintain function under adverse environmental phenomena. The reviewer, using engineering judgment and the results of failures modes and effects analyses, determines that:
 - a. The failure of systems not designed to seismic Category I requirements or of non-seismic Category I structures that house, support, or are close to the EDELS, will not preclude function of the system. Chapters 2 and 3 of the SAR describe related site features and provide the general structural arrangement and layout drawings

and a tabulation of seismic design classifications for the structures and systems. Statements in the SAR to the effect that the above design requirements are met are acceptable.

- b. The essential portions of the system are protected from the effects of floods, hurricanes, tornadoes, and internally and externally generated missiles.
3. The review verifies that the EDELS is protected from the effects of breaks in high and moderate energy lines. The system description in the SAR is reviewed to verify that there are no high or moderate energy piping systems close to the lube oil system, or that protection from effects of failure will be provided. The means of providing such protection are given in Chapter 3 of the SAR and procedures to review the information presented are given in the corresponding standard review plans.
4. The descriptive information, P&IDs, related system drawings, and system analyses in the SAR are reviewed to assure that essential portions of the system will function following design basis accidents, assuming a concurrent single active component failure. The reviewer evaluates the results of failure modes and effects analyses presented in the SAR to assure function of required components, traces the availability of these components on system drawings, and checks that minimum system requirements are met for each degraded situation over required time spans. For each case, the design is acceptable if minimum system requirements are met.

IV. EVALUATION FINDINGS

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

"The emergency diesel engine lubrication system includes the pumps, heat exchangers, valves, piping, makeup piping, and the points of connection or interfaces with other systems. The scope of review of the emergency diesel engine lubrication system for the _____ plant included layout drawings, flow diagrams, piping and instrumentation diagrams, and descriptive information for the system and supporting systems that are essential to its operation. [The review has determined the adequacy of the applicant's proposed design criteria and bases for the emergency diesel engine lubrication system and the requirements for system performance under all conditions of plant operation. (CP)] [The review has determined that the design of the emergency diesel engine lubrication system and auxiliary supporting systems is in conformance with the design criteria and bases. (OL)]

"The basis for acceptance in the staff review has been conformance of the applicant's designs and design criteria for the emergency diesel engine lubrication 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 lubrication 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 the 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.
7. Branch Technical Position EICSB-17, "Diesel-Generator Protective Trip Circuit Bypasses."

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