

NRC INSPECTION MANUAL

DQASIP

INSPECTION PROCEDURE 51051

ELECTRICAL COMPONENTS AND SYSTEMS - PROCEDURE REVIEW

PROGRAM APPLICABILITY: 2512

51051-01 INSPECTION OBJECTIVES

01.01 To determine whether technical requirements contained in the facility safety analysis report (SAR) for safety-related electrical systems and components have been adequately translated into applicable construction specifications, drawings, work procedures, and instructions, and whether these documents are of sufficient detail and clarity for adequate work performance and control.

01.02 To determine whether applicable quality assurance plans, instructions, and procedures for the control and installation of safety-related electrical systems and components have been established in licensee and contractor QA manuals and whether these conform to the QA program described in the facility SAR.

01.03 To determine whether any generic problems or other weaknesses exist within the operation of organizations responsible for quality assurance programs, work specifications, and instructions for control and installation of electrical components.

Inspection Schedule

| <u>Inspection</u> | <u>May Be Started</u> | <u>Must Be Started</u> | <u>Must Be Completed</u> |
|-------------------|------------------------------------|----------------------------|--|
| Initial | Four months before work is started | Before work is started | Substantially complete before work is 20% complete |
| Followup | After work is 40% complete | After work is 50% complete | Before work is 70% complete |

51051-02 INSPECTION REQUIREMENTS

02.01 Quality Assurance Program. Review licensee and contractor commitments and procedures covering the span of documents to be prepared for assuring the quality of safety-related electrical components and systems.

- a. Complete the requirements of Inspection Procedure (IP) 35100 for each onsite organization associated with safety-related electrical components. In addition, determine whether these procedures are consistent with the QA program described in the SAR.

- b. Determine whether responsibility assignments for procedures preparation, review, and approval include groups with necessary technical expertise.
- c. Determine whether groups that review and approve quality records are required to have the requisite technical expertise to ensure that the information to be recorded meets applicable requirements.

02.02 Specific Technical Review Areas. In addition to the broad areas covered by IP 35100, determine whether procedures covering work and inspection activities in the following areas are appropriate to the activity and are technically adequate:

- a. Receiving Inspection Procedures. Receiving inspection and related procedures provide means to ensure the following:
 - 1. Received components are as specified, properly identified and controlled - or otherwise noted.
 - 2. Input from other groups or other organizations to be used during receiving inspection activities are obtained and properly utilized, such as the results of source inspections, environmental qualification tests, and other required quality tests.
 - 3. Procurement requirements, such as qualification tests (seismic, environmental, etc.), functional tests, and other quality tests (material, physical, and chemical), have been successfully completed or status of how and when such requirements will be satisfied is documented and adequately controlled.
- b. Storage Procedures. Storage procedures provide means to ensure the following:
 - 1. The proper storage environments (as specified by the construction specifications and the manufacturers) are established for the various types of electrical components and meet applicable storage classification levels regardless of the location of the stored component.
 - 2. Storage inspection procedures require initial verification of storage conditions and periodic verifications (internal preservation, motor and generator shaft rotation, insulation resistance tests, etc.) for the duration of the storage period. They must also ensure that special and inplace storage requirements are met.
- c. Work Procedures. Work procedures are established to ensure the following:
 - 1. NRC requirements and SAR commitments are properly translated into the work procedures (construction specifications, drawings, and work instructions) for adequate control and installation of electrical components and associated items. Areas to review shall include, but are not limited to, the following:
 - (a) Electrical components are identified, located, oriented, and supported as specified.
 - (b) Physical separation and independence requirements of redundant components are met.
 - 2. Interface controls are adequate when multiple contractors are involved.

