INSPECTION PROCEDURE 51063

ELECTRIC CABLE - WORK OBSERVATION

PROGRAM APPLICABILITY: 2512

51063-01 INSPECTION OBJECTIVES

By direct observation and independent evaluation of work performance, work in progress, and completed work, determine whether:

01.01 Activities relative to safety-related electric cable systems are being controlled and accomplished in accordance with NRC requirements, safety analysis report (SAR) commitments and licensee procedures.

01.02 Inadequacies in completed work, partially completed work, or work activities in progress indicate management control problems 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 cable and associated items applicable to 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 Sections 02.02a and 02.02b may be reduced to annually when no significant deviations or other concerns are identified during the first two inspections of those activities.

51063-02 INSPECTION REQUIREMENTS

02.01 Sample Selection

a. General

1. Inspections shall be accomplished by observations of both in-process and completed work at the appropriate stage of completion for the cables and terminations selected.

2. When selecting cables, terminations, and associated items for inspection, consider their importance to operational safety, diversity of function and location in the plant. Some cables within containment shall be included. The selection shall emphasize cables and associated items that perform a direct safety function. The intent is to provide reasonable assurance that the objectives of this IP are met. Refer to Section 03.01 of IP 51061 for a listing of electric cables and associated items applicable to this IP.

   Power and control cables and their terminations selected as samples will be of varying capacities. The cables and terminations will be from a variety of locations, uses and types: large motors, diesel generators, motor-operated valves, solenoid valves, control centers, control room panels and cabinets, local panels and cabinets, coaxial and triaxial connectors, and stress cone terminations.

3. The following sample sizes are considered to be minimum. The actual samples selected shall be of sufficient size to determine whether the activities are being accomplished in accordance with established requirements. The terminations selected may be associated with the cables selected and inspected with the cables.

b. Receiving Inspection Sample. For each periodic inspection of the activities in Section 02.02a, below, select a sample consisting of:

   1. Two or more lots or shipments of cable.

   2. Two or more lots or shipments of termination material, e.g., kits, lugs, tape, termination blocks, etc.

c. Storage Inspection Sample. For each periodic inspection of the activities in Section 02.02b, below, select a sample consisting of:

   1. One lot or group of cables stored together or three individual cables stored in warehouses or protected areas.

   2. Three cables or cable segments stored in place.

   3. Three lots of termination materials stored in warehouses or in place.

d. In-Process Inspection Sample. For each periodic inspection of the activities in Section 02.02c, below, select a sample consisting of:

   1. Two cable installations.

   2. Four power cable terminations involving a stress cone, ten control cable terminations, and twenty instrument cable terminations.

e. Completed Work Inspection Sample. For each periodic inspection of the activities in Section 02.02d, below, select a sample consisting of:

   1. Ten cables.

   2. Twenty terminations.

f. As-Built Verification Sample. For each periodic inspection of the activities in Section 02.02e, below, select a sample consisting of:

1. Three cables.

2. Six power cable terminations, or ten control terminations, or twenty instrument cable terminations.

g. Cable Testing Inspection Sample. For each periodic inspection of the activities in Section 02.02f, below, select a sample consisting of one cable under test.

02.02 Inspection Activities

a. Receiving Inspection. Observe and evaluate portions of receiving inspection activities pertaining to the electric cables and associated items selected for inspection in Section 02.01b, 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 the cable and associated items and in the receiving documents.

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

3. Documentation relative to quality requirements (e.g., results of functional and qualification testing) received with cables and associated items is reviewed to and meets 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, follow up with the licensee to determine what means will be used to ensure that applicable environmental qualification will be satisfied.

4. Control of nonconforming cables and associated items.

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

b. Storage. Observe and evaluate storage activities and conditions for the inspection sample selected in section 02.01c, above. Determine whether:

1. Electric cables and associated items are stored in the proper storage level designation.

2. Cables and associated items 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 cables and associated items placed in storage are identified and/or 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 for the inspection sample selected in Section 02.01d, above. Determine whether:

1. The latest approved revision of applicable construction specifications, drawings, pull cards and procedures are available and used by the installers. (Verify later that pull card data are consistent with the latest cable tabulation sheets.)

