



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

9.5.4 EMERGENCY DIESEL ENGINE FUEL OIL STORAGE AND TRANSFER SYSTEM

REVIEW RESPONSIBILITIES

Primary - ~~Power Systems Branch (PSB)~~ Plant Systems Branch (SPLB)<sup>1</sup>

Secondary - ~~None~~ Materials and Chemical Engineering Branch (EMCB)<sup>2</sup>

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. SRP Sections 9.5.4 through 9.5.8 cover the review of various essential elements of the emergency diesel engine sets. This SRP Section 9.5.4 deals with the fuel oil storage and transfer system for these diesel engines up to the engine housing.

The ~~PSB~~SPLB<sup>3</sup> review of the emergency diesel engine fuel oil storage and transfer system (EDEFSS) is performed to assure conformance with the requirements of General Design Criteria 2, 4, 5, and 17 and includes all piping up to the connection to the engine interface,<sup>(1)</sup> the fuel oil storage tanks, the fuel oil transfer pumps, day tanks, and the tank storage vaults. In addition, the review includes the quality and the quantity of fuel oil stored onsite, and the availability and procurement of additional fuel from offsite sources.

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(1) As defined by the engine manufacturer.

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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.

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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, for each redundant diesel generator system, has been provided onsite to meet the engineered safety feature load requirements following a loss of offsite power and a design basis accident.
  - 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 each redundant diesel generator system 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 PSBSPLB<sup>4</sup> 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. For those plants that designate an emergency diesel engine as an alternate ac power source, the SPLB will determine the adequacy of the EDEFSS to perform its function in the event of a station blackout.<sup>5</sup>
- ~~3. The PSB will determine the adequacy of the design, installation, inspection, and testing of all electrical components required for reliable operation of the system, including interlocks.<sup>6</sup>~~

Review Interfaces:<sup>7</sup>

SPLB also performs the following reviews under the SRP sections indicated:

1. The SPLB determines that the EDEFSS is protected against failures in high-energy and moderate-energy piping systems outside containment as part of its primary review responsibility for SRP Section 3.6.1; and<sup>8</sup>
2. The SPLB reviews for the EDEFSS to determine the adequacy of fire protection provisions are coordinated and performed by the Chemical Engineering Branch as part of their review responsibility for SRP Section 9.5.1.<sup>9</sup>

In addition, the review of the diesel engine fuel oil storage and transfer system,<sup>10</sup> the PSBSPLB<sup>11</sup> will coordinate other branches' evaluations that interface with the overall review of the system as follows:

1. ~~Structural Engineering Branch (SEB)~~ Civil Engineering and Geosciences Branch (ECGB)<sup>13</sup> determines the acceptability of the design analyses, procedures, and criteria used to establish the ability of facility 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 as part of its primary review responsibility for SRP Sections 3.3.1, 3.3.2, 3.5.3, 3.7.1 through 3.7.4, 3.8.4, and 3.8.5.
2. The Mechanical Engineering Branch ~~(MEB)~~(EMEB)<sup>14</sup> reviews the seismic design qualification of components and determines that components, piping, and structures are designed in accordance with applicable codes and standards as part of its primary review responsibility for SRP Sections 3.9.1 through 3.9.3.
3. The ~~(MEB)~~EMEB<sup>15</sup> also determines the acceptability of the seismic and quality group classifications for system components as part of its primary review responsibility for SRP Sections 3.2.1 and 3.2.2.
- ~~— The Auxiliary Systems Branch (ASB) determines that the EDEFSS is in accordance with Branch Technical Positions ASB 3 and MEB 3-1 for cracks and breaks in high-energy and moderate-energy piping systems outside containment as part of its primary review responsibility for SRP Section 3.6.1.<sup>16</sup>~~
4. The ~~Materials Engineering Branch (MTEB)~~Materials and Chemical Engineering Branch (EMCB)<sup>17</sup> verifies upon request of PSBSPLB<sup>18</sup> the compatibility of the materials of construction with service conditions.
5. The ~~Procedures and Test Review Branch~~Quality Assurance and Maintenance Branch (HQMB)<sup>19</sup> determines the acceptability of the preoperational and startup tests as part of its primary review responsibility for SRP Section 14.02<sup>20</sup>. The reviews for quality assurance are also coordinated and performed by the ~~Quality Assurance Branch~~HQMB as part of their primary review responsibility for SRP ~~Section~~Chapter 17.0.<sup>21</sup>
6. The reviews for technical specifications are coordinated and performed by the ~~Licensing Guidance Branch~~Technical Specifications Branch (TSB)<sup>22</sup> as part of their primary review responsibility for SRP Section 16.0.
7. The Electrical Engineering Branch (EELB) determines the adequacy of the design, installation, inspection, and testing of all electrical components required for reliable operation of the system, including interlocks as part of its primary review responsibility for SRP Section 8.3.1.<sup>23</sup> The EELB also determines the adequacy of proposed alternate ac sources for station blackout as part of its primary review responsibility for SRP Sections 8.2 and 8.4 (proposed).<sup>24</sup>

For those areas of review identified above as being part of the primary review responsibility of other branches reviews under other SRP sections, the acceptance criteria necessary for the review and their methods of application are contained in the referenced SRP section of the corresponding primary branches.<sup>25</sup>

