FILE COPY

TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

SEQUOYAH NUCLEAR PLANT
AND
ALL FUTURE NUCLEAR PLANTS

GENERAL

CONSTRUCTION SPECIFICATION

NO. G-38

FOR

INSTALLING INSULATED CABLES RATED UP TO 15,000 VOLTS INCLUSIVE

July 25, 1973

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CONSTRUCTION SPECIFICATION

FOR

INSTALLING INSULATED CABLES RATED UP TO 15,000 VOLTS INCLUSIVE

SEQUOYAH NUCLEAR PLANT

AND

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PREFACE

This specification supersedes GENERAL CONSTRUCTION SPECIFICATION NO. G-4 for this project and all future nuclear plants.

Special instructions will be issued for areas where excessive temperature or environment prevent the use of standard cable and terminals.

CONSTRUCTION SPECIFICATION

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FOR

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1. GENERAL

1.1 Scope. It is the purpose of this specification to prescribe materials and procedures for installation, termination, splicing, and marking of insulated cables.

1.2 Drawings. All work shall be done as herein specified and as indicated on TVA project drawings and on the latest revisions of the following standard drawings:

30B1045 - Conduit and cable identification tags.
30A551 - Switchboard and panel wiring diagram.
30B1075 - Shielded cable termination ground sensor current transformer application.
30A1031 - Coaxial communication cable straight termination.
30A1032 - Junction box terminal details coaxial communication cable.
30A1033 - Terminals coaxial communication cable curved termination.
30A811 - Conduit sizes for cables various diameters.
30A565 - Switchboard panel wiring - Wiring methods.

1.3 Definitions. Wherever the words defined below appear in this specification, they shall have the meanings here given:

Raychem Terminating Kits. A package of material that includes all necessary items except for the terminal lug for cable termination including instructions. This kit is manufactured by the Raychem Corporation.

1.4 Reference Specifications. The latest revisions of the following specifications shall apply where referred to in this specification.

TVA Specification 25.013. Standard Specification for Polyethylene-Insulated Wire and Cable

TVA Specification 25.014. Standard Specification for Switchboard Insulated Wire

TVA Specification 25.016. Standard Specification for Cross-Linked Polyethylene-Insulated Wire and Cable

MIL Specification MIL-W-168784A. Wire Electrical, Type E, 200 C and 260 C, 600 Volts (Insulated, High Temperature)

2. MATERIALS

2.1 Cable. The cables covered by this specification are of the following TVA designated types:

Type PN - Single-conductor wire or cable with polyethylene insulation and a nylon jacket (TVA Standard Specification 25.013).

Type PJ - Single-conductor wire or cable with polyethylene insulation and a polyvinyl-chloride jacket (TVA Standard Specification 25.013).

Type PJJ - Multiple-conductor cable with a core consisting of type PJ cables with an overall polyvinyl-chloride jacket (TVA Standard Specification 25.013).

Type CPJ - Single-conductor wire or cable, with cross-linked polyethylene insulation and a polyvinyl-chloride jacket (TVA Standard Specification 25.016).

Type CPJJ - Multiple-conductor cable with a core consisting of type CPJ single conductors with an overall polyvinyl-chloride jacket (TVA Standard Specification 25.016).

Type CPSJ - Single-conductor cable similar to type CPJ except with electrostatic shielding tape added between the insulation and the jacket (TVA Standard Specification 25.016).

Type SROJJ - Multiple-conductor cable consisting of a core of single-conductor cables with silicone rubber insulation and a color-coded glass braid jacket with an overall asbestos braid jacket.

Type SROAJ - Single-conductor cable with silicone rubber insulation and an asbestos braid jacket.

Type E - Single-conductor cable with 200 C Teflon insulation. 600-Volt switchboard wire (Military Specification MIL-W-168784A).

Type SIS - Single-conductor cable with cross-linked polyethylene insulation. 600-Volt switchboard wire (TVA Specification 25.014, Tentative December 18, 1972).

Signal - Multiple-conductor cable with cross-linked polyethylene insulation*, overall shield, chlorosulfonated polyethylene* jacket.

Signal - Two-conductor cable with 200 C Teflon (FEP) insulation, twisted, shielded, Teflon (FEP) jacket.

*or TVA approved equal material suitable for reactor, containment, normal, and accident environment.

Instrumentation - RG-11/U triaxial cable modified for reactor containment environment.

Instrumentation - 8-Conductor combination cable, consisting of 2 single conductors, Tefzel insulated, 1 pair Tefzel insulated unshielded, 1 pair Tefzel insulated shielded, and two 75-ohm coaxial cables, chlorosulfonated polyethylene jacket.

2.2 Terminals and Splices. Vinyl-insulated or uninsulated ring tongue terminals shall be used for terminations for wire size 10 AWG and smaller. The insulated terminals with wire insulation grip shall be used where the insulation of the barrel of the terminal is necessary and where vibration or flexure at point of application is encountered. Uninsulated terminals shall be used for terminations larger than No. 10 AWG as shown in the table below. The uninsulated terminals are intended for applications where total temperature of the conductor does not exceed 175 degrees C (347 F). The insulated terminals are intended for applications where total temperature of the conductor does not exceed 105 degrees C (221 F).

Terminals and splices purchased from The Thomas and Betts Company shall be installed with tools purchased from that Company as follows:

Wire Range, AWG	Terminal Catalog No.	Tool No.	Die Catalog No.	Butt Splice Catalog No.
22-14	Series A & B	WT 130A	None	Series AA & BB
22-10	Series C	WT 130A	None	Series CC
8	54104 or 204	TBM15	15520	54504
6	54105 or 205		15522	54505
4	54106 or 206		15527	54506
2	54107 or 207		15528	54507
1/0	54109 or 209		15508	54509
2/0	54110 or 210		15526	54510
4/0	54112 or 212		15511	54512
250 mcm	54113 or 213		15510	54513
300 mcm	54114 or 214		15534	54514
400 mcm	54116 or 216		15512	54516
500 mcm	54118 or 218		15506	54518
750 mcm	54123 or 223		15515	54523

Terminals and splices purchased from the AMP Special Industries, Division of AMP Products Corporation, shall be installed with tools purchased from that Company as follows:

Wire Range, AWG	Terminal or Catalog No.	Butt Splice Catalog No.	Tool No.	Die Catalog No.	Terminal Catalog No. (2 Hole)
22-16	Solistrand	330367	49900	None	
16-14	20304	330368	49900	None	
12-10	↓	330369	49900	None	
22-16-Ins	PIDG	320559	59170	None	
16-14-Ins	L-101	320562	59170	None	
12-10-Ins	↓	320570	59239-4	None	
8	33460	34321	69355	None	
6	328142	328180	69120-1	69133-1	
4	328162	328182	with	69134-1	
2	325201	324457	69099	46765-2	
1/0	325303	322458	Head	46766-2	327281
2/0	325403	324459	↓	46767-2	327282
4/0	325603	324461		46750-2	327284
250 mcm	325705	324462		46751-2	327285
300 mcm	325805	324463		46752-2	327286
400 mcm	326005	324465	with	46754-2	327288
500 mcm	326105	324466	69082	46755-2	327289
750 mcm	326406	324469	Head	46758-2	327292
1000 mcm	326606	324471	↓	46760-2	327294

Tools from The Thomas and Betts Company and AMP Special Industries may be used interchangeably to install terminal lugs and splices only if they are certified by the manufacturer.

