



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

SECTION 9.5.4

EMERGENCY DIESEL ENGINE FUEL OIL STORAGE
AND TRANSFER SYSTEMREVIEW RESPONSIBILITIES

Primary - Auxiliary and Power Conversion Systems Branch (APCSB)

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

I. AREAS OF REVIEW

Nuclear power plants are required to have redundant onsite emergency power sources of sufficient capacity to power safety-related equipment. In almost all cases, the onsite power sources include diesel engine-driven generator sets. The standard review plans (SRP) numbered 9.5.4 through 9.5.8 cover the review of various essential elements of the emergency diesel engine sets. This plan, SRP 9.5.4, deals with the fuel oil storage and transfer system for these diesel engines up to the engine housing.

The APCSB review of the emergency diesel engine fuel oil storage and transfer system includes all piping up to the connection to the engine, the fuel oil storage tanks, the fuel oil transfer pumps, and the tank storage vaults. In addition, the review includes the quality and the quantity of fuel oil stored on site, and the availability and procurement of additional fuel from offsite sources.

1. The diesel engine fuel oil storage and transfer system is reviewed to determine that:
 - a. The system meets appropriate seismic design requirements.
 - b. The system will be designed, fabricated, erected, and tested to acceptable quality standards.
 - c. Sufficient space has been provided to permit inspection, cleaning, maintenance, and repair of the system.
 - d. A minimum of seven days supply of fuel oil had been provided onsite to meet the engineered safety feature load requirements following a loss of offsite power and a design basis accident.

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. 20546.

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- e. Adequate and acceptable sources of fuel oil are available, including the means of transporting and recharging the fuel storage tank, following a design basis accident (DBA) so as to enable the diesel engines to supply uninterrupted emergency power for as long as may be required.
 - f. Seismic Category I structures housing the system protect it from natural phenomena and external missiles.
2. The APCSB verifies that suitable precautions will be taken to prevent deleterious material from degrading the stored fuel and that periodic tests will be performed to verify that fuel degradation does not proceed to the point where engine performance is affected.
 3. The applicant's proposed technical specifications are reviewed for operating license applications as they relate to areas covered in this plan.

The review of the diesel engine fuel oil storage and transfer system will involve secondary review evaluations performed by other branches. Their evaluations are used by the APCSB to complete the overall system evaluation. The evaluations performed by other branches are as follows. The EICSB will determine the adequacy of the design, installation, inspection, and testing of all electrical components (sensing, control and power) required for reliable operation. The SEB will determine the acceptability of the design analyses, procedures, and criteria used to establish the ability of structures 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 design qualification of components and confirm that components, piping, and structures are designed in accordance with applicable codes and standards. The RSB will determine that the assigned 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.

II. ACCEPTANCE CRITERIA

Acceptability of the diesel engine fuel oil storage and transfer system, as described in the applicant's safety analysis report (SAR), is based on specific general design criteria and regulatory guides and on the proposed standard ANSI N195, "Fuel Oil Systems for Standby Diesel Generators." The review will also utilize information obtained from other federal agencies and reports, industry standards, military specifications, available technical literature, and operational performance data obtained from similarly designed systems at other plants having satisfactory operational experience.

The design of the diesel engine fuel oil storage and transfer system is acceptable if the integrated design of the system is in accordance with the following criteria:

1. General Design Criterion 2, as related to the ability of structures housing the system and the system itself 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 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 the capability of shared systems and component 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 1.29, as related to the seismic design classification of the system.
6. ANSI proposed standard N195, "Fuel Oil Systems for Standby Diesel Generators."
7. Branch Technical Positions APCSB 3-1 and MEB 3-1, as related to breaks in high and moderate energy piping systems outside containment.

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 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. The OL review includes verification that the content and intent of the technical specifications prepared by the applicant are in agreement with requirements for system testing, minimum performance, and surveillance developed as a result of the staff's review.

Plant-to-plant variations in the design of fuel oil storage and transfer systems will occur due to the number of architect-engineering companies having design responsibility in this area. Differences may occur in the number of redundant systems, in piping interconnections between diesel engines, and in sharing requirements between units. The reviewer will select and emphasize material from the paragraphs below to fit the particular design under review.

