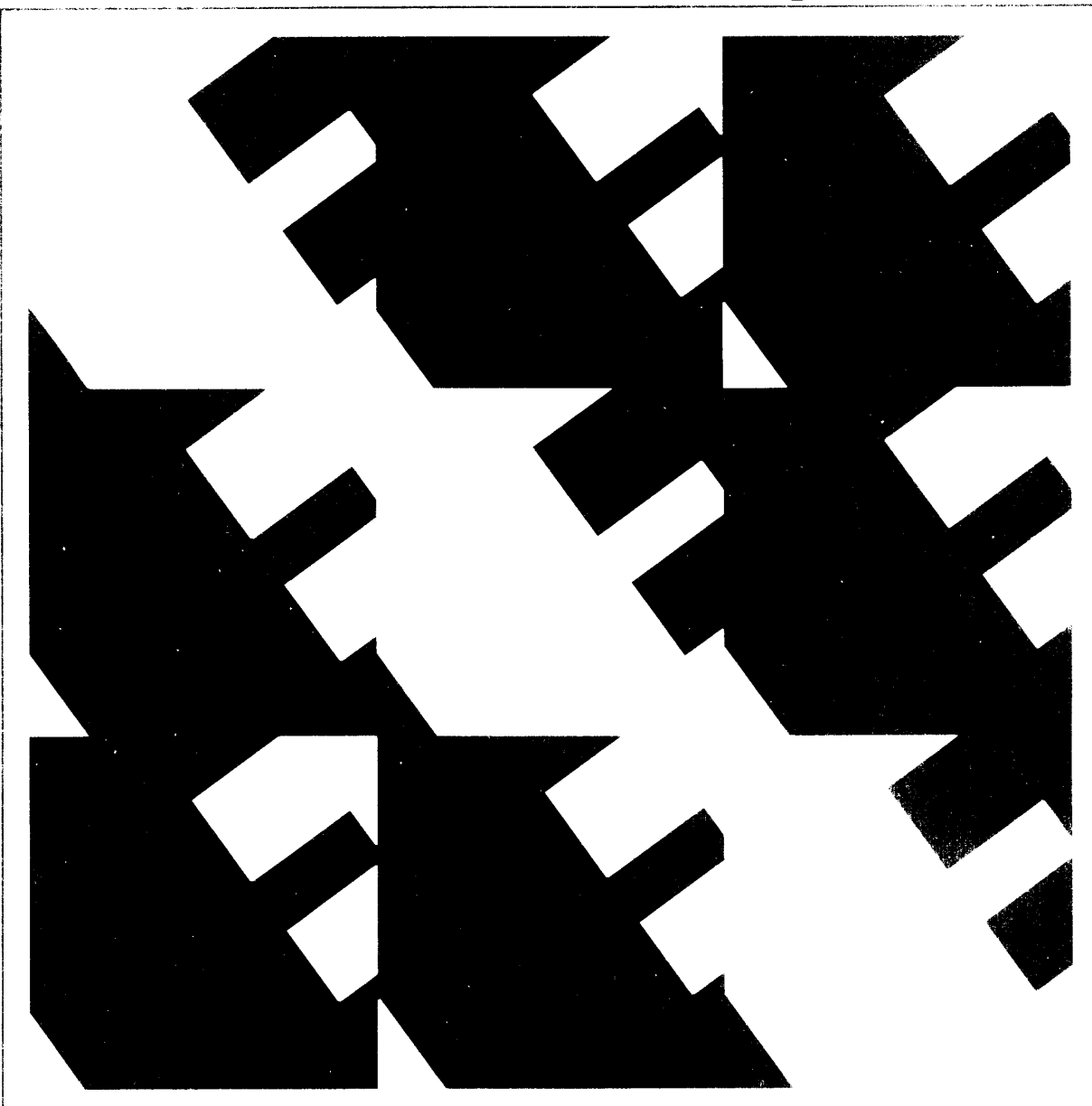


IEEE Standard for Qualification of Class 1E Static Battery Chargers and Inverters for Nuclear Power Generating Stations

ANSI/IEEE Std 650-1979



Published by The Institute of Electrical and Electronics Engineers, Inc 345 East 47th Street, New York, NY 10017, USA
October 12, 1979

SH07674

An American National Standard

**IEEE Standard for
Qualification of Class 1E Static
Battery Chargers and Inverters for
Nuclear Power Generating Stations**

Sponsor
Nuclear Power Engineering Committee
of the
IEEE Power Engineering Society

Approved March 15, 1979
IEEE Standards Board

Approved April 23, 1981
American National Standards Institute

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Foreword

(This Foreword is not a part of IEEE Std 650-1979, IEEE Standard for Qualification of Class 1E Static Battery Chargers and Inverters for Nuclear Power Generating Stations.)