2.3 Terminating Kits - 8 kV. For 8-kV terminations using Raychem Corporation terminating kits, installation instructions included in the kits must be adhered to. Use kits as follows:

#2/0-250 mcm - Kit #HVT-1-A-1
300-500 mcm - Kit #HVT-1-A-2
750-1000 mcm - Kit #HVT-1-A-3

2.4 Terminating Kits - 600 Volts. For 600-volt splices using Raychem Corporation splicing kits, use kits for wire size as follows:

Conductor Size	Sleeve Size
#8 thru #4 AWG	WCSF 220-12
#2 thru #2/0 AWG	WCSF 300-12
#3/0 thru 250 mcm	WCSF 500-12
300 mcm thru 500 mcm	WCSF 600-12
600 mcm thru 1000 mcm	WCSF 1000-18

2.5 Wire Strippers. Self-adjusting wire strippers shall be used for stripping insulation from cables No. 24 AWG to No. 10 AWG. The Thomas and Betts Company wire strippers catalog No. ABMK-1 may be used for wire size AWG 24 to 12, and catalog No. ABMK-3 may be used for wire size AWG 18 to 10. AMP Special Industries wire stripper catalog No. 29898-9 may be used for wire size AWG 22 to 10.

3. INSTALLATION

3.1 In Cable Tray or Conduit. The following maximum tension must not be exceeded when pulling a cable, except NIS cable (Special Handling):

a. The maximum tension (Tm) shall not exceed 0.008 times cmil area when pulled with mechanically assisted methods.

Where Tm = 0.008 x n x cmil
Tm = maximum tension lb
n = number of conductors in cable
cmil = circular mil area of each conductor

b. The maximum tension for leaded cables shall not exceed 1500 lb/in^2 of lead sheath area when pulled with a basket grip.

Tm = 4712t (D-t)
where t = lead sheath thickness, inches
D = outside diameter of cable, inches

c. The maximum tension shall not exceed 1000 lb for nonleaded cables when pulled with a basket grip. (However, maximum tension calculated for item a cannot be exceeded.)

d. The maximum tension at a bend shall not exceed 100 times the radius of curvature of the duct expressed in feet (but maximum tension calculated from items a, b, or c cannot be exceeded).

The cable shall be prepared for pulling by removing the insulation a sufficient length to allow the conductor to be folded back on itself in order to form a loop. The joint shall be taped with plastic tape to present a smooth surface to the inside of the conduit. This loop shall be the means of attachment to the pull rope. In no case will the rope be attached to the insulation of the conductors. If multi-conductor cable is pulled, each conductor shall be attached to the pulling rope. Coaxial and triaxial cable must have the shields and conductor fastened to the rope. The measurement of cable tension is not necessary if the cable is pulled by hand. If the cable is pulled by mechanically assisted methods, cable tension shall be limited to that given under 3.1a, b, c, and d.

When measuring or pulling cable in aluminum or plastic conduit, a fish tape with a protected end must be used in order to avoid damage to the inside of the conduit.

Lubricants for pulling cable having an outer covering consisting of a rubber-like jacket are recommended as follows: (1) dust with mica or soapstone, (2) water, (3), Wire Lube or Yellow 77 (Ideal Products Company), (4) talc, (5) soapstone and water, and (6) soap and water. Soap should be a low-alkali type such as Ivory soap flakes. Under no circumstances shall soap be used when installing cable in aluminum conduit.

Lubricants for pulling cable having asbestos-braid covering are recommended as follows: (1) soapstone, (2) talc, (3) soapstone-and-water thick paste--use very little water and smear the paste lightly on the cable.

Cleanliness is of great importance in the making of any splice or termination. The splicer's hands should be clean, particularly when applying the tapes, and every reasonable precaution should be taken to exclude dirt and moisture while the work is in process. In hot atmosphere, sweat bands around the splicer's wrists will tend to prevent perspiration from accumulating on the hands and are recommended.

5-, 8-, and 15-kV cable shields should be grounded at both switchboard ends and at equipment end of the run with No. 10 AWG bare copper or equivalent flexible copper braid unless the drawings specifically state otherwise.

On long runs, shields should also be grounded at intermediate points not over 800 feet apart. The locations of points of access, such as pull boxes and manholes, will determine the interval. In making the intermediate grounds, remove only an amount of the jacket sufficient to permit soldering the ground lead to the shielding tape and insulate with Raychem heat shrinkable tubing.

Shields of all conductors 1,000,000 cmil or larger shall not be grounded at both ends. The drawings will show the location of the grounds and of shield insulating joints if the latter are required.

Where shielded power cable is terminated through a ground sensor current transformer, the shield ground lead must be installed in accordance with standard drawing 30B1075 in order that the current transformer sees only the phase currents, and to avoid the ground connections constituting a shorted turn in the current transformer primary.

After pulling each run of cable and prior to cutting from the reel, the pulling end of the cable should be examined for any distortion or deformation to assure that a sufficient length of uninjured copper, insulation, and jacket is available as required for the splice or termination.

NIS cable to be installed per manufacturer's recommendations.

3.2 In Earth. The trench for the cable should be dug to at least 24 inches below surface grade so cable will not be disturbed by surface digging or frost. The bottom of the trench should be loosened and free of rocks and other rough material.

Prepare a bedding of sand or screened dirt in bottom of trench for the cable to rest on. In laying the cable on this bedding, permit it to snake slightly in the trench to allow slack when the earth settles. If single-conductor cables are to be laid in the same trench, it is desirable to keep them separated uniformly, about 6 inches between centers, so earth and sand can be filled in around them. Be certain there are no crossovers.

After the cable is laid and before backfilling, cover the cable at least 6 inches with screened dirt to improve heat dissipation and avoid bruising or distorting the cable during backfilling. In areas of heavy traffic or places where excavating is likely to occur, protective slabs should be placed over the screened dirt covering to protect the cable and warn workmen of its presence. If planks are used, be sure they are free of nails and not in contact with the cable.

4. TERMINATION AND SPLICING

4.1 Thermoplastic-Type Insulations. All terminations and splicing of conductors shall be accomplished by means of ring tongue terminal lugs and butt splices crimped onto the wires by means of matching tools, which are designed to produce a carefully controlled uniform pressure crimp.

Tools, terminals, and butt splices, which satisfy the basic requirements of this specification, must always be used. However, because of differences between tools and terminals of various manufacturers, the user should always familiarize himself with manufacturer's instructions for the specific type of terminals and tool he intends to use.

Both insulated and uninsulated terminals are available through size AWG No. 10. The principal advantage of the insulated terminal with insulation grip is its ability to provide mechanical stress relief at the junction of the insulation and barrel, and some protection against electrical faults and accidental contact with live terminals. All splices must be insulated either by preinsulated splices or Raychem Corporation terminating and splicing tubing must be used as follows:

1. Use a propane or butane gas tank.

2. Apply heat to the Raychem Corporation terminating and splicing tubing with a Raychem torch catalog No. FH 2609 or equal.

