

An American National Standard

**IEEE Standard Criteria for
Diesel-Generator Units Applied as
Standby Power Supplies for
Nuclear Power Generating Stations**

Sponsor

**Nuclear Power Engineering Committee of the
IEEE Power Engineering Society**

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Foreword

(This Foreword is not a part of IEEE Std 387-1984, IEEE Standard Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations.)

This standard is supplementary to IEEE Std 308-1980, IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations, and specifically amplifies 6.2.4, Standby Power Supplies, of that standard concerning requirements for diesel-generator units.

The IEEE has developed this standard to provide the principal design criteria, design features, qualification considerations, and testing requirements for individual diesel-generator units, including auxiliary equipment and controls within the scope of this standard used in the standby power supply of a nuclear facility, which comply with the Nuclear Regulatory Commission's Code of Federal Regulations (10 CFR 50). This standard presents specific procedures and criteria applicable to qualifying the diesel-generator unit and supplements the criteria described in IEEE Std 323-1983, IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations, and IEEE Std 627-1980, IEEE Standard for Design Qualification of Safety Systems Equipment Used in Nuclear Power Generating Stations.

This revision of the standard provides additional detail in the areas of:

- (1) Defining specific qualification requirements
- (2) Providing requirements for no-load and light-load operation, since extended operation under these conditions may be detrimental to unit performance
- (3) Expanding factory testing criteria
- (4) Establishing specific surveillance and maintenance requirements
- (5) Providing guidance for establishing a load profile (Appendix A)

The qualification requirements delineated in this standard include aging considerations as potential common mode failure mechanisms. Operating experience is generally available on diesel-generator units similar to those covered by this standard, and is useful in establishing the effect of aging mechanisms for those components where the technical state-of-the-art does not allow for techniques such as accelerated aging. The basis for allowing operating experience is supplemented by noting that the application of these diesel-generator units for nuclear service is such that the actual operating time under loaded conditions is expected to be less than one year continuous service in the 40 year life expectancy of the plant. For areas where the state-of-the-art is not as limited, accelerated aging techniques should be used.

Components or assemblies which have experienced accelerated aging should not be shipped for in-service use unless sufficient margin in the qualified life exists. Likewise, equipment that has been seismically tested may require analysis to demonstrate its adequacy for in-service use. Additional research is required in the industry to evaluate these concerns. Additional work is also required in the area of replacement parts and their specific qualification requirements. As the overall state-of-the-art of equipment qualification progresses, this standard will be revised as required.

Other industry standards exist or are being developed to cover topics related to this standard, including detailed periodic testing criteria and the American Nuclear Society (ANS) 59 series standards¹ describing design requirements for diesel-generator unit auxiliary systems.

Adherence to these criteria may not suffice for ensuring public health and safety because it is the integrated performance of the structures, the fluid systems, the instrumentation systems, and the electrical systems of the station that establishes the consequences of accidents. Each applicant has the responsibility to assure himself and others that this integrated performance is adequate.

¹These publications are available from The American Nuclear Society, 555 North Kensington Avenue, LaGrange Park, Ill 60525.

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IEEE Standard Criteria for Diesel-Generator Units Applied as Standby Power Supplies for Nuclear Power Generating Stations

1. Scope

1.1 General. This standard describes the criteria for the application of diesel-generator units as individual units of the Class 1E standby power supplies in stationary nuclear power generating stations.

1.2 Inclusions. The following items are within the scope of this standard:

- (1) The diesel engine, including:
 - (a) The flywheel (if applicable)
 - (b) The combustion air system, starting at the engine air intake connection, including the effects of any remote air intake filter or silencer, or both
 - (c) The starting system
 - (d) The starting energy system
 - (e) The fuel oil system from the fuel oil day tank to the engine, including filters and strainers between the day tank and the engine
 - (f) The lubricating oil system
 - (g) The cooling system, starting at the point where the cooling medium is introduced to the diesel-generator unit
 - (h) The exhaust system, including the exhaust silencer, but excluding piping from the engine exhaust connection to the inlet of the silencer and silencer tail pipe
 - (i) The governor system
- (2) The generator, including:
 - (a) The main leads terminating at the generator terminals
 - (b) The excitation and voltage regulation systems
- (3) The local control, protection, and surveillance systems associated with the diesel engine, the generator, and their auxiliary equipment and systems cited above

(4) The ac and dc distribution systems associated with the diesel engine, the generator, and their auxiliary equipment and systems cited above, exclusive of the auxiliary power system beyond the generator terminals

(5) Those elements that are essential to the safety function of diesel-generator units within the scope (See Fig 1.)

