
INSPECTION PROCEDURE 75001 ATTACHMENT 06

ELECTRICAL SYSTEMS, COMPONENTS, AND CABLES

Effective Date: April 1, 2026

PROGRAM APPLICABILITY: IMC 2573

75001.06-01 INSPECTION OBJECTIVES

To verify that safety-related (SR) and non-safety-related, safety-significant (NSRSS) electrical systems and components can perform their required safety functions (RSFs).

75001.06-02 INSPECTION REQUIREMENTS

02.01 Vertical Slice Inspection of Quality Assurance

Verify the licensee, manufacturer, or project vendor is effectively implementing its quality assurance (QA) and quality control (QC) requirements, in accordance with the quality assurance program (QAP) for activities associated with SR and NSRSS electrical systems and components. Inspection guidance for this inspection is provided in IP 75001, Appendix A.

02.02 SSC Inspection Samples

Verify the SR and NSRSS as-built electrical systems and components are designed and constructed in accordance with the applicable codes and standards (e.g. IEEE), design requirements, and the safety analysis report (SAR).

Verify electrical independence (i.e., separation and isolation) is maintained between safety-related divisions and between safety-related divisions and non-safety-related circuits and cables.

Verify testing activities for the SR and NSRSS as-built electrical systems and components conform to applicable codes and standards (e.g. IEEE), design requirements, the SAR, and the licensee's testing requirements.

02.03 ITAAC Inspections: (Only applicable for construction under a COL)

Verify the inspections, tests, and analysis (ITA), for ITAAC related to electrical systems and components, are performed and that the acceptance criteria (AC) in the combined license (COL) are met.

02.04 Operational Programs:

Verify activities for the implementation of the environmental and seismic qualification programs are being performed satisfactorily in accordance with the established requirements.

75001.06-03 INSPECTION GUIDANCE

General Guidance

The purpose of this inspection procedure is to provide insights into the quality of work being performed in the electrical systems and components inspection area. These insights will support the Advanced Reactor Construction Oversight Program's (ARCOP) continual assessment process described in Inspection Manual Chapter (IMC) 2572, "Assessment of Advanced Reactor Construction Projects."

The specific components selected for inspection, and the depth and breadth of inspection during each inspection may vary widely and will depend on the structure, system, and component's (SSC's) risk significance for the design, the timing and location of the inspection, and the construction activities completed or in progress at the time of inspection.

Each inspection using this IP will constitute at least one inspection sample, regardless of how many sections are implemented during the inspection. As described in IMC 2572 and IMC 2573, "Inspection of the Advanced Power Reactor 'Quality of Reactor Plant Construction' Strategic Performance Area," the number of inspection samples needed to complete inspections in the inspection area are determined by the specified range of inspection samples listed in the project-specific inspection scoping matrices and on the results of the continual assessment process.

This IP is used for various advanced reactor designs and is scalable and flexible. Completion of every section/step of this IP is not expected or required for individual inspections or to complete the baseline inspection program for a project. Inspectors should perform the inspection activities in the following sections of this IP, as available.

In addition to the guidance below, inspectors may refer to Attachment 1 of this IP for supplemental inspection guidance and to other IPs as necessary to aid in completing the inspections in this procedure.

Inspection samples shall be selected in accordance with the ARCOP project-specific inspection scoping matrices, as described in IMC 2573.

Specific Guidance

03.01 Quality Assurance Implementation

The inspectors should refer to IP 75001, "Inspection of Manufacturing and Construction Quality for Advanced Power Reactor Structures, Systems, and Components," and IP 75001, Appendix A, "Implementation of the Quality Assurance Program," for additional inspection guidance. The inspectors should select a sample of QA attributes to inspect during each inspection based on the scope and content of the planned

inspection, the prior completed samples, and indication of potential issues for a particular attribute.

03.02 SSC Inspection Samples

Verify that electrical systems and components conform to applicable codes and standards, such as IEEE, ANSI, NFPA, the design specification, and the SAR; and can withstand the maximum expected loads and are adequately protected from the maximum over-current conditions.