3. Adjust torch to obtain a blue flame with a small yellow tip. Pencil-like blue flames should be avoided.

4. Start shrinking the tubing at one end and work towards the middle. (Keep the flame moving continuously to avoid scorching the tubing.)

5. Apply heat until surface of tubing is smooth and the sealant is flowing out both ends of the sleeve. Tubing should be smooth and wrinkle free with inner components clearly defined.

4.2 Rubber or Rubber-Like Insulations. Cables with rubber or rubber-like insulations (types SROAJ and SROJJ) shall be terminated or spliced by one of the following procedures:

a. Install uninsulated terminal or connector as listed under section 2.2 and build up over exposed copper surfaces with 3M Company, Scotch 70 tape to a thickness equal to the original insulation and jacket.

b. For splices in multiple-conductor cable, splice the single conductors in accordance with a. above and build up final cover with Scotch 70 tape to approximately the same thickness as the original jacket.

4.3 Coaxial and/or Triaxial. Coaxial and/or triaxial cables shall be terminated with the appropriate connectors that are furnished on the instrumentation equipment contract as referenced on the TVA wiring connection drawings. The procedure used shall be in full compliance with the instructions furnished by the instrumentation equipment manufacturer and the terminations shall be made with appropriate tools and supplemental materials (such as solder, sleeving, etc.) furnished by the instrumentation equipment manufacturer. Splicing of coaxial and triaxial cable shall not be permitted.

4.4 Signal. Where multiconductor signal cable is to be terminated in multipin connectors supplied with instrumentation equipment, the same procedure shall be followed as outlined in section 4.3 for coaxial cable.

4.5 Special. TVA terminations on equipment where terminals are furnished by the manufacturer shall conform to this specification. If certified tooling is not available for the terminals furnished by the manufacturer, terminals and tooling that are certified shall be used.

5. TORQUING REQUIREMENTS

5.1 Torque Wrenches and Screwdrivers. Tightning of screws and bolts on terminal blocks, motors, panels, boards, etc., will be accomplished by using torque wrenches and screwdrivers. The following table shall be used to set the torque required:

Screw Size	Torque in inlb
4	7
5	10
6	12
8	18
10	20
1/4	30

*Torque in ft-lb

Bolt Size	Steel Bolts (Standard)	Steel Bolts (High Strength)	Duronze Bolts
3/8	15	25	20
1/2	25	50	40
5/8	40	90	75

*Data from H. K. Porter Company. The torque values given have a safety factor of from 2 to 4 depending on the size of bolts. (The larger the bolt, the greater the safety factor).

Tensile strength of duronze bolts = 100,000 psi
Tensile strength of steel (standard) bolts = 55,000 psi
Tensile strength of steel (H.S.) bolts = 120,000 psi

6. IDENTIFICATION TAGS

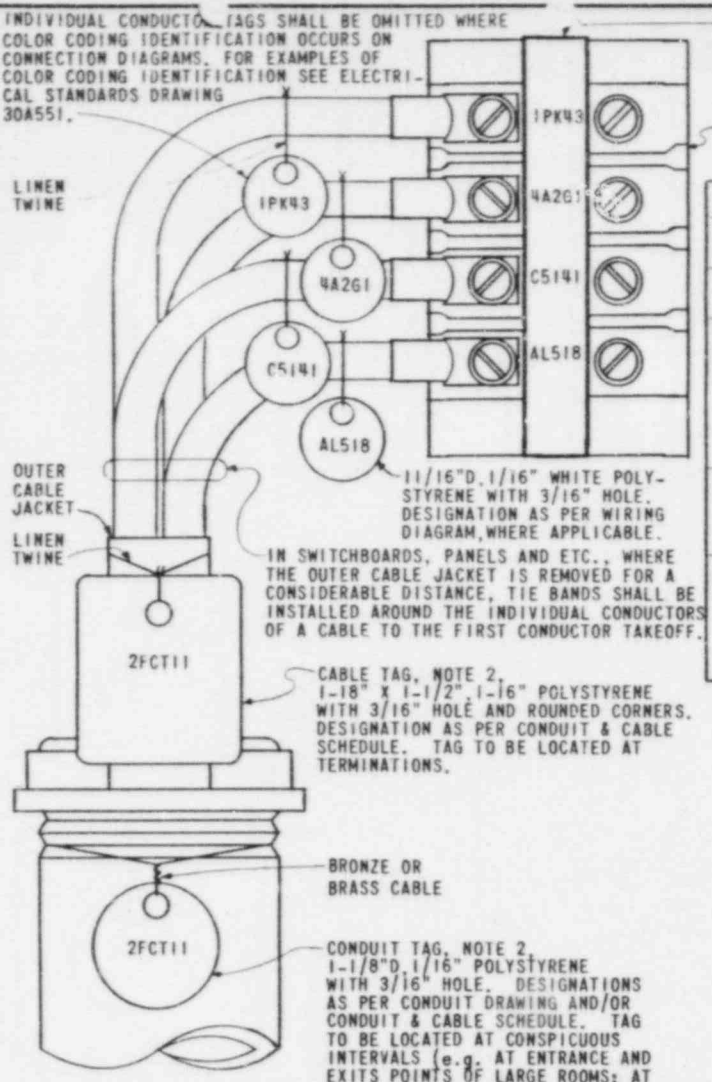
6.1 Conduit and Cable. Each conduit and cable shall be tagged and marked in the manner shown on standard drawing 30B1045.

6.2 Terminal Blocks and Strips. All terminal blocks shall be marked the same as designations on wiring diagrams. All tag markings shall be of the size stated on the drawing. Terminal strips shall be marked using waterproof ink. The letters and figures shall be carefully made to produce clearly legible designations.

7. TOOL MAINTENANCE AND INSPECTION PROCEDURE

7.1 Tool Maintenance. Division of Construction must follow the recommendation of the tool manufacturer in setting up a maintenance-inspection program to ensure that continued use of the tools will result in dependable and uniform terminations.

7.2 Documentation. Division of Construction has the responsibility of documentation of the program to assure that correct terminals and tools have been used.



LOCATION OF TAGS

TABLE A

SEQUOYAH & WATTS BAR NUCLEAR PLANTS (NOTE 2)

SYSTEM	DIVISION OF SEPARATION	BACKGROUND COLOR	LETTERING	CABLE OR CONDUIT SUFFIX
ENGINEERED SAFETY FEATURES (ESF), ESSENTIAL SUPPORTING AUXILIARY SYSTEMS ESAS), AND CLASS 1E DIESEL GENERATOR POWER SYSTEMS.	TRAIN A TRAIN B	ORANGE BROWN	WHITE WHITE	A B
NOTE 1 (EXAMPLE: COMPONENT COOLING SYSTEM PUMP C-S)	SPECIAL	GOLD	BLACK	S
REACTOR PROTECTION SYSTEMS (RPS) AND CLASS 1E VITAL AC AND DC BATTERY SYSTEMS	CHANNEL I CHANNEL II CHANNEL III CHANNEL IV	RED BLACK BLUE YELLOW	WHITE WHITE WHITE BLACK	I II III IV

NOTES:

1. FOR ADDITIONAL INFORMATION ON SPECIAL DIVISIONS OF SEPARATION, SEE DESIGN CRITERIA SQ-DC-V-12.2 AND WB-DC-30-4 RESPECTIVELY FOR SEQUOYAH AND WATTS BAR NUCLEAR PLANTS.
2. TAGS FOR NONDIVISIONAL CONDUITS AND CABLES SHALL BE WHITE POLYSTYRENE, OR EQUAL, BACKGROUND WITH BLACK LETTERING. TAGS FOR DIVISIONAL CONDUITS AND CABLES SHALL BE COLOR-CODED AND LETTERED IN ACCORDANCE WITH TABLE A.
3. TAGS AND TERMINAL MARKER STRIPS SHALL BE CLEARLY LETTERED BY ONE OF THE FOLLOWING METHODS:
   A. USE MEDIUM PENCIL (HB) & SPRAY IMMEDIATELY WITH KRYLON PERMANENT CRYSTAL CLEAR SPRAY NO.1303 OR EQUAL.
   B. USE FLOW-MASTER INK OR EQUAL & OMIT SPRAY.
4. ALL CONDUIT TAGGING OR BANDING SHALL BE DONE WHEN THE CONDUIT RUNS ARE COMPLETED.
5. ALL TAGGING OF CABLE & MARKING OF TERMINAL STRIPS SHALL BE DONE WHEN THE CABLE & WIRE CONNECTIONS ARE MADE.
6. DEC PROCUREMENT SPECIFICATIONS FOR TAGS & TERMINAL STRIPS SHALL CALL FOR 1/16" FLAME RETARDENT HIGH IMPACT POLYSTYRENE OR EQUAL.
7. PROCUREMENT SOURCES:
   POLYSTYRENE: KEYS-DAVIS CO., P.O. BOX 155, BATTLE CREEK, MICHIGAN.
   KRYLON SPRAY: KRYLON, INC., NORRISTOWN, PENNSYLVANIA.
   FLOW-MASTER INK: ANY SUPPLY HOUSE HANDLING ESTERBROOK PENS.

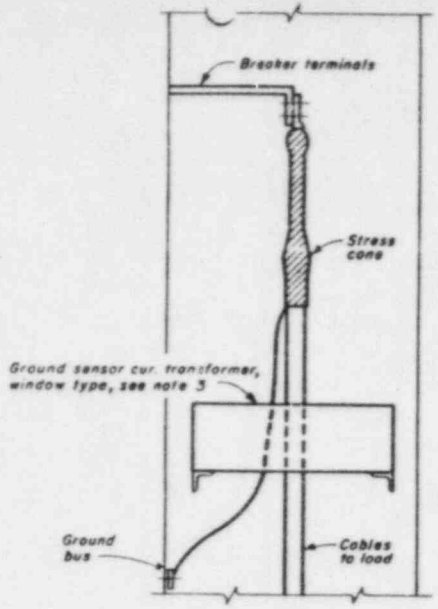
SCALE: 12" = 1'-0"

ELECTRICAL STANDARDS

CONDUIT & CABLE IDENTIFICATION TAGS

PRESS.W REAC (PWR) NUCLEAR PLNTS
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

SUBMITTED	RECOMMENDED	APPROVED
C.N. Lutz II	K.M. Hodges	M.J. Grace
KNOXVILLE	2-28-73	G E 4 30B1045 R0

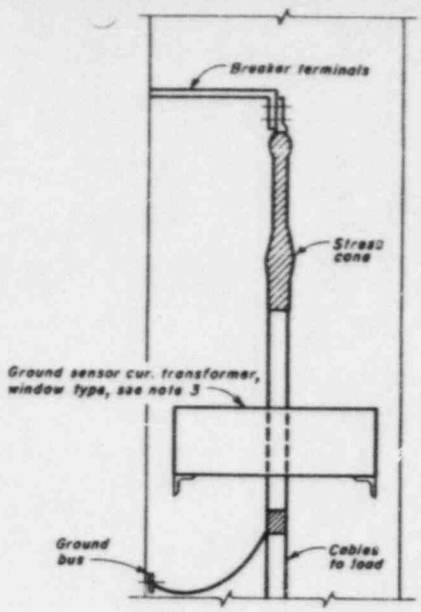


CASE A

Load cables leaving either top or bottom of switchgear (Cables leaving bottom shown)

NOTES:

1. All load cables must pass through the window of the current transformer.
2. When current transformer is mounted as in Case A, terminate cables per standard drawing 30-E-4-3081040, 1042 or Construction Specification G-4.
3. When cables leave top of switchgear, current transformer will be above breaker terminals.

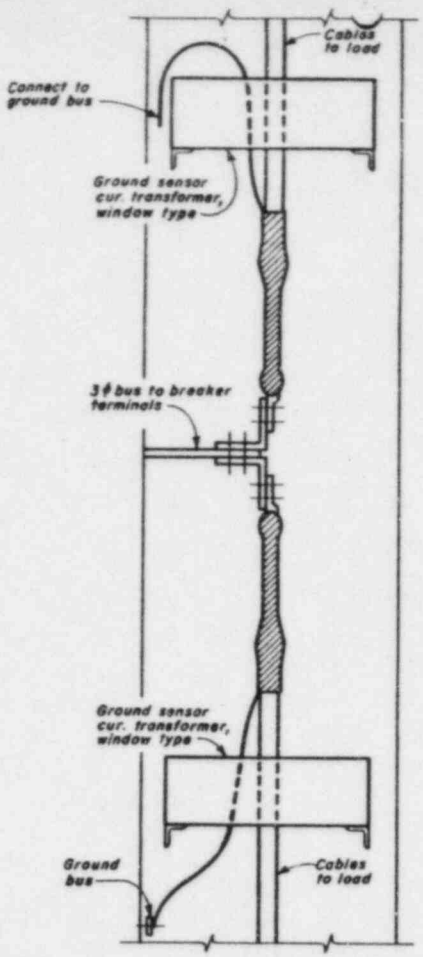


CASE B

Load cables leaving either top or bottom of switchgear (Cables leaving bottom shown)

NOTES:

1. All load cables must pass through the window of the current transformer.
2. Terminate cables the same as Case A, except omit the ground strip at the stress cone and insulate it on the load side of the current transformer by cutting through the outer jacket and carefully soldering the ground strip to the shield.
3. When cables leave top of switchgear, current transformer will be above breaker terminals.



CASE C

Load cables leaving both top and bottom of switchgear

NOTES:

1. When load cables leave from both top and bottom of switchgear, the ground sensor current transformers will be installed as shown.
2. Terminate cables the same as Case A.

