

An American National Standard

IEEE Standard for the Qualification of Switchgear Assemblies for Class 1E Applications in Nuclear Power Generating Stations

Sponsor
**Switchgear Committee
of the
IEEE Power Engineering Society**

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Foreword

(This Foreword is not a part of ANSI/IEEE C37.82-1987, IEEE Standard for the Qualification of Switchgear Assemblies for Class 1E Applications in Nuclear Power Generating Stations.)

ANSI/IEEE Std 323-1984, IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations, was developed to provide qualification requirements for Class 1E (safety-related) electrical equipments that would confirm the adequacy of such equipments to perform their safety functions on a continuing basis throughout their installed life. This document is based on ANSI/IEEE Std 323-1983 and is intended to present specific qualification procedures for switchgear assemblies in Class 1E application.

In approaching the task of developing a standard for these procedures, the authors noted that

- 1) Standards for switchgear assemblies have been developed over a long period of time through the efforts of IEEE, AEIC, EEI, NEMA, and other interested parties under the auspices of the American National Standards Institute (ANSI).
- 2) The switchgear assembly products that have been produced in accordance with these standards and that have been properly manufactured, applied, handled, installed, operated, and maintained, have had long and successful performance records.
- 3) Because switchgear assemblies are protective equipments, the standards are conservative and provide ample margin with respect to normal application. Design and application also tend to be conservative.
- 4) The application of switchgear assemblies is always outside the containment in a nuclear power generating station. Normal service conditions are not severe. The only unusual requirements sometimes presented are
 - a) The need to meet safety-related performance demands during a design basis event (DBE) at any time, up to and including the end of a stipulated period known as the *qualified life*.
 - b) Qualification to the requirements of the DBE, which is usually a specified seismic event but may include severe environmental conditions for stipulated periods of time subsequent to the seismic and other DBE.
- 5) Switchgear assemblies are not cataloged “off-the-shelf” items as are motors, valves, pumps, etc. They are built from standardized components and subassemblies but in varied arrangements to satisfy the needs of different applications. The complements of devices such as relays, etc, are rarely the same from assembly to assembly and are subject to modification during production and even after installation.

In order to precisely define the task, it is important to understand what is meant by *qualification*. As described in ANSI/IEEE Std 323-1983, qualification is only one part of an overall quality assurance program that includes design, qualification, production quality control, installation, maintenance, and periodic testing. The overall program is required to assure that the equipment will meet or exceed its performance requirements throughout its installed life.

Qualification is that part that establishes the capability of the equipment to meet such requirements. Put another way, the qualification procedure must establish that the equipment *can*; the overall program is required to assure that it *will*.

Qualification programs should identify design and material characteristics that, after a period of time and during a DBE, may precipitate common failure modes due to aging of redundant equipment. The concept of *aging* must be included in the qualification procedure in order to investigate the possibility that aging degradation might be the source of common failure modes in redundant Class 1E equipments. In order to provide maximum assurance that the equipment can meet its safety-related performance requirements on a continuing basis throughout its installed life and for the stipulated DBE, it may be necessary to limit the installed life or establish a maintenance program for replacement of some components whose qualified life is shorter than the desired qualified life for the total equipment.

Based on the foregoing considerations, the authors of this document have developed a standard that is in accordance with the *combined qualification* procedure, as described in 5.4 of ANSI/IEEE Std 323-1983. The details of this procedure are covered in Section 7 of this document. Basically, it consists of using the standard design tests as prescribed by industry standards to establish the capability of the equipment in an “as new” condition, and to supplement this with tests and other data on critical components and materials to evaluate long-term performance. Analysis is used to determine the performance requirements, identify the critical components and materials, and relate

the aging data to the performance requirements in order to project a qualified life for the total assembly. Note that this approach to qualification provides the necessary flexibility to respond to the variations and modifications that are characteristic of switchgear assemblies.

Tests on complete assemblies have been used in this qualification procedure when it could be reasoned that the interrelationship of components in the complete assembly was important for realistic test results. Examples are the dielectric, continuous current, and short-circuit current tests required by industry standards, and the seismic tests required by ANSI/IEEE Std 344-1975, IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations.

However, the authors reasoned that accelerated aging tests (particularly thermal aging) in a complete assembly would not provide valid results. Many materials and components respond differently, relatively speaking, to accelerated aging than they do to natural aging. This changes the interrelationships and may produce unrealistic test results when accelerated aging is attempted on combinations of materials. Therefore, this standard requires aging data only for components and materials, rather than for complete assemblies.

It should be noted that this approach makes it desirable to define *margin* as the difference between demonstrated capability and required capability. The capability of switchgear assemblies is demonstrated by the design tests prescribed by relevant industry standards that show that the assemblies meet the ratings required by those standards. Because the equipment is rarely, if ever, applied up to its full rating, it is usually possible to show ample margin even when the equipment has aged. The *usual service conditions* defined in 4.1 of this standard are consistent with application practices for Class 1E assemblies in nuclear power generating stations and, hence, ensure margin for such applications. They are not derating factors.

Note that the end result of the qualification procedure is the projection of a qualified life for the switchgear assembly. There must be adequate documentation to support the projection.

The realization of the projected qualified life requires a joint effort by the manufacturer and the user. The manufacturer is responsible for the design and production of the equipment. In order to support the qualification of the equipment, he must provide and maintain documentation showing that it is capable of meeting specified performance requirements in specified service conditions throughout its qualified life. The documentation must also show that the equipment is capable of performing its safety function during and, if required, for a specified time after exposure to a DBE, which might occur at any time during the life of the equipment. In order to satisfy this latter requirement, the manufacturer must provide documentation relative to the long-term performance of components and materials that are critical with respect to the capability of performing the safety function. The manufacturer must provide guidance on the proper application, handling, storage, installation, and maintenance of the equipment. The maintenance guidance must include identification of components and materials whose long-term characteristics are not adequate, so that a replacement program can be developed.

The user is responsible for identification of the Class 1E equipment and components specifically requested by him. He must specify service conditions and performance requirements that are safety-related. He is responsible for proper application, handling, storage, installation, and maintenance in accordance with the guidance provided by the manufacturer. Proper application includes the maintaining of a generally favorable service environment that contributes greatly to successful long-term performance. A favorable service environment is defined by the usual service conditions listed in 4.1 of this standard.

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