## 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 regulations,<sup>26</sup> general design criteria, regulatory guides and industry standards. 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, and the position of Regulatory Guide 1.117, as related to the protection of structures, systems, and components (SSC)<sup>27</sup> important to safety from the effects of tornado missiles, Appendix Item Position<sup>28</sup> 13.
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, and the position of Regulatory Guide 1.115, as related to the protection of SSC important to safety from the effects of turbine missiles, Position C.1.
3. General Design Criterion 5, as related to the capability of shared systems and components important to safety to perform required safety functions.
4. General Design Criterion 17, as related to the capability of the fuel oil system to meet independence and redundancy criteria, and the guidance and positions of the following:
  - a. Regulatory Guide 1.9 as related to the design of the diesel engine fuel oil systems,
  - b. Regulatory Guide 1.137 as related to the diesel engine fuel oil system design, fuel oil quality and tests.
  - ~~c. Branch Technical Position ICSB-17 (PSB) as related to diesel engine fuel oil systems' protective interlocks during accident conditions.<sup>29</sup>~~
  - d.<sup>30</sup> NUREG/CR-0660, "Enhancement of Onsite Emergency Diesel Generator Reliability" (Reference 11).<sup>31</sup>

ed.<sup>32</sup> ANSI/IEEE Standard<sup>33</sup> 387 as related to the design of the diesel engine fuel oil system (Reference 13).<sup>34</sup>

fe.<sup>35</sup> ANSI-N195 "Fuel Oil Systems for Standby Diesel Generators"<sup>36</sup> (Reference 12).<sup>37</sup>

gf.<sup>38</sup> Diesel Engine Manufacturers' Association (DEMA) Standard (Reference 14)<sup>39</sup> as related to the design of the diesel fuel oil system.

Plants that have emergency ac sources in excess of minimum redundancy requirements for loss-of-offsite-power conditions may use one of the existing emergency sources as an alternate ac (AAC) power source for the purposes of coping with a station blackout, provided it meets the applicable criteria for an AAC source. For a plant relying on an emergency diesel engine as an AAC power source, the design of the fuel oil storage and transfer system for that engine is acceptable if it meets 10 CFR Part 50.63, "Loss of All Alternating Current Power", paragraph (a)(2), and Regulatory Guide 1.155, Position C.3.<sup>40</sup>

#### Technical Rationale:<sup>41</sup>

The Technical Rationale for application of the above acceptance criteria to the EDEFSS is discussed in the following paragraphs.

1. GDC 2 requires that structures, systems, and components important to safety be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunamis, and seiches without loss of capability to perform the safety function. Regulatory Guide 1.117 provides the methods acceptable to the staff for tornado design classification of structures, systems and components important to safety. Position 13 of the appendix to Regulatory Guide 1.117 identifies Class 1E electrical systems that must be protected from the effects of tornadoes. The safety function of the EDEFSS is to store a quality fuel supply for the EDE, and transfer the fuel to the emergency diesel engine following an engine start signal. A reliable and quality fuel supply to the emergency diesel engine is necessary to ensure the prompt restoration of ac power to safety related components that are necessary to maintain the integrity of the reactor coolant pressure boundary, to safely shutdown the reactor and maintain it in a safe shutdown condition, and to prevent or mitigate the consequences of accidents. Compliance with the requirements of GDC 2 and Regulatory Guide 1.117 ensures that emergency ac power will be available to safety-related components in the event of a loss of offsite power resulting from natural phenomena events.
2. GDC 4 in relevant part requires that structures, systems, and components important to safety be designed to withstand the dynamic effects of pipe ruptures such as pipe whip and jet impingement, and externally or internally generated missiles. Regulatory Guide 1.115, Position C.1, identifies those essential systems that should be protected against low- trajectory turbine missiles. The safety function of the EDEFSS is to store a quality fuel supply for the EDE, and transfer the fuel to the emergency diesel engine following an engine start signal. In order to ensure the availability of emergency ac power, the EDEFSS must be capable of supplying fuel to the engine under the expected operational and postulated accident conditions for the plant. These conditions include consideration

of the dynamic effects of equipment failures such as pipe ruptures and turbine missiles, and events and conditions external to the plant. Compliance with GDC 4 and the applicable portion of Regulatory Guide 1.115 provides assurance that the dynamic effects of equipment failures, and events external to the plant, will not affect the capability of the EDEFSS to provide fuel to the emergency diesel engines.