Not to scale

ELECTRICAL STANDARDS

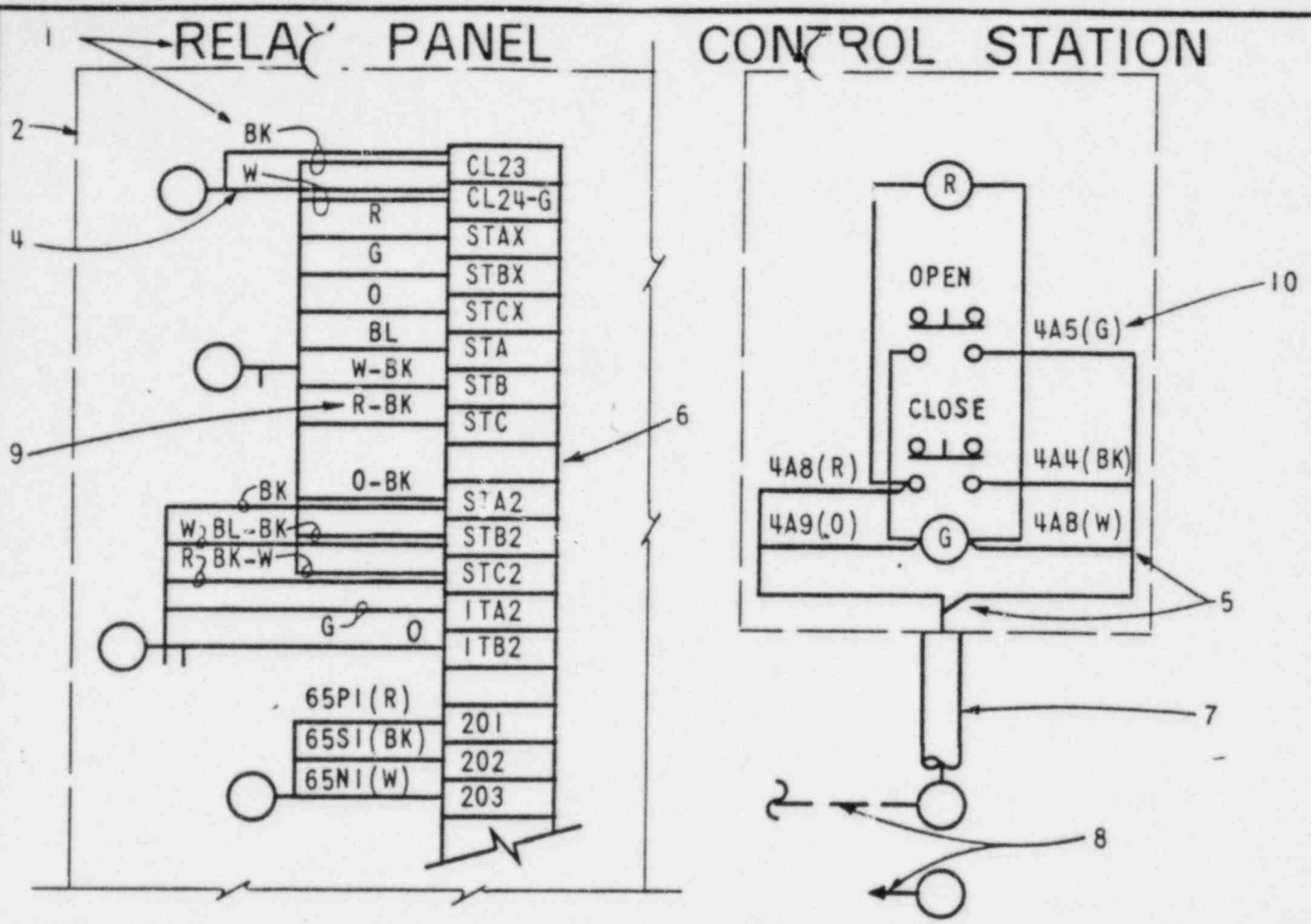
SHIELDED CABLE TERMINATION GROUND SENSOR CUR. TRANSF APPLICATION

DESIGN AND DRAFTING STANDARDS
TENNESSEE VALLEY AUTHORITY
DIVISION OF DESIGN

DESIGNED	DRAWN	TRACED	CHECKED
P.R. Lewis	J.R. Snyder		C. McCord

KNOXVILLE	7-7-64	6	8	4	30B1075 R1

THIS DRAWING SUPERSEDES 30A1075 R0



SHOW:

1. ALL LETTERING IN CAPITAL SLANT LETTERS. MAIN DESIGNATIONS (PANEL ETC) NO. 6 SIZE LETTERS, ALL OTHERS NO. 4. VERTICAL LETTERS WHERE REQUIRED TO MATCH LETTERING PRODUCED ON DRAFTING MACHINES.
2. PANEL OUTLINES WITH DASHED, 4 WIDTH LINES.
3. INSTRUMENT OUTLINES WITH UNBROKEN, 4 WIDTH LINES.
4. CONTROL OR INSTRUMENT CONDUCTORS WITH UNBROKEN, 4 WIDTH LINES.
5. DIRECTION OF WIRES JOINING A GROUP AT RIGHT ANGLES TO THE GROUP, EXCEPT WHEN 45° CORNERS ARE REQUIRED FOR CLARITY.
6. TERMINAL BLOCK SECTIONS WITH UNBROKEN, 4 WIDTH LINES (SIZE 0.6" X 0.2").
7. CONDUITS WITH A BROKEN CONDUIT SYMBOL (SIZE 0.7" X 0.2").
8. ROUTE LINES WITH DASHED, 4 WIDTH LINES. IF ROUTE LINES CONFUSE THE DRAWING DIRECTIONAL ARROWS MAY BE USED.
9. ABBREVIATED COLOR CODING OF INDIVIDUAL CONDUCTORS IN CABLES: BLACK-BK, WHITE-W, RED-R, GREEN-G, ORANGE-O, BLUE-BL, YELLOW-Y, VIOLET-V, PURPLE-PR, BROWN-BR, SLATE-S, WITH HYPHEN TO SEPARATE BASE AND TRACER COLOR(S).
10. CONDUCTOR COLOR CODING IN PARENTHESES ONLY WHEN IT APPEARS TOGETHER WITH ANOTHER CONDUCTOR DESIGNATION.

NOTE:
THE SIZE OF LETTERS AND WIDTH OF LINES REQUIREMENTS FOR DRAFTING MACHINE WORK DIFFER SLIGHTLY FROM THESE STATED ABOVE, AND LETTERING PRODUCED ON THESE MACHINES IS VERTICAL INSTEAD OF SLANT.

DRAWING CHANGE RECORD						
GENERAL REVISION REQUIRED						
REV NO	DATE	MADE	CHKD	SUPV	W SUP	SUBMITTED
ISSUE		H	M	O	SUPV	H M O
CHNG		H	M	O	W SUP	H M O
CHNG		H	M	O		
TRCG		V	F	V	ENGINEER	
COMP		H	M	O		