2. Cables, 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 (power, control, instrument).

10. Cable identification is preserved.

11. Proper bending radius is maintained (during and after installation).

12. Cable and other conductor supports are provided.

13. Cable entry to terminal point is acceptable.

14. Torque wrenches and crimping tools are in proper working order and properly calibrated.

15. Jumpers are controlled.

16. Terminations are of the correct type and properly located.

17. Tightness of connections is acceptable.

18. Appropriate scaffolding, walkways, and climbing aids are used in lieu of cable trays, conduits, etc.

19. Cabinets, control centers, cable trays, junction boxes, etc. are maintained free of debris (periodically cleaned).

20. Coiled cables are properly secured (i.e., not draped from cable trays, lying on floor, coil supported by single tie wire, etc.).

21. Unterminated cable ends are properly protected (i.e., moisture protection), if required.

22. Specified fire barriers, compartment boundary seals, and fire-retardant materials are being installed or applied, where specified.

23. Electricians are adequately qualified by an effective indoctrination and training program.

24. QC inspectors are properly qualified and are present and performing their assigned tasks, when required, during handling and installation activities.

25. Nonconformances are identified and handled in accordance with procedures, including adequate justification for use-as-is disposition.

26. Installation and inspection activities are being documented during the activity.

d. Completed Work. Observe and inspect the completed cable and termination installations for the sample selected in section 02.01e, above. Determine whether applicable requirements are met in the following areas:

1. 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, 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 are properly and timely completed.

17. Nonconforming conditions are identified and handled in accordance with approved procedures, including adequate justification for use-as-is disposition.

e. As-Built Verification

1. When the electric cables and associated items selected in Section 02.01f, above, are completely (or essentially) installed and inspected, obtain the latest revision (as-built, if available) installation drawings.

(a) Compare the actual installation of the cables selected with the drawings.

(b) Select several additional cables from each drawing and determine whether they have been installed in accordance with the drawing and are of the type specified.

2. Before performing items (a) and (b), above, verify the number and status of outstanding design changes on the selected drawings (or related specifications).

3. 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

1. Observe the following cable testing applicable for the sample selected in Section 02.01g, above, or equivalent sample.

(a) High potential tests on high-voltage power cables and 4160-volt cables.

(b) Insulation resistance tests.

(c) Continuity tests.

2. 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 are 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.

02.03 Raceway Loading. For inspections conducted during the later stages of construction, determine whether loading requirements are met for the following raceways (or equivalent sample) based on cable count, licensee and contractor inspection records, and review of design documents:

a. Three power cable trays from each division (thermal and mass loadings).

b. Three power cable conduits from each division (thermal and mass loadings).

c. Two control cable trays from each division (mass loading).

d. Two control cable conduits from each division (mass loading).

e. Two instrument cable trays (mass loading).

f. Two instrument cable conduits (mass loading).

02.04 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.

51063-03 INSPECTION GUIDANCE

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 use 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 51061, Section 03, for additional guidance, background material and references.

b. Because cable systems are important and extensive, inspection activities are to be conducted periodically. The intent of this procedure is to perform some inspection during various installation activities. Additional inspections may be conducted if conditions warrant and if deemed appropriate by regional management. For example, cable installation activities should be reassessed if the activities have been subjected to significant procedural, design, or personnel changes.

c. The inspector should review work procedures, quality records, and IP 51061 inspection reports relating to work in progress. The licensee's documentation will include QC inspection reports, design change documentation, and nonconformance reports. Licensee and contractor procedures for a particular activity should be approved and available for use before that activity is started.

d. The inspector may not be able to observe all facets of work activities in progress relative to cable pulling and terminations. However, portions of important activities involving several crews or different shifts should be observed directly.

e. The inspector should bear in mind that the NRC's sample covers only a very small portion of the cables and terminations 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.

f. 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 02.01a2. The samples selected shall include a variety of cables and terminations from engineered safety features systems such as reactor protection, emergency core cooling, containment spray, and containment fan cooler.

b. Inspection Requirement 02.01b. The samples for each periodic inspection may be the same type of item but with another variable changed. For example, two lots of high-voltage power cable supplied by different manufacturers may be selected for one inspection and then control cable supplied by two manufacturers may be selected for the next. The same procedure may be used with the termination material samples.

c. Inspection Requirement 02.01d

1. The type and/or location of the cable selected for each periodic inspection should be different.

2. The number and types of terminations selected will be contingent upon their complexity and length of time required to complete the termination.

d. Inspection Requirement 02.01g. One cable test will be witnessed. The type of cable and test selected for each periodic inspection will be varied.