3. GDC 5 prohibits the sharing of structures, systems, and components important to safety among nuclear power units unless it can be demonstrated that such sharing will not significantly impair their ability to perform their safety functions, including in the event of an accident in one unit, an orderly shutdown and cooldown of the remaining unit. The safety function of the EDEFSS is to store a quality fuel supply for the EDE, and transfer the fuel to the emergency diesel engine following an engine start signal. In order to ensure the availability of emergency ac power to safety-related components, the EDEFSS must be designed to perform this safety function in each unit regardless of events, failures, and conditions in the other unit(s). Compliance with GDC 5 provides assurance that equipment failures and events occurring in one unit of the site will not propagate to other units of the site.
4. GDC 17, in relevant part, requires provision of an onsite electric power system to permit the functioning of structures, systems and components important to safety. GDC 17 requirements include that the onsite electric power system have sufficient independence and redundancy to perform their safety functions assuming a single failure. Typically, the emergency diesel generator system is the onsite electric power system relied upon to meet these requirements. The diesel engine fuel oil storage and transfer system is integral to the emergency diesel generator system. Regulatory Guides 1.9 and 1.137 provide regulatory positions with regard to EDE and fuel oil system design criteria and features applicable to GDC 17 compliance. Meeting the GDC 17 requirements provides assurance that electric power will be available for systems necessary to: 1) prevent fuel damage in the event of anticipated operational occurrences; and 2) maintain core cooling and containment integrity in the event of postulated accidents.
5. 10 CFR 50.63 requires that each light-water-cooled nuclear power plant be able to withstand and recover from a station blackout (i.e., loss of the offsite electric power system concurrent with reactor trip and unavailability of the onsite emergency ac electric power system). Paragraph (a)(2) of 50.63 establishes the conditions under which provision of an alternate ac (AAC) power source will constitute acceptable capability to withstand station blackout. Regulatory Guide 1.155 describes a method acceptable to the NRC staff for complying with 10 CFR 50.63. Plants that have emergency ac sources in excess of minimum redundancy requirements for loss-of-offsite-power conditions may use one of the existing emergency sources as an AAC power source for the purposes of coping with a station blackout. Any emergency diesel engine designated as an AAC power source is dependent on support systems such as the fuel oil storage and transfer system. Compliance with 10 CFR 50.63 and the positions of Regulatory Guide 1.155 regarding the ability to cope with a station blackout provides additional defense-in-depth against unacceptable offsite radiological consequences should both offsite and onsite emergency ac power systems fail concurrently.<sup>42</sup>

### 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 subsection II of this SRP section. 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 ~~EGT~~GBTSB<sup>43</sup> review, as indicated in subsection I of this SRP section.

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.

The primary reviewer will coordinate this review with other branches for their particular areas of responsibility as stated in subsection I. The primary reviewer obtains and uses such input as required to assure that this review procedure is complete.

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 bases, natural phenomena, and internally and externally generated missiles. The review of internally generated missiles will consider the relative locations and orientation 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 ~~SEB~~ ECGB<sup>44</sup> reviews the seismic design bases and the ~~MEB~~MEB<sup>45</sup> reviews the quality and seismic classification as indicated in subsection I of this SRP section. The ~~PSB~~SPLB<sup>46</sup> assures that essential portions of the EDEFSS including the isolation valves separating essential and nonessential portions are classified Quality Group C and Seismic Category I. Components and system descriptions in the SAR that identify mechanical and performance characteristics are reviewed to verify that the above seismic and quality group classifications have been included and that the P&IDs indicate any points of change at the systems and/or systems components interfaces.
5. The reviewer verifies that the design is such as to minimize the creation of turbulence of the sediment at the bottom of the fuel oil storage tank or 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 verify that the diesel fuel oil test program have been incorporated to assure that the quality of the stored fuel oil meets minimum requirements at all times is in accordance with Regulatory Guide 1.137 and includes the following elements for verifying fuel oil quality:

- a. Inspection at least once per 92 days (or once per 31 days [if the groundwater table is equal to or higher than the bottom of the fuel oil storage tanks]) to check for and remove accumulated water from the fuel oil storage tanks;
  - b. Sampling and testing from the storage tanks at least once per 92 days and from new fuel oil prior to its addition to the storage tanks to verify that the sample meets the following minimum requirements:
    - 1) A water and sediment content of less than or equal to 0.05 volume percent;
    - 2) A kinematic viscosity at 40°C of greater than or equal to 1.9 mm<sup>2</sup>/s (1.9 centistokes)<sup>47</sup>, but less than or equal to 4.1 mm<sup>2</sup>/s (4.1 centistokes)<sup>48</sup>;
    - 3) A specific gravity as specified by the manufacturer at 16/16°C (60/60°F)<sup>49</sup>, or an API gravity at 16°C (60°F)<sup>50</sup>, within limits established in accordance with Positions 2.a and 2.b of Regulatory Guide 1.137;
    - 4) A tested impurity level of less than 2 mg of insolubles per 100 ml. The fuel oil testing program should specify that analysis shall be completed within 7 days after obtaining the sample but may be performed after the addition of new fuel oil; and
    - 5) The other properties shall be tested as specified in Regulatory Guide 1.137 and associated standards. The fuel oil test program shall specify that analysis shall be completed within 14 days after obtaining the sample but may be performed after the addition of new fuel oil.<sup>51</sup>
6. The descriptive information and drawings in the SAR are reviewed to verify that:
- a. Each storage tank is equipped with an outside fill and vent line, located and protected so as to minimize the chance of damage, from vehicles, tornado, tornado missiles, and floods. The fill and vent point should be located higher than the PMF flood level. Each tank is also provided with a stick gauge connection for determining fuel level in the tank.
  - b. The minimum onsite inventory of fuel oil for each redundant diesel generator system 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 physical location of the day tank associated with each diesel-generator set is located at an elevation to assure a slight positive pressure at the engine-driven fuel oil pump(s). Where this requirement is contrary to manufacturers' recommendation, justification and a detailed system description shall be provided in the SAR. Additionally, the justification for locating the day tank other than stated above shall assure that the diesel-generator unit can start automatically and attain the required voltage and frequency within acceptable limits and time. If a booster pump is required, it shall be powered from a reliable power supply and arranged to operate when the engine receives a start signal and it shall operate during the engine starting cycle or until system fuel oil pressure is established by the engine-driven fuel oil pump.
  - d. A day or integral tank 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).
  - f. The day or integral tank and storage tanks associated with each diesel-generator set include provisions for removal of accumulated water.
7. 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 compartmentation of redundant elements are used to minimize the potential causes and consequences of fires and explosions.
8. The reviewer verifies that the system function will be maintained as required in the event of failure of nonseismic 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.
9. 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 by ASB<sup>52</sup> are given in the corresponding SRP sections.
10. 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.

