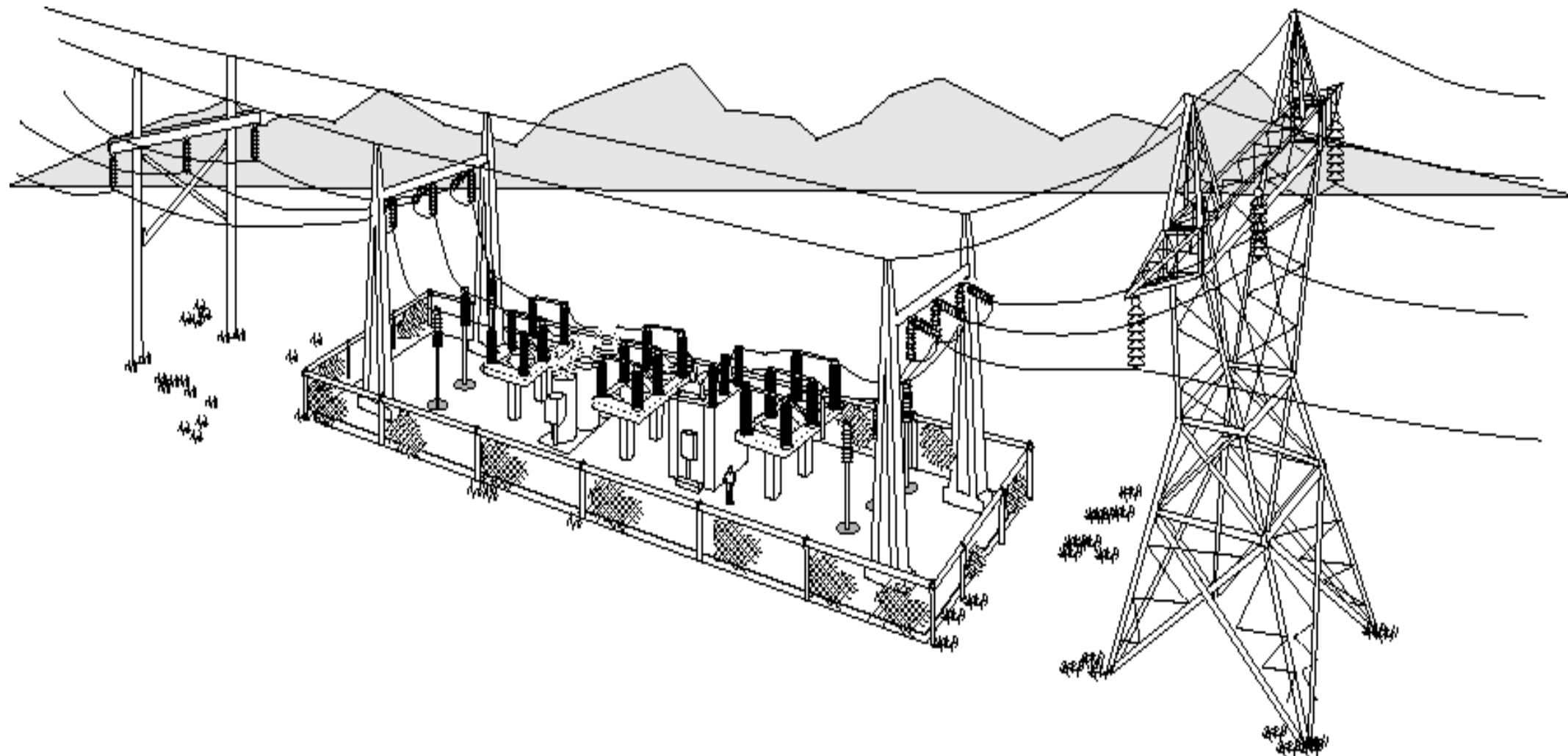


STANDARD DRAWINGS: PART 1

SUBSTATION

**ELECTRICAL DETAILS, GROUNDING, SIGNS, CONCRETE, PLATFORMS,
CONDUIT, FENCE, AND COMMUNICATION**



LIST OF DRAWINGS:

Electrical Details:

- 1. 31 1004 Rev. C – Substation Standards Insulation Coordination
- 2. 31 1005 Rev. F – Substation Standards Buses and Switches Spacings and Clearances
- 3. 31 1007 Rev. G FIO – Substation Standards Hot-Line Fittings Details (For Information Only)
- 4. 31 1020 Rev. G – Substation Standards Insulator and Hardware Assemblies
- 5. 31 1081 Rev. F FIO – Substation Standards Stacking Post Insulators (For Information Only)
- 6. 31 1084 – Substation Standards Stacking Post Insulators
- 7. 31 1085 Rev. K – Substation Standards Terminal and Fuse Boxes
- 8. 31 1086 Rev. D – Substation Standards Type G, H, and K Terminal Boxes
- 9. 31 1087 Rev. B FIO – Substation Standards Stacking Post Insulators Upright M & E Ratings (For Information Only)
- 10. 31 1088 Rev. B FIO – Substation Standards Stacking Post Insulators Underhung M & E Ratings (For Information Only)
- 11. 31 1097 Rev. E – Substation Standards Fiber Optic Cable Mounting
- 12. 31 1099 Rev. B – Substation Standards Fiber Optic Cable Armored Cable Installation
- 13. 31 1100 Rev. I – Substation Standards Equipment and Material Index
- 14. 31 1131 Rev. A – Substation Standards A-Frame 30° Bus Details

Outdoor Lighting:

- 15. 31 1073 Rev. E FIO – Substation Standards Lighting Fixture Pole and Bracket Mounting (For Information Only)
- 16. 31 1091 – Substation Standards Floodlight and Junction Box Details

Outdoor Equipment Schematic Wiring:

- 17. 31 0001-1 Rev. A - Substation Standards Switching Diagram Operating Numbers Bus Configuration
- 18. 31 0001-2 Rev. B - Substation Standards Switching Diagram Operating Numbers Bus Configuration
- 19. 31 0001-3 – Substation Standards Switching Diagram Symbol Legend

Concrete:

- 20. 01 2004-1 Rev. D - Concrete Standards General Outline and Reinforcement Notes
- 21. 01 2004-2 Rev. D - Concrete Standards General Outline and Reinforcement Notes
- 22. 01 2005 Rev. B – Standard Designs Sitework Typical Water Crossing
- 23. 01 2006-1 Rev. B – Concrete Standards Building Slabs-On-Ground Specifications, Notes, Plans & Details

- 24. 01 8000 Rev. B – Design Standards Unified Soil Classification

Platforms:

- 25. 31 2007 Rev. C – Standard Designs Steel Structures Equipment Cabinet Platform
- 26. 31 2014 Rev. B – Substation Standards Switch Operating Platforms Steel Design and Details
- 27. 31 2044 Rev. F – Substation Standards Equipment Cabinet Platforms Steel Design and Details
- 28. 31 2045 Rev. E – Substation Standards – Switch Operating Platforms Steel Design and Details
- 29. 31 2046 Rev. A – Substation Standards – Switch Operating Platforms Steel Design and Details
- 30. 31 2048 – Substation Standards – Switch Operating Platforms Steel Design and Details
- 31. 31 2050 Rev. B – Substation Standards Transformer Platforms Steel Design and Details
- 32. 31 2051 Rev. C – Substation Standards Control Building Structural Building Entry Platform

Signs:

- 33. 31 1000 Rev. D – Substation Standards Identification and Security Signs
- 34. 31 1079 Rev. C – Substation Standards Danger Sign for Shunt Capacitors
- 35. 31 1089 Rev. C – Substation Standards Danger Sign
- 36. 31 4015-1 Rev. B – Controls Standards Nameplate Details Switchboard Front (SH 1 of 3)
- 37. 31 4015-2 Rev. B – Controls Standards Nameplate Details Switchboard Front (SH 2 of 3)
- 38. 31 4015-3 Rev. B – Controls Standards Nameplate Details Switchboard Front (SH 3 of 3)
- 39. 31 1095 Rev. B – Substation Standards Prohibida La Entrada Sign

Grounding:

- 40. 31 1500 Rev. C – Substation Standards Grounding Plans Typical Components
- 41. 31 1501 Rev. E - Substation Standards Fence Grounding Connections Details
- 42. 31 1507 – Substation Standards Sliding Gate General Requirements and Grounding
- 43. 31 1075 Rev. L – Substation Standards Switch Operating and Equipment Platforms Electrical Design and Details
- 44. 31 1058 Rev. D FIO– Substation Standards Typical Grounding Details (For Information Only)
- 45. 31 1059 Rev. D – Substation Standards Typical Grounding Details
- 46. 31 1060 Rev. I – Substation Standards Grounding Details
- 47. 31 1061 Rev. G – Substation Standards Cable Trench Grounding
- 48. 31 1063 Rev. H – Substation Standards Pipe-Bus Grounding Plan
- 49. 31 1077 Rev. E – Substation Standards Ground Cable on Tubular Steel Structures Support Details

- 50. 31 1510 – Substation Standards Grounding Plans Typical Details
- 51. 31 1502-1 – Communications Standard Communication Site Grounding Typical Plan
- 52. 31 1502-2 – Communications Standard Communication Tower Grounding Details for Substation Located Towers
- 53. 31 1503 Rev. A – Communications Standard Communication Tower Grounding Details
- 54. 31 1504 Rev. B – Communications Standard Building Grounding Substation Details
- 55. 31 1505 Rev. A – Communications Standard Building Grounding Remote Site Details
- 56. 31 1506 Rev. B – Communications Standard Guy Tower Grounding Anchor Ground Details
- 57. 53 7051 Rev. A – Equipment Rack Anchoring & Grounding Details

Conduit:

- 58. 31 1006 Rev. I – Substation Standards Conduit Typical Details
- 59. 31 1700 Rev. B – Substation Standards Conduit Installation Details

Fence:

- 60. 31 2000-1 Rev. B – Substation Standards Chain-Line Fence General Requirements (Sheet 1 of 2)
- 61. 31 2000-2 Rev. C – Substation Standards Chain-Line Fence General Requirements (Sheet 2 of 2)
- 62. 31 2001 Rev. I – Substation Standards Chain-Link Fence Gate Latches
- 63. 31 2002 Rev. C – Substation Standards – 5/8 & 3/4 DIA Connection Bolts
- 64. 31 2038 Rev. B – Substation Standards Chain-Link Fence Swing Gates

Indoor Electrical:

- 65. 31 4001 Rev. C – Substation Standards Typical Duplex Switchboard Surge Suppressor Networks Detail Layout
- 66. 31 4003 Rev. D – Substation Standards Control Switches Escutcheons, Lamps and Developments
- 67. 31 4004 Rev. E – Substation Standards Transformer Sudden Pressure Relay Schematic Diagram
- 68. 31 4005 Rev. D – Substation Standards Duplex Switchboard Panel Wiring Diagram and Cabling Methods
- 69. 31 4008 Rev. C – Substation Standards Mimic Bus Color Standard
- 70. 31 4018 Rev. B – Control Standards Typical Arrangement Details CT Junction Boxes and Interface Cabinets
- 71. 31 5103 Rev. C – Substation Standards Hand Reset Auxiliary Relay Test and Monitor Circuits
- 72. 31 6000 Rev. F – Substation Standards PCB Control Cabinets Shielded Cable Grounding
- 73. 31 6005 Rev. A – Substation Standards Control Cable Color Code Identification
- 74. 31 6010 Rev. A – Standard Drawing Switchboard DC Circuit Bus Wiring Diagram
- 75. 31 6011 Rev. B – Substation Standards Typical Power Circuit Breaker Wiring Diagram (Sh 1 of 3)

- 76. 31 6012 Rev. B – Substation Standards Typical Power Circuit Breaker Wiring Diagram (Sh 2 of 3)
- 77. 31 6013 Rev. B – Substation Standards Typical Power Circuit Breaker Wiring Diagram (Sh 3 of 3)

Communication:

- 78. 31 2049-1 Rev. B – Substation Standards Control Switchboard Equipment & Communication Rack (Sheet 1 of 2)
- 79. 31 2049-2 Rev. A – Substation Standards Control Switchboard Equipment & Communication Rack (Sheet 2 of 2)
- 80. 53 7050 Rev. A – Equipment Rack Layout & Details

EXPLANATION

(a)___DO NOT USE AT ANY ELEVATION.

INSULATION COORDINATION

RATED SYSTEM VOLTAGE KV	INSULATION LEVEL	GROUNDED NEUTRAL SYSTEM(TYPICAL)					INSULATION LEVEL	UNGROUND NEUTRAL SYSTEM(UNCOMMON)				
	BIL KV	MINIMUM # 5 3/4x10 INSULATOR DISCS REQUIRED	MAXIMUM ELEVATION- FEET				BIL KV REQUIRED	MINIMUM # 5 3/4x10 INSULATOR DISCS REQUIRED	MAXIMUM ELEVATION- FEET			
			SUSPENSION INSULATOR DISCS	SWITCH AND BUS INSULATORS	POWER CIRCUIT BREAKERS	TRANSFORMERS			SUSPENSION INSULATOR DISCS	SWITCH AND BUS INSULATORS	POWER CIRCUIT BREAKERS	TRANSFORMERS
8.3	95	2	3,200				200	3	8,500			5,500
15.5	110	2	3,200				200	3	4,600			1,400
27.0	150	3	3,200				250	(a)	(a)			(a)
27.0	200	3	10,900				350	5	11,200			8,400
38.0	200	3	3,200				250	(a)	(a)			(a)
38.0	250	4	9,200				350	5	3,500			300
48.3	250	4	3,200				350	(a)	(a)			(a)
48.3	350	5	12,200				450	6	4,300			1,100
72.5	250	4	3,200				450	6	4,300			1,100
72.5	350	5	12,200				550	7	9,700			6,700
72.0	550	7	24,300				650	8	14,100			11,400
123.0	550	7	3,200				650	(a)	(a)			(a)
123.0	650	8	7,700				1050	14	5,900			2,700
145.0	650	8	3,200				750	(a)	(a)			(a)
145.0	750	9	8,100				1300	18	7,100			4,000
170.0	750	10	3,200				900	(a)	(a)			(a)
170.0	900	12	8,100				1300	18	3,300			50
245.0	900	12	3,200				1300	(a)	(a)			(a)
245.0	1050	14	7,400				1800	18	3,300			50
245.0	1300	18	13,100									
362.0	1300	18	3,200				1800	(a)	(a)			(a)
550.0	1800	24	3,200				1800	(a)	(a)			(a)

NOTES

1. LIGHTNING ARRESTERS SHOULD BE APPLIED IN ACCORDANCE WITH THE MANUFACTURER'S STANDARDS, UNLESS OTHERWISE NOTED.
2. COUPLING CAPACITORS AND INSTRUMENT TRANSFORMERS SHOULD BE APPLIED TO SAME ELEVATIONS AS GIVEN FOR SWITCH AND BUS INSULATORS
3. THE RATED KVA CAPACITY OF TRANSFORMERS WILL BE REDUCED FOR EACH 330 FEET THAT THE ALTITUDE IS ABOVE 3300 FEET:
FOR OIL-IMMERSED SELF-COOLED-----0.4%
FOR FORCED-AIR-COOLED-----0.5%
FOR FRT-TYPE SELF-COOLED-----0.3%
FOR DRY-TYPE FORCED-AIR-COOLED----0.5%
4. ALTITUDE CORRECTION CALCULATION METHOD:
SUSPENSION/SWITCH & BUS/PCB: IEC 60071-2 (EXP.)
TRANSFORMER: IEEE C37.100.1 (CONT.)

C4-17-26A7-KVCHANGED # OF INSULATOR DISCS REQUIRED TO MIN # OF DISCS REQUIRED. UPDATED TABLE VALUES.

FORMERLY DWG NO. 140-D-407

UNITED STATES DEPARTMENT OF ENERGY
WESTERN AREA POWER ADMINISTRATION
CORPORATE SERVICES OFFICE - GOLDEN, COLORADO

SUBSTATIONS STANDARDS
INSULATION COORDINATION

DESIGNED BUREC_____APPROVED _____
ELECTRICAL ENGINEERING
MANAGER

AJANUARY 13, 1984311004

TABLE A
SPACINGS AND CLEARANCES FOR BUSES AND SWITCHES IN SUBSTATIONS (NOTES 1, 2 & 3)

LINE NUMBER ↓ (COLUMN) →	RATED MAXIMUM VOLTAGE (KV RMS)	BIL (KV CREST)	PHASE- TO-PHASE METAL- TO-METAL (MINIMUM (FEET-INCHES)	PHASE-TO-GROUND CLEARANCES		CENTERLINE-TO-CENTERLINE PHASE SPACING			CLEARANCE FROM OVERHEAD CONDUCTOR TO GROUND AND ROAD SURFACES INSIDE SUBSTATIONS	
				MINIMUM (FEET-INCHES)	RECOMMENDED (FEET-INCHES)	VERTICAL BREAK DISCONNECTING SWITCHES AND BUS SUPPORTS (FEET-INCHES)	SIDE BREAK (HORIZONTAL BREAK) DISCONNECTING SWITCHES (FEET-INCHES)	ALL HORN GAP SWITCHES VERTICAL AND SIDE BREAK (FEET-INCHES)	TO GROUND SURFACES (FEET-INCHES)	TO ROAD SURFACES (FEET-INCHES)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1	15.5	110	1'-0"	0'-7"	1'-0"	* 2'-0"	* 2'-6"	* 3'-0"	11'-0"	20'-0"
2	27	150	1'-3"	0'-10"	1'-3"	* 2'-6"	* 3'-0"	* 4'-0"	11'-0"	22'-0"
3	38.0	200	1'-6"	1'-1"	1'-11"	* 3'-0"	* 4'-0"	5'-0"	11'-0"	22'-0"
4	48.3	250	1'-9"	1'-5"	1'-11"	* 4'-0"	5'-0"	6'-0"	11'-0"	22'-0"
5	72.5	350	2'-7"	2'-1"	2'-7"	5'-0"	6'-0"	7'-0"	11'-0"	23'-0"
6	123	550	4'-5"	3'-6"	3'-11"	7'-0"	9'-0"	10'-0"	12'-0"	24'-0"
7	145	650	5'-3"	4'-2"	4'-5"	8'-0"	11'-0"	12'-0"	13'-0"	25'-0"
8	170	750	6'-0"	4'-10"	5'-2"	9'-0"	13'-0"	14'-0"	14'-0"	26'-0"
9	245	900	7'-5"	5'-11"	6'-7"	12'-0"	16'-0"	16'-0"	15'-0"	27'-0"
10	245	1050	8'-9"	6'-11"	7'-7"	13'-0"	18'-0"	18'-0"	16'-0"	28'-0"
11	362	1300	9'-11"	8'-8"	8'-10"	16'-0"	-	20'-0"	18'-0"	30'-0"
12	550	1800		12'-0"	12'-8"	25'-0"	-	30'-0"	30'-0"	35'-0"
ADJUST FOR ELEVATIONS OVER 3,300 FT (NOTE 3)				* NOTE 1						

COLUMNS 3 THRU 8: MEETS OR EXCEED VALUES BASED ON IEEE C37.30.1 TABLE 14

COLUMNS 9 & 10: MEETS OR EXCEEDS VALUES BASED ON NESC C2, TABLE 232-1

TABLE B
STATION FENCE SAFETY CLEARANCES (NOTES 3 & 4)

LINE NUMBER ↓ (COLUMN) →	MAXIMUM PHASE-TO- PHASE (KV RMS)	MAXIMUM PHASE-TO- GROUND (KV RMS)	IMPULSE BIL (KV CREST)	DIMENSIONS FOR FIGURE 1 (NESC C2 FIGURE 110-1)				
				MINIMUM ZONE			RECOMMENDED MINIMUM ZONE	
				DIMENSION-A (FEET-INCHES)	PEDESTRIAN ONLY DIMENSION-A (FEET-INCHES)	DIMENSION-B (FEET-INCHES)	DIMENSION-A (FEET-INCHES)	DIMENSION-B (FEET-INCHES)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	15.5-38	22	110-150	20'-1"	15'-1"	10'-7"	25'-1"	15'-0"
2	48.3-72.5	42	250-350	21'-1"	16'-1"	11'-7"	26'-1"	15'-0"
3	121	70	550	21'-1"	16'-1"	13'-0"	26'-1"	16'-0"
4	145	84	650	21'-7"	16'-7"	13'-8"	26'-7"	16'-8"
5	169	98	750	22'-0"	17'-0"	14'-4"	27'-0"	17'-4"
6	242	140	900	23'-5"	18'-4"	15'-5"	28'-5"	18'-5"
7	242	140	1050	23'-5"	18'-4"	16'-5"	28'-5"	19'-5"
8	362	209	1300	25'-8"	20'-8"	18'-4"	30'-8"	21'-4"
9	555	318	1800	29'-5"	24'-5"	21'-6"	29'-5"	24'-6"
ADJUST FOR ELEVATIONS OVER 3,300 FT (NOTE 3)								

COLUMN 4: BASED ON NESC C2, TABLE 232-1 FOR ROADWAYS, DRIVEWAYS, ALLEYS, PARKING LOTS; CULTIVATED, GRAZED OR FORESTED LAND (NOTE 3).