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

f. Inspection Requirement 02.02b5. Readily visible and permanently marked tags or some other identifying scheme are to 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 02.02b6

1. Control of storage conditions for items stored in place usually requires special effort. The inspector should note whether the specified storage conditions are being maintained.

2. Determine whether licensee and contractor personnel are conducting periodic inspections of stored items in accordance with procedures. This may be done by conversing with inspection personnel, observing activities in the storage area, and reviewing records at the storage areas.

h. Inspection Requirement 02.02c1. The intent is to determine whether cables and terminations are being installed according to properly approved drawings, either the original design drawings or properly approved revisions. If revisions are in process, determine that these changes are properly handled and controlled in accordance with established procedures.

1. Drawings and construction specifications used in the field should be reviewed periodically to assure that the most recently approved revisions are used.

2. Any changes in design, installation or materials should result in generation of the appropriate documentation. Changes found under this requirement should be used for inspection of records under IP 51065.

i. Inspection Requirement 02.02c2

1. It should be possible to readily determine from cable identification whether the specified type and size of cable is being used. Site records should include for all Class 1E electric systems, the type and size of cable specified as well as the cable installed.

2. Lubricants (pulling compounds) should be compatible with cable jackets, insulations, and the environment. They should not set up or harden during installation.

j. Inspection Requirement 02.02c3. Caution should be observed to prevent the pulling tensions on cables from exceeding allowable limits. The maximum pulling force of cables shall be in accordance with manufacturers' recommendations or with approved design calculations. The inspector should be alert for the following situations:

1. A dynamometer should be used on runs when pulling-force calculations indicate allowable stresses may be exceeded. Pulling-force calculations should include consideration of such parameters as friction and sidewall load (pressure) as well as the usual fill, configuration, and bending considerations.

2. Consideration should be given to the preferred pulling direction to minimize the cable pulling tension.

3. Pulling winches and other necessary equipment should be of adequate capacity to ensure a steady continuous pull on the cable.

4. The pulling cable used may be rope of hemp, wire, or synthetic fiber. Bare wire rope should not be used as a pulling cable in nonmetallic or aluminum conduits which contain bends.

5. A swivel should be attached between the pulling eye and the pulling cable. All sharp points of the hardware that connect the cable to the eye, such as bolts and cable clamps, should be thoroughly taped to prevent such projections from catching at conduit ends or damaging conduits or cables.

6. A suitable flexible feeder tube or cable protector may be used to protect and guide the cable from the cable reel into the raceway. The radius of the feeder tube or cable protector should be as large as possible but not less than the minimum bending radius of the cable. If a feeder tube or cable protector is not used, the cable should be guided into the raceway by hand.

k. Inspection Requirement 02.02c4. Before a cable is pulled, the cable reel should be stored at the temperature and for the length of time recommended by the cable manufacturer. The minimum temperature at which cable can be pulled will depend on the type of insulation and sheath material.

l. Inspection Requirement 02.02c5. Before pulling cables, the raceways should be thoroughly inspected and cleaned.

m. Inspection Requirement 02.02c7. Cable should be traced from termination to termination to determine whether routing, protection, separation, etc., meet

applicable requirements of cable routing drawings and specifications. (The actual installation also should agree with the electrical contractor's pull cards because these cards usually represent the as-installed routing.)

n. Inspection Requirement 02.02c8. Refer to the following for information pertaining to separation and physical independence: 10 CFR 50, Appendix A, Criteria 5, 17, 21 and 22; RG 1.75; and IEEE Standard 384.

1. Redundant circuit cables shall not cross each other or in any other way compromise the established separation distance criteria. In the event that separation distance is compromised, an approved barrier shall be installed. A cable for one redundant circuit shall not terminate on a terminal block for the opposite redundant cable.

   When specified separation criteria for physical independence are not met, the SAR may allow the licensee to evaluate acceptability for specific deviations. If such provisions exist in the SAR and evaluation of deviations has not been completed or identified, controls in this area should be considered deficient and not in compliance with the SAR. Generally, the SAR will require NRR approval of deviations from the original separation criteria when the licensee demonstrates the effects of lesser separation to be acceptable.