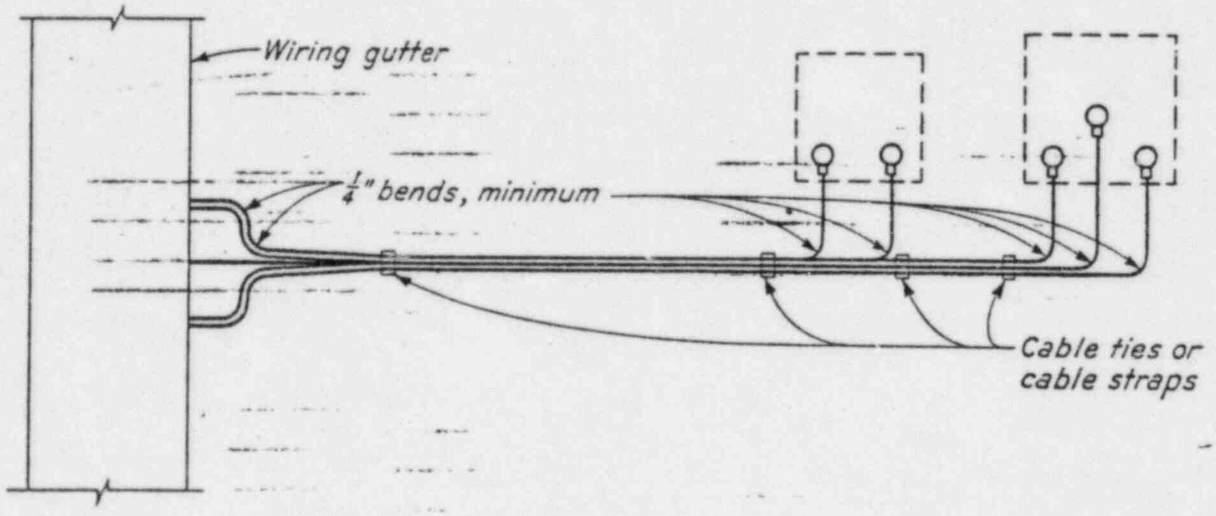
ELECTRICAL STANDARDS

SWITCHBOARD AND PANEL WIRING ARRANGEMENT

DESIGN AND DRAFTING STANDARDS
TENNESSEE VALLEY AUTHORITY
DIVISION OF ENGINEERING DESIGN

SUBMITTED	RECOMMENDED	APPROVED
W. L. Boop	P. A. Hopkins	George E. Rich

KNOXVILLE	10-6-41	G	E	0	30A551	R1



1. Switchboard wires, running from any panel-mounted device (relay, instrument, switch, etc.) to terminal blocks or into wiring gutters, shall be grouped in round packs and tied together as required for adequate support.
2. For binding unsupported wire packs use molded, high temperature cable ties similar to:
   a. Thomas & Betts, tool applied, Cat. No. TY-5.
   b. Thomas & Betts, self locking, Cat. No. TY-25.
   c. Panduit Corp, "Lok-strap," Type LST-2.
3. Where supporting of the wire pack by the cable tie is required use molded, high temperature cable straps similar to:
   a. Thomas & Betts, tool applied, Cat. No. TY-15.
   b. Thomas & Betts, self locking, Cat. No. TY-35.
   c. Panduit Corp, "Lok-strap", Type LSC-2.
4. The routing and points of support shall be determined by the electrical engineer in the field.
5. All bends in switchboard wire shall not be less than $\frac{1}{4}$" radius.
6. Unless otherwise noted on the switchboard wiring diagram drawing all wiring is to be stranded, Awg size 14.
7. Wire stripping tools and compression type lugs are to be used for switchboard wire and cables.

Revisions:
3 — Notes 6 and 7 added
2 — Notes revised
1 — Note 1 revised

REV NO	DATE	MADE	CHKD	SUPV	INSP	SUBM	RECM

DSGN ... DRWN T.B. ... SUPV ... INSP W.C.B. ... CHKD ... TRCD ... ENGINEER ... COMP ...

Sources of supply:
Thomas & Betts Co.
Elizabeth, N. J.
Panduit Corporation
14461 Waverly Ave.
Midlothian, Ill.

ELECTRICAL STANDARDS

SWITCHBOARD PANEL WIRING
WIRING METHODS

GENERAL
TENNESSEE VALLEY AUTHORITY
DIVISION OF DESIGN

SUBMITTED H.M. Osmun | RECOMMENDED J. Kravan | APPROVED R.A. Monroe

KNOXVILLE | 5-15-57 | G | E | 4 | 30A565 R3

CONDUIT SIZES FOR CABLES OF VARIOUS DIAMETERS

When cables of variable diameters are pulled into the same conduit, the conduit size is determined by allowing the cable areas to occupy not more than 40 percent of the conduit area.

Example: Conduit size required for:

3 single-conductor power cables with outside diameter	= 1.26 in.
1 five-conductor control cable with outside diameter	= 0.92 in.
Area 1 single-conductor power cable = 1.244 sq in.; 3 cables	= 3.732 sq in.
Area 1 five-conductor control cable	= 0.664 sq in.
	4.396 sq in.
Conduit area = 4.396 ÷ 0.40	= 10.99 sq in.
From which conduit diameter	= 3.74 in.

Referring to Rigid Steel Conduit Data on 30A809, it is noted that a 4-in. conduit would be required.

CABLE BENDING RADII FOR PULLING IN CONDUIT

Cables should have a bending radius equal to the outside diameter multiplied by the factors given below. In no case should the radius of the bend be less than that obtained by using the minimum factor and then only if approved by the supervising engineer.

Type Insulation	Recommended	Minimum
Varnish cambric		
Unshielded	9	6
Shielded	12	12
Lead covered	12	12
Paper insulated		
Lead covered	12	12
Polyethylene		
Unshielded	8	6
Shielded	12	12
Rubber		
Unshielded	8	6
Shielded	12	12
Cross-linked polyethylene		
Unshielded	9	7
Shielded	14	14

