

N45.2.4-1972 ■ Std 336-1971

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:

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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

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

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 instrumentation sensing lines
- (3) Aligning or verifying alignment, or both, of Class I rotating equipment
- (4) Verifying structural 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

that installation, inspections, and tests are performed in accordance with latest information and shall include as appropriate:

- (1) Installation specifications
- (2) Inspection and test objectives
- (3) Precautions to avoid component or system damage during testing or inspection
- (4) Inspection and test equipment required
- (5) Sequence of tests (if applicable)
- (6) Sequential actions to be followed
- (7) Frequency of inspection or test
- (8) Prerequisites
- (9) Approvals
- (10) Data report form
- (11) Identification of test equipment and date of required recalibration where required for interpretation of test results
- (12) Inspection and test acceptance limits

2.4 Results. Inspection and test results shall be documented in a suitable test report or data sheet. Each report shall identify the item to which it applies, the procedures or instruction followed in performing the task, and the identification of the following:

- (1) Conditions encountered which were not anticipated, including nonconformance
- (2) Identity of inspector or tester
- (3) Completion date

Test reports and data sheets shall include an evaluation of the acceptability of inspection and test results and provide for identifying the individual who performed the evaluation.

2.5 Measuring and Test Equipment.

2.5.1 Selection. Inspection and testing equipment with acceptable accuracy for performing the required function shall be selected. When general voltage levels, flow directions, or other parameters are checked, an instrument without high precision may be used. When characteristics, efficiencies, capabilities, or other properties are measured to appraise compliance with specifications, the instrument must have adequate accuracy to determine the measured quantity to the precision required by the stated limits of the specifications. Use shall be made of approved industry standards relating to measuring procedures. Test equipment and/or apparatus supplying electrical, mechanical, or other test inputs shall have adequate capacity and be compatible with items under test so that the results will not be distorted.

2.5.2 Calibration and Control. Measuring and test equipment used to determine compliance with specifications, shall be adjusted and calibrated at prescribed intervals against certified equipment having known valid relationships to nationally recognized standards. If no national standards exist, the basis for calibration shall be documented. Records of the calibrations shall be maintained and equipment suitably marked to indicate date of next required calibration. When inspection and testing equipment are found to be out of calibration, an evaluation shall be made of the validity of previous inspection or test results and of the acceptability of items previously inspected or tested. Test equipment found to be out of calibration shall be clearly identified as such.

2.6 Nonconforming Items. Defects, deficiencies, discrepancies, or other nonconforming situations shall be resolved in accordance with established procedures. These procedures shall provide for identifying, documenting, and obtaining authorization for resolving each nonconforming situation.

3. Preconstruction Verification

While it is recognized that the requirements for initial receipt inspections and storage are covered by another standard, it is necessary to verify that the quality of an item has not suffered during the interim period. It is not intended to duplicate inspections but rather to verify that items are in a satisfactory condition for installation. The verifications shall include:

(1) Verification that materials and equipment received by the installers are identified in accordance with the latest approved-for-construction drawings, equipment lists, and specifications

(2) Verification that approved procedures, instruction manuals, and/or any special work instructions if required for specific equipment are available

(3) Checking of records of protective measures maintained during storage for conformance to storage requirements

(4) Visual examination of materials and equipment to assure physical integrity such as absence of physical damage, rust or corrosion, contact contamination, and condensation

4. Installation

Equipment shall be located, installed, assembled, and/or connected in strict accordance with the following as applicable:

- (1) Latest approved-for-construction drawings
- (2) Manufacturers' instructions
- (3) Installation specifications and procedures

Care shall be especially exercised in following the provisions of the above documents for operations such as:

- (1) Cable pulling
- (2) Cable splicing
- (3) Cable terminating
- (4) Cable routing including maintaining required separation between redundant systems
- (5) Tagging and/or identifying various items including cable
- (6) Installing electric and instrumentation penetration assemblies and assuring the integrity of the containment seals

5. Verification During Construction

5.1 Inspections. Surveillance of construction activities shall include inspections of the work areas and the work in progress to assure conformance to applicable requirements. Inspections shall include the following, as appropriate:

5.1.1 Inspections to Verify Correctness of Installation. Inspection shall be made to verify that equipment is being located, installed, assembled, and/or connected to comply with latest approved-for-construction drawings, manufacturers' instructions, and installation specifications. Such inspections shall include, as appropriate, verification of:

- (1) Leveling and alignment
- (2) Clearances and tolerances
- (3) Proper location and routing of cables and sensing lines
- (4) Tightness of connections and fastenings
- (5) Freedom of movement
- (6) Correct polarity
- (7) Proper grounding
- (8) Terminations
- (9) Fluid levels and pressures
- (10) Absence of leaks
- (11) Physical integrity
- (12) Identifications

5.1.2 Inspections to Verify Housekeeping.

Inspections shall be made to verify adequacy of housekeeping in work areas. Adequacy of barriers and protective covers shall be evaluated to assure that items will not be damaged as a result of adjacent construction activity. Adequacy of protective measures shall be evaluated to assure that equipment being used for testing will not be damaged.

