INSPECTION PROCEDURE 52053

INSTRUMENT COMPONENTS AND SYSTEMS - WORK OBSERVATION

PROGRAM APPLICABILITY: 2512

52053-01 INSPECTION OBJECTIVES

01.01 By direct observation and independent evaluation of work performance, work in progress, and completed work, determine whether activities relative to safety-related instrument components and systems are being accomplished in accordance with NRC requirements, SAR commitments, and licensee procedures.

01.02 Determine whether inadequacies in completed work, partially completed work, or work activities in progress associated with instrument components indicate a management control problem or generic weaknesses.

Inspection Schedule

May Be Started	Must Be Started	Must Be Completed
After work has started	Before work is 20% complete	Before work is 90% complete

For the instrument systems listed in this inspection procedure (IP), periodic inspections shall be performed on a frequency commensurate with construction progress, but in general, no less frequently than semi-annually. The frequency of inspection for Subsection 02.02a, Receiving Inspection, and Subsection 02.02b, Storage, may be reduced to annually when no significant deviations or other concerns are identified during the first two inspections of those activities.

52053-02 INSPECTION REQUIREMENTS

02.01 Inspection of Systems and Components

a. General

1. Inspection of selected components and associated items of the following instrument systems shall be accomplished by observation and evaluation of both in-process and completed work at the appropriate stage of completion for the activity to be inspected.
2. Sample selection shall be based on importance to operational safety and shall include redundant components and a diversity of components and locations.

3. Before inspection of selected items, review the specifications, drawings, work procedures, QA/QC procedures and work schedules applicable to the systems and components selected for inspection. Additionally, review the results of inspections performed by IP 52051.

b. Reactor Trip System (RTS)

1. For each periodic inspection of the activities in Section 02.02 below, select one process variable that is required to be monitored for reactor trip (SCRAM) initiation.

2. Complete the inspection requirements of Subsections 02.02a through f below for the instrument components and associated items pertaining to the RTS variable selected for that subsection. The sample shall include redundant components.

c. Engineered Safety Features Actuation System (ESFAS)

1. For each periodic inspection of the activities in Section 02.02 below, select one process variable that can actuate an engineered safety feature.

2. Complete the inspection requirements of Subsections 02.02a through f below for the components and associated items pertaining to the variable selected for that subsection. The sample shall include redundant components.

d. Safety-Related Display Instrumentation

1. For the applicable inspection activities of Section 02.02 below, select one process variable which is displayed to provide information to the reactor operator so that required manual safety actions can be taken.

2. Complete the inspection requirements of Subsections 02.02b through f for the components pertaining to the process variable selected for that subsection.

e. Instrument Air System

1. For the applicable inspection activities of Section 02.02 below, select one major component (and associated items) of the instrument air system used for safety-related control components.

2. Complete the inspection requirements of Subsections 02.02d and 02.02e for the component and associated items selected.

02.02 Inspection Activities

a. Receiving Inspection. Observe and evaluate portions of receiving inspection activities pertaining to the instrument components and associated items selected for inspection in the appropriate subsections of Section 02.01 above. Determine whether receiving inspection activities are being controlled and performed in a manner which will ensure that applicable requirements are satisfied in the following areas:

1. Identification appears on components and in receiving documents.

2. Physical condition (damage, deterioration, etc.).

3. Documentation relative to quality requirements (e.g., results of functional and qualification testing) received with components is reviewed to and meets requirements. Where qualification testing of components to be placed in a harsh environment (e.g., inside containment) is not a requirement of the specification, followup with the licensee to determine what means will be used to assure that applicable environmental qualification will be satisfied.

4. Control of nonconforming components.

5. Adequate number of qualified personnel are available to perform the receiving inspection function.

b. Storage. Observe and evaluate storage activities and conditions for six instrument components associated with the process variables/subsystems selected in the appropriate subsections of Section 02.01. Determine whether:

1. Components are stored in the proper storage level designation.

2. Components are properly identified.

3. Storage conditions (temperature, humidity, cleanliness, etc.) are controlled and monitored as specified.

4. Licensee and contractor inspection and monitoring activities are being performed in accordance with procedural requirements - if in progress during NRC inspection.

5. Nonconforming items placed in storage are identified and segregated as required.

6. In-place storage requirements are satisfied.

7. An adequate number of qualified personnel are available to perform the required storage functions.

c. In-Process Installation. Observe and evaluate portions of the in-process installation activities of six instrument components associated with the process variables/subsystems selected in the appropriate subsections of Section 02.01, above. Determine whether:

1. The latest approved revision of applicable construction specifications, drawings and/or procedures are available and used by the installers.