Confirm that electrical components and cables are installed at the correct location, orientation, and configuration, and that mounting hardware, supports, and anchors meet design and material requirements. Installation records should indicate the craft personnel who performed the work, the independent reviewer who verified the work, and signoff blocks to indicate who performed or verified a particular step in the work procedures.

Special attention should be paid to electrical independence (i.e., physical separation and electrical isolation) criteria for redundant SR trains and divisional independence, as these mitigate common-cause failures. Improper installation of electrical components, such as incorrect cable separation, unqualified mounting, or use of non-conforming materials, can result in single-failure vulnerabilities or loss of division independence.

Verify that testing activities for electrical systems and components are performed in accordance with applicable codes, standards, and the licensee's testing requirements. Testing should include pre-operational activities such as continuity checks, insulation resistance, operational performance, and calibration. Continuity (or ring out) checks demonstrate that the wire is not broken, the wire is connected to the correct point at both ends and that the end device is powered from the correct train or channel. Fiber optic cable continuity checks consist of an optical power and optical loss or reflection tests. The tests should be conducted across the entire wavelength spectrum ratings of the cable.

Testing should demonstrate that the electrical systems and components can achieve their required accuracy, tolerance, and performance under expected service conditions. Inadequate testing or use of uncalibrated equipment can lead to undetected cable damage, unreliable power supplies, and failure of critical components during plant events. Inspectors should observe testing activities and review test records to confirm:

- Use of current, approved test procedures.
- Properly identified, traceable, and calibrated test equipment.
- Personnel qualifications for testing.
- Immediate recording of test results and disposition of discrepancies.
- Adherence to acceptance criteria.

Attachment 1 contains supplemental inspection information and guidance that the inspector may use to enhance the inspection.

03.03 ITAAC Verification

Review the licensee's plan for completion of applicable ITAAC associated with the work activities being inspected. Review the activities that the licensee intends to credit for future ITAAC closure. For example, if the licensee intends to rely on a specific quality control (QC) observation during the installation of an SSC, then the inspector should review a sample of these QC observations to determine whether the activity was performed in accordance with applicable quality and technical requirements.

03.04 Operational Program Inspections

Verify the licensee implements activities related to their Reliability Assurance Program (RAP) for SR and NSRSS as-built electrical systems and that components are appropriately qualified to perform their required safety functions (RSFs), for a harsh environment, seismic conditions, and functional qualification.

The inspectors should refer to IP 75001.QUAL, "Qualification of Mechanical, Electrical, and Instrumentation and Control (I&C) Components," for additional inspection guidance for environmental, seismic and the functional qualification of electrical components. This should include review of qualification data packages (e.g., seismic test reports, environmental qualification data, interface requirements such as conduit seals, drip loops, T-drains).

Safety-related isolation devices (e.g., battery chargers, regulating transformers, isolation fuses, etc.) should be qualified for the specific application and their rated over voltage and over current conditions should meet or exceed assumptions used in design basis analyses.

The EQ test reports should state that equipment is qualified for its application and meets its specified performance requirements (voltage, current, frequency, accuracy, etc.) when subjected to the conditions predicted to be present and when it must perform its safety function, up to the end of its qualified life.

Seismic qualification of equipment is grouped into three general categories: (1) analysis, (2) tests, and/or (3) qualify by combination of tests and analysis. One of these methods may be adequate to verify the ability of the equipment to meet the seismic qualification requirements.

Inspectors should confirm that equipment is installed in configurations bounded by qualification testing and that any changes in location, mounting, or interface do not invalidate the qualification. Consider focus on electrical penetration assemblies (EPAs), equipment in harsh environments (e.g., cable ties in containment), and components subject to vibration.

75001.06-04 RESOURCE ESTIMATE

The number of inspection samples and inspection hours are identified in the site-specific inspection scoping and planning matrix.

75001.06-05 PROCEDURE COMPLETION

Completion of this IP is based on 1) completing the minimum required inspection samples identified in the site-specific inspection scoping matrix and 2) an assessment pursuant to IMC 2572 that the construction activities for electrical systems and components are being accomplished with quality in accordance with the licensing basis requirements.