2. Vendor-supplied equipment also must meet separation criteria and requires specific consideration. The licensee or contractor must inspect separation of internal wiring of panels and cabinets before the wiring becomes inaccessible.

o. Inspection Requirement 02.02c9. The facility SAR should specify segregation requirements.

1. High- and medium-voltage power cables are to be installed in raceways separate from low-voltage power and control cables and low-level signal cables.

2. In vertically stacked trays, the highest voltage cables should be in the highest position in the tray stack.

p. Inspection Requirement 02.02c10. Class 1E cable must be marked to ensure positive identification. This marking should include separation channel identification and cable-unique numbers. Such identification shall be at locations that are easily visible from normal and easily accessible vantage points. Identification should be readily apparent during installation and after installation.

q. Inspection Requirement 02.02c12. The National Electrical Code lists several suitable methods of supporting conductors in vertical raceways. These include clamping by insulation wedges in conduit, inserting at intervals boxes with installed insulating supports, and deflecting the cables a minimum of 90 degrees in junction boxes. The Code also provides for maximum spacing intervals for the supports. Support recommendations for special cables such as armor, shielded, coaxial, etc. should be obtained from the manufacturer. For any method of conductor support, installation should not damage the insulation or result in significant indentation.

1. In vertical trays, lashing the cable to the tray rungs every 2 to 4 feet will normally provide support for most types of cables. When split blocks are used, they should be spaced 6 to 8 feet apart. (Generally, lashing the cable to tray rungs is not considered in seismic design analysis. It does not replace required seismic supports.) Cable also should be lashed at support points

and at intermediate locations to keep all cable completely within the side rails.

2. Conductors within switchgear, panels, etc. should be installed and supported in a way to eliminate stress from the terminating point.

3. The weight of a vertical cable should not be supported by the terminals to which it is connected.

r. Inspection Requirement 02.02c14. Various tools are used to facilitate cable terminations and connections. These include mechanical cutters and indenters for small conductors and lugs and hydraulic cutters and compression tools for large conductors, connectors, and lugs. These items should be part of a controlled tool inventory which identifies the tools subject to a calibration program.

s. Inspection Requirement 02.02c16

1. For high- and medium-voltage cables, each type of insulation and jacketing material requires specific tapes and other materials that are suitable for use when constructing splice joints and terminations.

2. General techniques appear to be similar. However, details can vary with changes of a conductor's rated voltage, type of insulation and sheath materials, grounding or shielding provisions, system operating characteristics, or with installation factors such as indoor, hazardous, or corrosive environments. The NRC inspector should refer to specific step-by-step instructions and drawings when witnessing termination installations.

3. Splices in certain locations, such as raceways, may not be allowed. Refer to the appropriate NRC requirements and licensee commitments, such as RG 1.75.

4. When terminating shielded cables, the shield must be removed carefully and completely and proper stress control materials or devices used. Manufacturers' instructions and recommendations as to the termination of shielded cables should be followed in detail.

t. Inspection Requirement 02.02c21. After pulling, the ends of cables located outdoors or in moist areas should be sealed.

u. Inspection Requirement 02.02c24. The intent is to determine the effectiveness of inspection personnel. The total number of personnel involved and their educational qualifications are not as significant as their effectiveness.

1. Observe QC inspection activities in progress, and determine whether procedures are being properly performed at the specified frequency and whether records are being generated during inspection activities.

2. Several QC inspectors should be interviewed to determine whether they are familiar with the quality requirements associated with the activity being inspected, what construction specifications or other criteria are used to determine acceptance, how their inspection results are recorded, etc.

