TENNESSEE VALLEY AUTHORITY

SEQUOYAH NUCLEAR PLANT

MODIFICATIONS AND ADDITIONS INSTRUCTION

M&AI-6

INSTALLATION OF CONDUIT AND JUNCTION BOXES

Revision 6

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The last page of this instruction is number: 22

SEQUOYAH NUCLEAR PLANT

PLANT INSTRUCTION REVISION LOG

MODIFICATIONS AND ADDITIONS INSTRUCTION M&AI-6

REVISION LEVEL	Date Approved	Pages Affected	REASON FOR REVISION (INCLUDE COMMITMENTS AND ALL ICF FORM NUMBERS)
0	11/08/79	All	
1	11/19/81	18	
2	07/08/82	Revised: 12,13,16, 17; Added:19, 20,21	
3	11/29/82	11	
4	08/17/83	15,17,18	
5	09/25/85	All	
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1.0 GENERAL

1.1 Scope

This instruction provides guidelines for field installation of all electrical conduit systems for Sequoyah Nuclear Plant. Procedures provided by the contractor shall be followed for those portions of the design under separate contract. Vendor installed conduit falls outside the scope of this instruction. Any questions or concerns as to the use and application of this procedure shall be addressed to the cognizant engineer.

1.2 References

The latest revision of the documents listed below in effect at the time of installation shall be followed.

DS-E1.2.2 - Electrical Equipment Nameplates - Sequoyah and Subsequent Nuclear Plants

SD-E13.1.1 - Expansion/Contraction Joint for Embedded Aluminum, Intermediate Metal, and Steel Conduit

SD-E13.1.2 - Expansion and Deflection Fitting for Embedded Aluminum, Intermediate Metal, and Steel Conduit

SD-E13.6.3 - Conduit Boxes, Frames, and Covers

SD-E13.6.5 - Conduit Box Connection (Watertight)

SD-E15.3.4 - Conduit, Cable, and Wire Identification Tags (Sequoyah Nuclear Plant and All Subsequent Nuclear Projects)

G-32 - Bolt anchors set in hardened concrete

G-40 - Installing Electrical Conduit Systems and Conduit Boxes

47A056 Series Drawings - Seismic Support Conduit Drawings

Where specific instructions are lacking on design documents, Office of Engineering (OE) shall be requested to provide the necessary information on a case-by-case basis.

1.3 Definitions

Class 1E. The safety classification of the electric equipment and systems that are essential to emergency reactor shutdown, containment isolation, reactor core cooling, and containment and reactor heat removal, or otherwise are essential in preventing significant release of radioactive material to the environment.

1.4 Prerequisites

1.4.1 Radiation Work Permit (RWP) Areas

For installation work that tranverses a radiation area requiring a RWP contact Health Physics (HP). Contact ALARA to evaluate ALARA preplanning requirements.

CATEGORY I STRUCTURES

The Category I structures other than the primary containment structures are listed as follows:

1. Auxiliary-Control Building
   a. Control Bay Portion
   b. Additional Equipment Building
   c. Waste Packaging Area
   d. Condensate Demineralizer Waste Evaporator Building Portion
2. Condenser Cooling Water Pumping Station and Retaining Walls
3. Auxiliary Essential Raw Cooling Water Structures
4. Diesel-Generator Buildings
5. CO_2 Storage Building
6. Refueling Water Tanks and Pipe Tunnels
7. Class IE Electrical Systems Structures
8. East and West Steam Valve Rooms
9. Essential Raw Cooling Water Pumping Station and Access Cells
10. ERCW Discharge Box

2.0 MATERIALS

2.1 General

Materials used in the original installation of the electrical conduit systems and conduit boxes shall be new; shall meet the requirements of an approved recognized standard; and shall be compatible with the environment and configuration in which they are to be located.

2.2 Major or Special Materials

Major materials and those of a special nature used in the installation shall be designated on OE detailed design drawings or standard drawings, described in the electrical bill of material, and requisitioned by personnel in the EEB Equipment Requisition Group.

2.0 MATERIALS (continued)

2.3 Miscellaneous Materials

These materials are of a standard nature and shall be purchased directly by the field. Included are conduit bodies and covers, conduit fittings, joints and terminations, flexible conduit, and other minor materials necessary for installation but not requisitioned by OE personnel.

Metallic conduit bodies, fittings, joints, couplings, and terminations (except for slip joints as permitted in section 3.2.3.7) shall be of the threaded type and approved for use with conduit systems which serve as the equipment grounding conductor.

Liquid tight flexible metal conduit with a synthetic jacket (similar to the Anaconda Company, Brass Division, "Sealtite type UA") and connectors (similar to Ideal Industries, Incorporated, "Vap-Oil-Tight" series) shall be used for flexible conduit applications. Other equivalent vendors are O. Z. Gedney's type UAG and American Flexible Conduit Co.'s AmerTite Bonded (UL).