COLUMN 5: SPACES SUBJECT TO PEDESTRIANS OR RESTRICTED TRAFFIC ONLY. READ THE FULL DESCRIPTION IN NESC C2, TABLE 232-1, FOOTNOTE 9 FOR APPLICABILITY.

COLUMN 5: BASED ON NESC C2, PROTECTIVE ARRANGEMENTS IN ELECTRIC SUPPLY STATIONS SECTION AND NESC C2 TABLE 110-1.

COLUMN 6: COLUMN 6 ADDS 5'-0" BUFFER PER WAPA POLICY IN ADDITION TO NESC C2 REQUIREMENTS.

COLUMN 7: COLUMN 7 ADDS A 3'-0" BUFFER TO ACCOUNT FOR MAXIMUM ALTITUDE CORRECTION APPLIED TO COLUMN 5. A MINIMUM OF 15'-0" HORIZONTAL CLEARANCE IS REQUIRED FOR ACCESS AND MAINTENANCE. FOR VEHICULAR TRAFFIC BETWEEN LIVE PARTS AND FENCE, HORIZONTAL CLEARANCE OF AT LEAST 30 FEET (40 FEET FOR SUBSTATIONS 345KV OR HIGHER) IS REQUIRED.

TABLE C
SEPARATION OF TRANSFORMERS & OIL FILLED EQUIPMENT (NOTE 5)

LINE NUMBER ↓ (COLUMN) →	TRANSFORMER RATING (KVA)	OIL (GALLONS)	FROM BUILDINGS	FROM TRANSFORMERS
			(X) SEPARATION WITHOUT FIREWALL (FEET-INCHES)	(Y) SEPARATION WITHOUT FIREWALL (FEET-INCHES)
(1)	(2)	(3)	(4)	(5)
1	1,000 OR LESS	LESS THAN 500	5'-0"	5'-0"
2	UP TO 10,000	500 TO 5,000	25'-0"	25'-0"
3	OVER 10,000	OVER 5,000	50'-0"	50'-0"

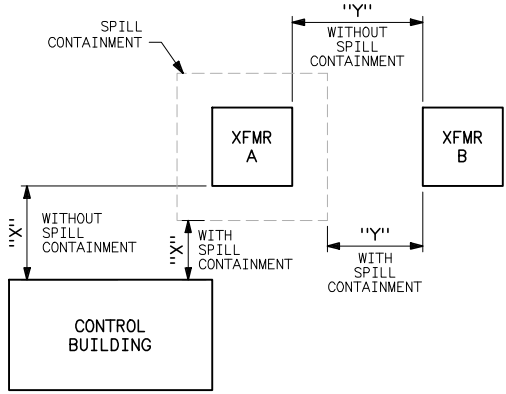


FIG 2
MINIMUM SEPARATION DISTANCE FOR OIL FILLED EQUIPMENT

NOTES

- FOR NEW CONSTRUCTION, PHASE SPACING SHALL BE NO LESS THAN 5'-0" TO LIMIT ANIMAL INDUCED OUTAGES.
- EXCEPT FOR SEISMICALLY QUALIFIED INSTRUMENT TRANSFORMERS (8'-0"), CLEARANCES FROM GROUND TO THE BOTTOM OF EQUIPMENT BUSHINGS OR INSULATORS SHALL BE NO LESS THAN 8'-6".
- MINIMUM DISTANCES SHALL BE INCREASED FOR ELEVATIONS ABOVE 3300' USING THE FOLLOWING FORMULA:
$$(((\text{ELEVATION}-3300)\div1000)\times3\%)\times\text{DISTANCE}$$
- WAPA USES A 15'-0" VEHICLE REFERENCE HEIGHT. NESC C2 TABLE 232-3 PERMITS A 14'-0" REFERENCE HEIGHT. THE ADDITIONAL 1'-0" ACCOMMODATES TALLER VEHICLES, INCLUDING FARM EQUIPMENT AND IS ALREADY INCORPORATED INTO TABLE B CLEARANCES.
- MINIMUM SEPARATION DISTANCES ARE IN ACCORDANCE WITH IEEE 979 AND NFPA 850.

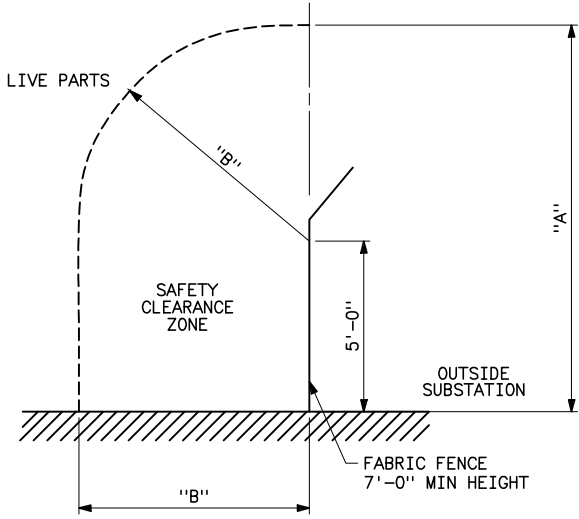
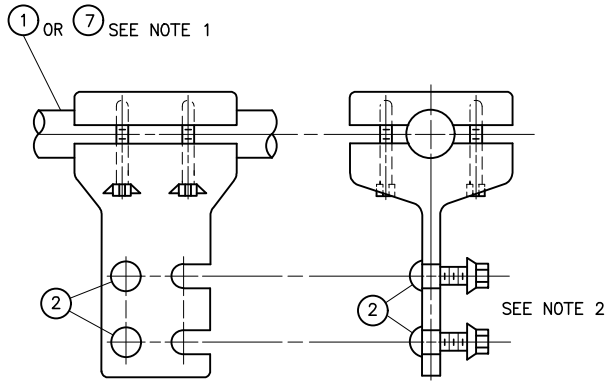


FIGURE 1
SAFETY-CLEARANCE TO ELECTRIC-SUPPLY STATION FENCES

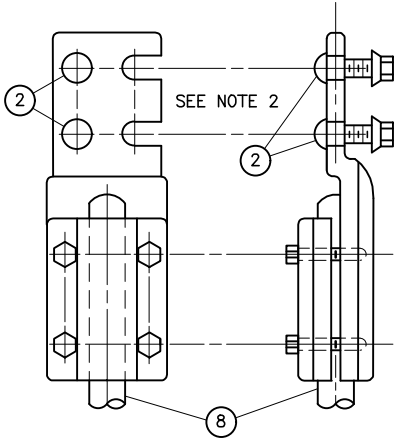
F	4-17-26 A7-KV	REVISED NOTES AND A & B VALUES IN TABLE B. UPDATED CODE REFERENCES.
E	7-20-06 A7-RC	REVISED TABLE A, COLUMN (6) FOR 242 AND 362KV
D	3-12-01 A7-RMC	ADDED FIG 1 AND ASSOCIATED DIMENSIONS TABLE B.
C	8-18-00 A3-RMC	REDRAWN, REVISED COLUMN 4 TO AGREE WITH NEMA SG-6, ADDED LINE 12, AND ADDED NOTES.
FORMERLY DWG NO. 40-D-411		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - GOLDEN, COLORADO		
SUBSTATION STANDARDS BUSES AND SWITCHES SPACINGS AND CLEARANCES		
DESIGNED	BUREC	APPROVED ROSS M. CLARK ELECTRICAL ENGINEERING MANAGER
DATE	JANUARY 6, 1984	31 1005

Sep 15, 2026- 12:45pm Plotted By: court S:\Projects\Misc\StandardDrawings\Drawings\DesignReadyForFinal\Scripts\31_1007g_11a.dwg Last Saved By: court IMAGES:



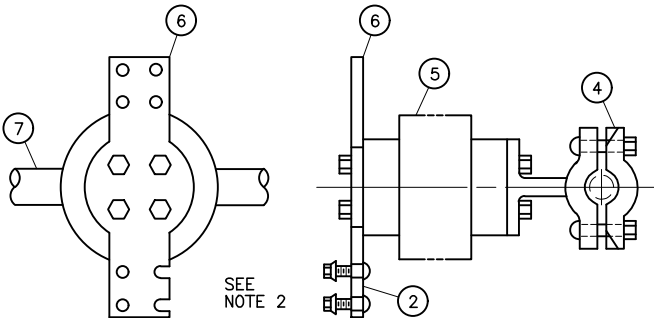
DETAIL A

HOT-LINE T-CONNECTOR (NTS)



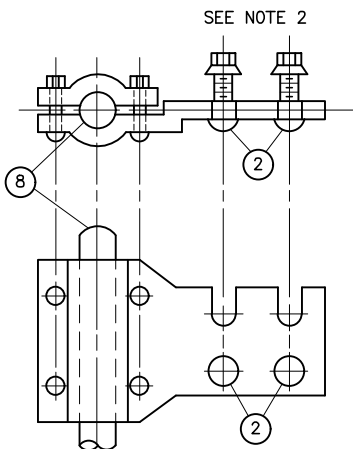
DETAIL C

HOT-LINE STUD TO PAD CONNECTOR (NTS)



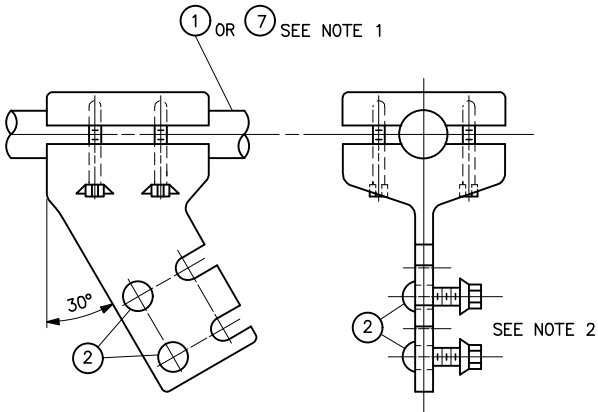
DETAIL E

STAND OFF INSULATOR ASSEMBLY (NTS)



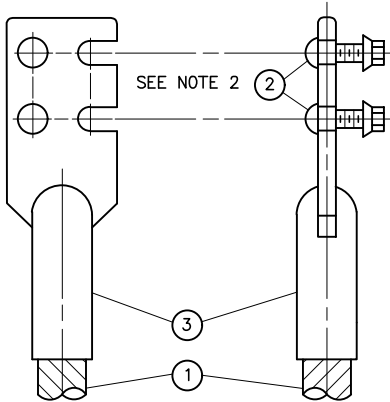
DETAIL G

90° HOT-LINE STUD TO PAD CONNECTOR (NTS)



