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

IEEE Power and Energy Society

Sponsored by the
Switchgear Committee

IEEE
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USA

IEEE Std C37.82™-2017
(Revision of IEEE Std C37.82-1987)

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Abstract: The methods and requirements for qualifying switchgear assemblies for indoor areas outside of the containment in nuclear power generating stations are described in this document. These assemblies include: metal-enclosed low-voltage power circuit breaker switchgear assemblies, as defined in IEEE Std C37.20.1™; metal-clad switchgear assemblies, as defined in IEEE Std C37.20.2™; metal-enclosed bus, as defined in IEEE Std C37.23™; and metal-enclosed interrupter switchgear assemblies, as defined in IEEE Std C37.20.3™.

Keywords: Class 1E metal-enclosed power switchgear assemblies, design basis event, DBE, IEEE C37.82™, qualified life

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Introduction

This introduction is not part of IEEE Std C37.82-2017, IEEE Standard for the Qualification of Switchgear Assemblies for Class 1E Applications in Nuclear Power Generating Stations.

This standard complements IEEE Std 323™-2003, IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations, by providing specific requirements for the qualification of switchgear assemblies for safety-related applications in Nuclear Power Generating Stations.[1] This standard is typically used in combination with seismic qualification standards IEEE Std 344™ and IEEE Std C37.81™ to perform a complete qualification program for switchgear assemblies.

The primary purpose of this standard is to define the requirements that should take place prior to a seismic qualification program. Significant degradation could occur during the service life of switchgear assemblies; therefore it is important that test samples be in a state of degradation prior to seismic event simulation. IEEE Std 323-2003 provides guidance for evaluating time based aging mechanisms caused by excessive ambient temperatures and /or a radiation environment. Safety-related switchgear assemblies are typically located in mild environments, and are not impacted by these time-based aging mechanisms.

Circuit breakers and other switchgear components used in nuclear facilities may be subjected to frequent cycling through testing or routine plant operation. Therefore, a pre-seismic aging program that cycles circuit breakers and components through endurance testing is typically required. This standard considers that qualified life may be a time interval, operational cycles, or both, whereas IEEE-323-2003 defines qualified life as a time interval.

Changes in this standard include adding definitions of Seismic Category I and Seismic Category II equipment. Seismic Category I is equivalent to Class 1E. Seismic Category II is for equipment that is not required to function but whose failure could adversely affect the safe shutdown of any Seismic Category I equipment.

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

a) Standards for switchgear assemblies have been developed over a long period of time through the efforts of the Institute of Electrical and Electronics Engineers (IEEE), the National Electrical Manufacturers Association (NEMA), and other interested parties under the auspices of the American National Standards Institute (ANSI).

b) 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.

c) Because switchgear assemblies are protective equipment, the standards are conservative and provide ample margin with respect to normal application. Design and application also tend to be conservative.

d) 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 as follows:

    1) 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

    2) 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.

[1]Information on references can be found in Clause 2.

e) 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 complement 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. Additionally, switchgear assemblies include removable elements and draw-out mounted devices that may be used in various positions in the switchgear (e.g., connect, test, and disconnect).

f) Qualification programs should identify design and material characteristics that, after a period of time or number of operations and during a DBE, may precipitate common cause failure 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 cause failure in redundant Seismic Class 1 equipment. 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.

g) Modern switchgear assemblies may include digital or advanced analog components that may require susceptibility testing for EMI/RFI and power surges. Guidelines for ensuring electromagnetic compatibility of safety systems can be found in IEEE Std 603™ [B2] and IEEE Std 7-4.3.2™ [B1] and U.S. NRC RG 1.180 (Revision 1) [B3].[2]

[2]The numbers in brackets correspond to those of the bibliography in Annex A.

Contents