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REGULATORY GUIDE

OFFICE OF NUCLEAR REGULATORY RESEARCH

REGULATORY GUIDE 1.9
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SELECTION, DESIGN, QUALIFICATION, AND TESTING OF EMERGENCY DIESEL GENERATOR UNITS USED AS CLASS 1E ONSITE ELECTRIC POWER SYSTEMS AT NUCLEAR POWER PLANTS

A. INTRODUCTION

Criterion 17, "Electric Power Systems," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," requires that onsite electric power systems have sufficient independence, capacity, capability, redundancy, and testability to ensure that (1) specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded as a result of anticipated operational occurrences and (2) the core is cooled and containment integrity and other vital functions are maintained in the event of postulated accidents, assuming a single failure.

Criterion 18, "Inspection and Testing of Electric Power Systems," of Appendix A to 10 CFR Part 50 requires that electric power systems important to safety be designed to permit appropriate periodic inspection and testing to assess the continuity of the systems and the condition of their components.

Criterion III, "Design Control," and Criterion XI, "Test Control," of Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50 require that (1) measures be provided for verifying or checking the adequacy of design by design reviews, by the use of alternative or simplified calculational methods, or by the performance of a suitable testing program and (2) a test program be established to ensure that systems and components perform satisfactorily and that the test program include operational tests during nuclear power plant operation.

Section 50.63, "Loss of All Alternating Current Power," of 10 CFR Part 50 requires that each light-water-cooled nuclear power plant be able to withstand and recover from a station blackout (i.e., loss of offsite and onsite emergency ac power systems) for a specified duration. The reliability of onsite ac power sources is one of the main factors contributing to the risk of core melt resulting from station blackout.

Diesel generator units have been widely used as the power source for onsite electric power systems. This regulatory guide provides guidance acceptable to the NRC staff for complying with the Commission's requirements that diesel generator units intended for use as onsite emergency power sources in nuclear power plants be selected with sufficient capacity, be qualified, and have the necessary reliability and availability for station blackout and design basis accidents.

Any information collection activities mentioned in this regulatory guide are contained as requirements in 10 CFR Part 50, which provides the regulatory basis for this guide. The information collection requirements in 10 CFR Part 50 have been approved by the Office of Management and Budget, Approval No. 3150-0011.

B. DISCUSSION

An emergency diesel generator unit selected for use in an onsite electric power system should have the capability to (1) start and accelerate a number of large motor loads in rapid succession while maintaining voltage and frequency within acceptable limits, (2) provide power promptly to engineered safety features if a loss of offsite power and an accident occur during the same time period, and (3) supply power continuously to the equipment needed to maintain the plant in a safe condition if an extended loss of offsite power occurs.

IEEE Std 387–1984,[1] "IEEE Standard Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations," delineates principal design criteria and qualification and testing guidelines that, if followed, will help ensure that selected diesel generator units meet performance requirements. (IEEE Std 387–1977 was endorsed by Revision 2 of Regulatory Guide 1.9, "Selection, Design, and Qualification of Diesel-Generator Units Used as Standby (Onsite) Electric Power Systems at Nuclear Power Plants.") IEEE Std 387–1984 was developed by Working Group SC 4.2 of Subcommittee 4 (Auxiliary Power) of the Nuclear Power Engineering Committee (NPEC) of the Institute of Electrical and Electronics Engineers, Inc. (IEEE), approved by NPEC, and subsequently approved by the IEEE Standards Board on March 11, 1982. IEEE Std 387–1984 is supplementary to IEEE Std 308–1980, "IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations," and specifically amplifies paragraph 6.2.4, "Standby Power Supplies," of IEEE Std 308 with respect to the application of diesel generator units.

IEEE Std 387–1984 also references other standards that contain valuable information. Those referenced standards not endorsed by a regulatory guide or incorporated into the regulations, if used, are to be used in a manner consistent with current regulations.