11. The EELB reviews protective interlocks as indicated in subsection I of this SRP section. Protective interlocks in this system are acceptable if the SAR indicates that the interlocks are in conformance with Position C.1.8 of Regulatory Guide 1.9.<sup>53</sup>
12. For those plants that will use an emergency diesel generator as the alternate AC source in response to a station blackout event, the reviewer verifies the adequacy of the fuel oil supply and recharging capability, independent of preferred and onsite emergency ac power, of the emergency diesel engine fuel oil storage and transfer system in accordance with Regulatory Position C.3.3.5 of Regulatory Guide 1.155.<sup>54</sup>

For standard design certification reviews under 10 CFR 52, the procedures above should be followed, as modified by the procedures in SRP Section 14.3 (proposed), to verify that the design set forth in the standard safety analysis report, including inspections, tests, analysis, and acceptance criteria (ITAAC), site interface requirements and combined license action items, meet the acceptance criteria given in subsection II. SRP section 14.3 (proposed) contains procedures for the review of certified design material (CDM) for the standard design, including the site parameters, interface criteria, and ITAAC.<sup>55</sup> For DC reviews the diesel engine vendor may not have been selected; therefore, the interfaces between the diesel engine and the support (auxiliary) systems may not be fully defined. Portions of the EDE and associated support systems design may be considered outside the scope of the design submitted by applicants for design certification (DC). Portions of the design determined not to be within the DC scope are the responsibility of the applicant referencing the certified design. The DC applicant's submittal should provide a conceptual design and interface requirements for that portion of the design outside the scope of the DC as required by 10 CFR 52.47(a)(1)(vi-ix).<sup>56</sup>

#### 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 emergency diesel engine fuel oil storage and transfer system (EDEFSS) includes storage tanks, fill, vent, stick gauge 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 interfaces. 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 essential portions of the EDEFSS that are necessary for the safe shutdown of the reactor or necessary to mitigate the consequences of an accident are designed to seismic Category I and Quality Group C.

The basis for acceptance of the EDEFSS in our review was conformance of the design criteria and bases to the Commission's regulations as set forth in the General Design Criteria (GDC) of Appendix A to 10 CFR Part 50. The staff concludes that the plant

design is acceptable and meets the requirements of GDC 2, 4, 5 and 17. This conclusion is based on the following:

1. The applicant has met the requirements of GDC 2, "Design Bases for Protection Against Natural Phenomena," with respect to the ability of structures housing the EDEFSS and the system itself to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, and floods, and GDC 4, "Environmental and ~~Missile~~Dynamic Effects<sup>57</sup> Design Bases," with respect to structures housing the system and the system itself being capable of withstanding the effects of externally and internally generated missiles, pipe whip, and jet impingement forces associated with pipe breaks. The EDEFSS, except for the buried fuel oil storage tanks and related components and piping, is housed in a Seismic Category I structure which provides protection from the effects of tornadoes, tornado missiles, turbine missiles, and floods. The buried portions are also protected from tornado, tornado and turbine missiles, and floods. This meets the positions of Regulatory Guide 1.115, "Protection Against Low-Trajectory Turbine Missiles," Position C.1, and "Tornado Design Classification," Appendix Position 13.
2. The applicant has met the requirements of GDC 5, "Sharing of Structures, Systems, and Components," with respect to capability of shared systems and components important to safety to perform required safety functions. Each unit of the \_\_\_\_\_ plant has its own emergency diesel generators whose EDEFSS is not shared between the diesel generators.
3. The applicant has met the requirements of GDC 17, "Electric Power Systems," with respect to the capability of the fuel oil system to meet independence and redundancy criteria. Each EDEFSS is independent and physically separated from the other system serving the redundant diesel generator. A single failure in any one of the ~~two systems~~EDEFSS<sup>58</sup> will affect only the associated diesel generator. This meets the positions of Regulatory Guide 1.9, "Selection, Design, and Qualification, and Testing of Diesel Generator Units Used As ~~Standby (Onsite)~~Class 1E Onsite Electric Power Systems At Nuclear Power Plants,"<sup>59</sup> and Regulatory Guide 1.137 "Diesel Generator Fuel Oil Systems." The applicant has also met the positions of ~~Branch Technical Position ICSB-17 (PSB), "Diesel Generator Protective Trip Circuit Bypasses,"~~<sup>60</sup> and NUREG/CR-0660, "Enhancement Of Onsite Emergency Diesel Generator Reliability." The applicant has met the requirements of the following industry standards: ANSI-N195<sup>61</sup> "Fuel Oil Systems for Standby Diesel Generators," IEEE-Standard 387 "IEEE Standard Criteria For Diesel Generator Units Applied As Standby Power Supplies For Nuclear Power Generating Stations," and Diesel Engine Manufacturers Association (DEMA) Standard.