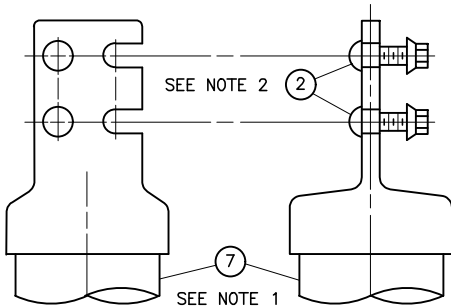
DETAIL B

30° HOT-LINE T-CONNECTOR (NTS)



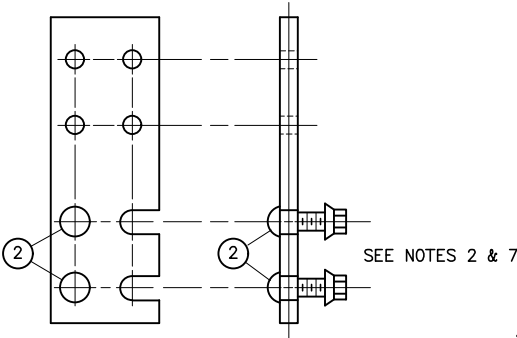
DETAIL D

HOT-LINE JUMPER CONNECTOR (NTS)



DETAIL F

WELDED HOT-LINE END COUPLER (NTS)



DETAIL H

HOT-LINE PAD TO PAD (NTS)

ITEM NO.	DESCRIPTION (SEE NOTE 6)
1	STRANDED ALUMINUM OR ACSR CONDUCTOR
2	WELDED AND POLISHED BOLT HEAD
3	COMPRESSION FITTING
4	BUS SUPPORT CLAMP 3-INCH BC
5	POST INSULATOR (TR NO. 202)
6	TERMINAL LUG CONNECTOR PLATE 3-INCH BC
7	SPS ALUMINUM TUBING
8	TERMINAL STUD

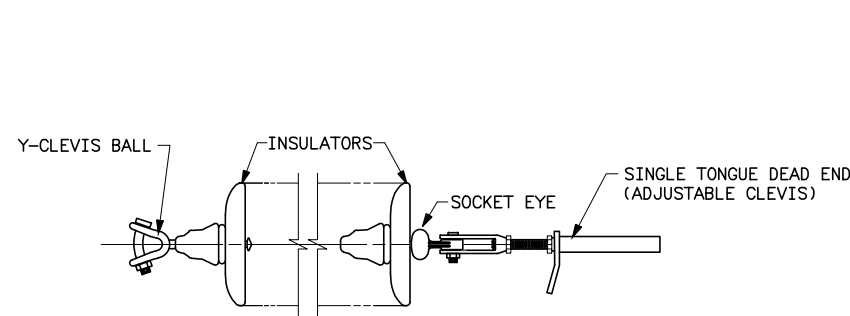
NOTES

1. WELDMENT TYPE FITTINGS SHALL BE USED ON RIGID BUS IN LIEU OF BOLTED UNLESS OTHERWISE SPECIFIED.
2. BOLT LENGTH SHALL BE SUFFICIENT TO ALLOW INSTALLATION AND REMOVAL OF MATING TERMINAL PAD WITHOUT REQUIRING REMOVAL OF HEX-HEAD NUT. AFTER INSTALLATION THE BOLT SHALL NOT EXTEND BEYOND TOP OF NUT.
3. TERMINAL CONNECTOR PADS TO CONFORM WITH NEMA STANDARDS CC-1/ANSI C119.3.
4. ALL CONNECTORS, INCLUDING SHIELDING CAPS, SHALL BE SUITABLE FOR INSTALLATION AND REMOVAL BY USE OF HOT-LINE TOOLS.
5. ALL NUTS USED IN CONJUNCTION WITH HOT-LINE FITTINGS SHALL BE COMBINATION NUT-WASHERS (SHOULDER NUTS) OF THE REUSABLE CAPTIVE TYPE.
6. CONNECTORS FOR USE AT VOLTAGES OF 230KV AND ABOVE SHALL BE DESIGNED TO BE CORONA FREE OR SHIELDING CAPS SHALL BE PROVIDED ON THE CONNECTORS TO CONTROL CORONA.
7. DETAIL "H" IS DESIGNED FOR USE WITH OTHER HOT-LINE FITTINGS, WITH BOLTS REVERSED WHEN NECESSARY.

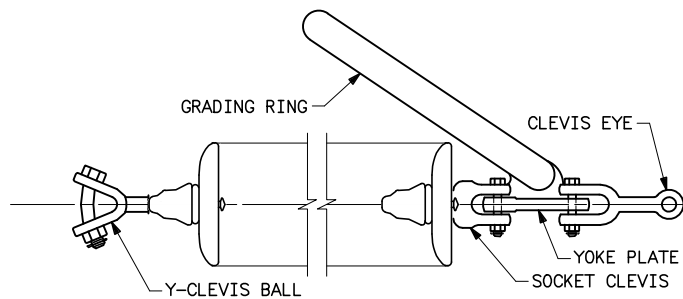
HOT LINE FITTINGS ARE NO LONGER USED AT WAPA FOR NEW CONSTRUCTION. FOR CONNECTION TO LEGACY FITTINGS, NEW NEMA 4 FITTINGS CAN BE BOLTED DIRECTLY TO EXISTING FITTING.

FOR INFORMATION ONLY

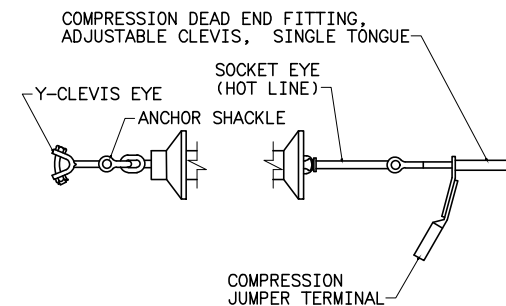
G	8-7-26 A7-KB	HOT LINE FITTINGS ARE NO LONGER USED AT WAPA FOR NEW CONSTRUCTION. FOR CONNECTION TO LEGACY FITTINGS, NEW NEMA 4 FITTINGS CAN BE BOLTED DIRECTLY TO EXISTING FITTING.
F	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.
E	5-14-99 A3-OP	REDRAWN.
SUPERSEDES DWG NO. 40-D-6928		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS HOT-LINE FITTINGS DETAILS		
DESIGNED BUREC _____ APPROVED ROSS M. CLARK ELECTRICAL ENGINEERING MANAGER		
C A E	MAY 18, 1979	31 1007



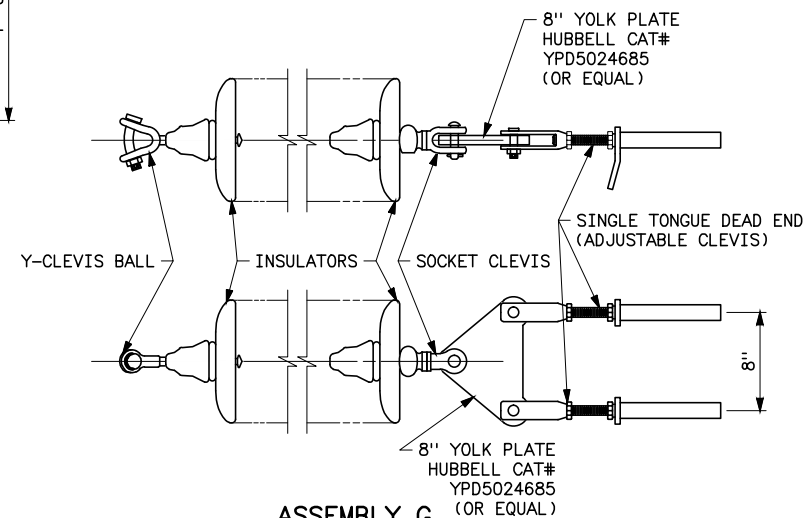
ASSEMBLY A



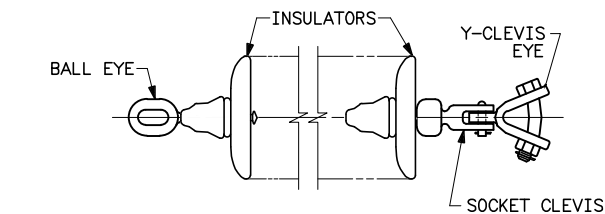
ASSEMBLY W



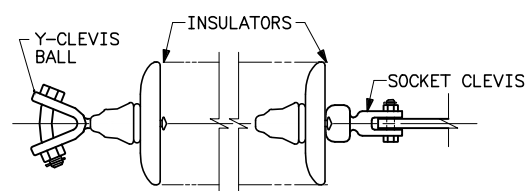
ASSEMBLY F
SINGLE POLYMER-FIBERGLASS INSULATOR STRING
ONE SUBCONDUCTOR (NOTE 5)