It shall be permissible to use the following as an alternative. Pressure tight stainless steel flexible conduit with a convolute core structure (similar to Servicair Company type SS60 series or American Boa, Incorporated, type NB1-0 series) and connector fittings of compatible materials (available from the respective supplier) may be used for flexible conduit applications inside primary containment and may be used for applications outside containment. Radiation resistant elastomer seals, such as silicon rubber, ethylene-propylene rubber, or other TVA approved material, shall be used with the connector fittings inside containment to maintain leak-tightness. Either the above type conduit or the type with a closed weave single braid stainless steel jacket (similar to Servicair Company type SS63 series or American Boa, Incorporated, type NB1-a series) may be used. The stainless steel flexible conduit and appropriate connector fittings shall be installed in accordance with the manufacturer's instructions.

If additional restrictions or limitations are required on miscellaneous materials to be purchased, these shall be so stated on the design drawings.

3.0 INSTALLATION

3.1 General

3.1.1 Installation of conduit, boxes, fittings, and accessories shall conform to the latest edition of the National Electric Code (NEC) and the drawings and standards described in section 1.2. In the event of a conflict between design drawings and NEC, the drawings shall govern.

3.0 INSTALLATION (continued)

3.1.2 If interferences occur, the cognizant engineer shall be notified for resolution by established procedures, with OE.

3.1.3 If it should become necessary to make a field change, every precaution shall be taken to ensure that the change is coordinated with other conduit work, structural work, plumbing work, piping, and architectural features; and information shall be obtained regarding the completed conduit run to ensure there will be no interferences when the conduit run is extended. A complete record of any such change shall be sent to OE per AI-19, part IV.

3.1.4 Unless specifically called for on the detailed design drawings, structural steel or reinforcing bars shall not be cut or drilled in seismic structures without permission from OE.

3.1.5 Materials shall be properly protected while in storage.

3.2 Conduit

3.2.1 General

3.2.1.1 Conduit exposed to the weather, embedded in concrete, or in wet locations shall be sloped for drainage, if possible. Embedded conduit systems shall be rigidly supported and braced in position to avoid settling and to prevent the formation of pockets if heavy batches of concrete are placed on the conduit.

3.2.1.2 To terminate a conduit beneath a switchboard or at an apparatus, a bushing, chase nipple, or condulet shall be used unless otherwise defined on design drawings. In certain instances where it may be impossible to install a conduit bushing or chase nipple at each termination point of a conduit because of limited space, the conduit end should be smoothed of all burrs and obstructions (beveled or rounded to approximately a 1/16" radius) so that cables will not be damaged.

3.2.1.3 After a conduit run is completed, it should be inspected and cleaned out. Compressed air shall be used in blowing out any accumulation of trapped liquid. This pertains to areas in an outside environment or wet locations only.

3.2.1.4 Conduit identification tagging shall accompany the conduit installation. The tag shall be as designated on the conduit design drawings and/or conduit schedule and in accordance with electrical standard drawing SD-E15.3.4.

3.0 INSTALLATION (continued):

3.2.1.4 (continued)

In yard areas where conduits are exposed to the natural environment, the conduit tag may be of 1/2-inch minimum-width stainless steel ribbon material.

3.2.2 Exposed Conduit

3.2.2.1 Exposed conduits shall be run in straight lines parallel to column lines, walls, or beams. Where conduits are grouped, the bends and fittings shall be installed to present an orderly appearance. Unnecessary bending or crossing shall be avoided.

3.2.2.2 Supports for straight runs of exposed rigid metal conduit shall not exceed the maximum distances listed in the NEC for systems made up with threaded couplings.

In seismic Category I structures, exposed conduits shall be supported as defined on design documents. (Ref 47A056 series drawings). This also needs to be referenced for conduit runs not mounted directly to walls or ceilings.

3.2.2.3 Malleable iron 1-hole pipe straps, clamps, U-bolts, hangers, or close bracket-type pipe supports may be used. One pipe backspacer shall be used for the 1-hole malleable iron pipe supports. Care shall be taken to assure the 1-hole prestrap assembly has been properly tightened to prohibit slippage or movement.

3.2.2.4 In nonseismic structures, galvanized steel members may be drilled or punched for conduit supporting bolts provided the holes are immediately coated with zinc-dust zinc-oxide paint (Federal Specification TT-P-641d) and galvanized or rust-resisting bolts are used. Threaded stud bolts, Nelson stud anchors, or equivalent, may be used instead of drilling or punching steel members.