This standard provides the methods of qualifying class 1E static battery chargers and inverters in accordance with IEEE Std 323-1974, Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations, to which this document is a supplement. The static chargers and inverters discussed in this standard are safety related, however, this document addresses this equipment only as a subsystem in the safety related electrical system.

The guidelines of IEEE Std 381-1977, Standard Criteria for Type Tests of Class 1E Modules Used in Nuclear Power Generating Stations, have been utilized for aging complex electronic equipment. The reliability analysis requirements of ANSI/IEEE Std 577-1976, Standard Requirements for Reliability Analysis in the Design and Operation of Safety Systems for Nuclear Power Generating Stations, and the methods described in ANSI/IEEE Std 352-1975, Guide for General Principles of Reliability Analysis of Nuclear Power Generating Station Protection Systems, have also been utilized along with statistical data.

The efforts of the working group on this standard and its appendixes will continue for the purpose of updating and disseminating more information regarding qualification techniques. The subject of aging in accordance with the latest state of the art will continue to be investigated and will be among the areas considered by the working group in future revisions of IEEE Std 650-1979.

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An American National Standard

IEEE Standard for Qualification of Class 1E Static Battery Chargers and Inverters for Nuclear Power Generating Stations

1. Scope and Purpose

This standard describes methods for qualifying static battery chargers and inverters for Class 1E installations in environmentally controlled areas outside containment in nuclear power generating stations. The application of this equipment in the plant's electrical system is not within the scope of this standard as other industry standards such as IEEE Std 308-1978, Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations, ANSI/IEEE Std 279-1971, Standard Criteria for Protection Systems for Nuclear Power Generating Stations, and IEEE Std 603-1977, Trial-Use Standard Criteria for Safety Systems for Nuclear Power Generating Stations, exist for this purpose. In addition, industry standards exist for equipment performance such as NEMA PV 5-1976, Constant-Potential-Type Electric Utility (Semiconductor Static Converter) Battery Chargers. Performance requirements are not specified in this standard.

The purpose of this standard is to provide specific procedures to meet the requirements of IEEE Std 323-1974, Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations. For the purpose of this standard, battery chargers and inverters must perform their intended function under specified service conditions.

The demonstration that an installed battery charger or inverter will meet its design specification requires many steps in a program of design, fabrication, quality control, qualification, installation, maintenance, and periodic testing. This standard treats only the qualification area of this program. The result may provide a basis for determination of long term maintenance requirements.

Qualification may be accomplished in several ways: type testing, operating experience,

or analysis. These methods may be used individually or in combination, although IEEE Std 323-1974 indicates that type testing using simulated service conditions is the preferred method of qualification. The qualification methods in this standard employ a combination of type testing and analysis. Operating experience is a method of limited use as a sole means of qualification, but of great use as a supplement to testing in that the experience may provide an insight into the change in behavior of materials and components through time under actual service and maintenance conditions. Qualification by analysis shall include justification of methods, theories, and assumptions used. In general, battery chargers and inverters are too complex to be qualified by analysis alone although it is effective in the extrapolation of test data and determination of the effects of minor design changes to equipment previously tested.

2. References

When any of the following standards are superseded by an approved revision, the revision shall apply.

ANSI C83.67-1972 (R1977), Fixed Paper Dielectric Capacitors for Alternating Current Applications.¹

ANSI C83.67a-1974 (R1977), Fixed Paper Dielectric Capacitors with Non-PCB Impregnant for Alternating Current Applications.¹

ANSI C83.97-1973, Paper, Paper-Film Dielectric Capacitors for Power Semiconductor Applications.¹

¹These documents are available from the American National Standards Institute (ANSI), 1430 Broadway, New York, New York, 10018.

