
INSPECTION PROCEDURE 75001 ATTACHMENT 07

INSTRUMENTATION AND CONTROL (I&C) SYSTEMS AND COMPONENTS

Effective Date: April 1, 2026

PROGRAM APPLICABILITY: IMC 2573

75001.07-01 INSPECTION OBJECTIVES

To verify that safety-related (SR) and non-safety-related, safety-significant (NSRSS) instrumentation and control (I&C) systems and components can perform their required safety functions (RSFs).

75001.07-02 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 I&C systems and components. Inspection guidance for this part of the inspection is provided in IP 75001, Appendix A.

02.02 SSC Inspection Samples:

Verify SR and NSRSS as-built I&C systems and components conform to the applicable codes and standards (e.g. ANSI, IEEE) documented in the design basis and the safety analysis report (SAR).

Verify testing activities are designed and implemented to ensure that the as-built systems will continue to meet the design bases documents and the SAR.

02.03 Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC). Only applicable for construction under a combined operating license (COL):

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

02.04 Operational Program Inspections:

Verify that as-built I&C systems and components are qualified, under all environmental conditions, to reliably perform their intended functions in their installed location as specified in the design basis and the SAR. Note that cyber security aspects of I&C systems are inspected under the Security and Safeguards ARCOP strategic performance area are not part of this inspection.

75001.07-03 INSPECTION GUIDANCE

General Guidance

The purpose of this inspection procedure is to provide insights into the implementation of the QAP and its oversight in the inspection area for I&C systems and components. 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 information gathered during each inspection may vary widely between inspections 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 information and 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.

This inspection procedure applies to the installation of equipment and components that make up SR and NSRSS I&C systems. When the cabling is an integral part of a sensor, then it should be considered part of the sensor.

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 QAP attribute.

03.02 SSC Inspection Samples

Verify as-built I&C systems conform to the applicable codes and standards documented in the design basis and the SAR.

Verify the installation, orientation, and configuration conform to the design basis and material requirements documented in qualification records.

Installation records should identify the craft personnel who performed the work, the independent reviewer who verified the work, and include signoff blocks for each step in the work or test procedures.

Proper identification and traceability of I&C system components should be maintained throughout installation and recorded in accordance with construction drawings and specifications.

Verify that any field or design changes made during construction are approved and documented to the same degree as the original design, ensuring the as-built configuration remains qualified to the intended design basis.

Verify that as-built physical separation and electrical independence between redundant I&C channels or trains were maintained. Records should document how separation criteria and divisional independence were achieved. In addition, records should document how any deviations from the design basis were justified and reconciled to maintain conformance to the applicable single-failure criterion and defense-in-depth principles.

Installation procedures and records should demonstrate how temporary or permanent protective measures ensure the functional integrity of I&C system components, e.g., electrical isolation of welding electrodes and circuits from the I&C system components.

Verify that testing activities were conducted in accordance with applicable codes and standards documented in the design basis. In accordance with the QAP, these activities should be conducted by qualified personnel and equipment using approved procedures.

03.03 Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC). Applicable only for construction under a combined operating license (COL):

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. Because ITAAC has special regulatory significance, licensees should document ITAAC closure under their QAP.

03.04 Operational Program Inspections

Verify that as-built SR and NSRSS I&C system components can perform their intended functions. Verify that the I&C equipment is installed in a manner bounded by the

qualifications, and that any changes in location, mounting, or interface do not invalidate the qualification.

Verify that the I&C components are qualified in accordance with the design basis and the SAR. Qualification requirements may include:

- environmental (mild and harsh environments)
- submergence
- seismic, and
- electrical (surge withstand capability (SWC), electromagnetic interference (EMI), electrostatic discharge (ESD), and radio frequency interference (RFI)).

The inspectors should refer to IP 75001.QUAL, "Qualification of Mechanical, Electrical, and Instrumentation and Control (I&C) Components," for additional inspection guidance.

The inspectors should review the qualification data package reports (QDPRs) and verify I&C systems and components are installed in a manner bound by the qualification.

