U.S. NUCLEAR REGULATORY COMMISSION

Revision 1
March 1976

REGULATORY GUIDE

OFFICE OF STANDARDS DEVELOPMENT

REGULATORY GUIDE 1.32

CRITERIA FOR SAFETY-RELATED ELECTRIC POWER SYSTEMS FOR NUCLEAR POWER PLANTS

A. INTRODUCTION

General Design Criterion 17, "Electric Power Systems," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Licensing of Production and Utilization Facilities," requires that an onsite electric power system and an offsite electric power system be provided to permit functioning of structures, systems, and components important to safety. In addition, Criterion 17 contains requirements concerning system capacity, capability, independence, redundancy, availability, testability, and reliability. General Design Criterion 18, "Inspection and Testing of Electric Power Systems," of Appendix A to 10 CFR Part 50, contains requirements concerning periodic inspection, testing, and testability of electric power systems important to safety. This guide describes a method acceptable to the NRC staff of complying with Criteria 17 and 18 with respect to the design, operation, and testing of safety-related electric power systems in all types of nuclear power plants.

B. DISCUSSION

IEEE Std 308-1974[1] is a revision of IEEE Std 308-1971 and was prepared by Working Group 4.1 of the Nuclear Power Engineering Committee (NPEC) of the Institute of Electrical and Electronics Engineers (IEEE). IEEE Std 308-1974 was approved by NPEC at its meeting on May 17-18, 1973, and subsequently by the IEEE Standards Board on December 13, 1973.

This revision to IEEE Std 308-1971 has made the standard consistent with the requirement in Criterion 17 for two circuits to the offsite network, each designed to be available in sufficient time following a loss of onsite alternating current power supplies and the other offsite electric power circuit. However, two potential conflicts with Criterion 17 remain unresolved: one in the area of availability of offsite power (Item 1) and the other in battery charger supply requirements (Item 2). In addition, an inconsistency exists between IEEE Std 308-1974 and IEEE Std 450-1975 (Item 3).

1. IEEE Standard 308-1974, Section 5.2.3(4), first paragraph, requires that offsite power be available within an acceptable time following a loss-of-coolant accident. In contrast, Criterion 17 requires that offsite power be available within a few seconds following a loss-of-coolant accident. Thus a potential for misunderstanding exists with regard to the maximum permissible time for access to the offsite network in the event of a loss-of-coolant accident, and further guidance is needed.

2. Section 5.3.4 of IEEE Std 308-1974 requires, in part, that each battery charger supply (a) furnish electric energy for the steady-state operation of connected loads required during normal and postaccident operation while its battery is returned to or maintained in a fully charged state and (b) have sufficient capacity to restore the battery from the design minimum charge to its fully charged state while supplying normal and postaccident steady-state loads. In contrast, the equivalent position of Criterion 17 requires that the onsite electric power supplies, including the batteries and the onsite electric distribution system, have sufficient independence, redundancy, capacity, and testability to perform their safety functions assuming a single failure. Criterion 17,

[1] IEEE Std 308-1974, "IEEE Standard Criteria for Class IE Power Systems for Nuclear Power Generating Stations," may be obtained from the Institute of Electrical and Electronics Engineers, United Engineering Center, 345 East 47th Street, New York, New York 10017.

therefore, does not restrict the battery charger supply loads to normal and postaccident steady-state loads. A conflict may therefore exist for those plants in which other loads (e.g., loads required during hot or cold shutdown, large startup loads during an accident, or other design basis events) are greater than the normal and postaccident steady-state loads.

3. Table 2, "Illustrative Periodic Tests," of IEEE Std 308-1974 lists a test interval of 3 years for the battery performance discharge test and refers to IEEE Std 450-1972, "Recommended Practice for Maintenance, Testing, and Replacement of Large Stationary Type Power Plant and Substation Lead Storage Batteries," for details regarding performance of such tests. Subsequent to the publication of IEEE Std 308-1974, IEEE Std 450-1972 was revised and published as IEEE Std 450-1975, "IEEE Recommended Practice for Maintenance, Testing, and Replacement of Large Lead Storage Batteries for Generating Stations and Substations." IEEE Std 450-1975 specifies a battery performance discharge test within the first two years of service and thereafter at intervals of 5 years until the battery shows signs of degradation or until 85% of expected service life is reached, at which time annual tests are required. The 3-year interval specified in IEEE Std 308-1974 conflicts with these requirements. IEEE Std 450-1975 also describes a battery service test, but no test frequency is specified. IEEE Std 308-1974 does not specifically mention the battery service test.

It should be noted that the scope of IEEE Std 308-1974 is more limited than that of Criteria 17 and 18. For example, the scope of IEEE Std 308-1974 excludes the unit generator(s) and their buses; step-up, auxiliary, and startup transformers; connections to the station switchyard; switchyard; transmission lines; and the transmission network. Except for the unit generator(s), these are all included within the scope of Criteria 17 and 18.