The staff concludes that the design of the diesel fuel oil storage and transfer system conforms to all applicable GDC, positions of the regulatory guides cited, NUREG/CR-0660, staff positions, and industry standards, and is therefore acceptable.

If the applicant proposes to designate an emergency diesel generator as the alternate AC source in response to a station blackout event, the following finding should be included:

The applicant has met the requirements of 10 CFR 50.63, "Loss of All Alternating Current Power," relevant to the design of the EDEFSS for the Alternate ac power source. The EDEFSS supporting the Alternate ac power source can supply fuel oil to its associated diesel generator and the fuel oil supply can be recharged independent of preferred and onsite emergency ac power for the specified duration of the station blackout. This meets the positions of Regulatory Guide 1.155 "Station Blackout."<sup>62</sup>

For design certification reviews, the findings will also summarize, to the extent that the review is not discussed in other safety evaluation report sections, the staff's evaluation of inspections, tests, analyses, and acceptance criteria (ITAAC), including design acceptance criteria (DAC), site interface requirements, and combined license action items that are relevant to this SRP Section.<sup>63</sup>

## V. IMPLEMENTATION

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

This SRP section will be used by the staff when performing safety evaluations of license applications submitted by applicants pursuant to 10 CFR 50 or 10 CFR 52.<sup>64</sup> Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the method described herein will be used by the staff in its evaluation of conformance with Commission regulations.

The provisions of this SRP section apply to reviews of applications docketed six months or more after the date of issuance of this SRP section.<sup>65</sup>

Implementation schedules for conformance to parts of the method discussed herein are contained in the referenced regulatory guides and NUREG.

## VI. REFERENCES

1. 10 CFR 50.63, "Loss of all alternating current power."<sup>66</sup>
- 12.<sup>67</sup> 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection against Natural Phenomena."
23. 10 CFR Part 50, Appendix A, General Design Criterion 4, "Environmental and Missile Dynamic Effects"<sup>68</sup> Design Bases."
34. 10 CFR Part 50, Appendix A, General Design Criterion 5, "Sharing of Structures, Systems, and Components."
45. 10 CFR Part 50, Appendix A, General Design Criterion 17, "Electric Power Systems."

- 56.<sup>69</sup> Regulatory Guide 1.9, "Selection, Design, and Qualification, and Testing of Diesel Generator Units Used As Standby (Onsite) Class 1E Onsite Electric Power Systems At Nuclear Power Plant."<sup>70</sup>
- 67.<sup>71</sup> Regulatory Guide 1.115, "Protection Against Low-Trajectory Turbine Missiles."
- 78.<sup>72</sup> Regulatory Guide 1.117, "Tornado Design Classification."
- 89.<sup>73</sup> Regulatory Guide 1.137, "Diesel Generator Fuel Oil Systems."
10. Regulatory Guide 1.155, "Station Blackout."<sup>74</sup>
- 1611.<sup>75</sup> NUREG/CR-0660, "Enhancement of Onsite Emergency Diesel Generator Reliability;" University of Dayton Research Institute; UDR-TR-79-07; February 1979.<sup>76</sup>
- 912.<sup>77</sup> ANSI-N195-1976<sup>78</sup>, "Fuel Oil Systems for Standby Diesel Generators."<sup>79</sup> American National Standards Institute.
- ~~10. Branch Technical Position ASB 3-1, "Protection Against Postulated Piping Failures in Fluid Systems Outside Containment" (attached to SRP Section 3.6.1).<sup>80</sup>~~
- ~~11. Branch Technical Position MEB 3-1, "Postulated Break and Leakage Locations in Fluid System Piping Outside Containment" (attached to SRP Section 3.6.2).<sup>81</sup>~~
- ~~12. Branch Technical Position ASB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants" (attached to SRP Section 9.5.1).<sup>82</sup>~~
- ~~13. Branch Technical Position ICSB-17 (PSB), "Diesel-Generator Protective Trip Circuit Bypasses" (attached to SRP 8.3.2, Appendix 8A).<sup>83</sup>~~
- 1413.<sup>84</sup> ANSI/IEEE Standard 387-1984, "IEEE Standard Criteria for Diesel Generator Units Applied As Standby Power Supplies for Nuclear Power Generating Stations;" American National Standards Institute.<sup>85</sup>
- 1514.<sup>86</sup> Diesel Engine Manufacturers Association (DEMA) Standard 1974<sup>87 88</sup>.

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### SRP Draft Section 9.5.4

#### Attachment A - Proposed Changes in Order of Occurrence

Item numbers in the following table correspond to superscript numbers in the redline/strikeout copy of the draft SRP section.