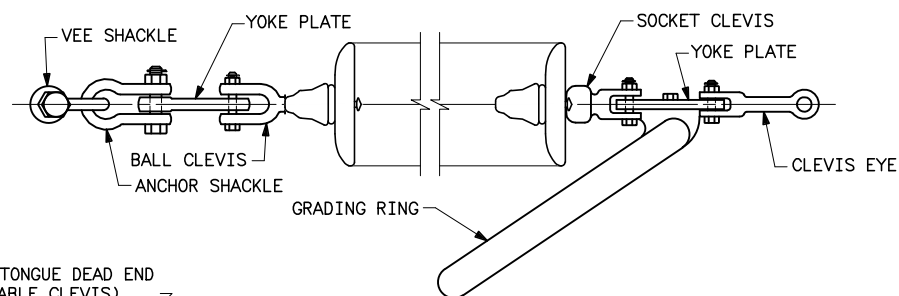
ASSEMBLY G



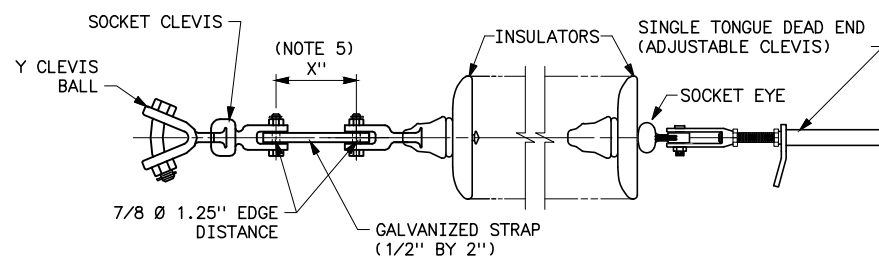
ASSEMBLY C



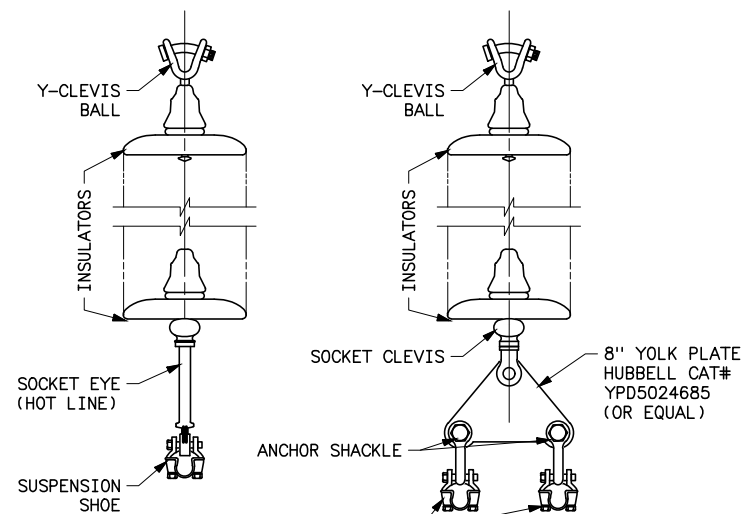
ASSEMBLY D



ASSEMBLY Y



ASSEMBLY E



ASSEMBLY H

ASSEMBLY I

GROUNDING NEUTRAL SYSTEM

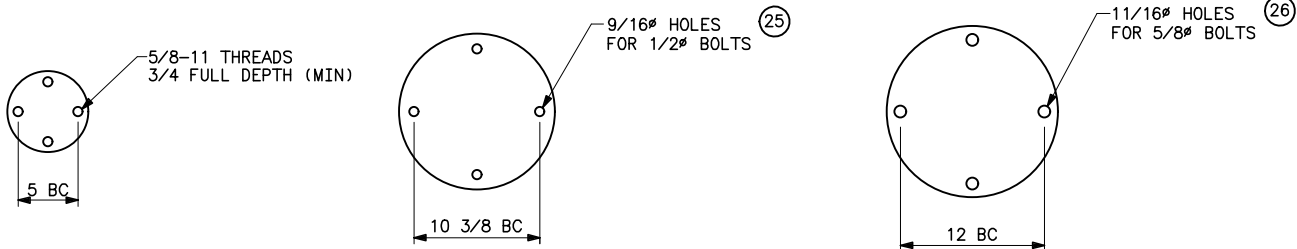
TABLE 1 PORCELAIN OR GLASS UNITS		
VOLTAGE (KV)	MAXIMUM ALTITUDE	NUMBER OF 5 3/4 DISCS
25	19,800	2
34.5	19,800	3
46	19,800	4
69	1900	7
115	18,100	10
138	16,900	11
161	15,900	12
230	10,700	15

NOTES

- INSULATORS SHALL BE SOCKET AND BALL TYPE ANSI CLASS 52-3, PORCELAIN, ANSI GREY WITH A MECHANICAL AND ELECTRICAL STRENGTH OF 20,000 LBS.
- ALL HARDWARE SHALL BE GALVANIZED MALLEABLE IRON OR FORGED STEEL WITH AN ULTIMATE STRENGTH HIGHER THAN THE RATED STRENGTH OF THE REFERENCED INSULATOR CLASS. YOKE PLATES AND TOWER ATTACHMENT HARDWARE FOR DOUBLE STRING ASSEMBLIES SHALL HAVE ULTIMATE STRENGTH TWO TIMES THE RATED STRENGTH OF REFERENCED INSULATOR CLASS.
- ALL HARDWARE BOLTS SHALL BE FURNISHED WITH NUT AND COTTER KEY.
- THE NUMBER OF PORCELAIN OR GLASS INSULATORS SHALL BE DETERMINED BY TABLE 1.
- THE SIZE, RATING, LENGTH, HOLE SIZES, ETC ARE SHOWN ON THE PLAN OR SECTION DRAWINGS.
- FITTINGS AND GRADING RINGS SHALL BE USED AT 345KV AND UP.

G	4-17-26 A7-KV	ADDED ASSEMBLIES G, H AND I. ADJUSTED INSULATION COORDINATION TO MATCH T-LINE
F	4-8-14 A7-RMJ	DELETED ASSEMBLY G. ADDED NOTE 6.
E	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.
D	6-6-01 A7-JTH	ADDED ASSEMBLIES F AND G.
C	10-31-96 A3-OP	ADDED TABLE 1.
B	8-2-96 A3-	REDRAWN. ADDED INSULATOR ASSEMBLIES WITH GRADING RINGS.
SUPERSEDES DWG NO. 40-D-5359		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS INSULATOR AND HARDWARE ASSEMBLIES		
DESIGNED J.D.T. W.C.W. APPROVED ROSS M. CLARK ELECTRICAL ENGINEERING MANAGER		
C	A	E
MAY 18, 1979	31	1020

Plotted By: court Sep 15, 2026- 12:47pm
Images: S:\Projects\Misc\StandardDrawings\Drawings\DesignDrawings\DrawingsReadyForFinal\Scripts\31-1081.rvt.dwg Last Saved By: Court, Donita (CONTR) on 9/15/2026 12:47 PM



END CAP FOR ALL INSULATOR STACKS

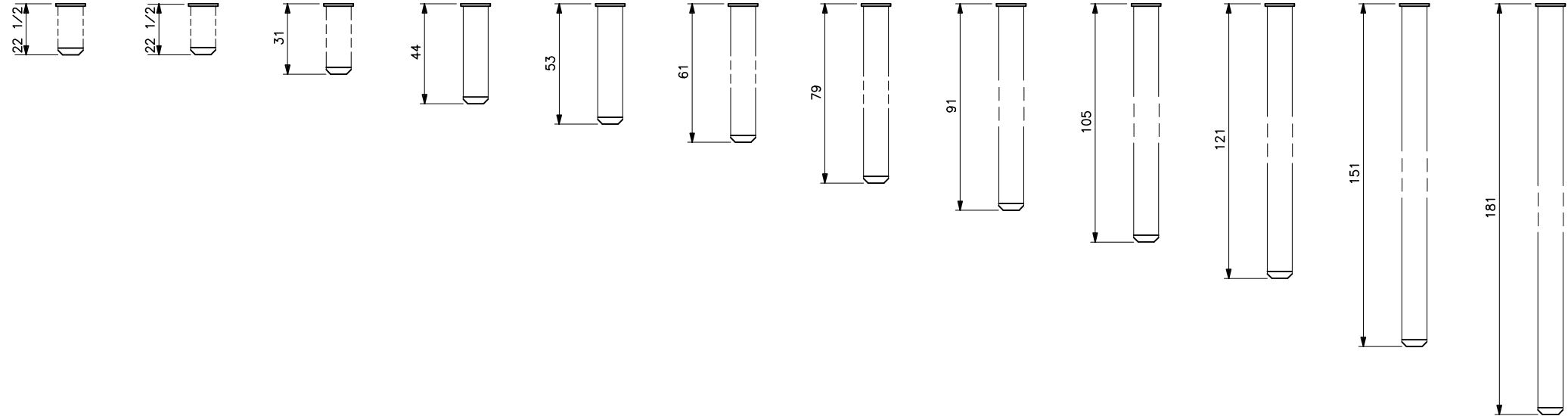
FLANGED BASE CAP FOR 200-1050KV BIL ASSEMBLIES

FLANGED BASE CAP FOR 1300-2050KV BIL ASSEMBLIES



ITEM 1 200KV BIL TR 267 EQUIV(HS)
ITEM 2 250KV BIL TR 267 EQUIV(HS)
ITEM 3 350KV BIL TR 278 EQUIV(HS)
ITEM 4 550KV BIL TR 287 EQUIV(HS)
ITEM 5 650KV BIL TR 289 EQUIV(HS)
ITEM 6 750KV BIL TR 295 EQUIV(HS)
ITEM 7 900KV BIL TR 308 EQUIV(HS)
ITEM 8 1050KV BIL TR 316 EQUIV(HS)
ITEM 9 1300KV BIL TR 369 EQUIV(EHS) (TAPERED)
ITEM 10 1470KV BIL TR 373 EQUIV(EHS) (TAPERED)
ITEM 11 1800KV BIL TR 391 EQUIV(SS) (TAPERED)
ITEM 12 2050KV BIL TR N/A (SS) (TAPERED)

UPRIGHT STACKING POST INSULATORS (NOTE 3)



ITEM 13 200KV BIL TR 267 EQUIV(HS)
ITEM 14 250KV BIL TR 267 EQUIV(HS)
ITEM 15 350KV BIL TR 278 EQUIV(HS)
ITEM 16 550KV BIL TR 287 EQUIV(HS)
ITEM 17 650KV BIL TR 289 EQUIV(HS)
ITEM 18 750KV BIL TR 295 EQUIV(HS)
ITEM 19 900KV BIL TR 308 EQUIV(HS)
ITEM 20 1050KV BIL TR 316 EQUIV(HS)
ITEM 21 1300KV BIL TR 369 EQUIV(EHS) (TAPERED)
ITEM 22 1470KV BIL TR 373 EQUIV(EHS) (TAPERED)
ITEM 23 1800KV BIL TR 391 EQUIV(SS) (TAPERED)
ITEM 24 2050KV BIL TR N/A (SS) (TAPERED)

UNDERHUNG STACKING POST INSULATORS (NOTE 3)

