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

Sponsor

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of the  
IEEE Power Engineering Society**

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**Abstract:** The basic principles, requirement, 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 323-1983, 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.

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## Foreword

(This foreword is not a part of IEEE Std 649-1991, 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 Code of Federal Regulations. Among them are the following:

- (1) 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.
- (2) 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.
- (3) 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.

IEEE Std 323-1983 provides general guidance for demonstrating and documenting the adequacy of electric equipment used in Class 1E systems. This standard has been revised to deal specifically with motor control center equipment, using IEEE Std 323-1983 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 603-1980 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 cause 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 cause failures due to design, manufacture, and age do not exist, and that the design and manufac-

ture 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 but are not, at this time, part of the requirements of this standard.

Motor control centers qualified in accordance with this standard will meet the requirements of IEEE Std 323-1983 or IEEE Std 627-1980, 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 649-1980 was made to clarify its requirements and to provide greater detailed guidance on both harsh and mild environment qualification. It also incorporates recent research on the use of experience data for seismic qualification.

This standard defines requirements that are adequate 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 cause failure in mild environments; however, other environmental service conditions may also be contributors.

The user of this standard should be aware that other methods of demonstrating qualification may be valid and more cost-effective than those described herein. Methodology should be reviewed at the time the qualification program is established to determine the most effective manner to demonstrate qualification.

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

## 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.

## 2. Purpose

The purpose of this standard is to

- (1) Define specific qualification requirements for Class 1E motor control centers and their components in accordance with the more general qualification requirements of IEEE Std 323-1983 [6]<sup>1</sup>
- (2) Provide guidance in establishing a qualification program for demonstrating the adequacy of Class 1E motor control centers in nuclear power generating station applications

## 3. References

This standard shall be used in conjunction with the following publications:

[1] EPRI NP-3326, Correlation Between Aging and Seismic Qualification for Nuclear Plant Electrical Components, Electric Power Research Institute, December 1983.<sup>2</sup>

[2] EPRI NP-5024, Seismic Ruggedness of Aged Electrical Components, Electric Power Research Institute, January 1987.

[3] IEEE C37.98-1978, IEEE Standard for Seismic Testing of Relays (ANSI).<sup>3</sup>

[4] IEEE Std 100-1988, IEEE Standard Dictionary of Electrical and Electronics Terms (ANSI).

[5] IEEE Std 101-1972, IEEE Guide for the Statistical Analysis of Thermal Life Test Data (ANSI).

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<sup>1</sup>The numbers in brackets correspond to those of the references in Section 3.

<sup>2</sup>EPRI publications are available from the Electric Power Research Institute, 3412 Hillview Avenue, Palo Alto, CA 94304.

<sup>3</sup>IEEE publications are available from the Institute of Electrical and Electronics Engineers, Service Center, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA.

[6] IEEE Std 323-1983 (Reaff 1990), IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations (ANSI).

[7] IEEE Std 344-1987, IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations (ANSI).

[8] NEMA ICS 1-1983, General Standards for Industrial Control and Systems.<sup>4</sup>

[9] NFPA 70-1978, National Electrical Code.<sup>5</sup>

[10] UL 508-1988, The Standard for Industrial Control Equipment.<sup>6</sup>

## 4. Definitions

All definitions, except as specifically covered in this section, shall be in accordance with IEEE Std 100-1988 [4].

**harsh environment.** An environment expected as the result of the postulated service conditions appropriate for the design basis and post-design basis accidents of the station.<sup>7</sup> Harsh environments are the result of a loss of coolant accident (LOCA)/high energy line break (HELB) inside containment and HELB or post-LOCA conditions outside containment (see IEEE Std 323-1983 [6].)

**mild environment.** An environment expected as a result of normal service conditions and extremes (abnormal) in service conditions where seismic motion is the only design basis event (DBE) of consequence (see IEEE Std 323-1983 [6].)

**motor control center.** A floor-mounted assembly of one or more enclosed vertical sections having a common horizontal power bus and principally containing combination motor starter units. These units are mounted one above the other in the vertical sections. The sections may incorporate vertical buses connected to the common power bus, thus extending the common power supply to the individual units. Units may also connect directly to the common power bus by suitable connections.

**significant aging mechanism.** An aging mechanism is significant if, in the normal and abnormal service environment, it causes degradation during the installed life of the equipment that progressively and appreciably renders the equipment vulnerable to failure to perform its safety function(s) under DBE conditions.

**unit.** One independent portion of a motor control center vertical section. It is normally a plug-in module that connects to the motor control center vertical bus.

**vertical section.** A portion of the motor control center normally containing one vertical bus assembly.

<sup>4</sup>NEMA publications are available from the National Electrical Manufacturers Association, 2101 L Street NW, Washington, DC 20037, USA.

<sup>5</sup>NFPA publications are available from Publications Sales, National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101, USA.

<sup>6</sup>UL publications are available from Underwriters Laboratories, Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096, USA.

<sup>7</sup>A design basis accident is that subset of a design basis event that requires safety function performance.