2. The components are as specified, such as: type, range, proof pressure/rating and material.

3. Associated mounting hardware and supports are of the type and material specified and properly located.

4. The components are installed in the proper location and orientation by qualified craft personnel using suitable equipment and tools.

5. The required component identification is properly maintained or established.

6. Licensee/contractor inspections are performed, or scheduled to be performed, before "covering up" the work to be inspected.

7. Inspection activities are timely and properly completed by qualified personnel.

8. Installed components are adequately protected from damage by adjacent construction activities.

9. Nonconformances are identified and handled in accordance with established procedures. Where corrective action is being taken, determine whether it meets the appropriate requirements.

d. Completed Work. Observe and inspect the completed installation of instrument components and associated items pertaining to the process variables or subsystems selected in Section 02.01. Determine whether:

1. Location, configuration and installation (including mounting and anchoring) are according to the latest approved design or construction specifications and drawings.

2. Specified instrument components and associated items have been used.

3. Components have been correctly and permanently identified.

4. Cleanliness requirements have been maintained or otherwise satisfied.

5. Installed equipment is adequately protected from adjacent construction activities and protective coatings, plugs, bushings, and other materials have been used as specified.

6. Instrument components and associated items, such as sensing lines and power supplies, maintain physical and electrical independence between redundant parts.

7. Safety-related protection systems and normal plant control systems are adequately separated and isolated from each other.

8. Nonconforming components or conditions have been identified and controlled in accordance with approved procedures.

9. Status of completion, maintenance, and readiness for preoperational testing is indicated or otherwise documented.

10. Adequate actions or provisions have been taken or maintained (as needed) to ensure that the validation of the environmental qualification of instrument components is maintained.

e. As-Built Verification. When instrument components and associated items, as selected in appropriate subsections of Section 02.01, are completely (or essentially) installed and inspected, select three of the latest revision (as-built, if available) of instrument design and/or installation drawings pertaining to the components selected. Also review construction specifications and other applicable installation documents as may be referenced by the drawing or otherwise applicable to the installation. Compare the actual installation with the above drawings and associated documents. For each drawing selected, determine whether several components shown on the drawing are of the type specified (function, range, accuracy, qualification, material, etc.) and whether they have been installed, located, oriented, supported, protected, etc., in accordance with this drawing.

1. Before performing the above, verify the number and status of outstanding design changes on the selected drawings or related specifications.

2. Discrepancies observed may result from in-process changes, such as those initiated in the field. If in-process changes are involved, determine whether the licensee has properly controlled and documented these changes for engineering review, approval, and subsequent incorporation into the as-built drawings.

f. Construction Testing and Calibration. Observe construction testing and calibration activities of two components associated with the process variables or subsystems selected in the subsections of Section 02.01. Determine whether:

1. The latest revision of applicable procedures and/or specifications are available at the work location and used by personnel performing the testing and calibration.

2. Properly identified, traceable, and calibrated measuring and test equipment are used.

3. Equipment or components calibrated are able to obtain the set point, degree of accuracy, and/or tolerance specified or otherwise noted.

4. Required testing and calibration results are recorded during the activity, not after the work has been completed.

5. Components are adequately identified as having been tested or calibrated.

6. Personnel performing the testing and calibration are properly qualified.

7. Test and calibration personnel adhere to any special handling or removal requirements.

02.03 Additional Inspections. Additional inspections, as determined by Regional management, may be conducted in the areas covered above when the licensee's performance is classified as Category 3 by the SALP program, or if Regional management concludes that recent findings will likely result in a SALP Category 3 rating. In these cases, particular consideration should be given to an expanded sample of items to be inspected under Sections 02.02c, 02.02d, and 02.02e.

General Guidance

a. Applicable portions of the SAR, Safety Evaluation Reports and NRR/licensee questions and answers should be reviewed during inspection preparation to determine licensee commitments relative to construction and inspection requirements. The inspector should then utilize the above information during the review of the licensee's construction specifications, drawings, work procedures, etc., before observing activities at the construction site. Refer to IP 52051, Section 03, for additional guidance, background material, and references.

b. Because the instrumentation is so important and extensive, inspection activities are to be conducted periodically. In-process installation inspections should be scheduled to match appropriate installation activities.

   1. It is expected that the scope of periodic inspections will vary with construction progress, problems encountered, etc. Additional inspections should be made when and where conditions warrant.