3. Procedures cover special handling, installation, and maintenance requirements, including those pertaining to protection, preservation of internal cleanliness, and maintenance of component qualification requirements. For example, all covers, seals, plugs, internal preservatives, and protective coatings are left intact until installation and/or use, as appropriate.
- d. Handling Procedures. Handling procedures are established to ensure that the following handling activities and conditions are controlled and performed as required during receipt, storage, and installation of large electrical equipment:
 1. attachment points
 2. use of rigging
 3. positioning
 4. special handling requirements
 5. temporary covers
- e. Inspection Procedures. Inspection procedures are established to ensure the following:
 1. All safety-related aspects of construction specifications, drawings, and work instructions are included in the scope of planned inspections.
 2. The technical aspects of inspection requirements and acceptance criteria are sufficient to determine whether the components and their installation, testing, maintenance, and protection conform to applicable design and construction specifications.
 3. Records of initial and followup inspections include the specific results of the inspection. This should include the specific characteristics being inspected (or the actual measured values), the inspector's determination of acceptability and identification of any nonconformances found.
- f. Construction Testing Procedures. Procedures are established to ensure that special conditions of testing electrical components (prerequisites, sequence, special handling, removal, precautions, etc.) are included and described in proper detail as required to conduct and monitor the work performed, including the following:
 1. Equipment and systems to be tested and the related test procedures are properly identified and controlled. Procedures specify which construction tests are to be performed on each component requiring testing.
 2. Proper type of test equipment (range, accuracy, etc.) is specified.
 3. Type of data to be recorded and method of reporting results.
 4. Review and evaluation of test results by qualified personnel.
 5. Resolution of discrepancies.
- g. Change Control Procedures. Procedures have been established to control design and field changes and ensure the following:

1. Retrieval of voided drawings and specifications at work sites is controlled.
2. Field changes are subject to adequate design control and are incorporated into the as-built records.
3. Coordination among participating design and construction organizations is adequate.

02.03 Followup Procedure Review. When electrical components and systems are about 50% installed, review work and QA/QC procedures pertaining to installation and inspection. Review a selected sample of the procedures addressed in Sections 02.01 and 02.02 above and note significant changes made (revisions, deletions, additions, etc.). Determine whether the changes are appropriate and whether NRC requirements and licensee commitments remain in these procedures.

02.04 Additional Inspection. Additional inspections, as determined by Regional management, may be conducted in the inspection areas covered above when licensee performance is classified as Category 3 by the systematic assessment of licensee performance (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 02.01, 02.02c, and 02.02e above.

51051-03 INSPECTION GUIDANCE

General Guidance

- a. Electrical components and systems consist of those elements of the facility that are designed to supply, use, control, transform, condition or interrupt electric power. This IP applies, but is not limited, to the following safety-related electrical components and associated items: raceways, raceway hangers and other supports, switchgear, motor control centers, transformers, batteries and racks, battery chargers, inverters, motor-generator sets, circuit breakers, relays, electrical penetration assemblies, motors, motor operators on valves, electrical control panels, local cabinets, limit switches, solenoid valves, and other protective devices.
- b. Applicable portions of the SAR, Safety Evaluation Report (SER), and NRR/licensee questions and answers should be reviewed during inspection preparation. Determine specific licensee procedural and work instruction commitments relative to construction and inspection requirements for electrical components. The inspector should then utilize the above information during the review of the licensee's construction specifications, drawings, work, and inspection procedures to determine whether the above requirements are adequately translated into the appropriate documents.
- c. To be adequate, procedures control activities such as storage, installation, inspection, and testing, must contain sufficient detail to ensure that the specific work steps, which affect the functioning of the installed equipment, will be performed properly. These work steps are to be identified and adequately controlled. While reviewing procedures, the inspection should be aware of and look for inadequacies that could lead to construction deficiencies and/or indicate an inadequate management control system.
- d. It may be appropriate to complete portions of this IP in conjunction with similar requirements of IP 52051 and 51061. Where the same contractor, procedures, and personnel are utilized for activities covered by the above IPs, it is not

necessary to repeat similar inspection requirements for each of these IPs. (If so, the NRC inspection records should reflect that both electrical and instrumentation areas have been addressed.)

- e. The inspector should bear in mind that the NRC's sample covers only a small portion of the procedures involved. Thus, substantive errors or departure from requirements identified in NRC's sample raises the issue of whether the licensee is maintaining adequate control and whether the NRC inspector and/or the licensee should conduct additional examinations to determine the extent of the identified problem.
- f. Findings from this inspection activity should include 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.
- g. Penetration assemblies, as covered by electrical 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.

