
INSPECTION PROCEDURE 88137

ELECTRICAL CABLE

PROGRAM APPLICABILITY: 2630, 2694, 2696

Note the term licensee refers to licensees, holders of certificates of compliance, applicants for a license, contractors, subcontractors, vendors, and other employers subject to NRC authority.

88137-01 INSPECTION OBJECTIVES

01.01 To determine whether technical requirements detailed or referenced in the facility's licensing documents (i.e., Construction Authorization Request (CAR), License Application, Safety Analysis Report (SAR) or Quality Assurance Plan (QAP)) associated with Items Relied on for Safety (IROFS) electric power, control, and data cable, terminations, and associated items have been adequately addressed in the licensee and/or contractor 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 (QA) plans, instructions, and procedures for IROFS electric power, control, and data cable, terminations, and associated items have been established in licensee and contractor QA/Quality Control (QC) manuals and whether these conform to the QA program described in the approved QAP.

01.03 To determine, through direct observation and independent evaluation of work, whether work and inspection performance relative to IROFS electric power, control, and data cable systems are being controlled and accomplished in accordance with approved specifications, drawings, and procedures.

01.04 To determine whether the licensee is adequately implementing the QA program associated with electrical cable, including preparing, reviewing, and maintaining a system of quality records; whether the records reflect work accomplishment consistent with the Nuclear Regulatory Commission's (NRC) requirements, licensing document statements, and the QAP.

01.05 To determine, by direct observation and independent evaluation, whether the records indicate any potentially generic problems, management control inadequacies, or other weaknesses that could have safety significance.

01.06 To determine proper receipt, handling and storage procedures are implemented.

88137-02 INSPECTION REQUIREMENTS

02.01 Procedure Review. Review the construction specifications and procedures on electrical systems and ascertain whether the specified technical requirements conform to the statements contained in the licensing documents. Determine whether the commitments in the approved QAP are being implemented, as follows:

- a. Adequate QA audit procedures have been established for this activity in accordance with the approved QAP including: (1) scope and frequency of audits; (2) audit criteria; (3) reporting requirements; (4) follow-up action; and (5) resolution of findings by those audited.
- b. Provisions have been made to ensure that those engaged in conducting audits are qualified and have been adequately trained. Provisions must ensure that auditors do not have direct responsibility in the areas being audited.
- c. Means have been established to verify that technical requirements, acceptance criteria, installation methods, and required documentation are specified in design and procurement documents.
- d. Means have been established to verify that any significant design and field changes from approved drawings are adequately controlled and processed commensurate with the original design.
- e. Provisions have been established to ensure that quality requirements are met and that those deviations, non-conformances, and defects are adequately documented and processed through to complete resolution.
- f. Provisions have been established to ensure that construction drawings incorporate the most recent design requirements. (Note: Field change requests should be reviewed to determine whether there may be a potential generic issue associated with the design process, or whether there are field conditions that have not been adequately anticipated during the design process.)
- g. The licensee has established a program for ensuring that all craft, nondestructive examination, and inspection personnel associated with the installation of electrical cable have been trained, or otherwise qualified for the work procedures involved.

02.02 Specific Technical Review Areas. Determine whether procedures covering work and inspection activities in the following areas are appropriate to the activity and are technically adequate:

- a. Receipt Inspection Procedures (IPs). Receipt 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 used, 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, certificate of conformance, 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 for the duration of the storage period. They must also ensure that special and in-place storage requirements are met.
- c. Work Procedures. Work procedures are established to ensure the following:
1. NRC requirements and licensing document commitments are properly translated into the work procedures (construction specifications, drawings, and work instructions) for adequate control and installation of electrical cable and associated items. Areas to review should include, but are not limited to, the following:
 - (a) Raceway completion (edge softeners, bushings, supports, grounding, routing location, pull fittings, pull cords, identification, sharp edges, etc) and condition (free of debris) before use.
 - (b) Cable/ busway type and size.
 - (c) Cable temperature (if stored in cold weather).
 - (d) Cable splices (where allowed).
 - (e) Pulling attachments, lubricating compounds, and tension (including calibration of tension devices).
 - (f) Bending radius (during and after installation).