3.2.2.5 In moist locations and in locations where appearance is of importance, precautions shall be taken, such as by use of strap-type wrenches or equivalent means, to avoid injuring the galvanized coating or surface of stainless steel conduit.

3.0 INSTALLATION (continued)

3.2.3 Embedded Conduit

3.2.3.1 A minimum 2-inch clearance shall be maintained between conduits embedded in poured concrete walls or floor slabs, except that detailed design dimensions shall be adhered to adjacent to conduit terminations, etc., where area is restricted.

Conduits and conduit sleeves, when located in a bank or group form in a wall pour, may be adjusted as required to line up the bottom outside edge of the smaller sized conduit with the bottom outside edge of the largest conduit in the group in order to continue the group run on a common exposed support.

Likewise, grouped conduits in a floor or ceiling slab may be shifted enough to take advantage of a common exposed wall or column support. Embedded conduit runs shall terminate within ±1/2 the nominal diameter of the conduit being installed, unless the above exceptions apply.

Conduits embedded in switchyards and transformer yards shall maintain a 1-inch minimum clearance between conduits.

3.2.3.2 In switchyards and transformer yards all single conduit or groups of conduits shall be encased in concrete with the outer coverage a minimum of 2-1/2 inches.

3.2.3.3 Where aluminum or nonmetallic plastic conduits are embedded in concrete, extreme care shall be taken to anchor this conduit so that it will not be floated when the concrete is placed.

3.2.3.4 Embedded conduit shall be rigidly supported to withstand concrete vibrators or batches of mass concrete placements.

3.2.3.5 In supporting embedded steel, aluminum or plastic conduit, extreme care shall be taken to avoid damage to the surface of the conduit if welding or brazing is used near the conduit. In no case shall the conduit be welded or brazed to the support. Nonmetallic plastic conduit in duct runs shall not be supported by reinforcing steel forming closed magnetic loops; preformed plastic spacers shall be used.

3.0 INSTALLATION (continued):

3.2.3.6 Concrete curbs shall be provided where specified on design project drawings.

3.2.3.7 Slip joints shall be installed where embedded conduits cross expansion or contraction joints in accordance with electrical standard drawing SD-E1.3.1, as defined and located on design drawings of the respective design project.

3.2.3.8 Wherever slip joints are used, suitable bonding in accordance with electrical standard drawing SD-E13.1.1 shall be provided around the joint to ensure a continuous ground circuit. Where use of expansion and deflection-type fittings (see SD-E13.1.1) are defined in design drawings, the manufacturer's instructions shall be followed in making ground connections.

3.2.3.9 All embedded conduits turning out of poured concrete shall terminate with a standard coupling flush with the surface of concrete unless otherwise specified on design drawings. Couplings shall be plugged pending exposed extension.

3.2.3.10 In duct runs the metallic conduit shall be grounded at each manhole or handhole by brazing the ground wire to the top of the conduit coupling or by using grounding bushings.

3.2.4 Rigid Metal Conduit

3.2.4.1 General

a. Metallic conduit systems, whether embedded or exposed, shall be installed in accordance with those portions of the NEC ensuring that the systems will be adequately grounded and electrically continuous to function as the equipment grounding conductor. When boxes do not have threaded hubs or bosses (or as in section 3.3.1.3), conduits shall be securely fastened to boxes and cabinets, each with a locknut and a bushing inside the box and a locknut outside. The conduits shall be of such length that when the bushings are screwed tight against the ends of the conduits, no appreciable space will be left between the bushings and the locknuts. The locknuts shall be sufficiently tightened against the box to avoid hotspots or sparking during fault conditions, but without deforming the box.

3.0 INSTALLATION (continued)

3.2.4.1 (continued)

b. Running threads shall not be used on rigid metal conduit for connection at couplings.

c. Welded or brazed grounds on conduit runs shall be done on the top of couplings only, and extreme care shall be taken to avoid injury to the inner surface of the conduit by excessive heating. The welded or brazed joint shall be coated with asphaltum (e.g., Koppers Bitumastic Jet-Set Primer), or equivalent.

d. Standard-radius field bends or manufacturer's elbows are generally to be used for metal conduits, but special long-radius bends shall be used wherever specifically called for on the design drawings. The long-radius bends shall have radii as large as physical conditions will permit, but never less than seven times the nominal diameter of the conduit. Short radius elbows shall be used only where specifically called for on the drawings.

e. Field bends for rigid metal conduit shall be made such that the internal diameter of the conduit is not materially changed and the protective coating on the inside and the outside of the conduit is not injured. The bends shall be free of kinks, nicks, necking, splits, indentations, or flattened surfaces. Heat shall not be applied in making any metallic conduit bend. (See section 3.2.5.4 for field bends for nonmetallic conduit.)

f. Motor control centers with conduits that are greater than 3 feet in length require conduit supports as shown on mechanical seismic support drawings (47A series) for conduit or as specified on structural steel drawings. For these longer runs, a length of flexible conduit is required as noted on conduit drawings.

