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IEEE Standard for Qualifying Class IE Equipment for Nuclear Power Generating Stations

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

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Foreword

(This foreword is not part of IEEE Std 323-1974, Qualifying Class IE Equipment for Nuclear Power Generating Stations.)

The following IEEE Standards establish basic requirements that equipment within their scope must be adequately qualified:

IEEE Std 279-1971 (ANSI N42.7-1972), Criteria for Protection Systems for Nuclear Power Generating Stations.

IEEE Std 308-1974, Criteria for Class IE Power Systems for Nuclear Power Generating Stations.

The Institute of Electrical and Electronics Engineers has developed this document to provide guidance for demonstrating and documenting the adequacy of electric equipment used in all Class IE and interface systems.

Adherence to this guide may not suffice for assuring 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 consequences of accidents. Each applicant has the responsibility to assure himself and others that this guide, if used, is pertinent to his application and that the integrated performance of his station is adequate.

Representative in-containment design basis event conditions for the principal reactor types are included in the appendixes for guidance in environmental simulation. These conditions may not be acceptable for all specific applications and the user should confirm the suitability of these data and modify them as appropriate for qualification in any given Nuclear Power Generating Station.

Guidance for demonstrating the capability of specific electric equipment may be found in the following documents which are in various stages of preparation or issue.

Project P-381, Guide for Type Tests of Modules Used in Nuclear Power Generating Station Protection Systems.

IEEE Std 334-1971, Trial-Use Guide for Type Tests of Continuous Duty Class I Motors Installed Inside the Containment of Nuclear Power Generating Stations.

IEEE Std 382-1972 (ANSI N41.6-1972), Trial-Use Guide for Type Test of Class I Electric Valve Operators for Nuclear Power Generating Stations.

IEEE Std 383-1974 Guide for Type Test of Class IE Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations.

IEEE Std 344-1971, Guide for Seismic Qualification of Class I Electric Equipment for Nuclear Power Generating Stations.

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IEEE
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(Supplement to
IEEE Std 323-1974)

Supplement to the Foreword of IEEE Std 323-1974
IEEE Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations

(This Supplement is provided to amplify the information in the Foreword; it is not a part of IEEE Std 323-1974.)

The concept of aging was addressed explicitly for the first time in IEEE Std 323-1974. The aging guidance therein reflects the requirement of IEEE Std 279-1971 (ANSI N42.7-1972) Section 4.4. It is based on an awareness by the IEEE that the ability of Class 1E equipment to perform its safety related function might be affected by changes due to natural, operational, and environmental phenomena over time (aging). It was not the intent that aging must be applied to all Class 1E equipment, but rather that aging must be considered in the same manner as environmental parameters. The need for aging of particular equipment should be determined based on an evaluation of the specific design and application. If aging is needed a further determination must be made as to whether accelerated aging techniques can be applied to the equipment and yield valid results, that may be correlated to real time, ongoing qualification.

It is acknowledged that the state-of-the-art regarding aging for some Class 1E equipment is more advanced than others. It is expected that known technology will be utilized in any aging program. Optionally (and particularly where the state-of-the-art is limiting), aging as part of the qualification program may be addressed by operating experience, analysis, combined, or ongoing qualification as detailed in Section 5.2, 5.3, 5.4 and 5.5.

Further clarification of aging as it applies to specific types of equipment will be provided in individual IEEE Class 1E equipment qualification documents. For example, an IEEE Standard is being prepared to establish criteria for Class 1E modules. IEEE Standards 334-1974, 382-1972 (ANSI N41.6), and 383-1974 (ANSI N41.10-1975) presently provide guidance for motors, valve operators, and cables respectively.

Nov 21 1975

Contents

SECTION	PAGE
1. Scope	7
2. Purpose	7
3. Definitions	7
4. Introduction	8
5. Principles of Qualification	9
5.1 Type Testing	9
5.2 Operating Experience	9
5.3 Qualification by Analysis	9
5.4 Combined Qualification	10
5.5 On-Going Qualification	10
6. Qualification Procedures and Methods	10
6.1 Identification of the Class IE Equipment Being Qualified	10
6.2 Equipment Performance Specifications	10
6.3 Type Test Procedures	11
6.4 Operating Experience	13
6.5 Analysis	14
6.6 On-Going Qualification	15
6.7 Criteria of Failure	15
6.8 Modifications	15
6.9 Documentation	15
7. Simulated Service Condition Test Profile	15
8. Documentation	16
8.1 General	16
8.2 Documentation Files	16
8.3 Type Test Data	16
8.4 Operating Experience Data	16
8.5 Analysis	17
8.6 Extrapolation	17
 FIGURES	
Fig 1 Simulated Service Environment Test Profile	16
 APPENDIXES	
Appendix A In-Containment Design Basis Event Environment Simulation for PWR and BWR. .	18
A1 General	18
A2 Simulation Sequence	20
Appendix B In-Containment Design Basis Event Environment Simulation for a High Temperature Gas Cooled Reactor (HTGR).	20
Appendix C Test Chamber Moisture Content	23
 FIGURES	
Fig A1 Test Chamber Profile for Accident Environment Simulation	18
Fig B1 Typical Temperature and Pressure History for Environment Simulation of HTGR Containment Atmosphere Response Following a Hot Helium Blowdown into Containment	21
Fig B2 Typical Temperature and Pressure History for Environment Simulation of HTGR Containment Atmosphere Response Following a Steam Line Rupture Inside the Containment	22

TABLES

Table A1 Test Conditions for Pressu.

