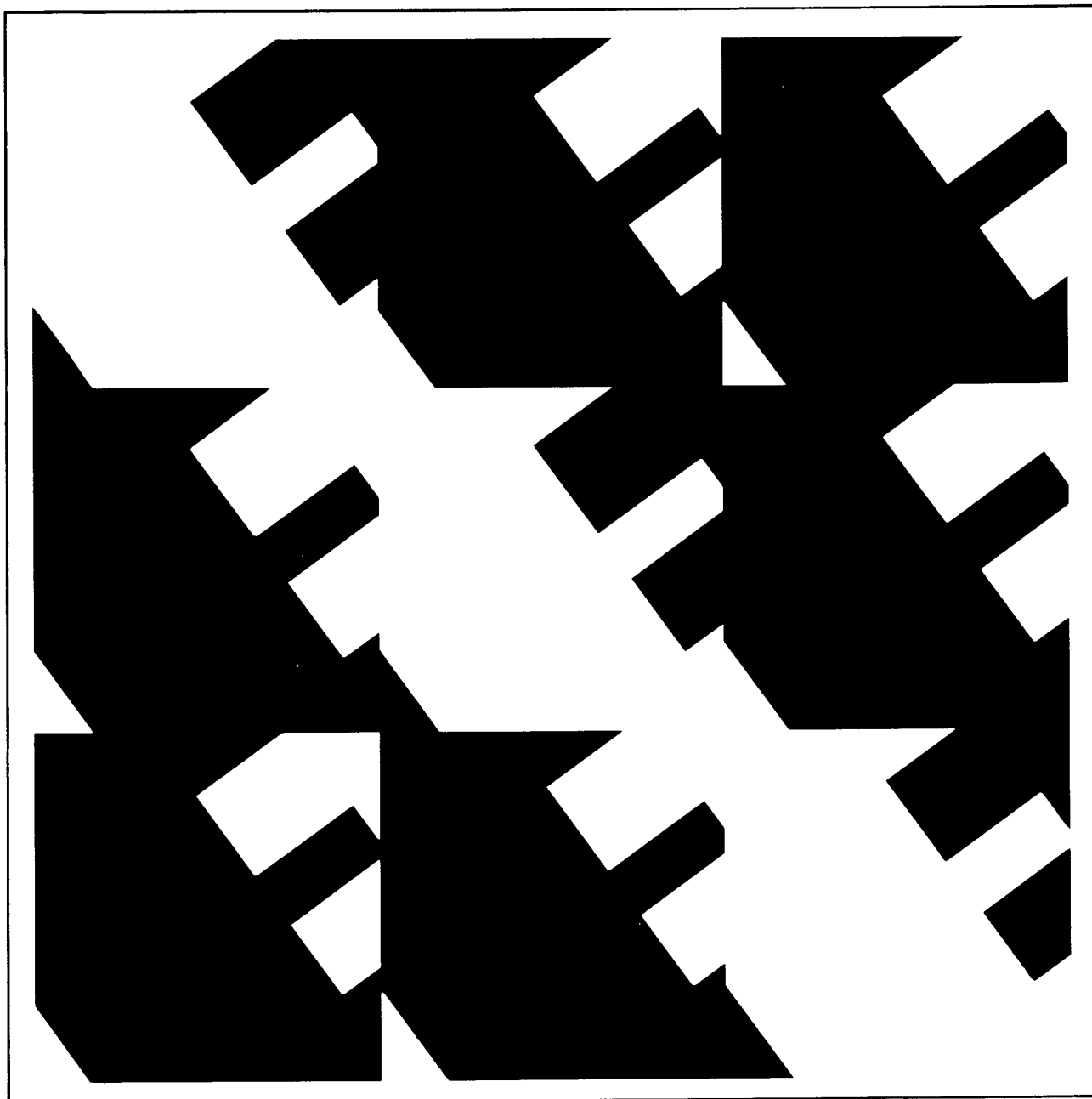


IEEE Standard Criteria for Type Tests of Class 1E Modules Used in Nuclear Power Generating Stations



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

The Institute of Electrical and Electronics Engineers has generated this document to provide direction for type testing Class 1E modules and obtaining specific type test data. It supplements IEEE Std 323-1974, Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations, which describes the basic requirements for Class 1E equipment qualification.