| Item | Source                                       | Description   |
|------|--|---|
| 1.   | Current PRB name and abbreviations.          | Editorial change made to reflect current PRB name and responsibility for SRP Section 9.5.4.   |
| 2.   | Current PRB names and abbreviations.         | Added the responsible Secondary Review Branch for SRP Section 9.5.4.  |
| 3.   | Current PRB name and abbreviations.          | Editorial change made to reflect current PRB name and responsibility for SRP Section 9.5.4.   |
| 4.   | Current PRB name and abbreviations.          | Editorial change made to reflect current PRB name and responsibility for SRP Section 9.5.4.   |
| 5.   | <b>Integrated Impact 250.</b>                | Added provisions to review the EDEFSS with regard to station blackout requirements for those plants that designate an EDE as an alternate ac power source.  |
| 6.   | SRP-UDP format Item Reformat Area of Review. | Changed electrical scope from an Area of Review to an interface item. The Power Systems Branch previously had responsibility for the emergency diesel generator (EDG), the EDG support systems, and the power and control circuits. The diesel generator (EDG) and the power and control circuits are now the responsibility of the Electrical Engineering Branch (EELB) and the SPLB has responsibility for the EDG support systems. |
| 7.   | SRP-UDP format Item.                         | Reformatted Areas of Review to include Review Interface subsection. The review interfaces are formatted into numbered paragraph form to distinguish individual PRB responsibilities. The PRB names and responsibilities have also been updated as appropriate.  |
| 8.   | Current PRB name and abbreviations.          | Relocated the responsibility to review for protection from failures in high- and moderate-energy lines to reflect that the responsibility shifted to the SPLB.  |
| 9.   | Current PRB name and abbreviations.          | Editorial change made to separate text and reflect current PRB name and responsibility for SRP Section 9.5.1.   |
| 10.  | Editorial.                                   | The lead-in sentence for the review interfaces between the PRB for SRP Section 9.5.4 and the PRB's responsible for reviews per other SRP Sections, was revised to be consistent with SRP-UDP format guidance.   |
| 11.  | Current PRB name and abbreviations.          | Editorial change made to reflect current PRB name and responsibility for SRP Section 9.5.4.   |
| 12.  | Editorial.                                   | Changed "Branch" to it plural form, "Branches".   |

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Attachment A - Proposed Changes in Order of Occurrence

| Item | Source   | Description  |
|------|--|--|
| 13.  | Current PRB name and abbreviations.  | Editorial change made to reflect current PRB name and responsibility for SRP Sections 3.3.1, 3.3.2, 3.5.3, 3.7.1 through 3.7.4, 3.8.4, and 3.8.5.  |
| 14.  | Current PRB name and abbreviations.  | Editorial change made to reflect current PRB name and responsibility for SRP Sections 3.9.1 through 3.9.3.   |
| 15.  | Current PRB name and abbreviations.  | Editorial change made to reflect current PRB name and responsibility for SRP Sections 3.2.1 and 3.2.2.   |
| 16.  | Current PRB name and abbreviations.  | Relocated the responsibility to review for protection from failures in high- and moderate-energy lines to reflect that the responsibility shifted to the SPLB.   |
| 17.  | Current PRB name and abbreviations.  | Editorial change made to reflect current PRB name and responsibility for material reviews.   |
| 18.  | Current PRB name and abbreviations.  | Editorial change made to reflect current PRB name and abbreviation for the Plant Systems Branch.   |
| 19.  | Current PRB name and abbreviations.  | Editorial change made to reflect current PRB name and responsibility for SRP Section 14.2.   |
| 20.  | Editorial.   | Corrected the reference to Section 14.0 to be 14.2. There is no Section 14.0.  |
| 21.  | Current PRB name and abbreviations.  | Editorial change made to separate text and reflect current PRB name and responsibility for SRP Section 17.0.   |
| 22.  | Current PRB name and abbreviations.  | Editorial change made to separate text and reflect current PRB name and responsibility for SRP Section 16.0.   |
| 23.  | SRP-UDP format item . Reformat Areas of Review and Current PRB name and abbreviations. | Added EELB interface based on the Power Systems Branch having previously had responsibility for the emergency diesel generator (EDG), the EDG support systems, and the power and control circuits. The diesel generator (EDG) and the power and control circuits are now the responsibility of the Electrical Engineering Branch (EELB) and the SPLB has responsibility for the EDG support systems. |
| 24.  | .SRP-UDP Integration of SBO Issues   | Added interface describing reviews of AAC sources by EELB under SRP Section 8.2, Appendix 8-C and SRP Section 8.4.   |
| 25.  | .SRP-UDP format item   | Revised using standard text to address both the interfaces listed with other SPLB reviews and with other PRBs.   |
| 26.  | <b>Integrated Impact 250.</b>  | Added the word regulation to the list of source document types used to determine acceptability in order to account for 10 CFR 50.63 being added to the Acceptance Criteria.  |