(6) Evaluation of the characteristics of the service environment, for example, relative to performance and qualification

1.3 Exclusions. The following items are outside of the scope of this standard:

- (1) The diesel-generator unit enclosure and foundations
- (2) The external service equipment and systems which are a part of, or which are housed in, the diesel-generator unit enclosure, other than those tabulated in 1.2, such as equipment for providing and conveying combustion air, ventilating air, etc, to the vicinity of the diesel-generator unit
- (3) The fuel oil storage system (day tank, storage tank, transfer pumps and filters, and strainers between the storage tank and the day tank)
- (4) The auxiliary power system beyond the generator terminals of the diesel-generator unit, including:
 - (a) The conductors for transmitting power from the generator
 - (b) The diesel-generator unit main disconnecting and protective device
 - (c) The generator circuit instrument transformers, whether furnished with the diesel-generator unit or not
 - (d) The generator protective relays

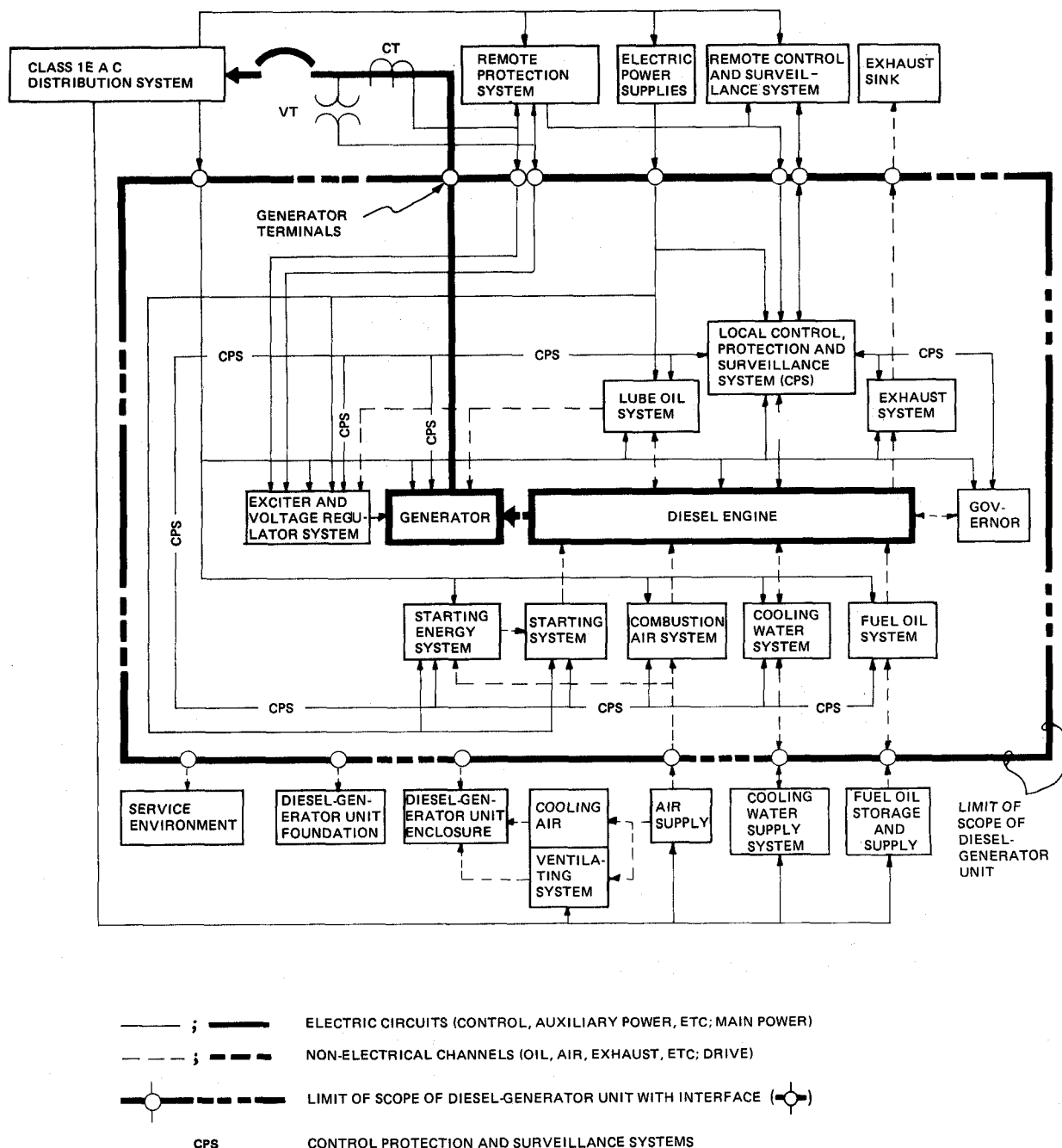


Fig 1
Scope Diagram

(5) The control, surveillance, and protection systems for:

- (a) Initiating the *Start Diesel Signal*
- (b) Loading the diesel-generator unit
- (c) Protecting the loads energized by the diesel-generator unit
- (d) Disconnecting the loads energized by the diesel-generator unit

(e) Prevention of common-mode failure between the preferred power supply and the standby power supply

(6) Determination of the characteristics of the service environment

1.4 Scope Diagram. The scope diagram presented in Fig 1 illustrates the delineation of the scope.

2. Purpose

The purpose of this standard is to provide the principal design criteria, the design features, testing and qualification requirements for the individual diesel-generator units which enable them to meet their functional requirements as a part of the standby power supply under the conditions produced by the design basis events cataloged in the Plant Safety Analysis.

3. Definitions

3.1 acceptable. Demonstrated to be adequate by the safety analysis of the plant.

3.2 design basis events. Postulated events used in the design to establish the performance requirements of the structures and systems.

3.3 design load. That combination of electric loads, having the most severe power demand characteristic, which is provided with electric energy from a diesel-generator unit for the operation of engineered safety features and other systems required during and following shut-down of the reactor.