Adherence to this document alone may not suffice for assuring public health and safety because it is the integrated performance of the structures, the fluid systems, the electrical systems, the instrumentation systems of the station, and in particular, the plant protection system of which these modules are a part that prevents accidents or limits the consequences of accidents. Each applicant to the Nuclear Regulatory Commission for a license to operate a nuclear power generating station has the responsibility to assure himself and others that this document, if used, is pertinent to his application and that the integrated performance of his station is adequate.

It is noted that some industry standards already exist for purposes of design verification, for example: (1) IEEE Std 313-1971 (ANSI C37.90-1971), Relays and Relay Systems Associated with Electric Power Apparatus; (2) IEEE Std 472-1974 (ANSI C37.90a-1974), Guide for Surge Withstand Capability (SWC) Tests; (3) ANSI C39.1-1972, Requirements for Electrical Analog Indicating Instruments. Some of these standards include requirements which may be useful in the qualification process.

The efforts of this working group on this document and its appendixes will be continuing for the purpose of updating and disseminating more information regarding module type testing. The subject of aging in accordance with the latest state of the art will continue to be investigated.

IEEE Std 381-1977 definitions of module "qualified life" and "qualified module" include and accept qualitative (cycle related) rather than require purely quantitative (time related) aging techniques. This approach is considered to satisfy IEEE Nuclear Power Engineering Committee position statement of July 24, 1975, IEEE Std 323A-1975 supplement to the foreword of IEEE Std 323-1974 "to utilize known technology in any aging program."

While radiation and vibration testing techniques are not discussed in this standard, these subjects are dealt with in documents either under development (for example, radiation by P573, Working Group 2.12) or previously issued (seismic in IEEE Std 344-1975, Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations).

Where more specific 1E equipment qualification documents exist such as those for cable, motors, switchgear, penetrations, batteries, connectors, and valve actuators, it is intended that the requirements of those documents govern the qualifications of that type of equipment.

Definitions in this standard have been discussed with the chairman of Subcommittee 7. Each definition has been reviewed in conjunction with IEEE Std 380-1975, Definitions of Terms Used in IEEE Nuclear Power Generating Stations Standards, and IEEE Std 100-1972 (ANSI C42.100-1972), Dictionary of Electrical and Electronics Terms. In some instances the scope or content of the current definitions in IEEE Std 380-1975 and IEEE Std 100-1972 were not adequate in the context of type testing 1E modules for nuclear power plants. In such cases Working Group P-381 prefixed what may appear to be a commonly used term (for example, accuracy) with the word "module" and provided a definition which fulfilled the requirements of an equipment qualification document. Working Group P-381 will continue to work with the SC-7 chairman in order to make appropriate modifications to IEEE Std 100-1972 and IEEE Std 380-1975.

This document was prepared by Working Group P-381 of Subcommittee 2 (Equipment Qualification) of the Nuclear Power Engineering Committee of the IEEE Power Engineering Society. The membership of the working group was:

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IEEE Standard Criteria for Type Tests of Class 1E Modules Used in Nuclear Power Generating Stations

1. Scope

This document describes the basic requirements of a type test program with the objective of verifying that a module used as Class 1E equipment in a nuclear power generating station meets or exceeds its design specifications.

This document is limited to class 1E modules from and including the sensor through the logic circuitry of the final actuation devices. Except for those that are part of a module, switchgear, cables, connections, motors, valve actuators, station batteries, and penetrations are not included and are covered by other IEEE documents.

2. Introduction

The purpose of this document is to *supplement* the procedures and requirements given in IEEE Std 323-1974 [24] for type testing Class 1E modules, thereby providing directions for establishment of a type test program which will obtain the required test data and yield the required documentation of test methods and results.

This standard is structured to present to the user the principal performance characteristics and environmental parameters which must be considered in designing a type test program for any given Class 1E module. These modules range from tiny sensors to complete racks or cabinets full of equipment that may be located inside or outside containment. The Class 1E modules are required to perform their function before, during, or after, or all, any design basis event specified *for the module*. The vast variety of modules covered by this document precludes the listing here of specific requirements for each type test.

The user of this document, after identifying

the specific module to be tested and its intended application, shall address all of the applicable guidelines of the Module Specifications, Section 4, and then the Type Test Method, Section 5.