A knowledge of the characteristics of each load is essential in establishing the bases for the selection of an emergency diesel generator unit that is able to accept large loads in rapid succession. The majority of the emergency loads are large induction motors. This type of motor draws, at full voltage, a starting current five to eight times its rated load current. The sudden large increases in current drawn from the diesel generator resulting from the startup of induction motors can result in substantial voltage reductions. The lower voltage could prevent a motor from starting, i.e., accelerating its load to rated speed in the required time, or could cause a running motor to coast down or stall. Other loads might be lost because of low voltage if their contactors drop out. Recovery from the transient caused by starting large motors or from the loss of a large load could cause diesel engine overspeed that, if excessive, might result in a trip of the engine, i.e., loss of the Class 1E power source. These same consequences can also result from the cumulative effect of a sequence of more moderate transients if the system is not permitted to recover sufficiently between successive steps in a loading sequence.

Generally it has been industry practice to specify a maximum voltage reduction of 10 to 15 percent when starting large motors from large capacity power systems and a voltage reduction of 20 to 30 percent when starting these motors from limited-capacity power sources such as diesel generator units. Large induction motors can achieve rated speed in less than 5 seconds when powered from adequately sized emergency diesel generator units that are capable of restoring the bus voltage to 90 percent of nominal in about 1 second.

Protection of the emergency diesel generator unit from excessive overspeed, which can result from an improperly adjusted control system or governor failure, is afforded by the immediate operation of a diesel generator unit trip, usually set at 115 percent of nominal speed. Similarly, in order to prevent substantial damage to the generator, the generator differential current trip must operate immediately upon occurrence of an internal fault. There are other protective trips provided to protect the emergency diesel generator units from possible damage. However, these trips could interfere with the successful functioning of the unit when it is most needed, i.e., during accident conditions. Experience has shown that there have been numerous occasions when these trips have needlessly shut down emergency diesel generator units because of spurious operation of a trip circuit. Consequently, it is important that measures be taken to ensure that spurious actuation of these other protective trips does not prevent the emergency diesel generator unit from performing its function.

The uncertainties inherent in estimates of safety loads at the construction permit stage of design are sometimes of such magnitude that it is prudent to provide a substantial margin in selecting the load capabilities of the emergency diesel generator unit. This margin can be provided by estimating the loads conservatively and selecting the continuous rating of the emergency diesel generator unit that exceeds the sum of the loads needed at any one time. A more accurate estimate of safety loads is possible during the operating license stage of review because detailed designs have been completed and component test and preperational test data are usually available. However, the sum of the total loads at the operating li-

[1]Copies may be obtained from the Institute of Electrical and Electronics Engineers, Inc., IEEE Service Center, 445 Hoes Lane, P. O. Box 1331, Piscataway, NJ 08855.

cense stage should not exceed the continuous rating of the emergency diesel generator.

The reliability of emergency diesel generators is one of the main factors affecting the risk of core damage from a station blackout event. Thus, attaining and maintaining high reliability of emergency diesel generators at nuclear power plants is a major contributor to the reduction of the probability of station blackout. In Regulatory Guide 1.155, "Station Blackout," the reliability of the diesel generator is one of the factors to be used to determine the length of time a plant should be able to cope with a station blackout. If all other factors (redundancy of emergency diesel generators, frequency of loss of offsite power, and probable time needed to restore offsite power) remain constant, a higher reliability of the diesel generators will result in a lower probability of a total loss of ac power (station blackout) with a corresponding coping duration for certain plants according to Regulatory Guide 1.155.

High reliability should be designed into the emergency diesel generator units and maintained throughout their service lifetime. This can be achieved by appropriate testing, maintenance, and operating programs and by institution of a reliability program that implements effective root cause analysis of all emergency diesel generator failures and that is designed to monitor, improve, and maintain reliability at selected levels.

This guide provides explicit guidance in the areas of preoperational testing, periodic testing, reporting and recordkeeping requirements, and valid demands and failures. The preoperational and periodic testing provisions set forth in this guide provide a basis for taking corrective actions needed to maintain high in-service reliability of installed emergency diesel generator units. The data base developed will assist ongoing monitoring of performance for all emergency diesel generator units after installation and during service.