**SRP Draft Section 9.5.4**  
Attachment A - Proposed Changes in Order of Occurrence

| Item | Source   | Description   |
|------|--|---|
| 27.  | Editorial change.  | Added "SSC" acronym for "structures, systems and components", and applied the acronym throughout the draft section.   |
| 28.  | Editorial change.  | The word "Position" is replaced by "Item" to be more consistent with the terminology in the Regulatory Guide.   |
| 29.  | <b>Integrated Impact 246.</b>                                    | Removed citation of BTP ICSB 17 since SRP Appendix 8-A indicates that it was superseded by Reg. Guide 1.9. As indicated in Review Interfaces, system interlocks are reviewed by EELB under SRP Section 8.3.1. |
| 30.  | Editorial.   | Renumbered to accommodate deletion of item II.5.c.  |
| 31.  | SRP-UDP format Item.   | Added reference designator from SRP Subsection VI, References, in accordance with SRP-UDP format requirements.  |
| 32.  | Editorial.   | Renumbered to accommodate deletion of item II.5.c.  |
| 33.  | <b>Integrated Impact 786.</b>                                    | Citation to IEEE 387 has been updated to reflect the title of the latest version by adding "ANSI" and abbreviating the term "Standard" as "Std" to be consistent with IEEE usage.                             |
| 34.  | SRP-UDP format Item.   | Added reference designator from SRP Subsection VI, References, in accordance with SRP-UDP format requirements.  |
| 35.  | Editorial.   | Renumbered to accommodate deletion of item II.5.c.  |
| 36.  | <b>Integrated Impact 381.</b> SRP-UDP Standards citation update. | Consideration should be given to changing the reference from ANSI N195 to ANSI/ANS 59.51-1989 pending the completion of the associated standard comparison.   |
| 37.  | SRP-UDP format Item.   | Added reference designator from SRP Subsection VI, References, in accordance with SRP-UDP format requirements.  |
| 38.  | Editorial.   | Renumbered to accommodate deletion of item II.5.c.  |
| 39.  | SRP-UDP format Item.   | Added reference designator from SRP Subsection VI, References, in accordance with SRP-UDP format requirements.  |
| 40.  | <b>Integrated Impact 250.</b>                                    | Added 10 CFR 50.63 as Acceptance Criteria for those plants that will use an emergency diesel generator as the alternate AC source in response to a station blackout.  |
| 41.  | SRP-UDP format Item, Develop Technical Rational.                 | Added technical rationale for Acceptance Criteria and guidance documents.   |

**SRP Draft Section 9.5.4**  
Attachment A - Proposed Changes in Order of Occurrence

| Item | Source  | Description   |
|------|---|---|
| 42.  | <b>Integrated Impact No. 250.</b>                                       | Added Technical Rationale for 10 CFR 50.63.   |
| 43.  | Current PRB name and abbreviations.                                     | Editorial change made to reflect current PRB name and responsibility.   |
| 44.  | Current PRB name and abbreviations.                                     | Editorial change made to reflect current PRB name and responsibility.   |
| 45.  | Current PRB name and abbreviations.                                     | Editorial change made to reflect current PRB name and responsibility.   |
| 46.  | Current PRB name and abbreviations.                                     | Editorial change made to reflect current PRB name and responsibility.   |
| 47.  | NRC Metrication Policy.   | Viscosity units were converted to SI equivalents.   |
| 48.  | NRC Metrication Policy.   | Viscosity units were converted to SI equivalents.   |
| 49.  | NRC Metrication Policy.   | Specific Gravity units were converted to SI equivalents.  |
| 50.  | NRC Metrication Policy.   | Temperature units for Specific Gravity specification were converted to SI equivalents.  |
| 51.  | <b>Integrated Impact 249.</b>   | Revised the Review Procedure on Fuel Oil quality to include specific testing requirements reflected in Generic Letter 83-26.  |
| 52.  | Current PRB names and abbreviations.                                    | Responsibility for this review shifted from the old ASB to the SPLB which is also responsible for this SRP Section.   |
| 53.  | <b>Integrated Impact 246.</b>   | Added review procedure related to system interlocks.  |
| 54.  | <b>Integrated Impact 250.</b>   | Added a new Review Procedure to address review of systems that support diesel generators designated as Alternate AC power supplies for coping with station blackout.  |
| 55.  | SRP-UDP integration task format item                                    | Added boiler-plate statement regarding reviews conducted in accordance with 10 CFR 52.  |
| 56.  | 10 CFR 52 applicability changes. Potential Impact Nos. 24285 and 24286. | Added a paragraph to address reviews for design certification applicants. Some portions of the design and interface between the diesel engine and the support systems are dependent on the selection of the diesel engine vendor. Since these design and interface criteria may not be available as part of the DC review, they are the responsibility of the applicant referencing the certified design. |
| 57.  | SRP-UDP format Item, Reformat reference citations.                      | Updated the title of GDC 4  |

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| Item | Source   | Description   |
|------|--|---|
| 58.  | Evaluation of ABWR and CE 80+ FSERs. PI No. 24287. | The ABWR has three emergency diesel generators (EDGs) and the ABB-CE System 80+ has two EDGs. The staff, in the section 9.5.4.2 of the ABWR FSER, was not number specific in their statements of evaluation findings. |
| 59.  | SRP-UDP format Item, Reformat reference citations. | Updated the title of Regulatory Guide 1.9.  |
| 60.  | <b>Integrated Impact 246.</b>                      | Removed citation of BTP ICSB 17 since SRP Appendix 8-A indicates that it was superseded by Reg. Guide 1.9. As indicated in Review Interfaces, system interlocks are reviewed by EELB under SRP Section 8.3.1.         |
| 61.  | <b>Integrated Impact 381.</b>                      | Consideration should be given to changing the reference from ANSI N195 to ANSI/ANS 59.51-1989 pending the completion of the associated standard comparison.   |
| 62.  | <b>Integrated Impact 250.</b>                      | Added specific Evaluation Finding for meeting 10 CFR 50.63 and Regulatory Guide 1.155. For those plants that will use a diesel generator as the alternate AC source in response to a station blackout.                |
| 63.  | SRP-UDP format, 10 CFR 52 Applicability.           | Added an evaluation finding to address reviews for design certification applicants. For design certification applicants, the entire design is reviewed during the design certification phase.                         |
| 64.  | SRP-UDP Format Item                                | Added boiler-plate statement indicating the applicability of the SRP to 10 CFR 52 license applications.   |
| 65.  | SRP-UDP Format Item                                | Added boiler-plate statement describing the applicability of the SRP to existing and new applications.  |
| 66.  | <b>Integrated Impact 250.</b>                      | Added a reference for 10 CFR 50.63.   |
| 67.  | Editorial  | Reordered and renumbered references in accordance with SRP-UDP guidance.  |
| 68.  | SRP-UDP format Item, Reformat reference citations. | Updated the title of GDC 4  |
| 69.  | Editorial.   | Renumbered to accommodate new Reference No. 5.  |
| 70.  | SRP-UDP format Item, Reformat reference citations. | Updated the title and date of reference to Regulatory Guide 1.9.  |
| 71.  | Editorial.   | Renumbered to accommodate new Reference No. 5.  |
| 72.  | Editorial.   | Renumbered to accommodate new Reference No. 5.  |
| 73.  | Editorial.   | Renumbered to accommodate new Reference No. 5.  |