75001.06-06 REFERENCES

ANSI/IEEE 422, "Guide for the Design and Installation of Cable Systems in Power Generating Stations"

IEEE 80, "Guide for Safety in AC Substation Grounding"

IEEE 81, "Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System"

IEEE 384, "Standard Criteria for Independence of Class 1E Equipment and Circuits"

IEEE 665, "Guide for Generation Station Grounding"

IEEE 690, "Standard for the Design and Installation of Cable Systems for Class 1E Circuits in Nuclear Power Generating Stations"

IEEE 1202, "Standard for Flame-Propagation Testing of Wire and Cable"

IEEE 1428, "Guide for Installation Methods for Fiber-Optic Cables in Electric Power Generating Stations and in Industrial Facilities"

NFPA 78, "Lightning Protection Code"

NFPA 262, "Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces"

RG 1.6, "Independence Between Redundant Standby (Onsite) Power Sources and Between Their Distribution Systems"

RG1.28, "Quality Assurance Program Criteria (Design and Construction)"

RG 1.30, "Quality Assurance Requirements for the Installation, Inspection, and Testing of Instrumentation and Electric Equipment"

RG 1.32, "Criteria for Power Systems for Nuclear Power Plants"

RG 1.41, "Preoperational Testing of Redundant On-Site Electric Power Systems to Verify Proper Load Group Assignments"

RG 1.63, "Electric Penetration Assemblies in Containment Structures for Nuclear Power Plants"

RG 1.75, "Criteria for Independence of Electrical Safety Systems"

RG 1.81, "Shared Emergency and Shutdown Electric Systems for Multi-Unit Nuclear Power Plants"

RG 1.89, "Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants"

RG 1.100, "Seismic Qualification of Electric and Mechanical Equipment for Nuclear Power Plants"

RG 1.106, "Thermal Overload Protection for Electric Motors on Motor-Operated Valves"

RG 1.128, "Installation Design and Installation of Vented Lead-Acid Storage Batteries for Nuclear Power Plants"

IP 75001, "Inspection of Manufacturing and Construction Quality for Advanced Power Reactor Structures, Systems, and Components"

END

List of Attachments:

Attachment 1: Additional Considerations for Code Design and Construction Requirements

Attachment 2: Revision History for IP 75001.06

Attachment 1: Supplemental Inspection Guidance

The purpose of this attachment is to provide guidance for inspection of electrical systems, components, and cabling per Section 02.02 of the main body of this IP. Some of the sections and guidance in this attachment may not apply to all facilities. ITAAC are only applicable to facilities constructed under a COL. Inspectors may consider:

- a. Field-mounted components that may be hidden by panels, floors, or walls. The installation records should indicate that each step of the installation was inspected by QA before proceeding with subsequent steps that could cover up the work just performed.
- b. Installed SSCs are located so they are not exposed to potential hazards, such as high-pressure piping or flammable material. The installation records should identify the potential hazards to the SSCs being installed, and they should indicate how the licensee protected and/or reported which SSCs need protection.
- c. Nonconformances and reporting should not only meet the licensee's procedural requirements but also the regulations 10 CFR 21, 10 CFR 50.55(e), and/or 10 CFR 50, Appendix B, Criterion XV. The records should identify any nonconformances, and they should indicate that they were processed and evaluated by established channels.
- d. Field and design changes are approved in the manner and to the same degree as the original design for the SSCs and in accordance with the licensee's procedures. The installation records should identify all field and design changes used for the installation.
- e. Information should be correctly translated into specifications, construction procedures, and drawings for safety-related SSCs. For example, the voltage drop calculation should show that the minimum voltage expected at the terminals of a device is greater than or equal to the manufacturer's minimum specified voltage. The licensee should have calculations demonstrating that the batteries, chargers, regulating transformers, DC distribution panels, motor control centers, and invertors, and their circuit breakers and fuses are sized to meet the expected load requirements without exceeding nameplate ratings.
- f. When observing cable pulling activities checks should be made of the following attributes:
 1. Minimum bend radius should not be exceeded
 2. Cable pulling lubrication should be used as specified in work package and appropriate for the materials.
 3. Cable pulling tension limits should typically be calculated before the pull begins
 4. Monitored during the pull, and conduit fill limitations should not be exceeded
- g. Use of any cable and raceway software is appropriate. Overrides of cable and raceway software are administratively controlled.