   2. Any installation activity that has been delayed or suspended for more than one year, or has been subject to significant procedural, design, or personnel change, should be re-evaluated immediately after resumption of the work or after the above changes have been made. Determine whether additional NRC inspection is required.

c. The inspector may not be able to observe all facets of all work activities in progress relative to instrument components and systems selected for inspection. However, portions of activities directly affecting plant safety must be covered.

d. In addition to observing whether specific instrument components and associated devices are as specified (properly identified, located, mounted, etc., as required), it is important also to ascertain whether certain components or conditions do not exist where prohibited. For example, instrument components for the engineered safety features actuation system must be located so they are not exposed to potential hazards such as high pressure piping or flammable material.

e. The inspector should use judgment during sample selection for the various instrument components and installation activities to be inspected. In general, selections should be made on the basis of importance to operational safety. Also, because of the harsher containment environment, some of the items selected should be located inside containment. The extent of inspection inside containment will vary with the type of containment. For example, more safety-related instrument components are located inside PWR and Mark III BWR containments than in Mark I and Mark II BWR containments. In general, selections should cover a diversity of components and locations. Emphasis should be placed on instrument components that perform a direct safety function.

f. Penetration assemblies, as covered by instrumentation IPs, refer to assemblies installed in a containment structure opening (sleeve, nozzle, or barrel) and not to the opening itself. The containment opening is considered to be a part of the containment structure.

g. Instrument cables and terminations are covered in IP 51063.

h. The inspector should bear in mind that the NRC's sample covers only a small portion of the instrumentation involved. Thus, substantive errors or departure from

requirements identified in NRC's sample raise the issue of whether the licensee is adequately controlling the process.

i. Findings from this inspection activity should address each functional area as being satisfactory, being unresolved and requiring resolution, or being in violation and requiring correction. When significant inadequacies are identified indicating weakness within the responsible organization, the inspector should inform cognizant Regional supervision. The issue should be addressed also at the appropriate level of licensee management.

03.01 Specific Guidance

a. Inspection Requirement 02.01b. Examples of process variables used for scram initiation include neutron flux, core coolant temperature, pressurizer pressure (PWR), reactor vessel water level (BWR), and turbine trip. Associated and interrelated devices include signal conditioning components, isolation devices, interlocks, bypasses, selector switches, resets, overrides, instrument tubing, racks, panels, and their supports.

b. Inspection Requirement 02.01c. Examples of process variables used in the engineering safety features actuation system include: containment pressure, pressurizer level and pressure (PWR), reactor coolant temperature, reactor vessel level (BWR), and high containment pressure. The SAR should include the specific variables, as well as the logic and logic devices, used in the system.

c. Inspection Requirement 02.02a. RG 1.38 (ANSI N45.2.2) or equivalent requirements are applicable here.

1. The SAR should identify and describe all instrument components which must operate in a hostile environment (e.g., high radiation, temperature, humidity) during or subsequent to an accident (e.g., loss-of-coolant, steamline break). Where environmental qualification testing, or other qualification provisions (such as seismic) are specified, receiving inspection activities should include verification that required testing has been satisfactorily completed.
2. All required documentation may not be received with the components. If not, review of this material can be performed in conjunction with IP 52055. However, the inspector should at this time determine that the licensee is following their system for identifying, controlling, and maintaining the status of the required documentation. This system should ensure eventual documentation of satisfactory completion of required testing.

d. Inspection Requirement 02.02b. RG 1.38 (ANSI N45.2.2) or equivalent storage requirements are applicable here.

e. Inspection Requirement 02.02b1. Control of storage conditions for equipment stored inplace usually requires special effort. The inspector should note whether the specified storage conditions are being maintained.

f. Inspection Requirement 02.02b2. Readily visible and permanently marked tags or other identifying scheme should be used for all nonconforming components and materials, and records relative to the nonconformance should be available at the site and readily retrievable.

g. Inspection Requirement 02.02c. Because of the uncertainties associated with scheduling of in-process installation inspections, it is expected that the scope of these periodic inspections will vary considerably. The intent is to observe the more

important installation activities for a variety of instrumentation components and associated items during the time such activities are in progress.

h. Inspection Requirement 02.02c1.

1. While reviewing construction specifications and drawings, also look for missing or inappropriate approvals.

2. Drawings and construction specifications used in the field should be reviewed periodically to ensure that the most recent approved revisions are used.

i. Inspection Requirement 02.02c3. For some of the supports and anchorages, the inspector should directly measure or otherwise independently verify that requirements pertaining to such items as location of equipment, location of supports, and bolt size are as specified.