Emphasis should be placed on components that are sensitive to movement and vibration, such as digital modules, instrument lines, racks, and panels. Inspectors should verify that these items are installed and supported in accordance with construction drawings, and that any changes in location, orientation, or mounting are adequately reviewed to ensure continued qualification.

Installation records should document that seismic and environmental requirements are met and should identify any deviations or justifications for as-built changes. For components installed in harsh environments (e.g., high radiation, temperature, or humidity), inspectors should verify that the as-built configuration maintains the environmental qualification (EQ) as documented in the SAR and supporting analyses.

75001.07-04 RESOURCE ESTIMATE

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

75001.07-05 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 there is reasonable assurance that the activities for I&C systems and components are being accomplished with quality in accordance with the licensing basis requirements.

75001.07-06 REFERENCES

10 CFR 50, Appendix A, "General Design Criteria for Nuclear Power Plants," Criteria 2, 4, 17, 19, 20, 21, 22, 23, 24, and 25

10 CFR 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants"

ANSI/IEEE C37.90.1-2002, "Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated With Electrical Power Apparatus"

ANSI/ISA 67.14.01-2000, "Qualification and Certification of Instrumentation Control Technicians in Nuclear Facilities"

ANSI/ISA S75.01.01-2002, "Flow Equations for Sizing Control Valves"

ASME NQA-1-2004, "Quality Assurance Requirements for Nuclear Facility Applications"

EPRI Report TR-102323, "Guide to Electromagnetic Interference (EMI) Susceptibility Testing for Digital Safety Equipment in Nuclear Power Plants"

Facility FSAR, including pertinent codes and standards referenced in the FSAR

GL 95-02, "Use of NUMARC/EPRI Report TR-102348, Guideline on Licensing Digital Upgrades"

IEC 880, "Software for Computers in Safety Systems of Nuclear Power Stations"

IEEE 1012-2004, "Standard for Software Verification and Validation Plans"

IEEE 1016-1998, "Recommended Practice for Software Design Descriptions"

IEEE 1028-1997, "Standard for Software Reviews and Audits"

IEEE 1050-2004, "Guide for Instrumentation and Control Equipment Grounding in Generating Stations"

IEEE 1074-1997, "Standard for Developing Software Life Cycle Processes"

IEEE 1228-1994, "Standard for Software Safety Plans"

IEEE 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations"

IEEE 323-2003, "Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations"

IEEE 336-2005, "Guide for Installation, Inspection, and Testing for Class 1E Power, Instrumentation, and Control Equipment in Nuclear Facilities"

IEEE 338-1987, "Standard Criteria for Periodic Surveillance Testing of Nuclear Power Generating Station Safety Systems"

IEEE 344-2004, "Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations"

IEEE 379-2000, "Standard Application of the Single-Failure Criterion to Nuclear Power Generating Station Safety Systems"

IEEE 384-1992, "Standard Criteria for Independence of Class 1E Equipment and Circuits"

IEEE 420-2001, "Standard for the Design and Qualification of Class 1E Control Boards, Panels, and Racks Used in Nuclear Power Generating Stations"

IEEE 518-1982, "Guide for the Installation of Electrical Equipment to Minimize Electrical Noise Inputs to Controllers from External Sources"

IEEE 603-1998, "Standard Criteria for Safety Systems for Nuclear Power Generating Stations"

IEEE 730-2002, "Standard for Software Quality Assurance Plans"

IEEE- 7-4.3.2-2003, "IEEE Standard Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations"

IEEE 741 -1997, "Standard Criteria for the Protection of Class 1E Power Systems and Equipment in Nuclear Power Generating Stations"

IEEE 828-2005, "Standard for Software Configuration Management Plans"

IEEE 829-1998, "Standard for Software Test Documentation"

IEEE 830-1998, "Recommended Practice for Software Requirements Specifications"

Information Notice (IN) 83-83, "Use of Portable Radio Transmitters Inside Nuclear Power Plants"

ISA 67.01.01-2002, "Transducer and Transmitter Installation for Nuclear Safety Applications"