This revision of Regulatory Guide 1.9 integrates into a single regulatory guide pertinent guidance previously addressed in Revision 2 of Regulatory Guide 1.9, Revision 1 of Regulatory Guide 1.108, and Generic Letter 84-15, and it endorses, as appropriate, guidelines set forth in IEEE Std 387-1984.

C. REGULATORY POSITION

Conformance with the guidelines in IEEE Std 387-1984, "IEEE Standard Criteria for Diesel Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations," is acceptable to the NRC staff for satisfying the Commission's regulations with respect to design, qualification, and periodic testing of diesel generator units used as onsite electric power systems for nuclear power plants subject to the following.

1. DESIGN CONSIDERATIONS

The guidelines of IEEE Std 387-1984 should be supplemented as follows:

1.1 Section 1.2, "Inclusions," of IEEE Std 387-1984 should be supplemented to include diesel generator auto controls, manual controls, and diesel generator output breaker.

1.2 When the characteristics of the required emergency diesel generator loads are not accurately known, such as during the construction permit stage of design, each emergency diesel generator unit of an onsite power supply system should be selected to have a continuous load rating (as defined in Section 3.7.1 of IEEE Std 387-1984) equal to the sum of the conservatively estimated loads (nameplate) needed to be powered by that unit at any one time plus a 10 to 15 percent margin. In the absence of fully substantiated performance characteristics for mechanical equipment such as pumps, the electric motor drive ratings should be calculated using conservative estimates of these characteristics, e.g., pump runout conditions and motor efficiencies of 90 percent or less and power factors of 85 percent or lower.

1.3 At the operating license stage of review, the predicted loads should not exceed the continuous rating (as defined in Section 3.7.1 of IEEE Std 387-1984) of the diesel generator unit.

1.4 Section 5.1.2, "Mechanical and Electrical Capabilities," of IEEE Std 387-1984 pertains, in part, to the starting and load-accepting capabilities of the diesel generator unit. In conformance with Section 5.1.2, each diesel generator unit should be capable of starting and accelerating to rated speed, in the required sequence, all the needed engineered safety feature and emergency shutdown loads. The diesel generator unit design should be such that at no time during the loading sequence should the frequency decrease to less than 95 percent of nominal nor the voltage decrease to less than 75 percent of nominal (a larger decrease in voltage and frequency may be justified for a diesel generator unit that carries only one large connected load). Frequency should be restored to within 2 percent of nominal in less than 60 percent of each load-sequence interval for stepload increase and in less than 80 percent of each load-sequence interval for disconnection of the single largest load, and voltage should be restored to within 10 percent of nominal within 60 percent of each load-sequence time interval. (A greater percentage of the time interval may be used if it can be justified by analysis. However, the load-sequence time interval should include sufficient margin to account for the accuracy and repeatability of the load-sequence timer.) During recovery from transients caused by the disconnection of the largest single load, the speed of the diesel generator unit should not exceed the nominal speed plus 75 percent of the difference between nominal speed and the over-speed trip setpoint or 115 percent of nominal, whichever is lower. Furthermore, the transient following the complete loss of load should not cause the speed of the unit to attain the overspeed trip setpoint.

1.5 Emergency diesel generator units should be designed to be testable as described in Regulatory Position 2. The design should include provisions so that testing of the units will simulate the parameters of operation (manual start, automatic start, load sequencing, load shedding, operation time, etc.), normal standby conditions, and environments (temperature, humidity, etc.) that would be expected if actual demand were to be placed on the system. If prewarm systems designed to maintain lube oil and jacket water cooling at certain temperatures or prelubrication systems or both are normally in operation, this would constitute normal standby conditions for that plant.

The units should be designed to automatically transfer from the test mode to an emergency mode upon receipt of emergency signals.

1.6 Design provisions should include the capability to test each emergency diesel generator unit independently of the redundant units. Test equipment should not cause a loss of independence between redundant diesel generator units or between diesel generator load groups. Testability should be considered in the selection and location of instrumentation sensors and critical components (e.g., governor, starting system components). Instrumentation sensors should be readily accessible and designed so that their inspection and calibration can be verified in place. The overall design should include status indication and alarm features.