The assurance that an installed module will reliably meet its design specifications requires many steps in a program of design, fabrication, quality control, qualification, installation, maintenance, and periodic testing. IEEE Std 323-1974 [24] treats only the qualification portion of the program, and this document treats primarily the type test method of qualification.

To ensure suitable performance of the system in which the module appears also requires, but is not limited to, the following:

(1) System design fabrication and installation to accommodate the limitations of the modules (type testing and qualification of modules does not assure proper application and installation of modules)

(2) Adequate and continuing quality control and manufacturing programs

(3) Appropriate system testing

(4) Suitable calibration schedule and procedures

(5) Suitable maintenance schedule and procedures.

These are the subjects of other IEEE documents, but have been listed here to provide the user of this standard with additional guidance.

Although IEEE Std 323-1974 [24] indicates that type testing modules using simulated service conditions is the preferred method of qualification, other acceptable methods of qualification are enumerated in Section 5 of IEEE Std 323-1974 [24]. The user of this document should be aware of inherent limitations of a type test program. Should one decide to qualify by type test alone, the test sample(s) are to be aged, unless excluded by criteria noted in 5.8, subjected to all required environmental influences, and operated under required post design basis event conditions

to provide data that required modules will be able to perform their intended functions under normal and design basis environments for at least the period for which it has been aged. When size or any other practical considerations limit or preclude type tests of modules, a portion of the demonstration may be completed by operating experience, qualification by analysis, or by combined qualification.

A type test for the purpose of qualification of a specific module may be considered to be representative for qualification acceptance of a similar module containing similar materials, similar components, similar functional performance characteristics, similar construction, and similar service ratings, and fabricated by the same manufacturer with similar procedures. Justification must be provided for such qualification by analysis. The following points, among others, may be considerations in establishing adequate justifications:

- (1) Component physical arrangement; size, mounting features, interconnections, stresses, heat generation/dissipation, and electromagnetic susceptibility
- (2) Aging effects
- (3) Environmental effects
- (4) Performance requirements

These considerations may make extrapolation appear difficult, but justification for many devices of the similar design can be acceptably achieved. These cases with adequate documented justification will be considered as having been qualified by analysis.

The user of this standard should take particular note of the use of the term *significant*. Wherever used in this document, the term significant relates *only* to those things demonstrated to be important by the safety analysis of the station. Refer to the definition of **significant** (Section 3).

IEEE Std 381-1977 is an individual equipment qualification document dealing with Class 1E modules. It supplements and modifies some requirements of IEEE Std 323-1974 [24] to account for module state of the art and incorporate the IEEE Qualification Subcommittee's current interpretations of IEEE Std 323-1974 [24] requirements. Where differences exist between this standard and IEEE Std 323-1974 [24], the present standard's requirements take precedence insofar as class 1E modules are concerned.

3. Definitions

The definitions in this section establish the meanings of words in the context of their use in this document. Each definition where appropriate is followed by the word *module* in parentheses, thus rendering it unique from the other IEEE standards definitions.

accuracy¹ (module). Conformity of a measurement value to an accepted standard value or true value.

actuated equipment. A component or assembly of components that performs, or directly contributes to the performance of, a protective function such as reactor trip, containment isolation, or emergency coolant injection. The following are examples of actuated equipment: an entire control rod with its release or drive mechanism, a containment isolation valve with its operator, and a safety injection pump with its prime mover.

actuation device. A component or assembly of components (or module) that directly controls the motive power (electricity, compressed air, etc) for actuated equipment. The following are examples of an actuation device: a circuit breaker, a relay, a valve (with its operator) used to control compressed air to the operator of a containment isolation valve (and a module containing such equipment).

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

accelerated aging (advanced life conditioning) (module). The acceleration process designed to achieve an advanced life condition in a short period of time. It is the process of subjecting a module or component to stress conditions in accordance with known measurable physical or chemical laws of degradation in order to render its physical and electrical properties similar to those it would have at an advanced age operating under expected service conditions.

¹For further information, see SAMA PMC-20.1-1973, Process Measurement and Control Terminology, available from Scientific Apparatus Makers Association, 1140 Connecticut Ave, NW, Washington, D.C. 20036.