The individual panels in some boards have large openings on the top that do not permit the use of locknuts for attaching conduits to the panel. P1001A or P1000 Unistrut bolted to panel structural members may be used as a point of attachment for conduits.

3.0 INSTALLATION (continued):

3.2.4.1 (continued)

Conduits entering the top of electrical boards in Class I buildings shall not be installed in a manner that results in a rigid tie between the top of the board and the cable trays or the building. The materials, bolts, etc., used shall conform to the requirements listed on mechanical drawings 47A056-1.

3.2.4.2 Steel Conduit and Intermediate Metal Conduit (IMC)

Steel and IMC conduit joints and connections shall be made water tight and rustproof by means of the application of a thread compound which will not insulate the joint. Each field-cut thread shall be cleaned to remove the cutting oil before the compound is applied. An electrically conductive and antiseize compound for metal surfaces such as Kopr-Shield (available from Thomas and Betts Company), shall be applied to only the male conduit threads to prevent the obstruction of the raceway.

3.2.4.3 Aluminum Conduit

a. Rigid aluminum conduit installed outdoors or in wet locations shall preferably be provided with aluminum fittings and supports. Galvanized fittings and supports may be used in special cases. Care must be taken to prevent the contact of aluminum conduit with corrosive materials in places where moisture can accumulate.

b. Strap-type wrenches or equivalent shall be used to avoid scratching and gouging the aluminum conduit.

c. Aluminum conduit joints at couplings or fittings tend to seize unless treated. Use a commerical compound such as Aloca Thread Lubricant. Satisfactory mixtures such as zinc dust and vaseline (50-50 by weight), or a heavy cup grease containing 25 percent graphite may be used. Aluminum threads shall not be coated with red lead or other lead compounds.

3.0 INSTALLATION (continued)

d. Standard benders may be used for aluminum conduit except that EMT benders shall be used for conduit 1 inch and below. Use an EMT bender 1/4-inch larger than the conduit size, i.e., 1-1/4 inches for 1-inch rigid, 1 inch for 3/4-inch rigid.

e. Aluminum conduit shall be grounded by inserting a galvanized steel coupling in the run, brazing the ground wire to the top of the coupling, and carefully coating the joint with asphaltum. The design drawings will show grounding when used for a single phase of a 3-phase circuit.

f. Rigid steel conduit and associated fittings may be used as a substitute for aluminum conduit and fittings, with the exception of those used for tie-in purposes.

g. Aluminum conduit, conduit fittings, or components shall not be used inside the reactor building primary containment.

3.2.5 Plastic Conduit

NOTE: Plastic conduit containing chlorides is not allowed in the powerhouse.

3.2.5.1 To prevent warping during storage, plastic conduit shall be stacked on a smooth, flat surface in an area not directly exposed to the rays of the sun. Spacers of 1-inch soft wood, approximately 2 feet apart, should be used between layers of conduit. Manufacturer's shipping bundles may also be used for direct storage.

3.2.5.2 Where plastic conduits are encased in concrete (such as in duct banks between buildings), the conduits shall be anchored with preformed plastic spacers prior to concrete placement. The conduits and spacers shall be located as shown on design drawings.

3.0 INSTALLATION (continued)

3.2.5.3 Plastic conduit may be cut with a hacksaw. After cutting, ends shall be trimmed and rough edges smoothed. Area to be solvent welded (outside of conduit and inside of coupling or fitting) shall be free from dust, dirt, grease, and moisture. Use methyl ethyl ketone (MEK) for cleaning. Polyvinyl chloride (PVC) solvent shall be brushed liberally on the end of the conduit and inside the fitting or coupling when making a joint. After fitting has been pushed on, it should be twisted one-fourth turn to spread the solvent evenly. Continue to hold joint for 15 seconds so that conduit does not push out of fitting.

3.2.5.4 Bends for nonmetallic conduit are usually purchased as required for the conduit system but for special cases may be made in the field. Extreme caution should be observed when any source of heat is near plastic conduit. Field bending can be accomplished by the use of a "hot air-cold air" blower; a hand-type dryer is recommended by the manufacturers.

3.2.6 Flexible Conduit

Flexible conduit shall be used to interface the rigid conduit system with electric equipment and components that rotate, vibrate are subject to thermal movement, or where seismic considerations must be taken into account as determined by cognizant engineer. Flexible conduit shall allow for relative displacement of Class 1E equipment or components and a rigid conduit system. After installation, the flexible conduit should not be tight or stretched between couplings or fittings. Fittings used on flexible conduit shall be installed per the manufacturers' instructions.