1.7 Section 5.5.3.1, "Surveillance Systems," of IEEE Std 387–1984 pertains to status indication of diesel generator unit conditions. The guidance in this section should be supplemented as follows:

1.7.1 A surveillance system should be provided with remote indication in the control room for displaying emergency diesel generator unit status, i.e., under test, ready-standby, lockout. A means of communication should also be provided between diesel generator unit testing locations and the main control room to ensure that the operators are cognizant of the status of the unit under test.

1.7.2 In order to facilitate trouble diagnosis, the surveillance system should indicate which of the emergency diesel generator protective trips has been activated first.

1.8 Section 5.5.4, "Protection," of IEEE Std 387–1984, which pertains to bypassing emergency diesel generator protective trips during emergency conditions, should be supplemented as follows:

> The emergency diesel generator unit should be automatically tripped on an engine overspeed and generator-differential over-current. All other diesel generator protective trips should be handled in one of two ways: (1) a trip should be implemented with two or more measurements for each trip parameter with coincident logic provisions for trip actuation, or (2) a trip may be bypassed under accident conditions provided the operator has sufficient time to react appropriately to an abnormal diesel generator unit condition. The design of the coincident logic trip circuitry should include the capability for indication of individual sensor trips. The design of the bypass circuitry should include the capability for (1) testing the status and operability of the bypass circuits, (2) alarming in the control room for abnormal values of all bypass parameters (common trouble alarms may be used), and (3) manually resetting the trip bypass function. Capability for automatic reset is not acceptable.

Section 5.5.4(2) of IEEE Std 387–1984, on retaining all protective devices during emergency diesel generator testing, does not apply to a periodic test that demonstrates diesel generator system response under simulated accident con-ditions per Regulatory Positions 2.2.5, 2.2.6, and 2.2.12.

2. DIESEL GENERATOR TESTING

Section 3, "Definitions," Section 6, "Testing,"[2] and Section 7, "Qualification Requirements," in IEEE Std 387–1984 should be supplemented as discussed below.

2.1 Definitions

Figure 1 illustrates those components and systems that should be considered to be within the emergency diesel generator boundary for purposes of evaluating failures. Systems that provide support to the emergency diesel generator and perform other plant functions are shown outside this boundary. IEEE Std 387–1984 and ANSI/ASME OM–16 provide similar definitions of components and system boundaries and may also be used as guidance.

The following definitions are applicable to the positions of this regulatory guide that address testing, recordkeeping, and reporting of emergency diesel generator performance.

Start demands: All valid and inadvertent start demands, including all start-only demands and all start demands that are followed by load-run demands, whether by automatic or manual initiation. A start-only demand is a demand in which the emergency generator is started, but no attempt is made to load the emergency diesel generator. See "Exceptions" below.

[2]Additional useful information on testing and test definitions can be found in the ASME O&M Part 16, "Inservice Testing and Maintenance of Diesel Drives at Nuclear Power Plants." Copies can be obtained by contacting the American Society of Mechanical Engineers (ASME), United Engineering Center, 345 East 47th Street, New York, NY 10017.