03.01 Specific Guidance

- a. Inspection Requirements 02.01 and 02.02. The expertise of the inspector is important for the proper completion of the inspection. The individual selected to perform 02.01 should have a general knowledge of and background in quality assurance, and the individual selected for 02.02 should be thoroughly knowledgeable about the technical requirements associated with electrical systems. One individual may perform both requirements if he/she exhibits appropriate knowledge in both areas.
- b. Inspection Requirement 02.02. For the purpose of this IP, the term "work procedures" includes construction specifications, drawings, and work instructions. (Procedures describing methods of fabrication, construction, and/or installation are sometimes called construction procedures.)
- c. Inspection Requirement 02.02a. The SAR should identify and describe all safety-related components that 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, the licensee shall establish means to ensure that the results of this testing are documented, reviewed, and determined to be acceptable. If this is not performed when components are received, the procedures should specify the organization that will be performing this review and the controls to ensure that all such documentation requirements are satisfied before the component is placed in use. This is a particularly significant area for NRC review.
- d. Inspection Requirement 02.02b
 - 1. Regulatory Guide (RG) 1.38 (ANSI N45.2.2) or equivalent requirements relative to storage are applicable here.
 - 2. Electrical components may be released for installation on the merits of certifications if the organization involved has established satisfactory program

control and audit requirements in this area (ANSI N45.2.1.3). However, certifications do not release the licensee from having other records for operation and for the life of the plant.

e. Inspection Requirement 02.02c

1. Appropriate and adequate construction specifications, procedures, and other work instructions for a particular activity are required to be approved and available before that activity is started.
2. Model number and type (only) are not considered to be adequate identification. Procedures should specify a unique identification number, along with the model number and name of manufacturer. Adequate (positive) identification is important because similar looking electrical components can be significantly different with respect to rating, output, material, etc. Safety-related electrical components should be listed in the SAR.
3. Anchor bolts holding or mounting electrical components should be of the type, size and length specified. Provisions should exist to prevent indiscriminate cutting of reinforcement steel during the drilling of anchor holes.
4. The licensee is required to meet IEEE Standard 279 and may be committed to RG 1.75, which endorses IEEE 279 with certain modifications. For example, procedures should be established to ensure that independence and separation requirements of safety-related functions from normal operating functions are met.

f. Inspection Requirement 02.02e

1. The licensee/contractor procedures involved will differ from site to site and may take various forms, such as formal procedures, instructions, checklists, drawings, etc. Review the inspection procedures and compare with the applicable requirements and construction specifications. Evaluation should indicate whether adequate quality-related inspection procedures are established and are based on appropriate criteria, and, further, whether the results of the licensee's inspection will be transmitted to responsible quality assurance and management personnel.
2. Provisions should include procedures for monitoring or surveillance of locally mounted components by inspection (QC) personnel. They should ensure that maintenance requirements while "stored in place" are satisfied and that adequate protection is provided against possible damage from adjacent construction activities, including construction traffic. (Where protective means used during construction may affect proper operation, provisions should be provided for timely removal.)

g. Inspection Requirement 02.02f. This area is to be inspected by NRC inspectors who are knowledgeable in the area of electrical systems in general and testing in particular.

1. The SAR should include or reference general testing requirements, and work procedures should provide detailed instructions. In addition, the QA manual should include general surveillance procedures relative to testing, i.e., activities should be monitored (inspected or audited, as appropriate) in accordance with established procedures.