3.2.6.1 Flexible conduit connected to floor mounted equipment shall be installed in accordance with the requirements stated in Figure 1.

3.2.6.2 Flexible conduit connected to mechanical systems subject to movement shall be installed in accordance with the requirements stated in Figure 2. The cognizant engineer shall also verify through OE the minimum lengths in Figure 2 are sufficient.

3.0 INSTALLATION (continued)

3.2.6.3 Follow dimensions given in Table 1 for determining the bend radius for flexible conduit for equipment in section 3.2.6.1 above and drawing 47A056-89 for equipment in section 3.2.6.2 above.

3.2.6.4 Install flexible conduit between flush and recessed lighting fixtures to rigid conduit systems when so indicated on design drawings.

3.2.6.5 Flexible conduit shall be installed in lengths not exceeding 6 feet, except as noted in design drawings, and located as near the equipment and components as practical. The conduit shall be prepared, assembled, and installed in accordance with manufacturer's instructions, including any torquing requirements, where applicable.

3.2.6.6 Where liquid tight flexible metal conduit has been damaged during handling or installation, it may be repaired in the following manner:

a. Ensure there is no significant damage to the metallic core of the conduit (no sharp edges inside the conduit). If the metallic core has been penetrated, the flexible conduit should be replaced.

b. Clean the area where the damage has occurred using a clean rage and denatured alcohol, or equivalent.

c. Wrap half-lapped layers of 3M Company Scotch 22 Electrical Tape or equivalent for a minimum 2-inch distance on each side of the damaged synthetic jacket.

3.3 Conduit Boxes

3.3.1 General

3.3.1.1 Where large boxes are embedded, they shall be properly braced on the inside so that concrete placement will not deflect them. Threaded holes in box frames shall be protected from injury.

3.0 INSTALLATION (continued):

3.3.1.2 Outlet boxes in architectural tile or masonry unit walls shall be installed strictly in accordance with design drawings and for best appearance.

3.3.1.3 Where watertight conduit connections to junction boxes without threaded hubs or bosses are required (see electrical standard drawing SD-E13.6.5), Appleton type HUB conduit hubs, or equivalent, may be used in place of welded hubs. Where clarity is needed, the cognizant engineer will verify the information with OE.

3.3.1.4 Exposed noncurrent-carrying metal parts of fixed equipment and boxes shall be grounded. Equipment not secured to, and in metallic contact with, grounded structural steel shall be connected to the grounding system, when indicated on the detailed design drawings, by brazing the grounding cable to the equipment and then carefully coating the joint with asphaltum, or equivalent.

3.3.1.5 For general information and field fabbing details concerning boxes, see electrical standard drawing SD-E13.6.3 series.

3.3.2 Painting of Level II Coating Outside Containment

Repair painted surface of junction boxes by removing rust spots and painting with chromate primer Federal Specification TT P 57, type 11.

Field fabricated surface mounted boxes shall be painted, inside and outside, immediately after fabrication. Field fabricated flush mounted boxes shall be painted on the inside and the exposed parts only. Primer paints shall be lead free. Zinc chromate primer (Federal Specification TT-P-57, Type II) is recommended for black sheet steel. Finish coats for exposed parts shall harmonize with the general painting scheme about the plant.

3.3.3 Seismic Mounting

Surface-mounted conduit boxes located in seismic Category I structures shall be seismically mounted. Where the mounting surface is poured concrete, boxes shall be attached to embedded steel plates or mounted to the concrete with bolt anchors as shown on equipment seismic support design drawings of the respective design project. Seismic mounting of flush or surface boxes to masonry walls shall be in accordance with specific design details.

3.0 INSTALLATION (continued)

3.3.4 Identification Marking

Junction boxes and/or pull boxes which are assigned junction box numbers and nameplate numbers on design drawings shall be identified by attaching the respective nameplate to its box as described in electrical standard drawing DS-E1.2.2 and its attachments. It shall be permissible to use 3M Scotch pressure-sensitive foam tapes for attaching nameplates.

Junction boxes and/or pull boxes which have assigned box numbers, but no assigned nameplate numbers on design drawings, shall be marked with the applicable color scheme defined for the respective nuclear plant (see electrical design standard DS-E1.2.2). The size lettering shall be determined by the cognizant engineer depending on the box size. The use of self-sticking Mylar markers (e.g., AMP Special Industries or LEM Products, Incorporated), self-adhesive Polyester markers (e.g., W.H. Brady Company), or equivalent, is a suitable means for box identification markings.

4.0 INSPECTION REQUIREMENTS

QA has the responsibility to ensure that conduits and conduit boxes designated for Class 1E cables (divisions of separation) have been installed according to the design documents in the workplan and this instruction. All other conduits and boxes may be inspected by the cognizant engineer or his appointed representative.