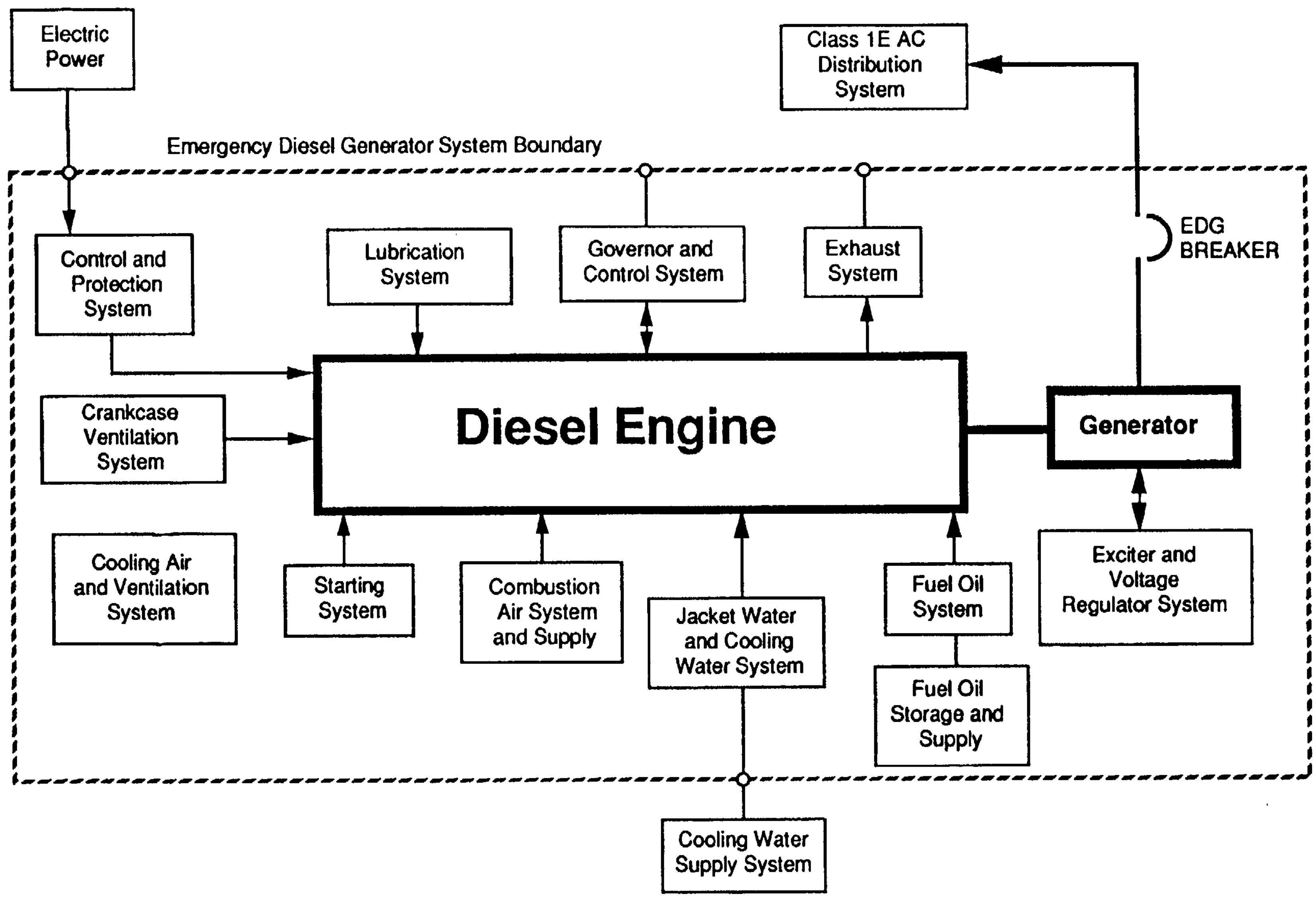

Figure 1. Boundary and Support Systems of Emergency Diesel Generator Systems

Start failures: Any failure within the emergency generator system that prevents the generator from achieving specified frequency (or speed) and voltage is classified as a valid start failure. (For the monthly surveillance tests, the emergency diesel generator can be brought to rated speed and voltage in a time that is recommended by the manufacturer to minimize stress and wear. Similarly, if the generator fails to reach rated speed and voltage in the precise time required by technical specifications, the start attempt is not considered a failure if the test demonstrated that the generator would start and run in an emergency.) See "Exceptions" below. Any condition identified in the course of maintenance inspections (with the emergency diesel generator in the standby mode) that would definitely have resulted in a start failure if a demand had occurred should be counted as a valid start demand and failure.

Load-run demands: To be valid, the load-run attempt must follow a successful start and meet one of the following criteria. See "Exceptions" below.

- A load-run of any duration that results from a real (i.e., not a test) automatic or manual signal.
- A load-run test to satisfy the plant's load and duration test specifications.
- Other operations (e.g., special tests) in which the emergency diesel generator is planned to run for at least 1 hour with at least 50 percent of design load.

