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(Revision of
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IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations

IEEE Power Engineering Society

Sponsored by the
Nuclear Power Engineering Committee

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Abstract: The basic requirements for qualifying Class 1E equipment and interfaces that are to be used in nuclear power generating stations are described in this standard. The principles, methods, and procedures described are intended to be used for qualifying equipment, maintaining and extending qualification, and updating qualification, as required, if the equipment is modified. The qualification requirements in this standard, when met, demonstrate and document the ability of equipment to perform safety function(s) under applicable service conditions including design basis events, reducing the risk of common-cause equipment failure.
Keywords: age conditioning, aging, condition monitoring, design basis events, equipment qualification, harsh environment, margin, mild environment, qualification methods, qualified life, radiation, safety related function, significant aging mechanism, test plan, test sequence, type testing

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Introduction

(This introduction is not part of IEEE Std 323-2003, IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations.)

IEEE Std 323-2003, a revision of IEEE Std 323-1983, is the result of a review of IEEE Std 323-1983 and present practices in equipment qualification. This revision incorporates current practices and lessons learned from the implementation of previous versions of this standard by the nuclear industry.

Several issues are clarified or changed in this revision:

— This standard defines the methods for equipment qualification when it is desired to qualify equipment for the applications and the environments to which it may be exposed. This standard is generally utilized for qualification of Class 1E (safety-related electric) equipment located in harsh environments, and for certain post-accident monitoring equipment, but it may also be utilized for the qualification of equipment in mild environments. The documentation requirements are, however, more rigorous for equipment located in a harsh environment.

— The term *design basis event* has been generally used instead of the acronyms DBE, DBA, LOCA, and HELB, and the term *design basis accident* in order to reduce the complexity of the text.

— Seismic events are identified as design basis events.

— The test margins have been updated to better identify the parameters that achieve test margin on design basis event profiles. Since quantitative margin can be adequately identified by increases in temperature, pressure, radiation, and operating time, the performance of two transients is no longer recommended.

— New digital systems and new advanced analog systems may require susceptibility testing for EMI/RFI and power surges, if the environments are significant to the equipment being qualified. Since existing instrument and control (I&C) systems were less vulnerable and have the benefit of successful operation under nuclear power plant EMI/RFI and power surge environments, qualification to EMI/RFI and power surges was not previously significant enough to be considered in environmental equipment qualification. As existing I&C equipment in nuclear power plants may be replaced with computer-based digital I&C systems or advanced analog systems, these new technologies may exhibit greater vulnerability to the nuclear power plant EMI/RFI and power surges environments. Documents such as NUREG/CR-5700-1992 [B32],[a] NUREG/CR-5904-1994 [B33], NUREG/CR-6384-1996, Volumes 1 and 2 ([B34], [B35]), NUREG/CR-6406-1996 [B36], NUREG/CR-6579-1998 [37], and NRC IN 94-20 [B31] have documented the environmental influence of EMI/RFI and power surges on safety-related electric equipment. Guidelines for ensuring electromagnetic compatibility of safety systems can be found in IEEE Std 603™-1998 and IEEE Std 7-4.3.2™-2003.[b]

— An important concept in equipment qualification is the recognition that significant degradation could be caused by aging mechanisms occurring from the environments during the service life, and therefore safety-related electric equipment should be in a state of degradation prior to imposing design basis event simulations. Previous versions recognized that the period of time for which acceptable performance was demonstrated is the qualified life. The concept of qualified life continues in this revision. This revision also recognizes that the condition of the equipment for which acceptable performance was demonstrated is the qualified condition. Thus, new license renewal and life extension options are available by assuring that qualified equipment continues to remain in a qualified condition.

Industry research in the area of equipment qualification and decades of its application have greatly benefited this standard. Future activities of the working group to update this standard will consider the following:

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

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

— Risk-informed approaches and impact of condition monitoring, performance, safety function assessment, and qualified life precision.

— Significance of refinements in aging mechanisms, equipment sealing, interfaces, extrapolation, similarity, test sequence and parameters (such as ramp rates, time duration, timing of spray initiation and its duration), and qualification documentation.

Participants

This standard was prepared by Working Group (SC 2.1) of the Subcommittee on Qualification (SC 2) of the Nuclear Power Engineering Committee of the IEEE Power Engineering Society. At the time of completion, SC 2.1 had the following membership:

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Contents

IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations

1. Scope

This standard describes the basic requirements for qualifying Class 1E equipment and interfaces that are to be used in nuclear power generating stations. The principles, methods, and procedures described are intended to be used for qualifying equipment, maintaining and extending qualification, and updating qualification, as required, if the equipment is modified. The qualification requirements in this standard, when met, demonstrate and document the ability of equipment to perform safety function(s) under applicable service conditions including design basis events, reducing the risk of common-cause equipment failure. This standard does not provide environmental stress levels and performance requirements.

NOTE—Other IEEE standards that present qualification methods for specific equipment, specific environments, or specific parts of the qualification program may be used to supplement this standard, as applicable. Annex A lists other standards related to equipment qualification.

2. References

This standard shall be used in conjunction with the following standards. When the following standards are superseded by an approved version, the revision shall apply.

IEEE Std 344™-1987 (Reaff 1993), IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations.[1,2]

IEEE Std 603™-1998, IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations.

IEEE Std 7-4.3.2™-2003, IEEE Standard Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations.

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