Table A2 Test Conditions for Boiling

Table B1 Test Conditions for High T

Table B2 HTGR Containment Build

IEEE Standard for Qualifying Class IE Equipment for Nuclear Power Generating Stations

1. Scope

This document describes the basic requirements for qualifying Class IE equipment and interfaces that are to be used in nuclear power generating stations. The requirements presented include the principles, procedures, and methods of qualification. These qualification requirements, when met, will confirm the adequacy of the equipment design under normal, abnormal, design basis event, post design basis event, and containment test conditions for the performance of Class IE functions.

2. Purpose

The purpose of this document is to provide guidance for demonstrating the qualification of Class IE equipment including components or equipment of any interface whose failure could adversely affect the performance of Class IE systems and electric equipment. Qualification required in IEEE Std 279-1971 (ANSI N42.7-1972), Criteria for Protection Systems for Nuclear Power Generating Stations and IEEE Std 308-1974, Criteria for Class IE Power Systems for Nuclear Power Generating Stations can be demonstrated by using the guidance provided in this document.

The qualification methods described shall be used for qualifying equipment and for updating qualification following modifications. Other qualification guides for specific electric equipment or test methods (for example, IEEE Std 344-1971, Guide for Seismic Qualification of Class I Electric Equipment for Nuclear Power Generating Stations) will present specific requirements and should be used to supplement this document.

3. Definitions

These definitions establish the meanings of

words in the context of their use in this guide.

analysis. A process of mathematical or other logical reasoning that leads from stated premises to the conclusion concerning specific capabilities of equipment and its adequacy for a particular application.

auditable data. Technical information which is documented and organized in a readily understandable and traceable manner that permits independent auditing of the inferences or conclusions based on the information.

Class IE. The safety classification of the electric equipment and systems that are essential to emergency reactor shutdown, containment isolation, reactor core cooling, and containment and reactor heat removal, or otherwise are essential in preventing significant release of radioactive material to the environment.

components. Items from which the system is assembled (for example, resistors, capacitors, wires, connectors, transistors, tubes, switches, springs, etc).

containment. That portion of the engineered safety features designed to act as the principal barrier, after the reactor system pressure boundary, to prevent the release, even under conditions of a reactor accident, of unacceptable quantities of radioactive material beyond a controlled zone.

demonstration. A course of reasoning showing that a certain result is a consequence of assumed premises; an explanation or illustration, as in teaching by use of examples.

design basis events. Postulated events, specified by the safety analysis of the station, used in the design to establish the acceptable performance requirements of the structures and systems.

design life. The time during which satisfactory performance can be expected for a specific set of service conditions.

equipment qualification. The generation and maintenance of evidence to assure that the equipment will operate on demand, to meet the system performance requirements.

installed life. The interval from installation to removal, during which the equipment or component thereof may be subject to design service conditions and system demands.

NOTE: Equipment may have an installed life of 40 years with certain components changed periodically; thus, the installed life of the components would be less than 40 years.

interface. A junction or junctions between a Class IE equipment and another equipment or device. (Examples: connection boxes, splices, terminal boards, electrical connections, grommets, gaskets, cables, conduits, enclosures, etc.)

nuclear generating station. A plant wherein electric energy is produced from nuclear energy by means of suitable apparatus. The station may consist of one or more units which may or may not share some common auxiliaries.

operating experience. Accumulation of verifiable service data for conditions equivalent to those for which particular equipment is to be qualified.

qualified life. The period of time for which satisfactory performance can be demonstrated for a specific set of service conditions.

NOTE: The qualified life of a particular equipment item may be changed during its installed life where justified.

sample equipment. Production equipment tested to obtain data that are valid over a range of ratings and for specific services.

service conditions. Environmental, power, and signal conditions expected as a result of normal operating requirements, expected extremes in operating requirements, and postulated conditions appropriate for the design basis events of the station.

type tests. Tests made on one or more sample equipments to verify adequacy of design and the manufacturing processes.

4. Introduction

The manufacturers and users of Class IE equipment are required to provide assurance

that such equipment will meet or exceed its performance requirements throughout its installed life. This is accomplished through a disciplined program of quality assurance that includes but is not limited to design, qualification, production quality control, installation, maintenance, and periodic testing. This document will treat only the qualification portion of the program.

It is the primary role of qualification to assure that for each type of Class IE equipment the design and the manufacturing processes are such that there is a high degree of confidence that future equipment of the same type will perform as required. The other steps in the quality assurance program require strict control to assure that subsequent equipment of the same type matches that which was qualified and is suitably applied, installed, maintained, and periodically tested. Margins used during type testing provide additional assurance that the equipment will perform as required.

Qualification may be accomplished in several ways: type testing, operating experience, or analysis. These may be used individually or in any combination depending upon the particular situation. In the first, it is expected that the equipment will be subjected to the environments and operating conditions for which it was designed and its performance measured. In a test program, it is usually practical only to simulate environments and operating conditions. The limitations in such simulations, the abbreviation of exposures permitted by increasing the severity of the environment, and the validity of data extrapolations must be taken into account in the design of the test. These points will be covered in greater detail in this and other guides. A representative test profile is given in Section 7.¹

Operating experience is a method of limited use as a sole means of qualification but of great use for the supplementation of testing in that it may provide an insight into the change in behavior of materials and equipment with time

¹Representative in-containment design basis event conditions for the principal reactor types are included in the appendixes for guidance in environmental simulation. These conditions may not be applicable for all specific applications and the user should confirm the suitability of these data and modify them as appropriate for qualification for any given Nuclear Power Generating Station.