Load-run failures: A load-run failure should be counted when the emergency diesel generator starts but does not pick up load and run successfully. Any failure during a valid load-run demand should be counted. See "Exceptions" below. (For monthly surveillance tests, the emergency diesel generator can be loaded at a rate that is recommended by the manufacturer to minimize stress and wear. Similarly, if the generator fails to load in the precise time required by technical specifications, the load-run attempt is not considered a failure if the test demonstrated that the generator would load and run in an emergency.) Any condition identified in the course of maintenance inspections (with the emergency diesel generator in the standby mode) that definitely would have resulted in a load-run failure if a demand had occurred should be counted as a valid load-run demand and failure.

Exceptions: Unsuccessful attempts to start or load-run should not be counted as valid demands or failures when they can be definitely attributed to any of the following:

- Any operation of a trip that would be bypassed in the emergency operation mode (e.g., high cooling water temperature trip).
- Malfunction of equipment that is not required to operate during the emergency operating mode (e.g., synchronizing circuitry).
- Intentional termination of the test because of alarmed or observed abnormal conditions (e.g., small water or oil leaks) that would not have ultimately resulted in significant emergency generator damage or failure.
- Component malfunctions or operating errors that did not prevent the emergency diesel generator from being restarted and brought to load within a few minutes (i.e., without corrective maintenance or significant problem diagnosis).
- A failure to start because a portion of the starting system was disabled for test purposes if followed by a successful start with the starting system in its normal alignment.

Each diesel generator *valid* failure that results in the emergency diesel generator being declared inoperable should be counted as one demand and one failure. Exploratory tests during corrective maintenance or preventive maintenance should not be counted as demands or failures. However, the successful test that is performed to declare the emergency diesel generator operable should be counted as a demand.

2.2 Test Descriptions

The following test descriptions are to be used in conjunction with the pre-operational and surveillance testing described in Table 1. The licensee should have detailed procedures for each test described here. The procedures should identify special arrangements or changes in normal system configuration that must be made to put the emergency diesel generator under test. Jumpers and other nonstandard configurations or arrangements should not be used subsequent to initial equipment startup testing.

2.2.1 Start Test: Demonstrate proper startup from standby conditions, and verify that the required design voltage and frequency is attained. For these tests, the emergency diesel generator can be slow-started and reach rated speed on a prescribed schedule that is selected to minimize stress and wear.

2.2.2 Load-Run Test: Demonstrate 90 to 100 percent of the continuous rating of the emergency diesel generator, for an interval of not less than 1 hour and until temperature equilibrium has been attained. This test may be accomplished by synchronizing the generator with offsite power. The loading and unloading of an emergency diesel generator during this test should be gradual and based on a prescribed schedule that is selected to minimize stress and wear on the diesel generator.

Table 1. Preoperational and Surveillance Testing

Tests Described in Regulatory Position 2.2		Preoperational Test Program	Monthly Surveillance Tests	6 - Month Tests	Refueling Outage	10-Year Tests
2.2.1	Start Test		X			
2.2.2	Load-Run Test	X	X	X*		
2.2.3	Fast-Start Test	X		X*	X	
2.2.4	Loss-of-Offsite-Power (LOOP) Test	X			X	
2.2.5	Safety Injection Actuation Signal (SIAS) Test	X			X	
2.2.6	Combined SIAS and LOOP Tests	X			X	
2.2.7	Single-Load Rejection Test	X			X	
2.2.8	Full-Load Rejection Test	X			X	
2.2.9	Endurance and Margin Test	X			X	
2.2.10	Hot Restart Test	X			X	
2.2.11	Synchronizing Test	X			X	
2.2.12	Protective-Trip Bypass Test	X			X	
2.2.13	Test Mode Change-Over Test	X			X	
2.2.14	Redundant Unit	X				X

*This test may be substituted for a monthly test.