In the foreword to IEEE Std 308-1974 it is noted that certain areas of this standard need more extensive treatment. These include shared systems in multi-unit stations, independence between redundant standby sources, connection of non-Class 1E equipment to Class 1E systems, and the definition of design basis events. Some of these topics have been the subject of other regulatory guides, e.g., Regulatory Guide 1.6 (Safety Guide 6), "Independence Between Redundant Standby (Onsite) Power Sources and Between Their Distribution Systems," which is concerned with electrical independence; Regulatory Guide 1.75, "Physical Independence of Electric Systems," which is concerned with physical independence of Class 1E systems and the connection of non-Class 1E equipment to Class 1E systems; and Regulatory Guide 1.81, "Shared Emergency and Shutdown Electric Systems for Multi-Unit Nuclear Power Plants." Other matters of importance to the regulatory process for electric power systems in nuclear power plants have been the subject of such regulatory guides as Regulatory Guide 1.9 (Safety Guide 9), "Selection of Diesel Generator Set Capacity for Standby Power Supplies," and Regulatory Guide 1.93, "Availability of Electric Power Sources."

The criteria and requirements in IEEE Std 308-1974 are indicated by the verbs "shall" and "must", and recommendations are indicated by the verb "should". The terms "may", "suggested", and "illustrative" indicate optional practices.

C. REGULATORY POSITION

1. For the portion of safety-related electric power system within its scope, the criteria, requirements, and recommendations in IEEE Std 308-1974 are generally acceptable to the NRC staff and provide an adequate basis for complying with the Commission's General Design Criteria 17 and 18 of Appendix A to 10 CFR Part 50 with respect to the design, operation, and testing of electric power systems, subject to the following:

a. **Availability of Offsite Power.** Consistent with the requirements of Criterion 17, the phrase "within an acceptable time" in Section 5.2.3(4), first paragraph, of IEEE Std 308-1974 should be construed to mean "within a few seconds". A preferred design would include two immediate access circuits from the transmission network. Detailed guidance for operating procedures and restrictions acceptable to the staff, applicable where two immediate access circuits are available, is contained in Regulatory Guide 1.93, "Availability of Electric Power Sources." An acceptable design would substitute a delayed access circuit for one of the immediate access circuits provided the availability of the delayed access circuit conforms to Criterion 17.

b. **Battery Charger Supply.** The capacity of the battery charger supply should be based on the largest combined demands of the various steady-state and transient loads and the charging capacity to restore the battery from the design minimum charge state to the fully charged state, irrespective of the status of the plant during which these demands occur.

c. **Battery Performance Discharge Tests.** The test interval for the battery performance discharge test should be as specified in IEEE Std 450-1975 instead of the 3 years specified in Table 2 of IEEE Std 308-1974, "Illustrative Periodic Tests." The battery service test described in IEEE Std 450-1975 should be performed in addition to the battery performance discharge test. The battery service test should be performed during refueling operations or at some other outage, with intervals between tests not to exceed 18 months. The note following Table 2 of IEEE Std 308-1974 should reference IEEE Std 450-1975 rather than IEEE Std 450-1972.

d. **Independence of Redundant Standby Sources.** Electrical independence between redundant standby (onsite) power sources should be in accordance with Regulatory Guide 1.6. Physical independence should be in accordance with Regulatory Guide 1.75.

e. **Connection of Non-Class 1E Equipments to Class 1E Systems.** The guidance presented in Regulatory Guide 1.75 should be followed.

f. **Selection of Diesel Generator Set Capacity for Standby Power Supplies.** The guidance presented in Regulatory Guide 1.9 should be followed.

2. The following optional practices are considered to be unacceptable as given below:

a. **Shared Electric Systems for Multi-Unit Nuclear Power Plants.** The provisions of Section 8.2 of IEEE Std 308-1974, which permit sharing of standby power supplies among units of a multi-unit station, are unacceptable except as specified in Regulatory Guide 1.81. The provisions of Section 8.3.1 of IEEE Std 308-1974 that permit sharing of battery supplies among units at a multi-unit plant are considered unacceptable and should be supplanted by the recommendations of Regulatory Guide 1.81.

b. **Availability of Electric Power Sources.** Table 3, "Suggested Operating Alternatives with Degraded Class 1E Power System Conditions," of IEEE Std 308-1974 is considered unacceptable and should be supplanted by the recommendations of Regulatory Guide 1.93.

D. IMPLEMENTATION

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

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, (1) the methods described in portions of this guide that reference other regulatory guides are being and will continue to be used in the evaluation of submittals for construction permit applications and (2) the methods described in other portions of this guide will be used in the evaluation of submittals for construction permit applications docketed after November 1, 1976, unless this guide is revised as a result of suggestions from the public or additional staff review.

If an applicant wishes to use this regulatory guide in developing submittals for applications docketed on or before November 1, 1976, the pertinent portions of the application will be evaluated on the basis of this guide.