- (g) Cable identification/ color coding/ imprinted information.
 - (h) Cable routing.
 - (i) Separation and independence.
 - (j) Segregation (power, control, data instrument).
 - (k) Cable supports (grips).
 - (l) Handling of cable and termination materials to ensure protection from damage and contamination (includes protection of cable ends from moisture).
 - (m) Protection of cables from adjacent construction activities.
 - (n) Hold points.
 - (o) Termination activities such as:
 - (1) Application of materials (lugs, tapes, stress cones, connectors, punch down blocks, terminal blocks, etc.).
 - (2) Use of calibrated torque wrenches and crimping tools.
 - (3) Termination preparation procedures (insulation stripping, compression tools, labeling, polishing (fiber optics)).
 - (p) Raceway loading.
 - (q) Fire barriers and seals as required.
 - (r) Less than maximum tensile force applied pulling (cable tensile rating).
 - (s) Shield grounding (as applicable).
2. Interface controls are adequate when multiple contractors are involved.
- d. Inspection Procedures. Inspection procedures have been established to ensure the following:
- 1. Positive identification of the cable system and/or activity to be inspected and the specific inspection method(s) to be used.
 - 2. All safety-related aspects of construction specifications, drawings, and work instructions are included in the scope of planned inspections.

3. The technical aspects of inspection requirements and acceptance criteria are sufficient to determine whether installation, testing, maintenance, and protection conform to applicable design and construction specifications.
 4. Records of initial and follow-up inspections include the specific results of the inspection. This should include the specific characteristics being inspected (or the actual measured values), the inspectors' determination of acceptability, and identification of any non-conformances found.
- e. Construction Testing Procedures Inspection Guidance. Procedures for IROFS cable system and component testing provide means to ensure that:
1. IROFS Cable systems and components 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.
 6. Special conditions or testing, prerequisites, sequence, precautions, etc., and acceptance criteria are specified and meet requirements.
- f. Personnel Qualifications Verification. A program has been established for ensuring that all craft, examination and inspection personnel associated with IROFS electric cable systems are trained and qualified to perform their assigned duties. The program includes:
1. The proper use of installation equipment (tension devices, pulling compounds, etc.).
 2. The proper handling, supporting and protection of cables and cable segments stored in place.
 3. Approved methods for cable end protection.
 4. Identification of requirements for the installation of safety-related cables.
 5. Approved methods for cable termination and splices.
 6. Approved methods for fiber optic/data cable termination and inspection.

- g. Change-Control Procedures. Procedures have been established to control design and field changes for cable systems 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 Follow-up Procedure Review. When cable and terminations are in process of being 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 regulatory requirements and licensee commitments remain in these procedures.

02.04 Follow-up Inspection. Follow-up inspections may be conducted in the inspection areas covered above if Regional management concludes that recent findings warrant additional attention. In these cases, particular consideration should be given to an expanded sample of items to be inspected under Sections 02.01, 02.02.c, and 02.02.d, above.

02.05 Inspection of Cable Systems and Components.

a. General.

1. Inspection of selected cable systems and terminations shall be accomplished by observation and evaluations of both in-process and completed work at the appropriate stage of completion for the activity to be inspected.
2. When selecting cables, terminations, and associated items for inspection, consider their importance to operational safety, diversity of function and location in the facility. The selection shall emphasize cables and associated items that perform a direct safety function.

Power, control, and data cables (fiber optic, communications, coax, twisted, multi-conductor, twisted, and shielded) and their terminations selected as samples will be of varying capacities. The cables and terminations should be from a variety of locations, uses and types e.g.: (1) large motors; (2) diesel generators; (3) motor-operated valves; (4) solenoid valves; (5) control centers; (6) control room panels and cabinets; (7) local panels and cabinets; (8) coaxial and triaxial connectors; (9) fiber optic connectors; and (10) stress-cone terminations.

