An American National Standard

IEEE Standard
Installation, Inspection, and Testing Requirements for Instrumentation and Electric Equipment During the Construction of Nuclear Power Generating Stations

Sponsor

Joint Committee on Nuclear Power Standards
of the
IEEE Nuclear Science Group
and the
IEEE Power Engineering Society

Approved March 1, 1972
American National Standards Institute

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Foreword

(This Foreword is not a part of IEEE Standard Installation, Inspection, and Testing Requirements for Instrumentation and Electric Equipment During the Construction of Nuclear Power Generating Stations.)

This standard sets forth the requirements for the installation, inspection, and testing of important instrumentation and electric equipment in a nuclear power generating station during its construction phase. This standard was prepared by the Institute of Electrical and Electronics Engineers (IEEE) in response to a request by American National Standards Committee N45 on Reactor Plants and Their Maintenance. The N45 committee has been chartered to promote the development of standards for the location, design, construction, and maintenance of nuclear reactors and plants embodying nuclear reactors, including equipment, methods, and components specifically for this purpose.

In May of 1969 the IEEE Joint Committee on Nuclear Power Standards (JCNPS) established an ad hoc committee on the Installation, Inspection, and Testing of Electric and Instrumentation Equipment. The purpose of this committee was to prepare a standard for general industry use that would define the requirements for installation, inspection, and testing of instrumentation and electric equipment that are necessary to assure attainment of a safe and reliable nuclear power generating station. The ad hoc committee was composed of representatives of key segments of the nuclear industry, including utilities, reactor suppliers, construction contractors, component manufacturers, and consultants.

The initial draft of this standard was completed in July 1970. Since then it has been revised to reflect comments received from committee members in IEEE, other quality assurance ad hoc committees of N45, and selected individuals from the nuclear industry and the United States Atomic Energy Commission. The standard contained herein was developed from this activity.

In April 1970, the N45 Committee established a subcommittee N45-3.0 to guide the preparation of nuclear quality assurance standards. This subcommittee is responsible for establishing guidelines and policy to govern the scope and content of the various standards; monitoring the status of standards in process; recommending preparation of additional standards; and final approval of standards prior to their submittal to the N45 Committee for balloting. Working with the N45-3.0 Subcommittee and concurrently with the development of this standard by the N45-3.4 ad hoc Committee, other ad hoc committees of N45 are developing a series of standards that set forth both general and detailed technical provisions for certain activities to assure quality during the construction phase of nuclear power generating stations.

The planning, management, and conduct of activities required in this standard are intended to be in accordance with applicable requirements of ANSI N45-3.0.

Suggestions for improvement gained in the use of this standard will be welcomed. They should be addressed to:

Secretary
IEEE Standards Committee
The Institute of Electrical and Electronics Engineers, Inc.
345 East 47 Street
New York, N.Y. 10017

The IEEE ad hoc Subcommittee on Installation, Inspection, and Testing of Instrumentation and Electric Equipment included the following personnel during the development of this standard.

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In May 1971, at the regular meeting of JCNPS, this standard was approved with minor non-substantive changes. Members of JCNPS at time of approval of IEEE Std 336-1971 were:

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IEEE Standard
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1. Introduction

1.1 Scope. This standard sets forth the requirements for installation, inspection, and testing of Class I and Class IE electric power, instrumentation, and control equipment and systems during the construction phase of a nuclear power generating station. These requirements are intended to assure that only materials and equipment of acceptable quality are incorporated into the plant, that quality is maintained and quality workmanship prevails throughout the construction process, and that completed installations conform to specified requirements, so as to promote public safety, prevent accidents and mitigate the consequences of accidents if they occur, and provide a high degree of plant reliability.

1.1.1 In addition to the Class I and Class IE systems, the requirements also apply to the following auxiliary equipment that are a part thereof.

(1) Connecting cables and raceways

(2) Electric and instrumentation containment penetrations

(3) Instrumentation sensing lines from the process root valves to and including input transducers

(4) Primary sensing devices (for example, orifices, flow nozzles, venturi tubes, and reference columns)

(5) Pneumatic instrumentation

(6) Output control transducers, including tubing and piping

(7) Fluid systems associated with standby generators and transformer cooling systems

(8) Switchgear fluid systems

(9) Panels, enclosures, and mountings

1.1.2 These requirements may also be extended to other appropriate parts of nuclear power generating stations when specified in contract documents.