- h. Cables installed in the conduits do not exceed ampacity, fill guidelines, or jamming ratio. Inspectors should consider situations where licensees might install new cables in existing conduits which already have cables installed. Such “cable pull-bys” can damage existing cables due to the pull rope cutting the already installed cables. Fiber optic cables are especially sensitive.
- i. For installed cable raceway, consider that:
 - 1. The size, material (e.g., steel, aluminum, galvanized), and style (e.g., ladder type, solid bottom, etc.) are as specified on the design documents.
 - 2. Correct dimensions from column line, from floor or ceiling, and between raceways installed in banks or arrays, and physical separation criteria are maintained.
 - 3. Raceway supports are constructed according to the approved drawings or instructions and are located at points specified on approved drawings.
 - 4. Fittings, clamps, bushings, conduits, flexible conduit, grounding wire and clamps are installed according to approved design.
 - 5. Raceways are installed such that the specified minimum cable bend radius will not be exceeded. To avoid cable-pull damage, no more than 360 degrees of conduit bends should be included between cable pull points.
 - 6. Underground ducts and concrete embedded conduits should be installed in a manner to provide for automatic water drainage and/or pump out. Cables installed in these locations should be materially appropriate for the conditions.
 - 7. Cables installed meet the design criteria from the ampacity, weight and depth of fill attributes. In cases where power cables are installed in a single layer, check that proper spacing is maintained. Seals and fire stops should be qualified for the application and are correctly installed at the specified locations.
- j. Terminations. Consider the following:
 - 1. The correct lug size and type is used.
 - 2. Lugs should be properly installed and crimped on the wire.
 - 3. Lugs are compatible with the terminal blocks or bus bar to which they are connected
 - 4. Lugs are compatible with cable type (i.e., solid or stranded conductor) and cable system voltage rating, and are installed in accordance with the lug manufacturer’s recommendations.
 - 5. Terminal block markings match wiring diagrams.
 - 6. Wire protrudes specify dimension beyond barrel, and “signature” dimple of the crimp tool indicates that proper compression has been achieved.
 - 7. Hold-down screws are torqued to recommended value.

8. If multiple wires are terminated on the same terminal point, the maximum number of terminations allowed by procedure on a terminal is not exceeded.
- k. Cable shield wires are grounded at points specified in the design output documents or work procedures and not grounded at any other points.
- l. Post-fire safe shutdown considerations impose special requirements on the separation of cables. Inspectors should consider if as-built cable routing meets design criteria, flame retardant cable is installed where required and fire barriers installed on raceways are correctly qualified and properly installed.
- m. Records were properly reviewed and approved. Records of the qualification of craft and quality control personnel associated with these activities should be reviewed.
- n. For fiber optic splices and termination connectors on patch panels, testing should demonstrate that optical power and loss are adequate.
- o. Primary containment electrical penetration faults inside containment could result in a penetration seal failure and breach of the containment.
 1. The licensee's design specifications prepared for procurement of containment EPAs and the original equipment manufacturer design documents should ensure that the equipment is adequately rated for its application.
 2. Calculations should be available for determining the rated continuous current (ac or dc); rated short time overload current and its duration; and rated short circuit current and its duration.
 3. Maximum available continuous and short-time overload currents should not exceed the continuous and the short-time overload ratings, respectively, of the containment EPA.
 4. Circuits should have redundant protection devices in series and should trip or open prior to the EPA's rated short circuit thermal capacity being exceeded.
 5. The rated short circuit current for DC circuits should be based on having a constant DC voltage applied unless otherwise specified.
 6. Electrical penetrations, which could fail in a manner to breach containment, are provided with dual primary protection operating separate interrupting devices, or primary and backup protection operating separate interrupting devices. Time current curves of the dual primary protection, or the primary and backup protection, should coordinate with the time current capability curve of the electrical penetration they are protecting.
- p. Station Grounding and Surge Protection protects plant personnel from dangerous electrical potentials such as transferred, step, and touch potentials during both normal operating and maximum ground fault conditions, provides connection to ground for power equipment neutrals, facilitates relaying in clearing ground faults, dissipates static charges and/or induced current from current carrying lines that need to be worked on, and dissipates lightning charges.