2.2.3 Fast-Start Test: Demonstrate that each emergency diesel generator unit starts from standby conditions. If a plant normally has in operation prewarm systems designed to maintain lube oil and jacket water cooling at certain temperatures or prelubrication systems or both, this would constitute normal standby conditions for that plant. Verify that the emergency diesel generator reaches required voltage and frequency within acceptable limits and time as defined in the plant technical specifications.

2.2.4 Loss-of-Offsite-Power (LOOP) Test: Demonstrate by simulating a loss-of-offsite power that (1) the emergency buses are deenergized and the loads are shed from the emergency buses, and (2) the emergency diesel generator starts on the autostart signal from its standby conditions, attains the required voltage and frequency and energizes permanently connected loads within acceptable limits and time, energizes the autoconnected shutdown loads through the load sequencer, and operates for greater than or equal to 5 minutes.

2.2.5 SIAS Test: Demonstrate that, on a safety injection actuation signal (SIAS), the emergency diesel generator starts on the autostart signal from its standby conditions, attains the required voltage and frequency within acceptable limits and time, and operates on standby for greater than or equal to 5 minutes.

2.2.6 Combined SIAS and LOOP Tests: Demonstrate that the emergency diesel generator can satisfactorily respond to a LOOP in conjunction with SIAS in whatever sequence they might occur (e.g., loss-of-coolant accident (LOCA) followed by delayed LOOP or LOOP followed by LOCA). A simultaneous LOOP/LOCA event would be demonstrated by simulating a LOOP and SIAS and verifying that (1) the emergency buses are deenergized and loads are shed from the emergency buses, and (2) the emergency diesel generator starts on the autostart signal from its standby conditions, attains the required voltage and frequency and energizes permanently connected loads within acceptable limits and time, energizes autoconnected loads through the load sequencer, and operates for greater than or equal to 5 minutes.

2.2.7 Single-Load Rejection Test: Demonstrate the emergency diesel generator's capability to reject a loss of the largest single load while operating at power factor between 0.8 and 0.9 and verify that the voltage and frequency requirements are met and that the unit will not trip on overspeed.

2.2.8 Full-Load Rejection Test: Demonstrate the emergency diesel generator's capability to reject a load equal to 90 to 100 percent of its continuous rating while operating at power factor between 0.8 and 0.9, and verify that the voltage requirements are met and that the emergency diesel generator will not trip on overspeed.

2.2.9 Endurance and Margin Test: Demonstrate full-load carrying capability at a power factor between 0.8 and 0.9 for an interval of not less than 24 hours, of which 2 hours are at a load equal to 105 to 110 percent of the continuous rating of the emergency diesel generator, and 22 hours are at a load equal to 90 to 100 percent of its continuous rating. Verify that voltage and frequency requirements are maintained.

2.2.10 Hot Restart Test: Demonstrate hot restart functional capability at full-load temperature conditions (after it has operated for 2 hours at full load) by verifying that the emergency diesel generator starts on a manual or autostart signal, attains the required voltage and frequency within acceptable limits and time, and operates for longer than 5 minutes. This test may be performed following the endurance and margin test above.

2.2.11 Synchronizing Test: Demonstrate the ability to (1) synchronize the emergency diesel generator unit with offsite power while the unit is connected to the emergency load, (2) transfer this load to the offsite power, and (3) restore the emergency diesel generator to ready-to-load status.

2.2.12 Protective Trip Bypass Test: Demonstrate that all automatic emergency diesel generator trips (except engine overspeed, generator differential, and those retained with coincident logic) are automatically bypassed upon an SIAS. This test may be performed in conjunction with Regulatory Positions 2.2.5 and 2.2.6.

2.2.13 Test Mode Change-Over Test: Demonstrate that with the emergency diesel generator operating in a test mode while connected to its bus, a simulated safety injection signal overrides the test mode by (1) returning the emergency diesel generator to standby operation and (2) automatically energizing the emergency loads from offsite power.

2.2.14 Redundant Unit Test: Demonstrate that, by starting and running both redundant units simultaneously, potential common failure modes that may be undetected in single emergency diesel generator unit tests do not occur.