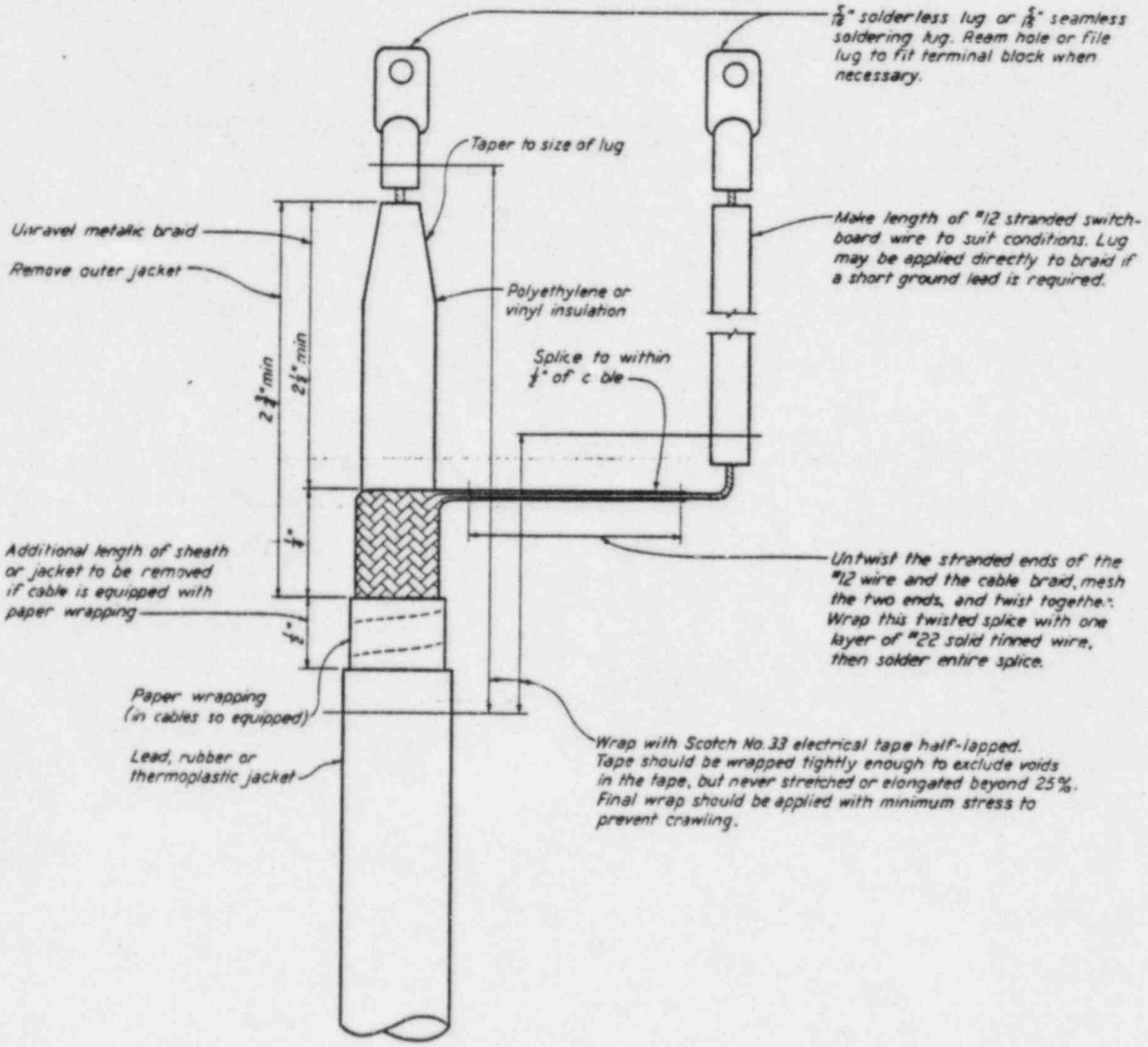
ELECTRICAL STANDARDS

CONDUIT SIZES FOR CABLES VARIOUS DIAMETERS

DESIGN AND DRAFTING STANDARDS
TENNESSEE VALLEY AUTHORITY
DESIGN DEPARTMENT

SUBMITTED	RECOMMENDED	APPROVED
W. L. Burke and	R. A. Hoskins	George Rich

KNOXVILLE	12-17-41	G	E	O	30A811R1



LEAD, RUBBER OR THERMOPLASTIC JACKET

Not to scale

BASE DRAWING: G E 4 30G1031
COMPANION DRAWINGS: 30A1032
30A1033

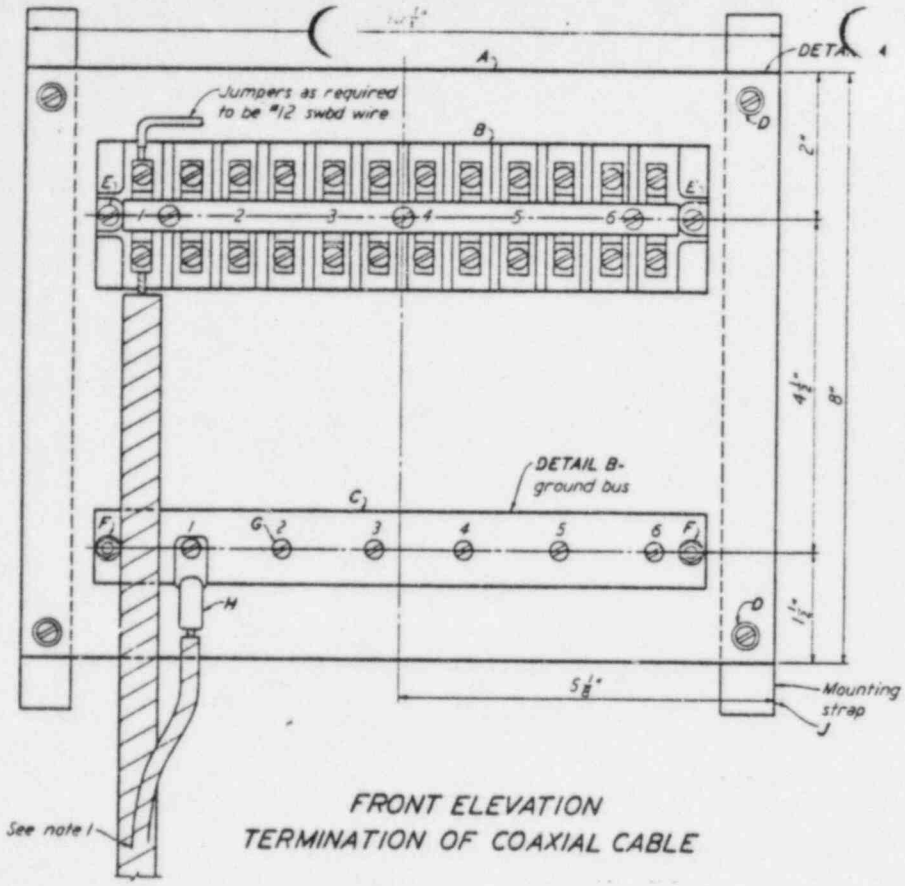
ELECTRICAL STANDARDS

TERMINALS
COAXIAL COMMUNICATION CABLE
STRAIGHT TERMINATION

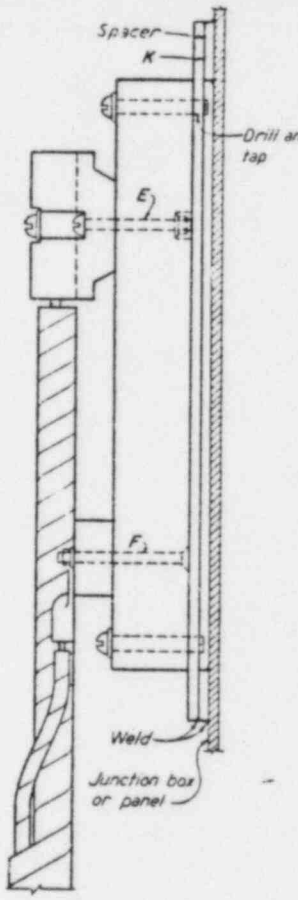
DESIGN AND DRAFTING STANDARDS
TENNESSEE VALLEY AUTHORITY
DIVISION OF DESIGN

SUBMITTED	RECOMMENDED	APPROVED

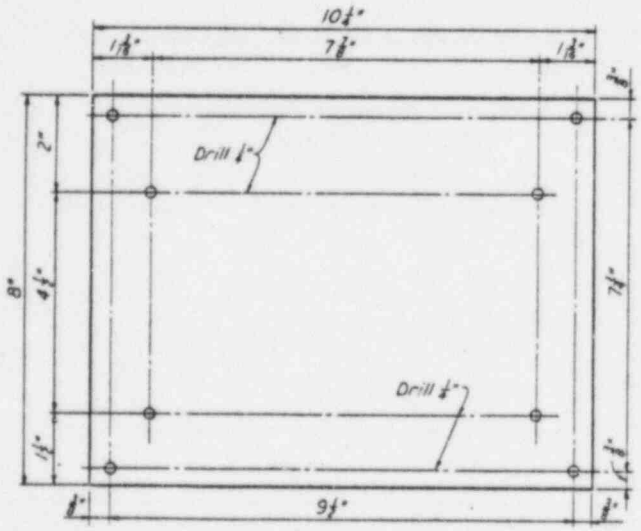
KNOXVILLE	11-7-44	G	E	4	30A1031R1



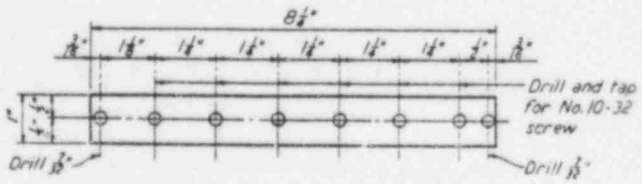
FRONT ELEVATION
TERMINATION OF COAXIAL CABLE



END ELEVATION



DETAIL A
Scale 3"=1'0"