1. During installation of equipment, anchorage holes are sometimes drilled in concrete structures. Indiscriminate cutting of reinforcing steel should not be allowed.

2. The inspector should ensure that proper welding requirements are specified and controlled. AWS D1.1, Structural Welding Code, is usually specified for welding of supports. Instrument tubing welds are generally in accordance with ASME Boiler and Pressure Vessel Code, Section III. Construction specifications and drawings should specify the welding requirements to be used.

j. Inspection Requirement 02.02c4. "Qualified craft personnel" means those employees who have achieved suitable proficiency to do their assigned tasks by appropriate training and/or previous experience and who understand the installation procedures, drawings, and specifications necessary for their work.

k. Inspection Requirement 02.02c7

1. The observation of inspection (QC) activities should include in-process and final inspections.

2. "Timely and properly completed" includes performing the proper inspections at the specified frequency and sequence.

3. Two or three QC inspectors should be interviewed to determine whether they are familiar with the quality requirements associated with the instrumentation being inspected, what construction specifications and other criteria are used to determine acceptance, how their inspection results are recorded, etc. The intent is to determine the effectiveness of instrumentation inspection personnel and management systems for indoctrination, training, and qualification of personnel.

4. RG 1.58/ANSI N45.2.6 or equivalent requirements are applicable to inspection personnel.

l. Inspection Requirement 02.02d1

1. Some instrument lines, racks, panels, and their supports, or other anchoring means are required to meet seismic requirements. (The SAR should indicate where applicable.) If specified for lines, racks, or panels selected for inspection, ascertain whether these requirements are met.

2. If the installation is different from approved drawings and specifications, determine whether the change is adequately documented and forwarded for review and approval.

m. Inspection Requirement 02.02d2. Sometimes similar instrument components are put in identical cases. The inspector should ascertain whether the various components inspected are as specified. This can be done by observing the name plate for identification numbers. For example, the model number may be the same on two components, but the ranges and identifying numbers will be different. The inspector should ascertain whether component identification is adequate. The installed instrument components should be uniquely identified on the component itself, the installation records, calibration records, and inspection records.

n. Inspection Requirement 02.02d5. Temporary protection during construction is generally required. Protection from overhead construction activities, especially welding and concrete placement, warrants special attention. Additionally, protection from inadvertent damage during plant operation and maintenance must be adequate and properly installed. Because it can be easily damaged, instrument tubing requires special attention. This is especially important when instrument tubing runs are part of a safety system that may be damaged by an event or accident for which the safety system is supposed to provide protection.

o. Inspection Requirement 02.02d6. 10 CFR 50.55a(h) requires protection systems to meet IEEE Standard 279. This standard requires channels that provide signals for the same protection function be independent and physically separated.

p. Inspection Requirement 02.02d7. Safety functions are to be independent of normal plant control functions, especially safety functions that provide protection against control malfunctions.

q. Inspection Requirement 02.02d8. The intent is to verify that nonconforming conditions are identified and result in the initiation of appropriate nonconformance documentation. Where revisions are made, verify that they are in accordance with approved corrective action dispositions.

r. Inspection Requirement 02.02e. The intent is to determine whether instrument components and associated items are being installed according to properly approved drawings and changes, such as engineering, design, field change requests, and changes to correct nonconforming conditions. As this inspection requirement is to verify "as-built" systems, a new sample should be selected if it is found that extensive rework is in progress. However, the NRC inspector should verify that the changes are properly handled in accordance with established procedures.

1. Appropriate standards can be used as a guide in this area. For example, ANSI N45.2.11 requires that where changes to previously verified designs have been made, design verification shall be required for the changes, including evaluation of the effects of those changes on the overall design. Additionally, 10 CFR 50, Appendix B, Criterion III, states in part that design and field changes shall be subject to the same design control procedures as the original design.

2. Changes may be made to instrument systems during construction that are different from the original (SAR) design. Such changes will result in the accumulation of various types of design change documents. Since these changes reflect as-built conditions, they should be adequately controlled and

available for future evaluations on the effect other design changes have on the overall design.

Additionally, the as-build process should result in proper and timely updating of the master drawings and specifications to incorporate such changes. Thus, an excessive number of accumulated changes not incorporated into the as-built records and affected analyses should be pursued. The NRC inspector should determine how the licensee ensures that the affect of each subsequent change will be adequately evaluated.