5.1.3 Inspection of Temporary Conditions.

Inspections shall be made to verify adequacy of protective measures applied for lay-up during construction. All temporary connections, such as jumpers and bypass lines, and temporary set points of control equipment shall be clearly identified and documented so that subsequent restoration can be ascertained prior to placing the item in service.

5.2 Tests. Surveillance of construction activities shall include tests performed in accordance with written test procedures to verify that items being installed comply with specified quality and performance requirements. These tests should be performed at appropriate points in the construction phase as access permits or when questions arise as to the quality of components or workmanship.

Where preliminary operation of equipment, during construction, is utilized for a testing function the purpose of the test, its scope, and results shall be clearly established and documented.

Tests shall be repeated if construction or associated activity affects the results of the tests. The need to repeat a test shall be ascertained at the time of preparing for post-construction testing in accordance with 6.2.

Tests during construction shall include the following:

5.2.1 Electrical Tests. The following electrical tests shall be performed:

(1) Tests to ascertain circuit continuity, absence of short circuits, correct polarity and correct direction of rotation

(2) Tests to ascertain proper functioning of systems, including indicating meters, recorders, transducers, targets and lamps, annunciators and alarms, controls and interlocks

(3) Voltage breakdown tests on liquid insulation

(4) Overpotential tests as specified

(5) Insulation resistance measurements as specified

When overpotential tests are performed, the values shall conform to the applicable codes and standards. The manufacturers' recommendations shall always be considered.

5.2.2 Mechanical Tests. Mechanical tests shall be performed to ascertain that electric and/or instrumentation components or systems can withstand systems pressure ratings. As a minimum, such tests shall be applied to pressure sensing and transmitting devices operating in steam, hydraulic, and vacuum systems and their hydraulic or pneumatic interconnecting piping or tubing and associated instruments. Pressurized equipment which is a part of electric apparatus such as heat exchangers, circulating systems, actuating systems, and electric and instrumentation containment penetrations shall likewise be tested if site assembled or fabricated. Manufacturers' tests on fabricated items may be accepted for equipment not disturbed during the construction phase.

These tests shall be in accordance with the applicable codes and standards. If equipment is assembled at the construction site, tests shall be conducted after the assembly is complete even though the components may have been previously tested.

5.2.3 Physical and Chemical Tests. These tests shall include, as appropriate:

(1) Chemical analyzing of fluids for oxygen or moisture content and purity

(2) Radiation sensitivity testing to confirm that radiation sensors and controlling devices are properly functioning

These tests shall be in accordance with the applicable codes in Appendix B.

6. Post-Construction Verification

6.1 Inspections. Installed equipment and systems shall be inspected to verify the following:

(1) That equipment and materials have not sustained damage during installation

(2) That good and proper workmanship has prevailed

(3) That the installation has been made in accordance with specified requirements

(4) That all nonconforming items have been satisfactorily resolved

(5) That appropriate protective measures are applied for lay-up after installation

(6) That all temporary conditions such as jumpers, bypass lines, and temporary set points have been clearly identified so that subsequent restoration can be ascertained prior to placing the items in service

To satisfy the above objectives, inspections defined in 5.1 shall be repeated, as appropriate.

6.2 Tests. Installed equipment and systems shall be tested to demonstrate that the installation has been made in accordance with design requirements and that the operation gives the desired result. Temporary electrical connections, temporary piping sections, abnormal chemical solutions, unspecified setting of devices, the fixing of a moving component, or the effecting of any other abnormality if made previously shall be rectified before final testing except in cases where fuel loading or other critical operations prevent using the complete assembly for the test. In these instances, a documented notice shall be prepared stating the substitutions that existed for the test.

In final testing that precedes system performance testing, normal system readout devices and installed transducers shall be used as far as possible to monitor the operation. Where the installed equipment is not adequate for the purpose of conducting tests, special measuring instruments and simulating devices shall be used.