DETAIL B
Scale 3"=1'0"

LIST OF MATERIAL

MK	DESCRIPTION
A	Ebony asbestos block 1"x8"x10½" (drill as per detail A)
B	Terminal block, 12 point, GE 16EB2AB4
C	Bar 1x⅛x0'-8½" brass (drill as per detail B)
D	Machine screw, brass, No. 10-32x1½" RH and washer
E	Machine screw, brass, No. 10-32x1½" RH with hex nut and washer
F	Machine screw, brass, No. 10-32x½" FH with hex nut and washer
G	Machine screw, brass, No. 10-32x½" RH and lockwasher
H	Seamless lug
J	Mounting strap, ⅜"x1½"x0'-9"
K	Spacer ½": ⅜"x0'-7"

NOTES:

1. For cable termination see specific drawing for manufacturer's type of cable. See also 30A1031.
2. When cable enters box through conduit close opening with oakum and sealing compound.

Scale ½"=1"
Except as noted

ELECTRICAL STANDARDS

JUNCTION BOX TERMINAL DETAILS COAXIAL COMMUNICATION CABLE

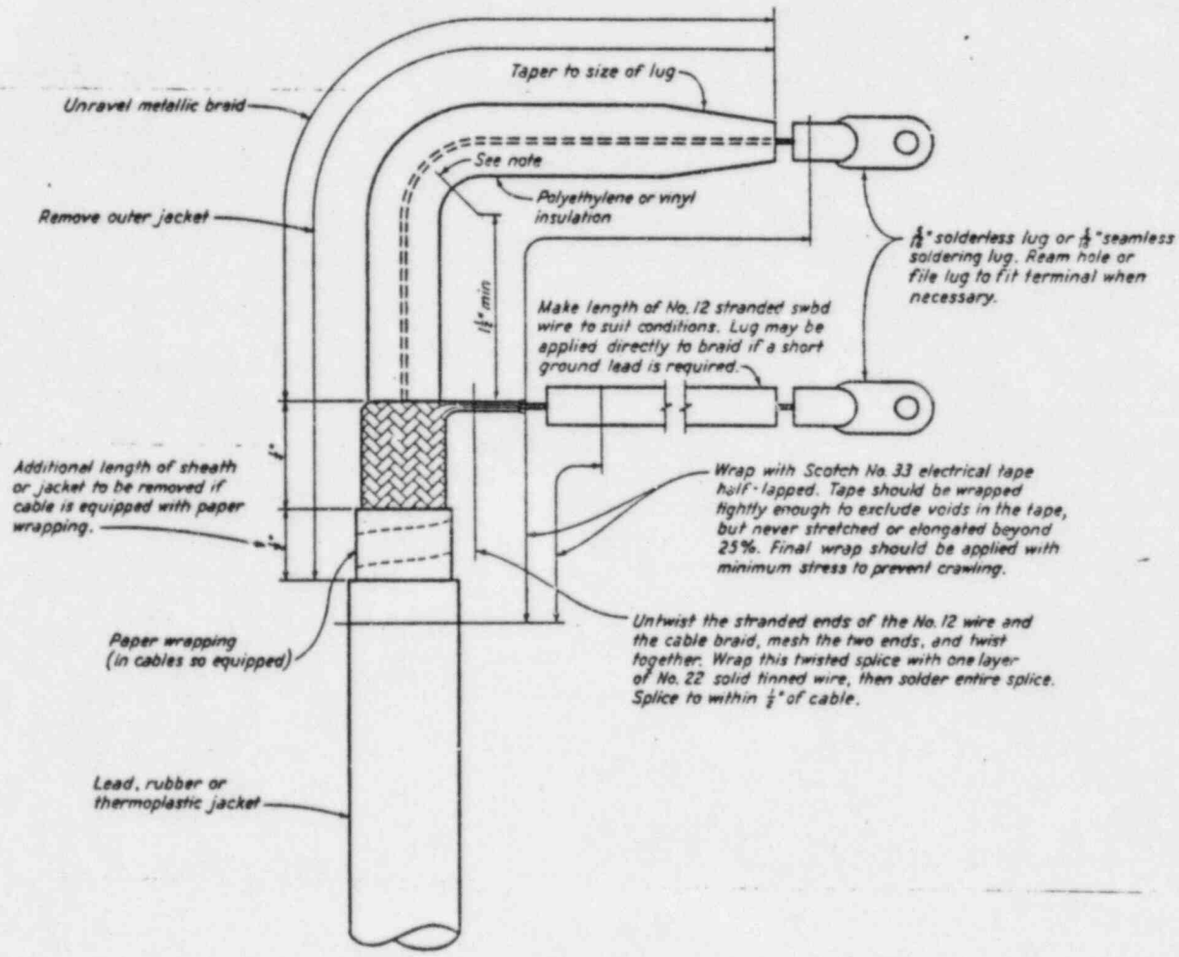
DESIGN AND DRAFTING STANDARDS
TENNESSEE VALLEY AUTHORITY
DESIGN DEPARTMENT

SUBMITTED	RECOMMENDED	APPROVED
	R. A. [illegible]	[illegible]

KNOXVILLE	11-7-44	G	E	4	30A1032 R0

BASE DRAWING 6C4 30G1032
COMPANION DRAWING: 30A1031

CD-65



LEAD, RUBBER OR THERMOPLASTIC JACKET

NOTE:
Apply heat slowly to point at which the polyethylene or vinyl insulated cable is to be bent. Bend the cable to desired shape and hold in position until cool.
Do not apply heat to rubber cable.

Not to scale

DRN	JAJ						
CHKD	CAMC. JAJ.						
TRCD	RHO.						
ENGRG	C. McCord						

BASE DRAWING: G E 4 30G1033
COMPANION DRAWINGS: 30A1031
30A1032

ELECTRICAL STANDARDS

TERMINALS
COAXIAL COMMUNICATION CABLE
CURVED TERMINATION

DESIGN AND DRAFTING STANDARDS
TENNESSEE VALLEY AUTHORITY
DIVISION OF DESIGN

SUBMITTED	RECOMMENDED	APPROVED
V. K. Jydstrup	L. Krause	A. A. Monroe

KNOXVILLE	8-20-58	G	E	4	30A1033 R0