1. The SAR is reviewed to verify that the diesel engine fuel oil storage and transfer system description and related diagrams clearly indicate all modes of system operation, including the means for indicating, controlling, and monitoring fuel oil level, temperature, and pressure as required for uninterrupted operation.
2. The reviewer verifies that the system is designed to withstand the effects of seismic events, other design basis, natural phenomena, and internally and externally generated missiles. The review of internally generated missiles will consider the relative locations and orientations of components as placed in the facility.

3. Piping and interconnections between systems are reviewed to verify that single active failures will not cause unacceptable results. The associated drawings are examined to ascertain that sufficient space has been provided around the components to permit inspection, cleaning, maintenance, and repair.
4. The reviewer verifies that the design is such as to minimize the chance of deleterious material entering the system during recharging, or by operator error, or due to natural phenomena. The reviewer will ascertain that provisions or a program have been incorporated to assure that the quality of the stored fuel oil meets minimum requirements at all times.
5. The descriptive information and drawings in the SAR are reviewed to verify that:
 - a. Each storage tank is equipped with an outside vent line, located so as to minimize the chance of damage, and with the vent point higher than the PMF flood level and the storage tank fill pipe opening.
 - b. The minimum onsite inventory of fuel oil is sufficient to enable the diesel generators to power required engineered safety features for a period of seven days following any design basis accident and loss of offsite power.
 - c. The day or integral tank associated with each diesel generator set is located at an elevation to assure a slight positive pressure at the engine fuel pumps.
 - d. An overflow line is provided to return excess fuel oil delivered by the transfer pump back to the fuel oil storage tank.
 - e. A low level alarm is provided to enable the operator to accomplish minor repairs or maintenance before all fuel in the day or integral tank is consumed (assuming full power operation).
6. The reviewer verifies that suitable precautions will be taken, once the fuel oil tank has been filled, to exclude sources of ignition such as open flames or hot surfaces, and that protective measures such as compartmentalization of redundant elements are used to minimize the potential causes and consequences of fires and explosions.
7. The reviewer verifies that the system function will be maintained as required in the event of failure of non-seismic Category I systems or structures located near the system. Reference to the SAR sections describing site features and the general arrangement and layout drawings will be necessary in this determination. Plant arrangement features, in conjunction with the protection obtained by location and the design of the system and structures, are considered in determining the ability of the system to maintain function in the event of such failures.
8. The diesel engine fuel oil storage and transfer system is reviewed to verify that protection from the effects of breaks in high and moderate energy lines has been

provided. Layout drawings are reviewed to assure that no high or moderate energy piping systems are located close to the fuel oil system, or that protection from the effects of failure will be provided. The means of providing such protection will be given in Section 3.6 of the SAR and the procedures for reviewing this information are given in the corresponding review plans.

9. The descriptive information, related system drawings, and the results of failure modes and effects analyses in the SAR are reviewed to verify that minimum system requirements will be met following design basis accidents assuming a concurrent single active component failure. For each case the design will be acceptable if minimum system requirements are met.

IV. EVALUATION FINDINGS

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

"The diesel engine fuel oil storage and transfer system includes storage tanks, fill, vent, drain, and overflow return lines, fuel oil transfer pumps, strainers, filters, valves, day tanks, and all components and piping up to the connections to the engine. The scope of review of the diesel engine fuel oil storage and transfer system for the _____ plant included layout drawings, piping and instrumentation diagrams, and descriptive information for the system and auxiliary supporting systems essential to its operation. [The review has determined the adequacy of the applicant's proposed design criteria and design bases for the diesel engine fuel oil storage and transfer system, and the requirements for system performance during normal, abnormal, and accident conditions. (CP)] [The review has determined that the design of the diesel engine fuel oil storage and transfer system and auxiliary supporting systems is in conformance with the proposed design criteria and bases. (OL)]

"The basis for acceptance in the staff review has been conformance of the applicant's design criteria and bases for the diesel engine fuel oil storage and transfer system and necessary auxiliary 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 diesel fuel oil storage and transfer system conforms to all applicable regulations, guides, staff positions, and industry standards, and is acceptable."

V. REFERENCE

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. ANSI proposed standard N195, "Fuel Oil Systems for Standby Diesel Generators," American National Standards Institute.
7. Branch Technical Positions APCSB 3-1, "Protection Against Postulated Piping Failures in Fluid Systems Outside Containment," attached to SRP 3.6.1, and MEB 3-1, "Postulated Break and Leakage Locations in Fluid System Piping Outside Containment," attached to SRP 3.6.2.

SRP 9.5.5

FOLDER #3