Connections to the station grounding grid should be available for:

1. instrument/computer grounding systems,
2. electrical system grounds from the neutral points of the main generator, main step-up transformers, auxiliary transformers, load center transformers, and onsite standby diesel generators,
3. equipment grounds for equipment enclosures, metal structures, metallic tanks, ground bus of switchgear assemblies, load centers, motor control centers, control cabinets, building structural steel, and piping and electrical raceways, and
4. lightning arresters are provided for lightning protection for exposed structures and buildings housing safety-related and fire protection equipment.

Station grounding grid drawings should be available showing the station grounding mat, ground cable, and taps or connections to each grounding sub-system as well as the lightning protection sub-system that is grounded to the station grounding grid.

The types of connections used in the installation of the grounding sub-systems should be verified by reviewing work documents for different types of grounding conductor connection hardware (installed using different installation techniques). The inspector should verify that the licensee's work controls, used for installing the different types of grounding conductor connection hardware, were correctly implemented in accordance with the approved QA requirements.

- q. Construction tests for electrical components and systems include the following types of inspections and tests:
 1. Initial energization of electrical components
 2. "Bumping" of direct current (DC) motors as well as 3-phase alternating current (AC) motors to ensure that they turn in the proper direction,
 3. Introduction of electrical signals into individual electrical divisions to ensure that components from different trains are wired into the separate and correct divisions,
 4. Tests of components (i.e., breakers) which are required to react to degraded voltage conditions,
 5. Tests of emergency battery chargers for loss of ac power reactions,
 6. Verification of applicable breaker positions and functions and applicable fuse status for testing coordination,
 7. Verification that protective relay settings and thermal overload devices are set at design specifications.

Some of the tests, such as initial energization and bumping of AC and DC motors may be steps in the installation procedure or work package. Inspectors should be knowledgeable of component and system design requirements as well as understanding individual procedure requirements and acceptance criteria.

Required tests such as the introduction of test signals into Class 1E electrical divisions to verify that components are wired into the correct division may be conducted by system or may be conducted by division. Inspectors should review the test procedure(s) to understand the full scope of the test. If the test is by electrical division, there may be a number of samples satisfied by one test.

r. Construction Tests for Electrical Cable

Construction tests of electrical cables include visual inspections and tests to confirm that cables are correctly installed and connected, and have not been damaged during installation, or by construction activities after installation. Construction tests and inspections include the following:

1. Continuity tests should be performed on all cables prior to testing or terminating.
2. Visual inspection of installed cable to look for evidence of damage by workers (including cable installation crews) walking on previously installed cable, or by welding activities above installed cable.
3. Visual inspection and testing of cables after installation including terminations, connectors, and splices before ultimate connection to equipment.
4. Insulation resistance (megger) tests, and high potential (hi-pot) tests on power cables as required by installation specifications and procedures. The tests should measure the insulation resistance between any possible combination of conductors in the same circuit and between each conductor and station ground.
5. Megger tests should be performed on signal cables if circuit performance is dependent on insulation resistance.
6. Specialized testing to verify adequate termination and acceptable signal degradation of fiber optic cable.

The inspector(s) should be familiar with system and component design requirements as well as cable manufacturer's specifications/requirements for megger and hi-pot testing.

END

Attachment 2: Revision History for IP 75001.06

Commitment Tracking Number	Accession Number Issue Date Change Notice	Description of Change	Description of Training Required and Completion Date	Comment Resolution and Closed Feedback Form Accession Number (Pre-Decisional Non-Public Information)
N/A	ML26057A070 04/01/26 CN 26-011	Initial Issuance.	N/A	N/A