Test equipment used shall have adequate capacity and be compatible with system under test so that the results will not be distorted.

6.2.1 Equipment Tests. Tests shall be performed to verify that the quality of installed equipment has not deteriorated during the construction phase.

Tests and shakedown runs shall be made on energized systems where necessary to evaluate operations and to properly condition for service (for example, the seating of brushes or bearings, the stabilization of instrumentation and burn-in of electronic devices).

Tests shall be made to assure that instrumentation and control channels are properly calibrated. In addition, specific tests shall be made at critical levels such as "set points" in a manner simulating the approach toward the set point. These calibrations shall be made with these devices in their normal positions if the calibration is dependent upon location or

attitude. Tests shall be made to determine that proper response is obtained over the operating range of the device. Particular attention shall be given to verifying independence and dependence, as appropriate, of the elements of the systems.

Items requiring calibration shall be tagged or labeled on completion indicating date of calibration and identity of person that performed the calibration.

6.2.2 System Tests. These tests shall be made to verify that all parts of a system properly coordinate with each other. Tests shall be made with attention given to demonstrating required independence and dependence of subsystems. Consideration shall be given to demonstrating freedom from unwanted or harmful effects of conducted or induced electrical noise.

A review shall be made of all testing that has preceded the final integrated system testing including both the tests made on assemblies and components with particular attention given to those that demonstrate functional or operational results. When these tests serve as a prerequisite or a part of the final system test, a review of construction activity which may have affected the results shall be made.

The final construction-phase testing shall be made with all assemblies and components of subsystems complete except where a critical operation requires that temporary electrical connections, piping sections, or structural supports be installed to make the tests.

7. Data Analysis and Evaluation

Procedures shall be established for processing inspection and test data and their analysis and evaluation. These procedures shall include acquisition and reduction of inspection and test data for prompt evaluation against acceptance criteria, operating limits, and performance standards. The data processing procedures shall provide for "on-the-spot" evaluation to determine the validity of the inspection and test results, the appropriateness of continuing the inspection or test. The data shall be analyzed and evaluated to verify completeness of results, achievement of inspection and test objectives, and operational proficiency of equipment and systems:

to identify additional inspection and or tests required; and to identify necessary changes to the installation inspection or test procedures. Inspection and test results that include inspection and test data, together with a report of data analysis and evaluation, shall be provided as specified in Section 8.

8. Records

Record copies of completed procedures, reports, personnel qualification records, test equipment calibration records, test deviation or exception records, and inspection and examination records shall be prepared. These shall be placed with other project records as required by code, standard, specification, or project procedures.

9. Applicable Codes, Standards, and Guides

The applicable published codes, standards, and guides shall be used. In cases where codes or standards were intended to cover the manufacturing phase of an item, these codes shall be used as guides. Refer to Appendix B for a listing, not necessarily complete, of additional codes, standards, and guides that should be considered during the construction phase.

The following guides or standards refer specifically to nuclear power generating stations and their construction, and shall be considered applicable.

(1) IEEE Std 279-1971, Criteria for Protection Systems for Nuclear Power Generating Stations

(2) IEEE Std 308-1971, Criteria for Class IE Electric Systems for Nuclear Power Generating Stations

(3) IEEE Std 317-1971, Electric Penetration Assemblies in Containment Structures for Nuclear Fueled Power Generating Stations

(4) IEEE Std 323-1971, Guide for Qualification of Class I Electric Equipment for Nuclear Power Generating Stations

(5) ANSI 18.2-1965, Nuclear Safety Criteria for the Design of Stationary Pressurized Water Reactor Plants

(6) ANSI B31.7-1969, Nuclear Power Piping

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

(8) IEEE Std 336-1971, Installation, Inspection and Testing Requirements for Instrumentation and Electric Equipment During the Construction of Nuclear Power Generating Stations

(9) IEEE Std 338-1971, Trial-Use Criteria for the Periodic Testing of Nuclear Power Generating Station Protection Systems

(10) IEEE Std 344-1971, Trial-Use Guide for Seismic Qualification of Class I Electric Equipment for Nuclear Power Generating Stations

Appendixes

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

Appendix A Supplementary Provisions for Multi-Unit Stations

For construction activity in nuclear power generating stations where one or more units are already operating or have reached a stage in their own construction where the fuel has been loaded in the reactor and associated systems energized for whatever purpose, the following measures shall be taken in addition to the provision defined in the body of this document.