Installed conduit systems and conduit boxes shall be inspected for the following:

A. Size, type, and location

B. Identification

C. Grounds

D. Conduit fittings

E. Flexible conduit installation

F. Burrs and sharp edges at terminations

G. Physical separation

H. Conduit hangers

I. Conduit terminations

4.0 INSPECTION REQUIREMENTS (continued):

J. Straps properly tightened

NOTE: Conduit box size, type, and location (where applicable) shall be verified and documented when inspection is performed on each conduit which terminates in the box.

ACCEPTANCE CRITERIA:

A. Size, type, and location shall conform to the OE approved drawing in the workplan.

NOTE: Rigid steel conduit may be substituted for aluminum conduit in the event of a shortage of aluminum conduit, if care is exercised in the selection of supports.

B. Identification

Conduit shall be tagged per TVA Standard Drawing SD-E-15.3.4 of General Construction Specification G-40. Conduit boxes shall be labeled with the assigned nameplate and junction box (identification number JB) specified on the applicable OE drawing. When no nameplate is assigned, the box shall be identified by the specified JB number. Nameplates will be installed in accordance with TVA Standard Drawing SD-E1.2.2.

NOTE: Temporary identification methods for conduit boxes are authorized pending receipt of permanent labels.

C. Grounds

1. Conduit shall be grounded at least once by one of the following:

   a. Securing to building steel or embedded plate;

   b. Securing to a grounded conduit support;

   c. Securing to a grounded junction box;

   d. Use of U-bolt grounding clamps, grounding straps, or grounding bushing secured to a ground conductor.

2. Conduit boxes shall be grounded at least once by one of the following:

   a. Securing to a building steel or embedded plate;

   b. Securing to a grounded conduit (If a conduit is used to ground a conduit box, the box shall not be used as a ground for any of the other conduits terminating in it);

ACCEPTANCE CRITERIA: (continued):

c. Using a Kearney stud connector or compression lug, and bolting an external ground to the box.

NOTE: Cable tray grounds may be used as a grounding connection when no other means are available.

D. Conduit Fittings

No threadless fittings shall be used in a conduit run in a seismic Class I building.

E. Flexible Conduit Installation For 1E Equipment and Class I Seismic Structures

1. The flexible conduit portion of an exposed conduit run shall be installed and supported in accordance with the requirements of the applicable 47A056 series drawings. The bend radius for flexible conduit to mechanical equipment shall be per drawing 47A056-89 and to floor mounted equipment per Table 1A of this instruction.

2. The end points of flexible conduit may be left free to facilitate cable pulling activities. Proper termination of the flexible conduit shall be verified after the cable is pulled.

3. Flexible conduit to floor mounted equipment shall meet requirements of Figure 1.

4. Flexible conduit to mechanical systems subject to thermal movement shall meet the requirements of Figure 2.

F. Burrs and Sharp Edges

Conduit and conduit boxes shall be free from burrs, cuts, sharp edges, rough surfaces, or any other defects that may be detrimental to the cable jacket.

G. Physical Separation

Conduit and conduit boxes shall conform to the physical separation requirements specified on OE drawings.

H. Conduit Hangers

1. In seismic Class I building, hangers shall be spaced per 47A056 typicals or applicable design approved drawings.

ACCEPTANCE CRITERIA: (continued)

2. Four inch or smaller 1-hole pipe straps and 4-inch or smaller conduit boxes, shall be installed in accordance with the requirements of drawings 47A056-2 and -76, respectively. Inspection shall be accomplished with the related conduit and documented by the inspector's signature and date on the inspection sheet.

3. In non-seismic areas, conduit supports shall be spaced in accordance with the National Electric Code (NEC) and documented by the inspector's signature and date on the inspection sheet.

I. Termination

1. Conduit terminating in a conduit box or cabinet that do not have threaded hubs or bosses shall be secured using a locknut and a bushing on the inside and a locknut on the outside. In wet locations conduit hubs may be used.

   NOTE: If there is insufficient space for bushing installation, conduit ends may be rounded to approximately 1/16 inch radius.

2. A bushing or chase nipple shall be installed when a conduit terminates beneath a cabinet or board.

J. Straps Properly Tightened

1. Straps secured by bolt and/or nut without washers or shims between the strap and the support member (Unistrut, tube, plate, etc.) shall be firmly fixed in contact with the conduit. The bolts or nuts shall be torqued as follows:

   a. All 1/4" bolts/nuts used to fasten conduit clamps to Unistrut or building steel/supports shall be torqued to 6 ft/lbs +3 -0 ft/lbs.

   b. All 3/8" bolts/nuts used to fasten conduit clamps to Unistrut or building steel/supports shall be torqued to 19 ft/lbs +3 -0 ft/lbs.