3. Obviously, the inspection requirements associated with as-build verification cannot be done until the work to be inspected is essentially complete. Consequently, this inspection requirement should be scheduled during later periodic inspections.

s. Inspection Requirement 02.02f

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

2. If calibration activities are in progress, determine whether the most recently approved calibration information is being used, and whether required procedures are being adhered to. The values of instrument ranges and zero set points are sometimes changed after receipt of the instruments at the site. The inspector should assure himself (by selective sampling) that current data are used for checking and calibrating instruments, and that these changes are within the limits of the instrument components involved.

3. As these inspection requirements cannot be done until testing and calibration activities are in progress, inspection in this area should be scheduled accordingly.

4. Final calibration and trip settings may be done later, usually during pre-operational testing or during startup preparation.

t. Inspection Requirements 02.02a4, and b5. The intent of these requirements is to verify that nonconforming conditions associated with instrument components and systems are identified by the licensee and result in the initiation of the appropriate nonconformance documentation and corrective action.

u. Inspection Requirement 02.03. The inspection requirements relative to additional inspection are intentionally general. The extent and type of additional inspection should be based primarily on the SALP Board findings.

03.02 Prevalent Problems and Concerns. The inspector should be alert to problems of a generic nature, such as:

a. Inadequate work quality because of rapid turnover of craft and/or inspection personnel.

b. Poor attitude toward quality work.

c. Lack of cooperation between craft and inspection personnel.

d. Inadequate identification and control of similar instrumentation components, especially during removal and replacement for calibration, modification, or repair.

e. Field changes made without proper authorization, and conversely, use of outdated drawings and/or installation specifications or procedures. Additionally, limits may not be set on the time or number of changes that can exist before they are incorporated into the as-built record and affected design documents. Without such controls it is difficult for the licensee to adequately evaluate the effect of successive changes on the overall design and, as a result, ensure that final as-built design records correctly represent the completed installation.

f. Unauthorized removal, modification, and replacement of instrumentation components.

g. Failure to meet separation criteria.

h. Inadequate documentation relative to status of equipment qualification.

52053-04 REFERENCES

04.01 General

10 CFR 50, Appendix A - General Design Criteria for Nuclear Power Plants, Criteria 1, 2, 4, 5, 13, 19, 20, 21, 23, and 24

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

Facility SAR, Chapters 1, 3, 4, 5, 6, 7, 8, 15, and 17, including pertinent codes and standards referenced in the SAR

04.02 NRC Regulatory Guides

Regulatory Guide 1.11 - Instrument Lines Penetrating Primary Reactor Containment

Regulatory Guide 1.28 - Quality Assurance Program Requirements (Design and Construction) (ANSI N45.2)

Regulatory Guide 1.29 - Seismic Design Classification

Regulatory Guide 1.30 - Quality Assurance Requirements for the Installation, Inspection, and Testing of Instrumentation and Electric Equipment (ANSI N45.2.4/IEEE 336)
Regulatory Guide 1.38 - Quality Assurance Requirements for Packaging, Shipping, Receiving, Storage, and Handling of Items for Water-Cooled Nuclear Power Plants (ANSI N45.2.2)

Regulatory Guide 1.39 - Housekeeping Requirements for Water-Cooled Nuclear Power Plants (ANSI N45.2.3)

Regulatory Guide 1.53 - Application of the Single-Failure Criterion to Nuclear Power Plant Protective Systems (IEEE 279 and IEEE 379)

Regulatory Guide 1.58 - Qualification of Nuclear Power Plant Inspection, Examination and Testing Personnel (ANSI N45.2.6)

Regulatory Guide 1.63 - Electric Penetration Assemblies in Containment Structures for Light-Water-Cooled Nuclear Power Plants (IEEE 317)

Regulatory Guide 1.75 - Physical Independence of Electric Systems (IEEE 384)

Regulatory Guide 1.89 - Qualification of Class 1E Equipment for Nuclear Power Plants (IEEE 323)

Regulatory Guide 1.97 - Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environ Conditions During and Following an Accident

Regulatory Guide 1.100 - Seismic Qualification of Electric Equipment for Nuclear Power Plants (IEEE 344)

Regulatory Guide 1.151 - Instrument Sensing Lines (ISA S67.02)

04.03 Instrument Society of America (ISA) Standards

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

ISA RP4.2 - Standard Control Valve Manifold Designs

ISA RP7.3 - Quality Standard for Instrument Air

ISA S7.4 - Air Pressures for Pneumatic Controllers and Transmission Lines

ISA RP25.1 - Materials for Instruments in Radiation Service

ISA S67.01 - Transducer and Transmitter Installation for Nuclear Safety Applications

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