1.1.3 This standard does not set forth specific requirements for the following, though related to the above equipment and systems:

(1) Inspection or testing, or both, of welds

(2) Cleaning and flushing of instrument sensing lines

(3) Aligning or verifying alignment, or both, of Class I rotating equipment

(4) Verifying structual integrity of support for Class I or Class IE electric equipment

For applicable codes on the above refer to Section 9.

1.2 Applicability. The requirements set forth in this standard apply to the work of any organization that participates in the construction phase of electric and instrumentation equipment and systems from the time that the equipment is turned over to the installers until the time it is integrated into systems in a condition to commence system performance testing. The requirements of this standard are basic minimum requirements which relate to nuclear power generating stations during construction or construction phases of modification or expansion. For supplementary requirements applicable to the construction phase of multi-unit stations, including expansions to existing stations, refer to Appendix A.

1.3 Responsibility. The organization or organizations responsible for establishing the applicable requirements for the activities covered by this standard shall be identified, and the scope of their responsibility shall be documented. The work of establishing practices and procedures and providing the resources in terms of personnel, equipment, and services necessary to implement the requirements of this standard may be delegated to other organizations, and such delegations shall also be documented. It is the responsibility of each organization participating in site construction activities to comply with the procedures and instructions issued for the project.

1.4 **Definitions.** The following definitions are provided to assure uniform understanding of select terms as they are used in this standard.

Class I equipment. Equipment that is essential to the safe shutdown and isolation of the reactor or whose failure or damage could result in significant release of radioactive material.

Class IE electric systems. The systems that provide the electric power used to shut down the reactor and limit the release of radioactive material following a design basis event.

system performance testing. Tests performed on completed systems, including all their electric, instrumentation, controls, fluid and mechanical subsystems under normal or simulated normal process conditions of temperature, flow, level, pressure, etc.

set point. A predetermined level at which a bistable device changes state to indicate that the quantity under surveillance has reached the selected value.

lay-up. Idle condition of equipment and systems during and after installation, with protective measures applied as appropriate.

1.5 **Referenced Documents.** Other documents that are required to be included as a part of this standard, as well as the issue or edition of such documents, are either identified at the point of reference or described in Section 9 of this standard.

2. General Requirements

Measures shall be established and implemented for documenting installation, inspection, and testing operations to verify conformance to specified requirements.

2.1 **Planning.** The installation, inspection, and testing activities shall be planned and outlined to define the operations to be used and the systematic, sequential progression of operations for each item or system, the responsibilities of parties concerned for each operation, and the measures employed to preserve the quality of equipment.

Planning shall take into account the need for the preparation and control of procedures and work instructions necessary to comply with the requirements for installation, inspection, and testing of components and systems.

Planning shall include a review of the system and component design specifications and drawings, and of the construction work plans and schedules, to assure that installation, inspection, and testing activities have been incorporated, that they can be accomplished as specified, and that time and resources are sufficient to accomplish the required actions.

2.2 **Prerequisites.** The following conditions shall have been met as required by other standards before the requirements set forth in this standard are applied.

(1) Qualification of personnel assigned to the construction phase has been in accordance with the requirements of appropriate codes and standards.

(2) Systems have been designed and engineered and equipment has been specified in accordance with the published applicable standards and specifically within the framework of the Quality Assurance program described in the Safety Analysis Report.

(3) Materials have been selected, and equipment has been fabricated and shop assembled, in accordance with the specifications and the applicable published codes and standards, the conformance to which has been demonstrated by the manufacturer.

(4) Materials and equipment have been shipped, received, handled and stored in accordance with the requirements of applicable codes, standards, and manufacturers' recommendations to preserve their integrity and prevent physical, mechanical, and/or electrical damage.

(5) The following documents relating to the specific equipment to be installed are available at the construction site:

(a) The latest applicable approved-for-construction drawings

(b) Installation specifications

(c) Manufacturers' instructions

(d) Evidence of compliance by manufacturer with purchase requirements, including quality assurance requirements

(e) Records of inspections and tests during on-site storage and handling.

2.3 **Procedures and Instructions.** Installation, inspection, and test procedures and work instructions shall be prepared and documented for those activities falling within the scope of this standard. These documents shall be kept current and revised as necessary to assure