ITEM NO.	DESCRIPTION				
	MATERIAL TO BE EQUIVALENT TO TYPES REFERENCED (SEE NOTES 1, 2 AND 3)				
	MANUFACTURER CATALOG NO.				
	LAPP	NEWELL	NGK-LOCKE	VICTOR	
1	J54795A	7001	PX0348	1710	
2	J54795A	7001	PX0348	1710	
3	J48404B	7001	PX0349	1714	
4	J313256-70	47821-7101	PH05512	1725-33	
5	J320613-70	47822-7101	PH06512	1726-33	
6	J52161FPA-70	47823-71-1	PH07512	1727-33	
7	J318201-70	47825-7101	PH090221	1728-32	
8	J50439F-70	47827-7101	PH105221	1729-32	
9	J311908A-70	47862-7101	PE13022	1603-35	
10	J310875-70	47848-7101	PE14722	1614	
11	J300744A-70	47854-7101	PE18032	1640	
12	J310877-70	47855-7101	PE20532		
13	J54796A	47163-7001	PX0315	1711	
14	J54796A	47163-7001	PX0315	1711	
15	J48405B	47169-7001	PX0316	1715	
16	J313248-70	47821-7201	PX0286	1725-34	
17	J320614-70	47822-7201	PX0313	1726-34	
18	J310921PA-70	47823-7201	PX0307	1727-34	
19	J318571-70	47825-7201	PX0309	1728-33	
20	J310924-70	47827-7201	PX0310	1729-33	
21	J313259-70	48149-7201	PX0311	1634-34	
22	J310927-70	47504-7201	PX0312	1615	
23	J313260-70	48191-7201	PX0306	1641	
24	J310920-70	47503-7201	PX0305		
25	BASE MOUNTING BOLTS 1/2 IN. GALV STEEL WITH LENGTH TO SUIT, COMPLETE W/NUTS AND LOCKWASHERS				
26	BASE MOUNTING BOLTS 5/8 IN. GALV STEEL WITH LENGTH TO SUIT, COMPLETE W/NUTS AND LOCKWASHERS				

EXPLANATION

SS ---- STANDARD STRENGTH
HS ---- HIGH STRENGTH
EHS ---- EXTRA-HIGH STRENGTH

NOTES

1. COLOR SHALL BE LIGHT GRAY (ANSI 70).
2. BIL RATINGS ARE FOR INSULATOR ASSEMBLIES. UNITS MAY BE ASSEMBLED WITH OR WITHOUT RAIN SHIELDS.
3. EQUIVALENT STACKING POST INSULATOR ASSEMBLIES SHALL MEET THE REFERENCED ANSI TR NUMBER ELECTRICAL AND MECHANICAL STRENGTH CHARACTERISTICS. HARDWARE CAPS SHALL BE IN ACCORDANCE WITH THIS DRAWING.

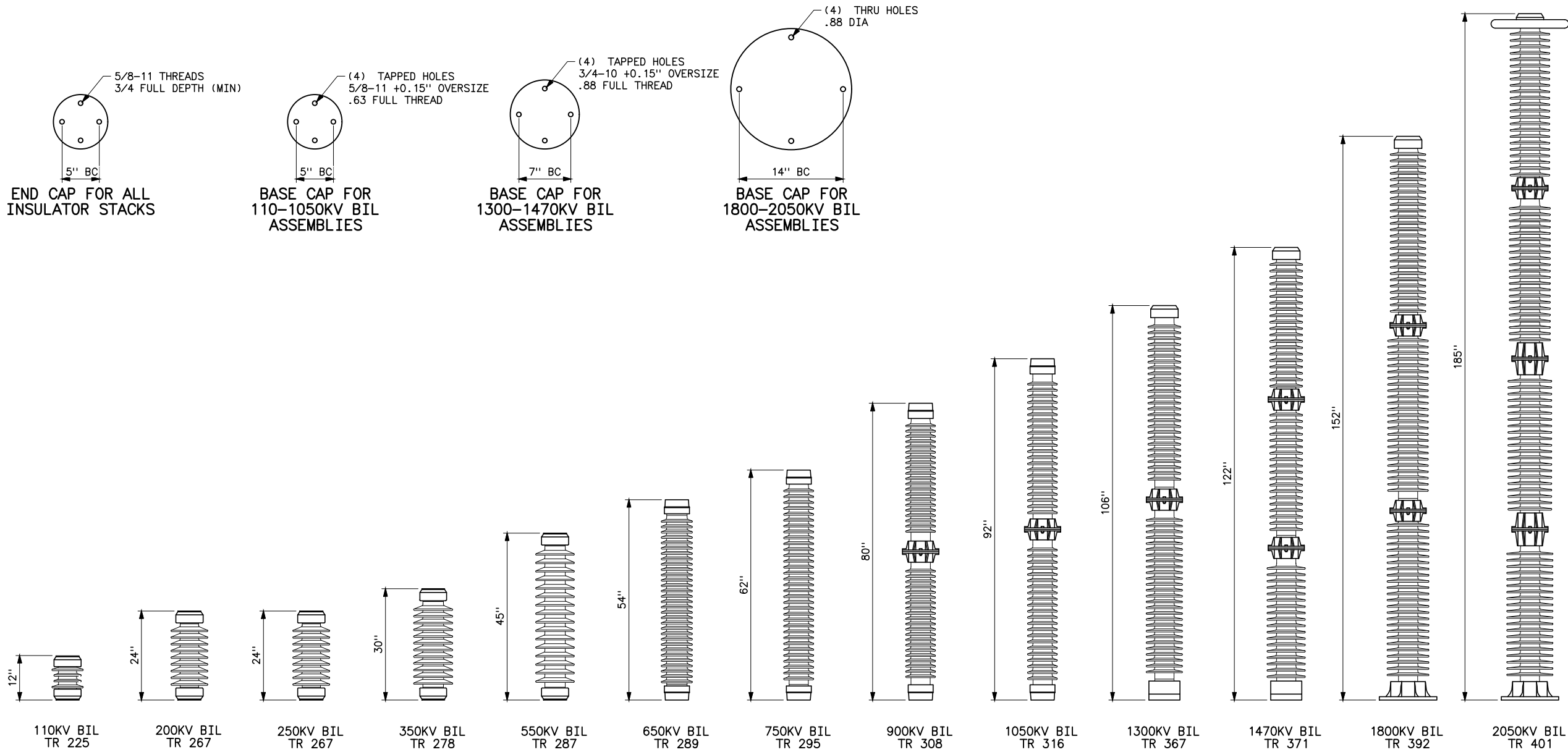
REFERENCE DRAWINGS

STACKING POST INSULATORS -
UPRIGHT M & E RATINGS -----31 1087
STACKING POST INSULATORS -
UNDERHUNG M & E RATINGS -----31 1088

DRAWING IS NO LONGER USED AT WAPA FOR NEW CONSTRUCTION.
SEE DRAWING 31 1084.

FOR INFORMATION ONLY

F	8-7-26 A7-KB	DRAWING IS NO LONGER USED AT WAPA FOR NEW CONSTRUCTION. SEE DRAWING 31 1084.
E	9-06-12 A7-DP	REVISED LAPP PART NUMBERS ON ITEMS 5,7,17, AND 19 IN THE DESCRIPTION TABLE.
D	3-26-09 B5-MK	REVISED NEWELL NUMBERS
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS STACKING POST INSULATORS		
DESIGNED D.R. TORGENSON _____ APPROVED GERALD D. BIRNEY _____ DIRECTOR, DIVISION OF SUBSTATION DESIGN		
A	NOVEMBER 3, 1986	31 1081



	ANSI TR 225 EQUIV NOTE 3	ANSI TR 267 EQUIV NOTE 3	ANSI TR 267 EQUIV NOTE 3	ANSI TR 278 EQUIV NOTE 3	ANSI TR 287 EQUIV NOTE 3	ANSI TR 289 EQUIV NOTE 3	ANSI TR 295 EQUIV NOTE 3	ANSI TR 308 EQUIV NOTE 3	ANSI TR 316 EQUIV NOTE 3	ANSI TR 367 EQUIV NOTE 3	ANSI TR 371 EQUIV NOTE 3	ANSI TR 392 EQUIV NOTE 3	ANSI TR 401 EQUIV NOTE 3
PHYSICAL DATA													
LEAKAGE DISTANCE, IN	15.5	43	43	72	99	116	132	165	198	231	264	360	432
PORCELAIN DIAMETER, IN	8.50	10	10	10.59	10.51	8.43	8.11	8.43	9.88	9.84/ 8.90	10.41/ 8.81/ 8.56	11.13/ 11.00/ 9.63	12.50/ 11.88/ 11.13/ 10.75
MECHANICAL VALUES													
CANTILEVER STRENGTH, LB	4000	4000	4000	3000	2600	2200	1850	1450	1250	1450	1170	1750	2000
TENSILE STRENGTH, LB	20000	25000	25000	25000	25000	25000	25000	25000	25000	25000	20000	20000	20000
TORSIONAL STRENGTH, IN-LB	14000	20000	20000	40000	90000	90000	90000	90000	90000	40000	40000	60000	60000
COMPRESSION STRENGTH, LB	20000	60000	60000	60000	75000	75000	75000	75000	75000	60000	60000	60000	60000
ELECTRICAL VALUES													
CRITICAL IMPULSE FLASHOVER, POS, KV	125	280	280	390	610	710	810	1010	1210	1410	1610	2000	2250
LOW FREQUENCY WET WITHSTAND, KV	45	100	100	145	230	275	315	385	455	525	590	710	830
IMPULSE WITHSTAND, KV	110	250	250	350	550	650	750	900	1050	1300	1470	1800	2050
RADIO INFLUENCE VOLTAGE													
TEST VOLTAGE, KV	10	30	30	44	73	88	103	146	146	220	220	318	318
MAX RIV-MICROVOLTS AT 1000KHZ	50	200	200	200	200	200	500	500	500	1000	1000	2000	2000

- NOTES
1. COLOR SHALL BE LIGHT GRAY (ANSI 70).
 2. BIL RATINGS ARE FOR INSULATOR ASSEMBLIES, UNITS MAY BE ASSEMBLED WITH OR WITHOUT RAIN SHIELDS.
 3. EQUIVALENT STACKING POST INSULATOR ASSEMBLIES SHALL MEET THE REFERENCED ANSI TR NUMBER ELECTRICAL AND MECHANICAL STRENGTH CHARACTERISTICS. HARDWARE CAPS SHALL BE IN ACCORDANCE WITH THIS DRAWING.