2.3 Preoperational and Surveillance Testing

Table 1 relates preoperational and surveillance tests to the anticipated schedule for performance (e.g., preoperational, monthly surveillance, 6-month testing, scheduled refueling period, and 10-year testing).

All planned tests described in Regulatory Position 2.2 should be preceded by a prelube period and should be in general accordance with the manufacturer's recommendations for reducing engine wear, including cool-down operation at reduced power followed by postoperation lubrication.

2.3.1 Preoperational Testing: A preoperational test program should be implemented for all emergency diesel generator systems following assembly and installation at the site. This program should include the tests identified in Table 1.

In addition, through a minimum of 25 valid start-and-load demands in accordance with Regulatory Positions 2.2.2 and 2.2.3 without failure on each installed emergency diesel generator unit, demonstrate that an acceptable level of reliability has been achieved to place the new emergency diesel generator into an operational category.

2.3.2 Surveillance Testing: After plants are licensed (after fuel load), periodic surveillance testing of each emergency diesel generator must demonstrate continued capability and reliability of the diesel generator unit to perform its intended function. When the emergency diesel generator is declared operational in accordance with plant technical specifications, the following periodic test program should be implemented.

2.3.2.1 Monthly Testing: After completion of the emergency diesel generator unit reliability demonstration during pre-operational testing, periodic testing of emergency diesel generator units during normal plant operation should be performed. Each diesel generator should be started as described in Regulatory Position 2.2.1 and loaded as described in Regulatory Position 2.2.2 at least once in 31 days (with maximum allowable extension not to exceed 25 percent of the surveillance interval).

2.3.2.2 Six-Month (or 184 days) Testing: (This test may be substituted for a monthly test.) In order to demonstrate the capability of the emergency diesel generator to start from standby and provide the necessary power to mitigate the loss-of-coolant accident coincident with loss of offsite power, once every 6 months each diesel generator should be started from standby conditions as described in Regulatory Position 2.2.3 to verify that the diesel generator reaches required voltage and frequency within acceptable limits and time as specified in the plant technical specifications. Following this test, the emergency diesel generator should be loaded as described in Regulatory Position 2.2.2. (See also Table 1.)

2.3.2.3 Refueling Outage Testing: Overall emergency diesel generator unit design capability should be demonstrated at every refueling outage by performing the tests identified in Table 1.

2.3.2.4 Ten-Year Testing: Demonstrate that the trains of standby electric power are independent once every 10 years (during a plant shutdown) or after any modifications that could affect emergency diesel generator independence, whichever is the shorter, by starting all redundant units simultaneously to help identify certain common failure modes undetected in single diesel generator unit tests. (See also Table 1.)

3. RECORDKEEPING

Section 7.5.2, "Records and Analysis," of IEEE Std 387–1984 should be supplemented as follows:

> Licensees should retain in an auditable and retrievable form the information related to emergency diesel generator failures to start and load-run that occur during all planned and unplanned demands and underlying failure causes and corrective actions taken in response to individual emergency diesel generator failures.

4. REPORTING CRITERIA

Licensees must conform to the reporting requirements of 10 CFR Part 21, 50.72, and 50.73.

D. IMPLEMENTATION

The purpose of this section is to provide information to applicants and licensees regarding the NRC staff's plans for using this regulatory guide.

Except in those cases in which an applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, this guide will be used in the evaluation of the selection, design, qualification, and testing for diesel generator units used as onsite electric power systems.

REGULATORY ANALYSIS

A separate regulatory analysis was not prepared for this regulatory guide. The regulatory analysis prepared for the station blackout rule, NUREG-1109, "Regulatory/Backfit Analysis for the Resolution of Unresolved Safety Issue A-44, Station Blackout," envelops the regulatory basis for this guide and examines the costs and benefits of the rule as implemented by the guide. A copy of NUREG-1109 is available for inspection and copying for a fee at the NRC Public Document Room, 2120 L Street NW., Washington, DC. Copies of NUREG-1109 may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Post Office Box 37082, Washington, DC 20013-7802; or from the National Technical Information Service, Springfield, VA 22161.

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