02.06 Inspection Activities.

- a. Receipt Inspection. Observe and evaluate portions of receipt inspection activities pertaining to the electric power, control, data cables and associated items selected for inspection. Determine whether receipt inspection activities are being controlled and performed in accordance with the licensee's commitments and procedures. Sample the following areas:
1. Components and receiving documents are properly identified.
 2. Physical conditions (damage, deterioration, etc.) are documented.
 3. Documentation related to quality requirements (e.g., results of functional and qualification testing) received with cables and associated items is reviewed and meets the requirements. Where qualification testing of cables and associated items to be placed in a harsh environment (e.g., inside containment) is not a requirement of the specification, determine what means will be used to ensure that applicable environmental qualification will be satisfied.
 4. Control of nonconforming cables and associated items, is conducted in accordance with applicable procedures and meets requirements.
 5. Adequately, qualified personnel are available to perform the receipt inspection function.
- b. Storage. Observe and evaluate storage activities and conditions for the selected components. Determine whether:
1. Electric power, control, data cables and associated items are stored in the proper storage level designation.
 2. Cables, busways and associated items are properly identified.
 3. Storage conditions (temperature, humidity, cleanliness, etc.) and requirements are controlled and monitored as directed by the applicable procedures and by the manufacturer's specifications.
 4. Licensee and contractor inspection and monitoring activities are being performed in accordance with procedural requirements, if in progress during NRC inspection.
 5. Nonconforming cables and associated items placed in storage are identified and/or segregated as required.
 6. In-place storage requirements are satisfied.

7. Adequately qualified personnel are available to perform the required storage functions.
- c. In-Process Installation. Observe and evaluate in-process installation to determine if the licensee is following their procedures pertaining to the components and associated items selected in the appropriate subsections of Section 02.01. Sample a representative number of the following attributes and determine whether:
1. The latest approved revision of applicable construction specifications, drawings, and/or construction procedures are available and used by the installers. (Verify later that pull card data are consistent with the latest cable tabulation sheets.)
 2. Cables, busways, associated materials, and pulling compounds are as specified.
 3. Pulling attachments and tensions used are acceptable.
 4. Cable temperature is acceptable before handling and installation.
 5. Raceway completion and condition are adequate before cable is installed.
 6. Cables are protected from sharp edges, hostile environments, and adjacent construction activities (especially welding and cutting activities).
 7. Cable routing is correct.
 8. Separation criteria for physical independence are maintained.
 9. Segregation is maintained (e.g. power, control, and instrument).
 10. Cable identification is preserved.
 11. Proper bending radius is maintained (during and after installation).
 12. Less than maximum tensile force is applied for pulling based on cable tensile rating
 13. Cable and other conductor supports are provided.
 14. Cable entry to terminal point is acceptable.
 15. Shields are grounded per construction drawings and specifications.
 16. Torque wrenches and crimping tools are in proper working order and properly calibrated.

17. Jumpers are controlled.
 18. Terminations are of the correct type and properly located.
 19. Shield terminations for I&C cables are installed in accordance with the appropriate detail drawing requirements, using the appropriate lead connections.
 20. Shields for cables rated 5KV and above are terminated with appropriate materials, including voltage stress relief devices that do not compromise the integrity of the cable's shield or insulation system, in accordance with project design standards.
 21. All cable shields are grounded appropriately per the project document requirements.
 22. Tightness of connections is acceptable.
 23. Appropriate scaffolding, walkways, and climbing aids are used in lieu of cable trays, conduits, etc.
 24. Cabinets, control centers, cable trays, junction boxes, etc. are maintained free of debris (periodically cleaned).
 25. Coiled cables are properly secured (i.e., not draped from cable trays, lying on floor, coil supported by single tie wire, etc.).
 26. Un-terminated cable ends or un-terminated instrument cable shielding are properly protected (i.e., moisture protection), if required.
 27. Specified fire barriers, compartment boundary seals, and fire-retardant materials are being installed or applied, where specified.
 28. Electricians are properly qualified.
 29. QC inspectors are properly qualified and are present and performing their assigned tasks, when required, during handling and installation activities.
 30. Non-conformances are identified and handled in accordance with procedures, including adequate justification for use-as-is disposition.
 31. Installation and inspection activities are being documented during the activity.
- d. Completed Work. Observe, inspect, and evaluate the completed installation of cables and associated selected items. Sample a representative number of the following attributes and determine whether:

1. Busway, cable, wire, and termination materials (lugs, tapes, stress cones, splice kits, connectors, terminal blocks, etc.) are as specified.
2. Cable routing is as specified on latest approved drawings.
3. Cable identification is preserved and located where specified.
4. Bending radius is as required.
5. Required separation criteria for physical independence are maintained.
6. Segregation is maintained (power, control, and instrument).
7. There is no evidence of damage to cable.
8. Terminations are properly located and made (entry, tightness, etc.) and are of the correct type.
9. Cable supports are provided and are adequate.
10. Cables are protected from sharp edges, hostile environments, and adjacent construction activities (welding, etc.).
11. Cable tray, conduit, etc. are adequately protected and not being used as ladders, walkways, etc.
12. Clearances between cable and adjacent components such as piping, ducts, and supports are as specified.
13. Cabinets, panels, cable trays, junction boxes, etc. are maintained free of debris (periodically cleaned).
14. Specified fire barriers, compartment boundary seals and fire-retardant materials are installed or applied, where required.
15. Specified inspections are made by qualified personnel.
16. Documentation of completed installation and inspection activities is properly completed, in a timely manner.
17. Nonconforming conditions are identified and handled in accordance with approved procedures, including adequate justification for use-as-is disposition.
18. Conductive grease and electrical contact lubricant (NO-OX-ID) has been applied to power connectors as required by construction drawings and specifications.

- e. As-Built Verification. When electrical power, control, data cables and associated items, as selected in appropriate subsections of Section 02.01, are completely (or essentially) installed and inspected, the latest revisions (as-built, if available) of installation drawings pertaining to the cables and items selected for verification. Review construction specifications and other applicable work instructions referenced by the drawings. Compare the actual installation with the above drawings and associated documents.
 - 1. Before performing the above, verify the number and status of outstanding design changes on the selected drawings and 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 final as-built drawings.

- f. Cable Testing. Observe the following cable-testing activities applicable for the sample selected in the appropriate subsections of Section 02.01, or equivalent sample.
 - 1. High potential tests on high-voltage power cables and 4160-volt cables.
 - 2. Insulation resistance tests.
 - 3. Continuity tests.
 - 4. Connector termination opacity test on...after cable.
 - 5. Connection resistance testing on DC battery connectors.
 - 6. Fiber optic cable testing
 - (a) Acceptance testing prior to installation
 - (b) Pre-installation: continuity test
 - (c) Post-installation: continuity test
 - 7. Determine whether the following requirements are being met for the above tests (as applicable):
 - (a) Use of and compliance with the proper procedure
 - (b) Calibration of the test equipment is current and test personnel qualified to use the equipment.

- (c) Results are properly and accurately recorded.
- (d) Test results are within specifications limits or discrepancies are identified for resolution.

02.07 Scope Expansion/Additional Inspections. Additional inspections may be conducted in the inspection areas covered above if Regional management concludes that recent findings regarding the licensee warrant such actions. In these cases, inspectors should carefully consider expanding the sample of items to be inspected under Subsections 02.02.e, and f, above.

02.08 Record Control and Review. Review licensee and contractor requirements covering the control of records for IROFS electrical cable, terminations and associated items.

- a. Ensure requirements determine who prepares each quality-related record, who reviews the records for accuracy, and who ensures that the recorded information meets requirements.
- b. Evaluate the information obtained above and determine whether the established record-management system satisfies licensing document commitments.

02.09 Work and Inspection Records. Review and evaluate pertinent quality records in the areas listed below. Determine whether: (1) adequate preparation; control, review, and evaluation of these records have been made; (2) they reflect that appropriate requirements have been met; and (3) the system of records is functioning properly. The following sample sizes are considered to be the minimum for the project, but can be reduced if necessary, with Branch Chief approval. The selection should include records associated with: (1) various safety related power, control, signal, data and instrument cables (including thermocouple wire); (2) cable connectors, splices, and support grips; (3) terminations, lugs, NO-OX-ID compound tapes, and pulling compounds; and (4) fire barriers, seals and retardants. The records selected shall represent a diversity of cable and associated items and include some cable and terminations located inside the process facility.