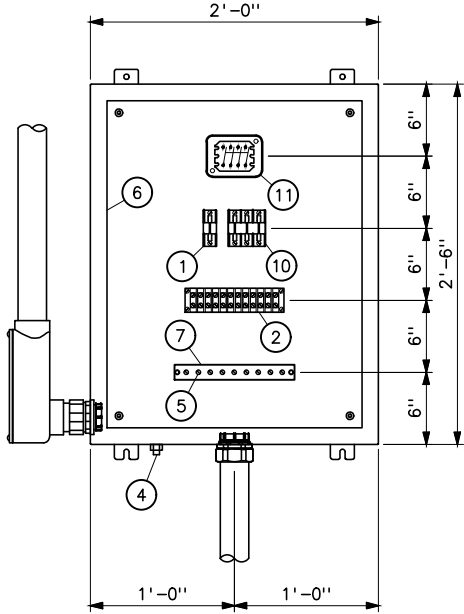
SUPERSEDES DWG NO. 31 1081, 31 1087 & 31 1088		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS STACKING POST INSULATORS		
DESIGNED C.KNEZEL	APPROVED K.VAUGHN ELECTRICAL ENGINEERING MANAGER	
DATE JULY 27, 2026	31	1084

Plotted By: court Jul 27, 2026- 11:11am
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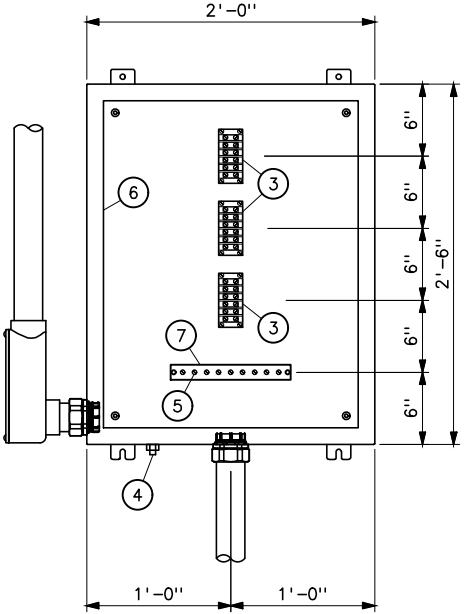
XREF(S):

TABLE NO. 1		
EQUIPMENT	FUSE HOLDER	FUSE
V.T.	BUSSMANN 0.1 TO 30A. 250V CAT. NO. HM25030-3SR	10A REN SUPER LAG
C.C.V.T METERING	BUSSMANN 0.1 TO 30A. 250V CAT. NO. HM25030-3SR	10A NON BUSS TRON
C.C.V.T. RELAY	BUSSMANN 0.1 TO 30A. 250V CAT. NO. HM25030-3SR	10A NON BUSS TRON

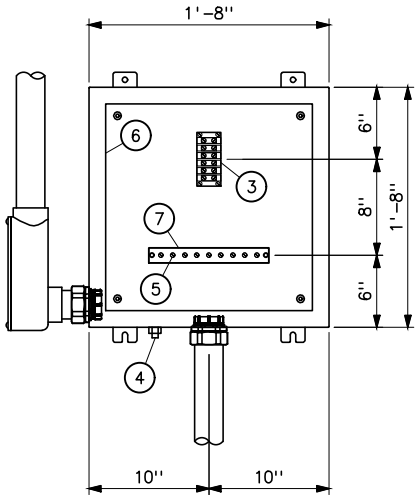
REFERENCE MATERIALS	
ITEM NO.	DESCRIPTION
1	1-POLE FUSE BLOCK, BUSSMANN HM25030-1SR OR EQUAL, WITH FUSE PER TABLE NO. 1
2	12-POINT TERMINAL BLOCK, G.E. CAT. NO. EB25B12
3	6-POINT TERMINAL BLOCK, SHORT CIRCUITING TYPE, G.E. CAT. NO. EB27B06SC
4	GROUND CONNECTOR, BURNDY MECHANICAL TYPE K2C WITH 2-EVERDUR NUTS AND LOCKWASHER SIZED FOR GROUND CONDUCTOR
5	BRONZE MACHINE SCREWS NO. 10 X 32 WITH BRONZE WASHERS AND NUTS
6	PANEL BOARD MOUNTED TO REAR OF TERMINAL BOX
7	COPPER BAR 1/4" X 1 1/4" X 10". DRILL AND TAP 9 HOLES FOR ITEM 5. DRILL 2 HOLES FOR ITEM 6.
8	COPPER BAR 1/4" X 1 1/4" X 18". DRILL AND TAP 12 HOLES FOR ITEM 5. DRILL 2 HOLES FOR ITEM 6.
9	COPPER BAR 1/4" X 1 1/4" X 24". DRILL AND TAP 18 HOLES FOR ITEM 5. DRILL 2 HOLES FOR ITEM 6.
10	3-POLE FUSE BLOCK WITH FUSES PER TABLE NO. 1
11	4-POLE GANGED DISCONNECT SWITCH, STATES TYPE SMH 404-E.
12	3-POLE GANGED DISCONNECT SWITCH, STATES TYPE SMH 403-N.



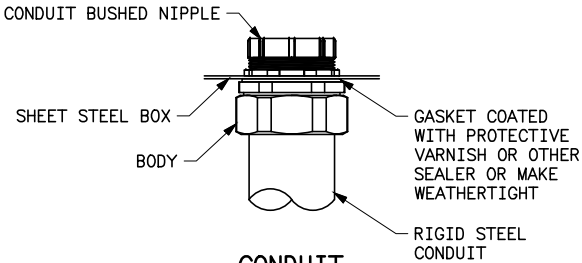
TYPE A
(FOR SINGLE-PHASE VOLTAGE TRANSFORMERS OR COUPLING CAPACITOR VOLTAGE TRANSFORMERS)
(TYPICAL)



TYPE C
(FOR 3-PHASE CURRENT TRANSFORMERS)
(TYPICAL)



TYPE D
(FOR SINGLE-PHASE CURRENT TRANSFORMERS)
(TYPICAL)



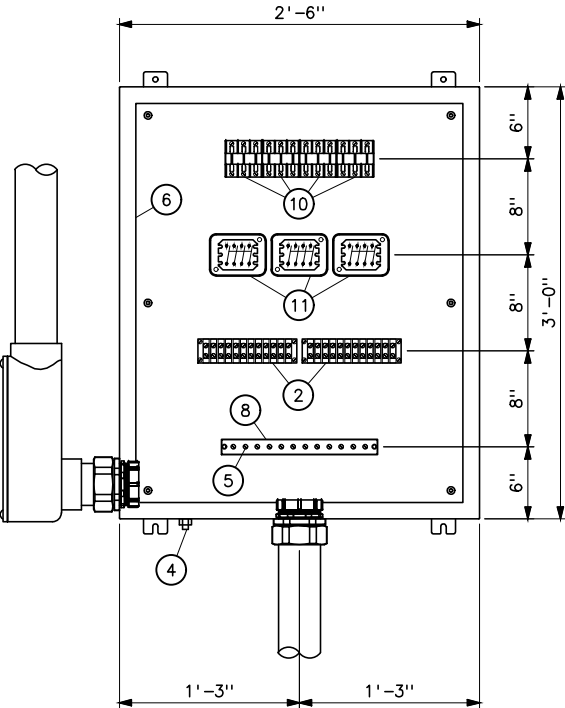
CONDUIT
ENTRANCE DETAIL
(NUMBER OF ENTRANCES AS REQUIRED)
(NOTE 8)

NOTES

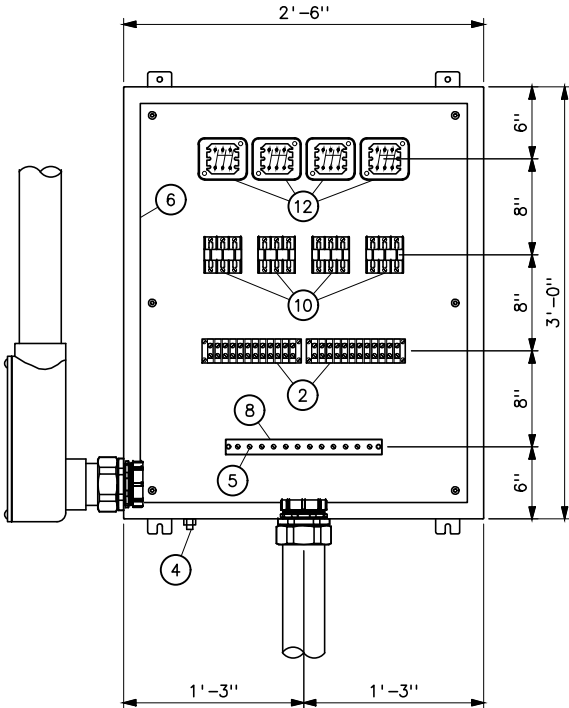
- CATALOG REFERENCES SHOWN ARE FOR COMPARISON OF TYPE, DESIGN, CHARACTER OR QUALITY OF ITEM DESIRED AND DO NOT PROHIBIT ITEMS THAT ARE EQUIVALENT.
- ALL DIMENSIONS GIVEN ARE INSIDE DIMENSIONS.
- TERMINAL BOXES SHALL BE NEMA 4 HOFFMAN OR WIEGMANN TYPE OR EQUAL. TERMINAL BOXES SHALL BE PAINTED WITH MANUFACTURER'S STANDARD PAINTING SYSTEM, COLOR ANSI 70 GRAY, AND SHALL MEET APPROPRIATE UL REQUIREMENTS.
- THE COVER SHALL HAVE AT LEAST TWO HINGES OR A CONTINUOUS HINGE ON ONE SIDE. ALL HARDWARE FOR COVER SHALL BE MADE OF NON-FERROUS, NON-CORROSIVE METAL.
- MOUNTING BOLTS, NUTS AND WASHERS FOR THE BOX, TERMINAL BLOCKS AND FUSE COUTOUT BASES SHALL BE HOT DIPPED GALVANIZED OR NON-FERROUS, NON-CORROSIVE METAL.
- ALL TERMINAL BOX COVERS SHALL BE PLAINLY MARKED WITH THEIR DESIGNATIONS.
- GROUND ALL BOXES TO THE MAIN GROUND GRID WITH 3 CONDUCTOR NO. 7 OR 7 CONDUCTOR NO. 4 BARE COPPER-CLAD CABLE.
- CONDUIT IS TERMINATED AT TERMINAL BOX USING A WATERTIGHT CONDUIT HUB WITH AN INSULATED THROAT. USE APPLETON "UNI-SEAL" TYPE HUB, CROUSE-HINDS TYPE HUB, OR EQUAL.
- THE COVER SHALL HAVE QUICK RELEASE LATCH WITH HASP. THE USE OF SCREWS TO SECURE THE COVER IS NOT PERMITTED.
- TYPICAL ARRANGEMENT SHOWN, ACTUAL ARRANGEMENT WILL BE DETERMINED BY THE COR.
- SEE DRAWINGS 31 1510 AND 31 6000 FOR TERMINAL BOX GROUNDING DETAILS.
- CONDUCTORS BETWEEN KNIFE SWITCHES, FUSES AND TERMINAL BLOCK'S SHALL EITHER BE COLOR MATCHED OR BLACK WITH CIRCUIT LABELS.