   The bolts shall not bottom out in the threaded fastener nor in a tapped hole. The nut shall not tighten onto the unthreaded section after bolt.

2. Straps secured by bolts and/or nut with washers or shims between the strap and the support member (Unistrut, tube, plate, etc.) may show space between the strap and conduit, the conduit and support member, and/or both of the above. Torquing requirements shall be the same as 1 a and b above.

3. Lock washers and/or flat washers are optional between the bolt head and the Unistrut strap and/or between the nut and the support member on all 47A056 series drawings unless otherwise noted.

ACCEPTANCE CRITERIA: (continued)

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J. Straps Properly Tightened

1. Straps secured by bolt and/or nut without washers or shims between the strap and the support member (Unistrut, tube, plate, etc.) shall be firmly fixed in contact with the conduit. The bolts or nuts shall be torqued as follows:

   a. All 1/4" bolts/nuts used to fasten conduit clamps to Unistrut or building steel/supports shall be torqued to 6 ft/lbs +3 -0 ft/lbs.

   b. All 3/8" bolts/nuts used to fasten conduit clamps to Unistrut or building steel/supports shall be torqued to 19 ft/lbs +3 -0 ft/lbs.

   The bolts shall not bottom out in the threaded fastener nor in a tapped hole. The nut shall not tighten onto the unthreaded section after bolt.

2. Straps secured by bolts and/or nut with washers or shims between the strap and the support member (Unistrut, tube, plate, etc.) may show space between the strap and conduit, the conduit and support member, and/or both of the above. Torquing requirements shall be the same as 1 a and b above.

3. Lock washers and/or flat washers are optional between the bolt head and the Unistrut strap and/or between the nut and the support member on all 47A056 series drawings unless otherwise noted.

DOCUMENTATION:

Conditions encountered that were not anticipated and any DRs, FCRs, design deviations, etc. shall be recorded in the "Remarks" section of the inspection sheet. This inspection shall be documented on the inspection sheet as shown on Attachment A or by signature in the work instructions of the workplan.

The identification of the conduit boxes included in this inspection shall be recorded in the "Remarks" section of the inspection sheet or near the signoff in the work instructions.

Data Sheet
Work Plan _____/MR _____
Page ____ of ____

(1) QA Inspector required on CSSC equipment only. Signature and date required.

EXPOSED CONDUIT AND JUNCTION BOX INSPECTION SHEET

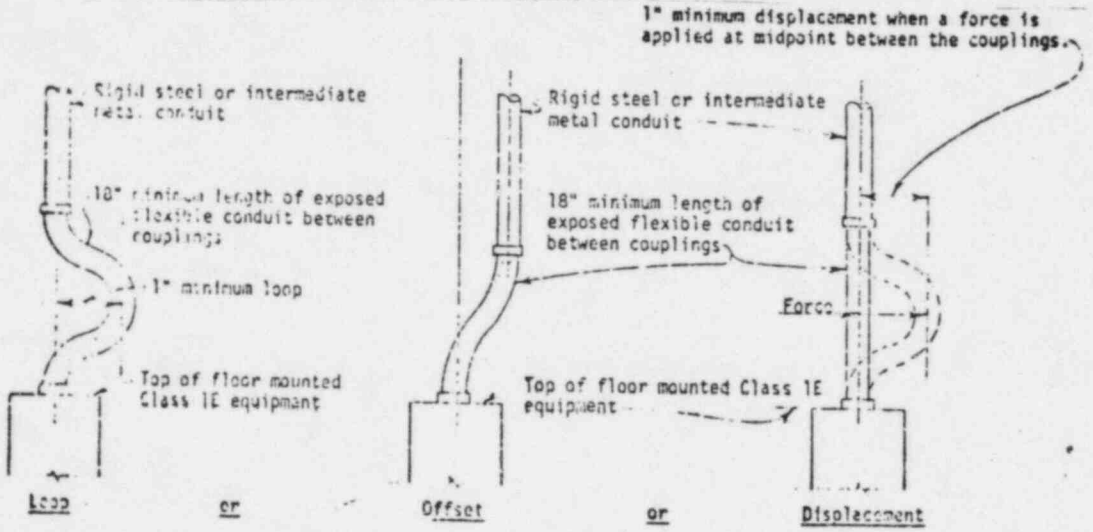
Ref. Drawings: _____

Conduit # or J-Box						
Torque Wrench ID						
Cal Due Date						
	Acceptable					
Size, Type, Location						
Routing						
Correct Coupling						
Identified Properly						
Burrs, Sharp Edges Removed						
Separation Requirements Met						
Hanger Spacing Acceptable						
Straps Properly Tightened						
Conduit Properly Grounded						

Remarks: _____

FIGURE 1

FLOOR MOUNTED EQUIPMENT



NOTES:

1. When conduits connect to the top of floor mounted, Class 1E equipment, an 18-inch minimum length of flexible conduit shall be used to connect between the rigid conduit and the equipment. As a general rule, the flexible conduit installation should contain enough slack to form a minimum 1-inch loop at midpoint between couplings, or to permit displacement of a minimum 1-inch between center lines of couplings. Maximum length of flexible conduit is 72" except as noted on design drawings.