ISA 67.02.01-1999, "Nuclear Safety-Related Instrument-Sensing Line Piping and Tubing Standard for Use in Nuclear Power Plants"

ISA 67.04.01-2006, "Setpoints for Nuclear Safety Related Instrumentation"

ISA 67.06.01-2002, "Response Time Testing of Nuclear Safety-Related Instrument Channels in Nuclear Power Plants"

ISA 7.0.01-1996, "Quality Standard for Instrument Air"

ISA 75.08.01-2000, "Face-to-Face Dimensions for Integral Flanged Globe-Style Control Valves Bodies: ANSI Classes 125, 150, 250, 300, and 600"

ISA RP3.2, "Flange Mounted Sharp Edged Orifice Plates for Flow Measurement"

ISA S75.16-1994, "Face-to-Face Dimensions for Flanged Globe-Style Control Valves Bodies: ANSI Classes 900, 1500, and 2500"

ISO 5167-2003, "Measurement of Fluid Flow by Means of Pressure Differential Devices Inserted in Circular Cross-Section Conduits Running Full, Parts 1 and 2"

MIL-STD-461, Revision F, "Requirements for Control of Electromagnetic Interference Characteristics of Subsystems and Equipment"

MIL-STD-462, Revision D, "Electro-magnetic Interference Characteristics Measurement"

NUREG/CR-3270, "Investigation of Electro-magnetic Interference (EMI) Levels in Commercial Nuclear Power Plants"

NUREG/CR-4640, "Handbook of Software Quality Assurance Techniques Applicable to the Nuclear Industry"

NUREG/CR-6303, "Method for Performing Defense-In-Depth and Diversity Analyses of the Reactor Protection System"

NUREG-0493, "A Defense-in-Depth and Diversity Assessment of the RESAR-414 Integrated Protection System"

NUREG-0700, "Human-System Interface Design Review Guideline"

NUREG-0711, "Human Factors Engineering Program Review Model"

NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," Chapter 7

NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," Chapter 13.2, "Training"

NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," Chapter 13.5, "Plant Procedures"

NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," Chapter 18, "Human Factors Engineering"

Regulatory Guide (RG) 1.11, "Instrument Lines Penetrating Primary Reactor Containment"

RG 1.118, "Periodic Testing of Electric Power and Protection Systems"

RG 1.151, "Instrument Sensing Lines"

RG 1.152, "Criteria for Programmable Digital Computer System Software in Safety-Related Systems for Nuclear Power Plants"

RG 1.22, "Periodic Testing System Actuation Functions"

RG 1.28, "Quality Assurance Program Requirements (Design and Construction)"

RG 1.29, "Seismic Design Classification"

RG 1.30, "Quality Assurance Requirements for the Installation, Inspection, and Testing of Instrumentation and Electric Equipment (ANSI N45.2.4/IEEE 336)"

RG 1.38, "Quality Assurance Requirements for Packaging, Shipping, Receiving, Storage, and Handling of Items for Water Cooled Nuclear Power Plants (ANSI N45.2.2)"

RG 1.53, "Application of the Single Failure Criterion to Nuclear Power Plant Protective Systems (IEEE 279 and IEEE 379)"

RG 1.58, "Qualification of Nuclear Power Plant Inspection, Examination and Testing Personnel (ANSI N45.2.6)"

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

RG 1.75, "Physical Independence of Electric Systems"

RG 1.97, "Instrumentation for Light Water Cooled Nuclear Power Plants to Assess Plant and Environ Conditions During and Following an Accident"

RG1.100, "Seismic Qualification of Electric Equipment for Nuclear Power Plants"

RG1.39, "Housekeeping Requirements for Water Cooled Nuclear Power Plants (ANSI N45.2.3)"

RG1.89, "Qualification of Class 1E Equipment for Nuclear Power Plants"

END

List of Attachments:

Attachment 1: Additional Considerations for Code Design and Construction Requirements

Attachment 2: Revision History for IP 75001.07

Attachment 1: Supplemental Inspection Guidance

The purpose of this attachment is to provide guidance for inspection of instrumentation and control systems and components 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:

SSC Design and Installation

- a. Systems and components must have the appropriate ratings, for example, for surge withstand capability, electromagnetic interference, electrostatic discharge, and radio frequency interference. These ratings should be addressed in qualification packages and listed in the design specifications. Where EQ testing or other qualification provisions are specified, licensee receipt inspection activities must verify that the required testing has been satisfactorily completed. The installation records should indicate that the proper components, for the environment, were installed, and they should identify any discrepancies.
- b. The inspector should independently verify a sample of physical installations where supports and anchorages were used. Verify certain items, such as equipment and support locations and bolt sizes, are as specified in qualification records or otherwise will not interfere with the intended design functions. The installation records should indicate that the proper supports were installed and located per drawings and should document how any discrepancies were reconciled.
- c. The inspector should verify that anchorages installed in concrete structures did not degrade the structure, and that proper welding requirements were specified and controlled. Construction specifications and drawings should specify the welding requirements to be used.
- d. The inspector should verify the craft's qualification/training records. The licensee should have qualification records that document the craft personnel experience and education relevant to I&C systems. The installation records should identify the craft personnel who performed the work and the independent reviewer who verified the work in accordance with the QAP. If craft personnel are available, during work, ask questions about the documentation being used and their understanding of them. "Qualified craft personnel" means those employees who achieved suitable proficiency to do their assigned tasks by training and/or previous experience, and who understand the installation procedures, drawings, and specifications necessary for their work.
- e. The inspector should verify that the I&C system components were correctly identified, labeled, and segregated in accordance with the design basis requirements. The installation records, drawings, and specifications should indicate trains, channels, systems, and class (SR or NSRSS).
- f. The installation records should indicate that the required QC inspections were properly performed, recorded, reviewed, and evaluated by qualified personnel prior to any actions that could prevent the verification of important design features later.
- g. The inspector should verify that the placement of plant components that could be hazardous to the I&C systems was considered during construction. Records should

identify the potential hazards and how they could affect the various qualifications for the I&C components.

- h. The I&C system firmware should be the exact same version as the one documented in the design basis and SAR. The installation records should indicate any component that was replaced and specify the documents (e.g., field change and design change) that justified the replacement qualification.
- i. The inspector should verify that any damage or degradation to I&C system components is being monitored and controlled in accordance with the QAP. This is especially important for components where degraded effects may not be immediately apparent (e.g., instrument tubing, sensors, and transmitters). The installation records should indicate any potential risks and the means of protection. The ANSI/ISA-67.02.01 standard prescribes several requirements for installation of instrument sensing lines. Damage can make pressure and level instruments, particularly level instruments, unacceptably inaccurate.
- j. Installation records for the SSCs should identify any deviations from the design basis. SR functions are to be independent of normal plant control functions, especially SR functions that provide protection against control malfunctions. Isolation devices or gateways are used to isolate SR systems from NSR control, data communication, and display systems. The latter can be demonstrated by reports but may be verified for a sample of I&C systems in the field. SR functions take precedence over NSR functions and should be available even if NSR functions are disabled during an accident or event. The installation records indicate any deviation between the design basis and the as-built installation.
- k. The grounding of I&C systems should be in accordance with the design basis and meet qualification requirements for EMI, RFI, etc. IEEE standard 1050 provides insights on how to ground I&C systems, and how to route cables to minimize electrical noise. Instrumentation cables should have shielding, sheaths, and insulation. The installation records should address any grounding and electrical noise concerns.

Construction Testing

Construction tests of I&C components and systems include the following:

- a. Initial calibration of instrumentation and systems.
- b. Introduction of simulated actuation signals for safety-related actuators (e.g., squib valves, motor-operated safety valves, etc.) from main control rooms and from remote shut-down stations.
- c. Verification that all devices respond as expected in response to simulated actuation signals.

The inspector should review the specified requirements and procedures before observing these activities. If special calibration requirements are specified, such as density compensation during liquid level instrument calibration, the inspector should determine whether these requirements are being met.

Attachment 2: Revision History for IP 75001.07

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	ML26057A071 04/01/26 CN 26-011	Initial Issuance.	N/A	N/A