ANSI/EIA-RS-454-78 Fixed Paper and Film Paper Dielectric Capacitors with Non PCB Impregnants for Alternating Current Applications.¹

ANSI/IEEE Std 100-1977, Dictionary of Electrical and Electronics Terms.

ANSI/IEEE Std 279-1971, Standard Criteria for Protection Systems for Nuclear Power Generating Stations.

ANSI/IEEE Std 338-1977, Standard Criteria for the Periodic Testing of Nuclear Power Generating Station Safety Systems.

ANSI/IEEE Std 344-1975, Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Generating Stations.

ANSI/IEEE Std 352-1975, Guide for General Principles of Reliability Analysis of Nuclear Power Generating Station Protection Systems.

ANSI/IEEE Std 382-1972, Trial-Use Guide for Type Test of Class 1E Valve Operators for Nuclear Power Generating Stations.

ANSI/IEEE Std 383-1974, Standard for Type Test of Class 1E Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations.

ANSI/IEEE Std 577-1976, Standard Requirements for Reliability Analysis in the Design and Operation of Safety Systems for Nuclear Power Generating Stations.

IEEE Std 101-1972, Guide for the Statistical Analysis of Thermal Life Test Data.

IEEE Std 259-1974, Standard Test Procedure for Evaluation of Systems of Insulation for Specialty Transformers.

IEEE Std 308-1978, Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations.

IEEE Std 323-1974, Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations.

IEEE Std 380-1975, Definitions of Terms Used in IEEE Standards on Nuclear Power Generating Stations.

IEEE Std 381-1977, Standard Criteria for Type Tests of Class 1E Modules Used in Nuclear Power Generating Stations.

IEEE Std 603-1977, Trial-Use Standard Criteria for Safety Systems for Nuclear Power Generating Stations.

NEMA PV 5-1976, Constant-Potential-Type Electric Utility (Semiconductor Static Converter) Battery Chargers.²

²These documents are available from the National Electrical Manufacturers Association (NEMA), 2101 L Street, N.W., Washington, DC 20037.

3. Definitions

These definitions establish the meaning of terms within the context of this standard.

aging (natural). The change with passage of time in physical, chemical, or electrical properties of components or equipment under design range operating conditions that may result in degradation of significant performance characteristics.

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.

break-in period. That early period, beginning at some stated time during which the failure rate of some items is decreasing rapidly. Also called early failure period.

burn-in. The operation of components or equipment, prior to type test or ultimate application, intended to stabilize their characteristics and to identify early failures.

common-mode failure. Multiple failure attributable to a common cause.

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 (DBE). 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, based upon component selection and application.

environment. The external conditions and influences such as temperature, humidity, altitude, shock and vibration which may affect the life and function of the components or equipment.

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

failure modes and effects analysis (FMEA). The identification of significant failures, irrespective of cause, and their consequences. This includes electrical and mechanical failures which could conceivably occur under specified service conditions and their effect, if any, on adjoining circuitry or mechanical interfaces displayed in a table, chart, fault tree or other format.

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 20 years with certain components changed periodically; thus, the installed life of the components would be less than 20 years (ANSI/IEEE Std 382-1972).

maintenance interval. The period, defined in terms of real time, operating time, number of operating cycles, or a combination of these, during which satisfactory performance is required without maintenance or adjustments.

malfunction. The loss of capability of Class 1E equipment to initiate or sustain a required function, or the initiation of undesired spurious action which might result in consequences adverse to safety.

operating basis earthquake (OBE). That earthquake which could reasonably be expected to affect the plant site during the operating life of the plant. It is that earthquake which produces the vibratory ground motion for which those features of the nuclear power plant necessary for continued operation, without undue risk to the health and safety of the public, are designed to remain functional.

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 (IEEE Std 323-1974).

random failure. Any failure whose cause or mechanism, or both, make its time of occurrence unpredictable.

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.

stress analysis. An electrical and thermal design analysis of component applications in specific circuits under the specified range of service conditions.

stress test. A type test performed on a sample equipment which "stresses" the equipment to the specified range of service conditions.

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

wear-out period. The time interval following the period of constant failure rate, during which failures occur at a greater rate.

4. Specifications

4.1 General. This section describes the specifications for the equipment to be qualified, the Class 1E performance characteristics, the energy supply and design environmental conditions for the equipment, and the effect of changes in energy supply and environmental conditions upon its Class 1E performance characteristics.