These procedures should include verification of the following:

- (a) Data sheets (or equivalent) are being used as specified.
 - (b) Testing procedures are current and approved for use; ranges, accuracies, etc., are specified.
 - (c) Testing techniques are appropriate for the component to be tested.
 - (d) Controls are included for removal and handling of components during testing activities.
2. Test data/records should include:
- (a) Specific identify of the component tested.
 - (b) The specific identity of the measuring and testing equipment used to perform the testing.
 - (c) Identity of the technician performing the test and date of test.
 - (d) Approval signature of responsible individual.
3. Certificates of calibration should be available at the site for test instruments used to perform tests. These certificates should show that the standards used to establish the accuracy of the test instruments are traceable to a nationally recognized standard. Procedures should require that the performance and accuracy of test equipment are demonstrated by periodic checking.
4. This item does not include preoperational testing. Construction testing generally verifies that certain components perform as intended, but it is not a test of system capability.
5. Typical tests which may be required include insulation resistance, continuity, battery load, and breaker trips.
6. The licensee is required to provide (in the SAR) information relative to protection of the safety-related portions of the onsite AC power system from certain fault conditions. Significant aspects of this protection include manual and automatic interconnections between buses, buses to loads, and buses to supplies, and capability of components to withstand anticipated fault conditions; interconnections between safety-related and non-safety-related buses; circuit protection network (e.g., selective trip) including setting criteria, protection for overvoltage, undervoltage, and frequency; and load-shedding devices.

One method to determine the adequacy of these protective systems and devices includes a relay coordination study. The inspector should determine whether provisions are established to ensure that adequate procedures are available for this activity. Means to verify that the results of this study are evaluated and determined to be acceptable by qualified personnel should be included also.

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

- a. Adequate procedures or other means have not been established to ensure and document that all safety-related electrical components and subsystems have met applicable acceptance criteria or are nonconforming in specific areas.
- b. Inspection procedures do not include adequate inspection requirements and acceptance criteria.
- c. Inadequate means to control location and status of electrical components; especially during removal for repair, modification, or replacement.
- d. Inadequate procedures to control the evaluation, approval, and use of field changes. (Means should be established also by the licensee/contractor to ensure that only the latest approved field changes and other revisions or changes are being used for construction and inspection activities.)

51051-04 REFERENCES

04.01 General

10 CFR 50, Appendix A - General Design Criteria for Nuclear Power Plants, Criteria 1, 2, 3, 4, 5, 17, 18, 19, 20, 21, 22, 23, 24, 34, 35, 38, 39, 40, and 46

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

Facility SAR, Chapters 1, 3, 4, 5, 6, 7, 8, 9 and 17, including pertinent codes and standards referenced in the SAR

04.02 NRC Regulatory Guides

Regulatory Guide 1.6 - Independence Between Redundant Standby (Onsite) Power Sources and Between Their Distribution Systems

Regulatory Guide 1.26 - Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants

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 1.32 - Criteria for Safety-Related Electric Power Systems for Nuclear Power Plants (IEEE 308)

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 1.40 - Qualification Tests of Continuous-Duty Motors Installed Inside the Containment of Water-Cooled Nuclear Power Plants (IEEE 334)

Regulatory Guide 1.47 - Bypassed and Inoperable Status Indication for Nuclear Power Plant Safety Systems

Regulatory Guide 1.53 - Application of the Single-Failure Criterion to Nuclear Power Plant Protection 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 1.73 - Qualification Tests of Electric Valve Operators Installed Inside the Containment of Nuclear Power Plants

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

Regulatory Guide 1.81 - Shared Emergency and Shutdown Electric Systems for Multi-Unit Nuclear Power Plants

Regulatory Guide 1.88 - Collection, Storage, and Maintenance of Nuclear Power Plant Quality Assurance Records (ANSI N45.2.9)

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

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

Regulatory Guide 1.106 - Thermal Overload Protection for Electric Motors on Motor-Operated Valves

Regulatory Guide 1.123 - Quality Assurance Requirements for Control of Procurement of Items and Services for Nuclear Power Plants (ANSI N45.2.13)

Regulatory Guide 1.128 - Installation Design and Installation of Large Lead Storage Batteries for Nuclear Power Plants (IEEE 484)

Regulatory Guide 1.129 - Maintenance, Testing, and Replacement of Large Lead Storage Batteries for Nuclear Power Plants (IEEE 484)

Regulatory Guide 1.144 - Auditing of Quality Assurance Programs for Nuclear Power Plants

Regulatory Guide 1.146 - Qualification of Quality Assurance Program Audit Personnel for Nuclear Power Plants (ANSI N45.2.23)

END