- a. Receipt Inspection Records. Select records applicable to the receipt of lots or shipments.
- b. Storage Records. Select records applicable to the storage, and storage inspection of lots or groups of cables and associated items, as determined in Table A.
- c. Installation Records. Select records applicable to the installation and inspection of several cables and associated terminations for risk important components.
- d. Cable-Testing Records. Select records applicable to the testing of cables, several of which shall be located inside process buildings.

- e. Raceway Loading Records. Review and evaluate records applicable to raceway loading for cable trays and cable conduits.
- f. Personnel Qualification Records. Review and evaluate records applicable to the qualification and training of inspectors and craftsmen.
- g. Change-Control Records. Review and evaluate design field change records.

02.10 Nonconformance and Deviation Reports. For the inspection, review and evaluate several reports applicable to non-conformances or deviations in cables, terminations and cable system installation. Determine whether:

- a. Records are legible, complete, and promptly reviewed by qualified personnel.
- b. Reporting requirements of 10 CFR Part 21 were recognized during evaluation and appropriate action was taken where necessary.
- c. Records have been routinely processed, evaluated in a timely manner and controlled through established channels, for resolution of the root-cause as well as the immediate problem.
- d. Records are properly identified and stored, indicate current status, and can be retrieved in a reasonable time.
- e. Non-conformance reports include the status of corrective action or resolution, and adequate justification is provided for use-as-is disposition.

02.11 Audit Records. For each inspection, review and evaluate licensee and electrical contractor audit records in general. Review and evaluate in detail two recent audits (one licensee audit and one electrical contractor audit).

- a. For audit records in general, determine whether:
 - 1. Audits have been performed in accordance with the schedule and functional areas established in the audit plan.
 - 2. All elements of the QA program applicable to cable systems are being audited periodically.
 - 3. Auditing organizations and personnel are independent of the work being audited.
 - 4. Licensee is informed of the results of the electrical contractor(s) audits.
- b. For the specific audit records, determine whether:
 - 1. Audit records are sufficient to verify that the intended purpose and scope of the audits were achieved.

2. Audit findings have been reported in sufficient detail to permit a meaningful assessment by those responsible for corrective action, final disposition, and trending.
3. The licensee and contractor have taken proper and timely follow-up action on those matters in need of correction.

88137-03 INSPECTION GUIDANCE

03.01 General Guidance.

- a. The term “cable” includes all conductors such as fiber optics wires, cables, and busbars. The term “termination” refers to all electric-conductor terminations such as lugs, splices, connectors, and terminal strips that directly contribute to the electrical continuity of the circuit. Terminations also include potheads, bushing, stress cones, taping, compounds, and other devices or techniques that directly contribute to the continuity of the electrical insulation system. This IP applies to all IROFS electric power, control and instrument cables, terminations, splices, fire barriers and seals.
- b. Determine specific licensee procedural and work-instruction commitments relative to construction and inspection (QC) requirements for electric cables and terminations. The inspector should then utilize the above information during review of the licensee’s construction specifications, drawings, work, and inspection procedures to determine whether the licensing document requirements are adequately translated into the appropriate documents.
- c. To be adequate, procedure control activities such as receipt, storage, installation, inspection, calibration and testing should 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, be aware of, and look for, inadequacies that could lead to construction deficiencies and/or indicate an inadequate management-control system.
- d. The inspector should remember that the procedures selected for detailed NRC review cover only a representative sample of the procedures involved. Thus, substantive errors, or departure from requirements identified in NRC’s sample, raise the issue of whether the NRC inspector and/or the licensee should conduct additional examinations, to determine the extent of the identified problem.
- e. 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 Management. The issue should be addressed also at the appropriate level of licensee management.

03.02 Specific Guidance.

Note: The numbering of the guidance below refers to specific subsections of 02, above.