3.4 diesel-generator unit. An independent source of standby electrical power that consists of diesel-fueled internal combustion engine (or engines) coupled directly to an electrical generator(s), the associated mechanical and electrical auxiliary systems and the control, protection, and surveillance systems.

3.5 load profile. The magnitude and duration of loads applied in a prescribed time sequence, including the transient and steady state characteristics of the individual loads.

3.6 qualified diesel-generator unit. A diesel-generator unit that meets the qualification requirements of this standard.

3.7 rating of diesel-generator unit

3.7.1 continuous rating. The electric power output capability that the diesel-generator unit can maintain in the service environment for 8760 h of operation per (common) year with only scheduled outages for maintenance.

3.7.2 short time rating. The electric power output capability that the diesel-generator unit

can maintain in the service environment for 2 h in any 24 h period, without exceeding the manufacturer's design limits and without reducing the maintenance interval established for the continuous rating.

NOTE: Operation at this higher rating does not limit the use of the diesel-generator unit at its continuous rating.

3.8 redundant equipment or system. An equipment or system that duplicates the essential function of another equipment or system to the extent that either may perform the required function regardless of the state of operation or failure of the other.

3.9 service environment. The aggregate of conditions surrounding the diesel-generator unit in its enclosure, while serving the design load during normal, accident, and post-accident operation.

3.10 standby power supply. The power supply that is selected to furnish electric energy when the preferred power supply is not available.

3.11 start diesel signal. That input signal to the diesel-generator unit start logic which initiates a diesel-generator unit start sequence.

3.12 surveillance. The determination of the state or condition of a system or subsystem.

4. References

[1] ANSI C50.10-1977, American National Standard General Requirements for Synchronous Machines.²

[2] ANSI N195-1976, American National Standard Fuel Oil Systems for Standby Diesel-Generators.

[3] ANSI/IEEE Std 344-1975 (R 1980) IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations.

[4] ANSI/NEMA MG-1-1978, Motors and Generators.

²ANSI publications are available from the Sales Department, American National Standard Institute, 1430 Broadway, New York, NY 10018.