A1. Planning and Preparation

Instructions, procedures or drawings shall be prepared to control installation, inspection and testing activities at areas of interface between the new and existing units. These instructions and procedures or drawings shall define:

- (1) The areas of interface between the new and existing units
- (2) Access control and authority for work at these interface areas
- (3) Nature of potential hazards to and from the existing equipment
- (4) Precautions required to be taken during installation
- (5) Supplementary objectives for inspection and testing

A2. Documentation

A2.1 The instructions, procedures or drawings described in Section A1 shall be documented and shall be kept current by revisions as necessary.

A2.2 The equipment and/or systems which are associated with existing unit(s) that are electrically energized or charged with pressurized and/or radioactive fluids and which are in the vicinity of the construction activity associated with the new unit shall be properly tagged or identified.

A2.3 The documentation associated with installation described in Section 2.2 of the main

document shall additionally include:

A2.3.1 The identification of the equipment and/or system defined in 2.2 above, which poses a potential hazard in the vicinity of current construction activity.

A2.3.2 Level of potential hazard from such neighboring energized systems, such as: voltage, radiation level, fluid pressure and or temperatures.

A2.4 Authorizations for access to and work at the areas of interface between the new and existing units shall be documented.

A3. Installation

A3.1 Suitable protective barriers shall be erected to prevent damage to equipment and/or systems associated with the existing unit(s).

A3.2 Spare capacities available in existing facility such as in cable raceways or in panelboards shall not be used unless expressly indicated on the latest applicable approved-for-construction drawings or installation specification.

A3.3 When working in an area common to the new and the existing units, such as the cable spreading room, control room, radioactive waste building or the battery room, care shall be especially exercised to avoid interference with existing facilities and to maintain required separation, where appropriate, between the systems associated with existing and new units.

A4. Inspection

A4.1 Inspection shall be performed to verify that existing equipment and or systems neighboring current construction activity are properly tagged and identified, and potential hazards therefrom identified and documented.

A4.2 Inspection shall be performed to verify that the existing facilities are properly protected from current construction activity.

A5. Testing

A5.1 In testing integrated electrical, control, and/or instrumentation systems where the plant design calls for interconnection between

the existing and new systems, care shall be especially exercised to prevent tripping or otherwise dislocating the operation of equipment and/or systems associated with the existing unit(s).

Appendix B Additional Codes, Standards and Guides

1. ANSI C1-1968,¹ National Electrical Code (NFPA 70-1968) (to be used as a guide when appropriate)
2. ANSI C29.1-1961, Test Methods for Electrical Power Insulators
3. ANSI Appendix C57.93, Guide for Installation and Maintenance of Oil-Immersed Transformers
4. ANSI Appendix C57.94, Guide for Installation and Maintenance of Dry-Type Transformers
5. ANSI C96.1-1969, Temperature Measurement Thermocouples
6. API RP550-1965,² Manual on Installation of Refinery Instruments and Control Systems, Part I — Process Instrumentation and Control
7. API RP550-1965, Manual on Installation of Refinery Instruments and Control Systems, Part II — Process Stream Analyzers
8. ASME Boiler and Pressure Vessel Code,³ Section III, Nuclear Power Plant Components, 1971
9. IEEE Std 4-1968, Techniques for Dielectric Tests (ANSI C68.1-1968)
10. IEEE Std 43-1961, Recommended Practice for Testing Insulation Resistance of Rotating Machinery
11. IEEE Std 51-1955, Guiding Principles for Dielectric Tests
12. IEEE Std 56-1958, Guide for Insulation Maintenance for Large AC Rotating Machinery
13. IEEE Std 62-1958, Guide for Making Dielectric Measurements in the Field
14. IEEE Std 64-1969, Guide for Acceptance and Maintenance of Insulating Oil in Equipment
15. IEEE Std 81-1962, Guide for Measuring Ground Resistance and Potential Gradients in the Earth
16. IEEE Std 95-1962, Guide for Insulation Testing of Large AC Rotating Machinery with High Direct Voltage
17. IEEE Std 112A-1964, Test Procedure for Polyphase Induction Motors and Generators
18. IEEE Std 114-1969, Test Procedure for Single-Phase Induction Motors
19. IEEE Std 115-1965, Test Procedure for Synchronous Machines
20. IEEE Std 118-1949, Master Test Code for Resistance Measurement
21. IEEE Std 120-1955 (withdrawn), Master Test Code for Electrical Measurement in Power Circuits
22. IEEE Std 262-1968, Test Code for Distribution, Power and Regulating Transformers, and Shunt Reactors (ANSI C57.12.90-1968)
23. IEEE Std 283-1968, Guide for Installation of Oil-Immersed Transformers
24. ISA-RP3.1,⁴ Flowmeter Installations, Seal and Condensate Chambers, 1960
25. ISA-S5.1, Instrumentation Symbols and Identification, 1968
26. ISA-RP7.1, Pneumatic Control Circuit Pressure Test, 1956
27. ISA-RP7.2, Color Code for Panel Tubing, 1957
28. ISA-RP8.1, Instrument Enclosures for Industrial Environments
29. ISA-RP25.1, Materials for Instruments in Radiation Service, 1957
30. ISA-S26, Dynamic Response Testing of Process Control Instrumentation, 1968
31. ISA-S37.1, Electrical Transducers Nomenclature and Terminology, 1969
32. ISA-RP42.1, Nomenclature for Instrument Tubing Fittings (Threaded), 1965
33. NEMA ICS-1970,⁵ Industrial Controls and Systems