- a. 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.)
- b. Inspection Requirement 02.02.a.
 1. Verify that requirements contained in the approved quality assurance program document, or other applicable licensing commitments, have been adequately translated into the licensee’s receipt inspection procedures, including provisions assuring that:
 - (a) Cable, busways (power, control, and data), and termination materials are in conformance with purchase specifications including special requirements.
 - (b) Adequate marking and identification are provided.
 - (c) As-received cleanliness and protection are adequate.
 - (d) Receiving inspection reports are complete.
 - (e) Control and disposition of non-conforming items are adequate.
 2. The licensee should identify and describe all safety-related cables and associated items that must operate in a hostile environment (e.g., high radiation, temperature, humidity) during or subsequent to an accident. Where environmental qualification testing or other qualification provisions are specified, the licensee shall establish means to ensure that the results of this testing are documented, reviewed, and determined to be acceptable. This is a particularly significant area for NRC review.
 3. Inputs from other groups or other organizations (e.g., source inspection results or other required quality tests) to be used during receiving inspection activities are properly used.
 4. Procurement requirements such as qualification tests, certificate of conformance, 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. Fire barriers and cable-penetration seals may require

qualification. The tests and criteria can be found in the American Society of Testing and Materials (ASTM) E 814 and/or American National Standards Institute/Underwriters Laboratory Inc. (ANSI/UL 1479.)

5. Samples of received electric power, control, and data cable, termination material and related items are subjected to detailed dimensional checks or other inspection to ensure conformance with the purchase specification.
- c. Inspection Requirement 02.02.b.
1. Special storage requirements are typically specified by the manufacturer or an industry standard, committed to by the licensee. The requirements should include such things as taping or sealing cable ends, controlling material and cable or cable reel identification, maintaining proper ambient temperature, separation from nonconforming items, and placement on dunnage.
 2. Cable and termination materials 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 facility.
- d. Inspection Requirements 02.02.c. Appropriate and adequate construction specifications and other work instructions for a particular activity should be approved and available before that activity is started.
- e. Inspection Requirement 02.02.c.1.(a). The procedure should require QC acceptance of raceway installations before routing cable.
- f. Inspection Requirement 02.02.c.1.(b). Some method or procedure should be established to assure that the cable is properly qualified for the environment in which it is to be located.
- g. Inspection Requirement 02.02.c.1.(d). Splices in certain locations, such as raceways, may not be allowed. Refer to RG 1.75 and licensee commitments.
- h. Inspection Requirement 02.02.c.1.(i). Refer to the following for information pertaining to separation and independence: 10 CFR 50, Appendix A, General Design Criteria 5, 17, 21, and 22; RG 1.75; and the Institute of Electrical and Electronic Engineers (IEEE) Standard (Std)384.
- i. Inspection Requirement 02.02.c.1.(p). Procedures should require verification that loading requirements (both thermal and mass) are not exceeded in final cable routings in trays, busways, conduits, etc. This verification should include review of actual cable routing, cable routing records, and design calculations.

- j. Inspection Requirement 02.02.c.1.(g). Only specified materials should be used for fire barriers, fire stops, and fire retardants; and installation should be in accordance with approved procedures.

- k. Inspection Requirement 02.02.d.
 - 1. The licensee or contractor procedures involved will differ from site to site and may take various forms, such as formal procedures, instructions, checklists, drawings, etc. Review the IPs and compare with the applicable requirements and construction specifications. Evaluation should indicate whether adequate quality-related IPs are established and are based on appropriate criteria, and further, whether the results of the licensee's inspection will be transmitted to responsible QA and management personnel.
 - 2. Provisions should include procedures for monitoring or surveillance of installed cables by inspection (QC) personnel. They should ensure that maintenance requirements 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.)