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| Item | Source   | Description   |
|------|--|---|
| 74.  | <b>Integrated Impact 250.</b>                      | Added a reference for Regulatory Guide 1.155.   |
| 75.  | Editorial.   | Renumbered to accommodate new and deleted References.   |
| 76.  | SRP-UDP format Item, Reformat reference citations. | Updated the reference for NUREG/CR-0660.  |
| 77.  | Editorial.   | Renumbered to accommodate new References.   |
| 78.  | <b>Integrated Impact 1398.</b>                     | Revised the reference for ANSI N195 to specify the date of the standard considered in development of the SRP or in effect when the existing SRP was published.  |
| 79.  | <b>Integrated Impact 381.</b>                      | Consideration should be given to changing the reference from ANSI N195 to ANSI/ANS 59.51-1989 pending completion of the associated standard comparison.   |
| 80.  | Editorial change.                                  | The Branch Technical Position (BTP) is only discussed in the Review Interface portion of the SRP. The topics covered by the BTP will be addressed by the review interface with the associated SRP section. Therefore, it is not necessary to reference the BTP in this SRP section.                                   |
| 81.  | Editorial change.                                  | The Branch Technical Position (BTP) is only discussed in the Review Interface portion of the SRP. The topics covered by the BTP will be addressed by the review interface with the associated SRP section. Therefore, it is not necessary to reference the BTP in this SRP section.                                   |
| 82.  | Editorial change.                                  | The Branch Technical Position (BTP) is not referenced in the SRP section and therefore can be deleted.  |
| 83.  | <b>Integrated Impact 246.</b>                      | Deleted a reference for BTP ICSB 17 which was superseded by Regulatory Guide 1.9.   |
| 84.  | Editorial.   | Renumbered to accommodate new and deleted References.   |
| 85.  | <b>Integrated Impact 786.</b>                      | The title for IEEE-387 was updated and the date (1984) was added to identify the applicable version of the standard.  |
| 86.  | Editorial.   | Renumbered to accommodate new and deleted References.   |
| 87.  | <b>Integrated Impact 673.</b>                      | The reference to the DEMA standard is revised to include the date of the version in effect when the SRP was published. According to the 28th annual edition of the Encyclopedia of Associations, the Diesel Engine Manufacturers Association (DEMA) is no longer active. Therefore, the standard will not be updated. |

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Attachment A - Proposed Changes in Order of Occurrence

| <b>Item</b> | <b>Source</b>                  | <b>Description</b>   |
|-------------|--------------------------------|--|
| 88.         | SRP-UDP Reference Verification | The DEMA organization is inactive. Based on information available from technical resources, the DEMA standard has not been revised since 1974. A copy of the standard was not available and the continued applicability of the standard could not be verified. |

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**SRP Draft Section 9.5.4**  
Attachment B - Cross Reference of Integrated Impacts

| Integrated Impact No. | Issue   | SRP Subsections Affected   |
|-----------------------|---|--|
| 246                   | Deletion of reference to BTP ICSB-17 which was superseded by Regulatory Guide 1.9.  | II.4, III, IV.3, and VI.   |
| 249                   | Incorporates requirements of Generic Letter 83-26.  | III.5  |
| 250                   | Incorporates the Station Blackout requirements of 10 CFR 50.63 and Regulatory Guide 1.155 with regard to EDGs as alternate ac sources.                | I.3, II, III.12, IV, and VI.   |
| 381                   | Placeholder Integrated Impact. Consider Replacing citation of ANSI N195 with ANSI/ANS 59.51.  | This Integrated Impact has not been processed. Subsections II, IV, and VI would be impacted if implemented.            |
| 701                   | Placeholder Integrated Impact. This Integrated Impact recommends changes to standard citations in Regulatory Guide 1.137 and does not affect the SRP. | No subsections are affected. The actions associated with this Integrated Impact are being tracked by IPD form 9.5.4-3. |
| 753                   | Placeholder Integrated Impact. This Integrated Impact recommends changes to standard citations in Regulatory Guide 1.137 and does not affect the SRP. | No subsections are affected. The actions associated with this Integrated Impact are being tracked by IPD form 9.5.4-2. |
| 673                   | Added date to DEMA Standard reference.  | VI.13  |
| 786                   | Updated the IEEE Std 387 reference.   | II.d, and VI.12.   |
| 1398                  | Added date to ANSI N195 Standard reference.   | VI.12  |