



IEEE Standard for Qualifying Class 1E Motor Control Centers for Nuclear Power Generating Stations

IEEE Power Engineering Society

Sponsored by the
Nuclear Power Engineering Committee

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IEEE Standard for Qualifying Class 1E Motor Control Centers for Nuclear Power Generating Stations

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Abstract: The basic principles, requirements, and methods for qualifying Class 1E motor control centers for both harsh and mild environment applications in nuclear power generating stations are described. In addition to defining specific qualification requirements for Class 1E motor control centers and their components in accordance with the more general qualification requirements of IEEE Std 323™-2003, this standard is intended to provide guidance in establishing a qualification program for demonstrating the adequacy of Class 1E motor control centers in nuclear power generating station applications.

Keywords: aging, analysis, class 1E, environmental qualification, harsh environment, mcc, mild environment, motor control center, operating experience, operational aging, qualification, qualified life, seismic, test

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Introduction

This introduction is not part of IEEE Std 649-2006, IEEE Standard for Qualifying Class 1E Motor Control Centers for Nuclear Power Generating Stations.

The requirements for qualification of Class 1E equipment are included in the United States Code of Federal Regulations. Among them are the following:

- a) 10CFR Part 50, Appendix B, Quality Assurance Criteria, III—Design Control. This requires that design control measures be established and that such measures provide for verifying or checking the adequacy of design. One of the methods of design verification is the performance of a suitable testing program.
- b) 10CFR Part 50, Appendix B, Quality Assurance Criteria, XI—Test Control. This requires that a test program be established and that testing be performed under suitable environmental conditions. These requirements, at least in part, can be met by suitable qualification.
- c) 10CFR Part 50, Section 50.49, Environmental Qualification of Electric Equipment Important to Safety. This rule codifies the qualification requirements for certain equipment, located in a harsh environment, that is important to safety.

Information pertinent to developing designs and their qualification requirements can be found in the above mentioned documents and in 10CFR Part 50, Appendix A, General Design Criteria 1, 2, 4, and 23. Other governing bodies in the international community also have similar documents relating to qualification of nuclear plant equipment and should be consulted for additional guidance, as deemed appropriate.

IEEE Std 323-2003 provides general guidance for demonstrating and documenting the adequacy of electric equipment used in Class 1E systems. IEEE Std 649-2006 has been revised to deal specifically with motor control center equipment, using IEEE Std 323-2003 as the parent document for guidance.

Adherence to this standard may not assure public health and safety because it is the integrated performance of the structures, fluid systems, instrumentation systems, and electrical systems of the station that limits the consequence of accidents. Each user is responsible for assuring that this standard, if used, is pertinent to his or her application.

Class 1E equipment used in nuclear power generating stations must meet its safety functional requirements throughout its installed life. This is accomplished by a thorough program of quality assurance, design, qualification, production, transportation, storage, installation, maintenance, periodic testing, and surveillance. This standard is for the qualification portion of the program.

The user should note that while this standard covers Class 1E equipment qualification, other documents, such as IEEE Std 603™-1998, also require system integrity. Therefore, attention needs to be given to equipment performance specifications and interfaces to ensure their adequate performance in a system.

The nuclear power generating station safety analysis, in part, considers the station and its safety system design in terms of postulated service conditions.

Inherent to each such analysis are two presumptions that must be evaluated. First, designs must be such that equipment can perform designated safety functions in postulated service environments. Second, in-service aging must not degrade Class 1E equipment to the point where it cannot perform designated safety functions when required.

Production testing, normal service testing, and surveillance may not be able to determine whether the equipment is vulnerable to failure, either as a result of inadequate design or in-service time and environment, because of the special environmental stresses associated with some postulated service conditions included in the station safety analysis. Under these circumstances, common mode failure of redundant Class 1E equipment might occur at the time its safety function(s) is required. It is the fundamental role of qualification to provide reasonable assurance, with due recognition given to the established technology, that common mode failures due to design, manufacture, and age do not exist, and that the design and manufacture are adequate to permit the equipment to perform its safety function(s) during postulated service conditions.

Synergistic effects and ionizing radiation dose-rate effects have become a concern within the industry and remain the subject of continuing research programs. Preliminary results indicate that synergistic effects can be either positive or negative. Such effects should be considered in developing a qualification program. The effects may be significant due to the inclusion of solid-state electronic components into motor control centers control schemes. Detrimental affects on the electronics may occur at radiation levels that have historically been considered a mild environment.

Motor control centers qualified in accordance with this standard will meet the requirements of IEEE Std 323-2003, which provide the basic principles for design qualification for all safety systems equipment for use in nuclear power generating stations. This revision to IEEE Std 649-1991 was made to update the standard to address industry concerns with solid-state electronics and to update references and requirements of other IEEE standards.

This standard defines requirements to qualify motor control centers and their components located in all areas of the nuclear power generating station, including harsh and mild environmental areas. At this time, it appears that the seismic event is the only design basis event with potential for common mode failure in mild environments; however, other environmental service conditions may also be contributors. Particular attention should be paid to the effects of radiation on solid-state electronics and the affects of EMI/RFI fields on the equipment.

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IEEE Standard for Qualifying Class 1E Motor Control Centers for Nuclear Power Generating Stations

1. Overview

1.1 Scope

This standard describes the basic principles, requirements, and methods for qualifying Class 1E motor control centers for both harsh and mild environment applications in nuclear power generating stations.

1.2 Purpose

The purpose of this standard is to:

- a) Define specific qualification requirements for Class 1E motor control centers and their components in accordance with the more general qualification requirements of IEEE Std 323TM-2003^{1, 2} and IEEE Std 344TM-2004.
- b) Provide guidance in establishing a qualification program for demonstrating the adequacy of Class 1E motor control centers in nuclear power generating station applications.

2. Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

ANSI/IEEE Std 101TM-1987 (Reaff 2004), IEEE Guide for the Statistical Analysis of Thermal Life Test Data.

¹ IEEE publications are available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, Piscataway, NJ 08855-1331, USA (<http://standards.ieee.org/>).

² Information on references can be found in Clause 2.