- l. Inspection Requirement 02.02.e. This item does not include preoperational testing. Construction testing generally verifies that certain components pass specific tests as required but is not a test of system capability, especially systems that include non-electrical equipment. The intent of this requirement is to determine whether adequate QA procedures have been established to assure that the required testing is satisfactorily completed and corrective action, if required, is properly performed. Procedures for cable system and component testing provide means to ensure that:
 - 1. Required construction testing is controlled and performed, as specified, using qualified personnel.
 - 2. Cable systems and components to be tested are properly identified, along with tests to be conducted.
 - 3. Proper type of test equipment (range, accuracy, calibration, etc.) is specified.
 - 4. Test parameters (e.g., voltage level) are according to standards and manufacturer's recommendations.
 - 5. Special conditions of testing, prerequisites, sequence, precautions, etc., and acceptance criteria, are specified and meet requirements.
 - 6. Type of data to be recorded and method of reporting results are specified.

7. Qualified personnel evaluate test results.
8. Discrepancies are resolved.

03.03 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 assure and document that all QA IROFS systems have met applicable criteria, or to specifically document non-conformances.
- b. IPs does not include adequate inspection requirements and acceptance criteria.
- c. Inadequate means to control location and status of electric cable and components - especially during removal for repair or replacement.
- d. Inadequate procedures to control the evaluation, approval and use of field changes. (The licensee or contractor also should establish means to assure that only the latest approved field changes and other revisions or changes are being used for installation and inspection activities.)

88137-04 RESOURCE ESTIMATE

Procedures should be reviewed (inspection requirements 02.01 thru 02.04) before work is started, and then work observation (inspection requirements 02.05 thru 02.07) should be started while installation is in progress. Work observation should be completed before work is mostly complete. Records should be reviewed (inspection requirements 02.08 thru 02.11) for the first time following installation start, and a second review should be conducted before cable installation is complete.

Depending on the complexity of the system, this IP is expected to take, on the average, 80 hours for each review of licensee/contractor activities, for a complex system. This IP should be scheduled quarterly during construction activities for completion.

88137-05 REFERENCES

National Electrical Manufacturers Association NEMA WC 55-1992, "Instrumentation Cables and Thermocouple Wire."

National Electrical Manufacturers Association, NEMA WC 57-1995, "Standard (Std) for Control Cables."

National Electrical Manufacturers Association, NEMA WC 70-1999, "Nonshielded Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy."

National Electrical Manufacturers Association, NEMA WC 71-1999, "Standard for Nonshielded Cables Rated 2001-5000 Volts for Use in the Distribution of Electric Energy."

National Electrical Manufacturers Association, NEMA WC 74-2000, "5-46 kV Shielded Power Cable for Use in the Transmission & Distribution of Electric Energy."

National Electrical Manufacturers Association, NEMA WC 53-2000, "Standard Test Methods for Extruded Dielectric Power, Control, Instrumentation and Portable Cables for Test."

National Fire Protection Association 801, "Standard for Fire Protection For Facilities Handling Radioactive Materials."

Institute of Electrical and Electronic Engineers Std 383-2003, "Qualifying Class 1E Electric Cables and Field Splices for Nuclear Power Generating Stations."

Institute of Electrical and Electronic Engineers Std 384-1992, "IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits –Description."

Institute of Electrical and Electronic Engineers Std 690-1984, "IEEE Standard for the Design and Installation of Cable Systems for Class 1E Circuits in Nuclear Power Generating Stations."

Institute of Electrical and Electronic Engineers Std 400-2001, "IEEE Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems."

Institute of Electrical and Electronic Engineers Std 1143-1994, "IEEE Guide of Shielding Practice for Low Voltage Cables."

Association of Edison Illuminating Companies CS8-00, "Specification for Extruded Dielectric Shielded Power Cables Rated 5 through 46 kV."

Electrical Training Course for U.S. Nuclear Regulatory Commission Inspectors, Unit III, "Design and Installation of Electrical Cable Systems in Nuclear Power Plant."

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END

ATTACHMENT 1

Revision History for IP 88137

Commitment Tracking Number	Issue Date	Description of Change	Training Needed	Training Completion Date	Comment Resolution Accession Number
N/A	04/01/10 CN 10-010	IP 88137 is a newly issued procedure. Issued for the fuel facility construction inspection program to improve effectiveness and efficiency by incorporating and consolidating vendor inspection requirements.	None	N/A	ML080701181