34. NEMA IS1.1-1969, Enclosures for Industrial Controls and Systems
35. NEMA SG 3-1965, Low-Voltage Power Circuit Breakers
36. NEMA SG 5-1971, Power Switchgear Assemblies
37. NEMA VE 1-1965, Ventilated Cable Trays

¹The American National Standard Institute, Inc., 1130 Broadway, New York, N. Y. 10018

²The American Petroleum Institute, 1801 K Street NW, Washington, D. C. 20006

³The American Society of Mechanical Engineers, 345 East 47 Street, New York, N. Y. 10017

⁴The Instrument Society of America, 530 William Penn Place, Pittsburgh, Pa. 15219

⁵National Electrical Manufacturers Association, 155 East 44 Street, New York, N. Y. 10017

SAFETY GUIDE 30

**QUALITY ASSURANCE REQUIREMENTS FOR THE INSTALLATION,
INSPECTION, AND TESTING OF
INSTRUMENTATION AND ELECTRIC EQUIPMENT**

A. Introduction

Appendix B to 10 CFR Part 50, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," establishes quality assurance requirements for the design, construction, and operation of nuclear power plant structures, systems, and components. This safety guide describes an acceptable method of complying with the Commission's regulations with regard to the quality assurance requirements for the installation, inspection, and testing of nuclear power plant instrumentation and electric equipment.

B. Discussion

Working Group N45-3.4 (formerly ad hoc committee N45-3.4, also designated ad hoc committee JCNPS/AH3 by the IEEE) of the American National Standards Institute Standards Committee N45, Reactor Plants and Their Maintenance, has developed a standard which includes quality assurance requirements for the installation, inspection, and testing of nuclear power plant instrumentation and electric equipment. This standard was approved by subcommittee N45-3, Nuclear Quality Assurance Standards, of the American National Standards Committee N45, and the full committee and its Secretariat, and it was subsequently approved and designated N45.2.4-1972 by the American National Standards Institute on March 1, 1972.

This standard was also approved by the IEEE Standards Committee on September 16, 1971, and was designated IEEE Std 336-1971.

C. Regulatory Position

The requirements for the installation, inspection, and testing of nuclear power plant instrumentation and electric equipment which are included in ANSI N45.2.4-1972, "Installation, Inspection, and Testing

Requirements for Instrumentation and Electric Equipment During the Construction of Nuclear Power Generating Stations" (also designated as IEEE Std 336-1971)¹ are generally acceptable and provide an adequate basis for complying with the pertinent quality assurance requirements of Appendix B to 10 CFR Part 50, subject to the following:

1. ANSI N45.2.4-1972 should be used in conjunction with ANSI N45.2-1971, "Quality Assurance Program Requirements for Nuclear Power Plants." (It is expected that future revisions of ANSI N45.2.4-1972 will include this provision.)
2. Section 9 of ANSI N45.2.4-1972 lists additional guides and standards made applicable by ANSI N45.2.4. The specific applicability or acceptability of these listed guides and standards has been or will be covered separately in other safety guides or in appropriate Commission regulations.
3. Although subdivision 1.1 of ANSI N45.2.4-1972 states that the requirements promulgated apply during the construction phase of a nuclear power plant, these requirements are also to be considered applicable for the installation, inspection, and testing of instrumentation and electric equipment during the operation phase of a nuclear power plant.

¹Copies may be obtained from either the Institute of Electrical and Electronics Engineers or the American Society of Mechanical Engineers, United Engineering Center, 345 E. 47th Street, New York, N.Y. 10017.