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

v. Inspection Requirement 02.02c25. The effectiveness of the management control system in this area can be determined, in part, by how promptly the root cause of nonconforming activities are identified and corrected. (Is management involved? Visible to construction personnel? Aggressively supports proper corrective action? Acts promptly to correct inadequate performance?) The inspector should determine whether established procedures are being followed relative to identification, evaluation, and corrective action of nonconforming activities and components, including activities to preclude repetition.

w. Inspection Requirement 02.02d. Most of the specific guidance items above for Section 02.02c also pertain to 02.02d.

x. Inspection Requirement 02.02e. The intent is to determine whether electric cable and associated items have been installed according to properly approved drawings and changes such as engineering, design, and 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. Numerous changes may be made to electric cable 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 and/or marked-up drawings. Because these changes reflect as-built conditions, they should be adequately controlled so they will be readily available. They must be used with affected original design documents during future evaluations on the effect other design changes have on the overall design. Additionally, the as-built process should result in proper and timely updating of the original or 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. Because the inspection requirements associated with as-built verification cannot be done until the work to be inspected is essentially completed, this inspection requirement should be scheduled during later periodic inspections.

y. Inspection Requirement 02.02f

1. Testing of cables after installation includes terminations, connectors, and splices before ultimate connection to equipment.

2. A satisfactory method of determining whether the cable insulation of newly installed cables has been damaged may require both low voltage (megger) dielectric testing and high potential (hi-pot) dielectric testing. Newly installed cables should be given a dielectric test preferably at "higher than normal use" values. Pertinent portions of the SAR should be consulted to determine

licensee commitments in this area. The inspector should consider the following:

(a) Continuity checks should be performed on all cables before testing or terminating.

(b) Before testing, cables should be isolated from all power sources and any other equipment which may be damaged; safety precautions should be observed.

(c) All medium-voltage (i.e., 601 to 15000 V) cables should be dc tested (low voltage) before their initial connection to equipment. The insulation resistance (megger) test voltage should be 2500-5000 volts (as specified by applicable electrical specifications, procedures or IEEE standards). The tests should measure the insulation resistance between any possible combination of conductors in the same circuit and between each conductor and station ground.

(d) In addition to the preconnection insulation resistance test, there may be a need for a more stringent voltage test. If so, cables should be tested (dc hi-pot test) in accordance with the IPCEA standards for voltage tests.

(e) All low-voltage (i.e., 600 V or less) power and control cables should be tested as outlined above, except that test voltages of 500 to 1000 volts should be used as specified by the applicable electrical specifications, procedures, or IEEE standards.

(f) Insulation resistance measurements (megger) should be performed on signal cables, if circuit performance is dependent on insulation resistance. The signal cable manufacturer's literature should be consulted for test voltages.

z. Inspection Requirement 02.03. Where fire stops, fire barriers, fire retardant coatings, etc. are used, additional cable derating may be required.

aa. Inspection Requirements 02.04. The inspection requirements relative to additional inspections are intentionally general. The extent and type of additional inspection should be based primarily on the SALP program findings.

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

a. Licensee or contractor does not make an adequate determination that cable and associated items meet required specifications at the time of site receipt or shortly thereafter (during initial storage). One area of current concern is whether the cable successfully passed required qualification tests for the environment in which it is to be used.

b. Design and field changes have been made and approved, but the changes have not reached, in a timely manner, those doing and inspecting the work.

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.

c. Lack of precautions to prevent cable damage during handling and installation. One concern relates to cable on reels. The damage usually results when cable reels are forcefully rolled into each other in such a way that the cable on one reel is damaged by the frame of another reel. (Cable reels on a truck, for example, should be fastened securely to prevent rolling.)

d. During cable installation in trays, cable jackets have been damaged by pulling crews walking on installed cable.

e. Cables not protected during adjacent welding activities.

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

g. Poor attitude toward quality work.

h. Lack of cooperation between craft and inspection personnel.

i. Field changes are made without proper authorization.

j. Required separation criteria for physical independence are not met and sometimes not identified by QC inspection personnel.

51063-04 REFERENCES

10 CFR 50, Appendix A, General Design Criteria for Nuclear Power Plants, Criteria 1, 2, 3, 4, 5, 17, 18, 19, 20, 22, 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, 6, 7, 8, 9, and 17, including pertinent codes and standards referenced in these chapters

National Electrical Code, NFPA 70-1978 (ANSI)

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

Regulatory Guide 1.32, "Criteria for Safety-Related Electric Power Systems for Nuclear Power Generating 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"

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 1.64, "Quality Assurance Requirements for the Design of Nuclear Power Plants"

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

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

Regulatory Guide 1.89, "Qualifications of Class 1E Equipment for Nuclear Power Plants" (IEEE 323)

END