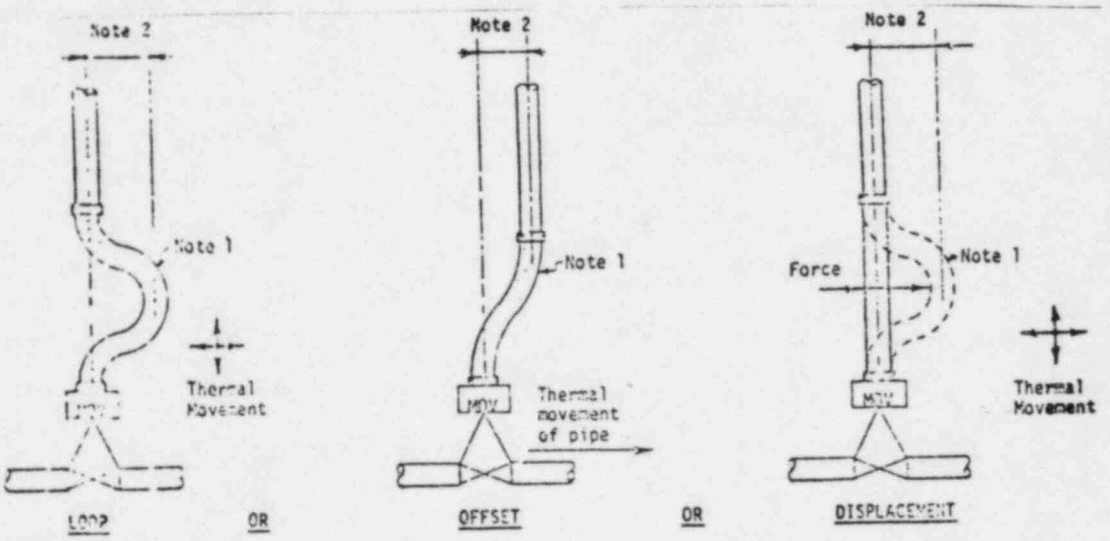
2. When conduits connect to the bottom of floor mounted Class 1E equipment, such as control panels, the minimum length of flexible conduit should be 18 inches, but may be less where physical limitations prevent or make it impractical.

3. When conduits connected to the sides of floor mounted, Class 1E equipment such as motors, the flexible conduit shall, as a minimum, be long enough to accomodate its minimum bend radius given in Table 1A.

4. Conduit connections to cable trays should be avoided; however, if conduits are connected to seismic Category I cable trays, an 18-inch minimum length of flexible conduit shall be installed as in Note 1 above.

FIGURE 2

MECHANICAL SYSTEMS SUBJECT TO MOVEMENT



NOTES:

1. The minimum length of exposed flexible conduit between couplings shall be as specified in the table below for the size conduit being used.

Flexible Metal Conduit--Nominal ID Size (Inches) (Note 1)	Dimensions	
	Minimum Length (Exposed Between Couplings)	Minimum Offset Loop or Displacement
1/2	18	4.5
3/4	24	6
1	30	7.5
1-1/2	32	8
2	36	9
2-1/2	48	12
3	60	15
4	72 (+2, -0 Tolerance)	18

2. The minimum loop, offset or displacement dimension shall be as specified in the above table.

3. Refer to dwg 47A056-89 for bend radius dimensions.

Table 1

MINIMUM BEND RADIUS FOR FLEXIBLE CONDUIT

A. To floor mounted equipment

Flexible Metal Conduit--Nominal ID Size (Inches)	Minimum Bending Radius (Inches)	
	Liquidtight Flexible With Synthetic Jacket--Minimum Inside Bend Radius (Note 1)	Stainless Steel Flexible -- Minimum Centerline Bend Radius (Note 1)
1/2	3.5	3
3/4	5	5
1	6	6.5
1-1/2	6.5	9.5
2	7	11
2-1/2	9.5	12.5
3	11.5	14.5
4	14	22
5	20	29
6	30	35

Note: 1. Plus allowing for straight run sections needed at the rigid connector(s).

B. To mechanical equipment subject to thermal movement; refer to drawing 47A056-89.