REFERENCE DRAWINGS

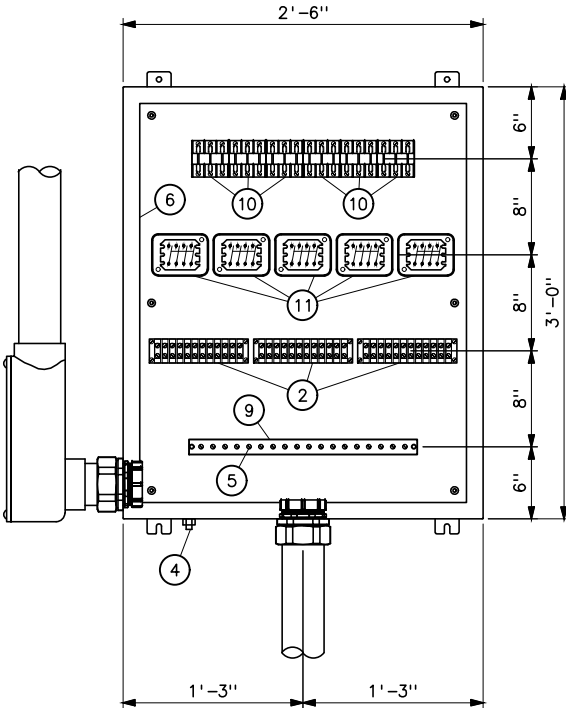
GROUNDING PLANS EQUIPMENT GROUNDING	31 1500
GROUNDING PLANS TYPICAL DETAILS	31 1510
EQUIPMENT CABINET SHIELDED CABLE GROUNDING	31 6000



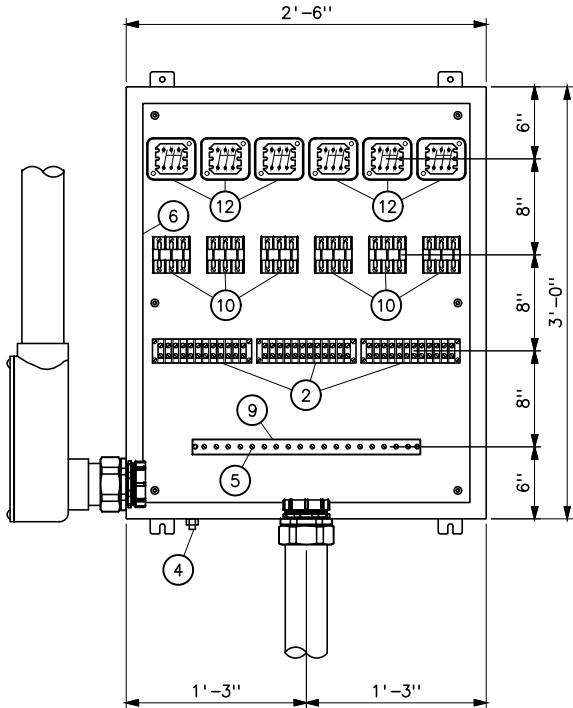
TYPE F (OPTION 1)
(FOR 3-PHASE VOLTAGE TRANSFORMERS OR COUPLING CAPACITOR VOLTAGE TRANSFORMERS)
(DSW ONLY)



TYPE F (OPTION 2)
(FOR 3-PHASE VOLTAGE TRANSFORMERS OR COUPLING CAPACITOR VOLTAGE TRANSFORMERS)
(TYPICAL)

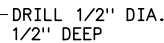
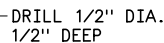
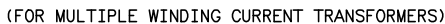


TYPE J (OPTION 1)
(FOR 3-PHASE COUPLING CAPACITOR VOLTAGE TRANSFORMERS WITH THREE SECONDARIES)
(DSW ONLY)



TYPE J (OPTION 2)
(FOR 3-PHASE COUPLING CAPACITOR VOLTAGE TRANSFORMERS WITH THREE SECONDARIES)
(TYPICAL)

K	7-27-26 A7-CK	REVISED TEMINAL BOX DIMENSIONS AND ADDED TERMINAL BOX GROUND DETAIL REFERENCE DRAWINGS.
J	2/26/25 A7-RMJ	ADDED NOTE 11, CORRECTED FUSE MANUFACTURER NO.
SUPERSEDES DWG NO. 31-1064		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS TERMINAL AND FUSE BOXES		
DESIGNED BRUCE A. HARRINGTON _____ APPROVED GERALD D. BIRNEY _____ DIRECTOR, DIVISION OF SUBSTATION DESIGN		
FA	FEBRUARY 22, 1990	31 1085



1. CATALOG REFERENCES ARE MADE AS STANDARDS OF COMPARISON FOR TYPE, DESIGN, CHARACTER OR QUALITY OF THE ITEM DESIRED AND DO NOT PROHIBIT ITEMS THAT ARE EQUIVALENT.
2. ALL DIMENSIONS GIVEN ARE INSIDE DIMENSIONS.
3. TERMINAL BOXES SHALL BE NEMA 4 HOFFMAN OR WIEGMANN TYPE OR EQUAL. TERMINAL BOXES SHALL BE PAINTED WITH MANUFACTURER'S STANDARD PAINTING SYSTEM, COLOR ANSI 61 GRAY, AND SHALL MEET APPROPRIATE UL REQUIREMENTS.
4. THE COVER SHALL HAVE AT LEAST TWO HINGES OR A CONTINUOUS HINGE ON ONE SIDE. ALL HARDWARE FOR COVER SHALL BE MADE OF NON-FERROUS, NON-CORROSIVE METAL.
5. MOUNTING BOLTS, NUTS AND WASHERS FOR THE BOX, TERMINAL BLOCKS AND FUSE CUTOFF BASES SHALL BE HOT DIPPED GALVANIZED OR NON-FERROUS, NON-CORROSIVE METAL.
6. ALL TERMINAL BOX COVERS SHALL BE PLAINLY MARKED WITH THEIR DESIGNATIONS. TYPE G AND TYPE H TERMINAL BOX INTERIORS SHALL HAVE THEIR VOLTAGE RATINGS PLAINLY MARKED BETWEEN TERMINAL STRIPS.
7. THE COVER SHALL HAVE A QUICK RELEASE LATCH WITH HASP. THE USE OF SCREWS TO SECURE THE COVER IS NOT PERMITTED.
8. GROUND BAR IN TERMINAL BOX TYPE K FOR CABLE SHIELD ONLY.
9. BOXES SHALL BE CONNECTED TO THE GROUND GRID USING COPPER-CLAD STEEL (CCS) CABLE AND SIZED IN ACCORDANCE WITH CONSTRUCTION STANDARD 9. CCS SIZING VARIES BY MANUFACTURER; FOR EXAMPLE, THE CCS EQUIVALENT OF 4/0 AWG BARE COPPER IS 19-NO. 8 FOR AFL AND 19-NO.9 FOR COPPERWELD.



D	3-13-26 A7-TC	REVISED NOTES.
C	7-12-05 A7-RMC	REVISED DIMENSIONS AND NOTES.
B	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.
A	6-23-93 A2-RAS	REVISED TYPE K TERMINAL BOXES, ADDED NOTES 9 AND 10, ADDED BILL OF MATERIAL ITEM 11.
SUPERSEDES DWG NO. 31-1065 AND 31-1066		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATIONS STANDARDS		
TYPE G, H, AND K TERMINAL BOXES		
DESIGNED <u>BRUCE A. HARRINGTON</u> _____ APPROVED <u>GERALD D. BIRNEY</u> _____ DIRECTOR, DIVISION OF SUBSTATION DESIGN		
C A F	FEBRUARY 22, 1990	31 1086

CATALOG NUMBER	ANST TR 267 EQUIV NOTE 1	ITEM NUMBER 1					ANST TR 267 EQUIV NOTE 1	ITEM NUMBER 2					ANST TR 278 EQUIV NOTE 1	ITEM NUMBER 3					ANST TR 287 EQUIV NOTE 1	ITEM NUMBER 4					ANST TR 289 EQUIV NOTE 1	ITEM NUMBER 5					ANST TR 295 EQUIV NOTE 1	ITEM NUMBER 6				
		NGK-LOCKE	LAPP	NEWELL	VICTOR			NGK-LOCKE	LAPP	NEWELL	VICTOR			NGK-LOCKE	LAPP	NEWELL	VICTOR			NGK-LOCKE	LAPP	NEWELL	VICTOR			NGK-LOCKE	LAPP	NEWELL	VICTOR			NGK-LOCKE	LAPP	NEWELL	VICTOR	
		PX0348	J54795A	47161-3070	1710			PX0348	J54795A	47161-3070	1710			PX0349	J48404B	47167-3070	1714			PH05512	J313256-70	047921-3071	1725-33			PH06512	J52591-FPA-70	47922-3072	1726-33			PH07512	J52161-FPA-70	47923-3072	1727-33	
PHYSICAL DATA																																				
LEAKAGE DISTANCE, IN	43	43	49	44.5	43		43	43	49	44.5	43		72	72	77	72	72		99	99	99	99	99		116	116	116	116	116		132	132	144	132	132	
PORCELAIN DIAMETER, IN	10	7.875	12	11.75	10		10	7.875	12	11.75	10		11	8.6875	12	11.75	10			9.25	12	11.75	10			9.25	12	11.75	10			9.6875	12	11.75	10	
MECHANICAL VALUES																																				
CANTILEVER STRENGTH, LB	4000	4000	5300	5200	4000		4000	4000	5300	5200	4000		3000	3000	3870	4000	3000		2600	2900	2600	2600	2600		2200	2450	2200	2450	2200		1850	2000	2050	2000	1850	
TENSILE STRENGTH, LB	25000	25000	25000	25000	25000		25000	25000	25000	25000	25000		25000	25000	25000	25000	25000		25000	25000	25000	25000	25000		25000	25000	25000	25000	25000		25000	25000	25000	25000	25000	
TORSIONAL STRENGTH, IN-LB	20000	20000	90000	90000	20000		20000	20000	90000	90000	20000		40000	40000	90000	90000	40000		90000	90000	90000	90000	90000		90000	90000	90000	90000	90000		90000	90000	90000	90000	90000	
COMPRESSION STRENGTH, LB	60000	60000	90000	90000	60000		60000	60000	90000	90000	60000		60000	60000	90000	90000	60000		75000	90000	90000	90000	75000		75000	90000	75000	90000	75000		75000	90000	75000	90000	75000	
ELECTRICAL VALUES																																				
CRITICAL IMPULSE FLASHOVER, POS, KV	280	280	280	280	280		280	280	280	280	280		390	390	390	390	390		610	610	610	610	610		710	710	710	710	710		810	810	810	810	810	
LOW FREQUENCY WET WITHSTAND, KV	100	100	100	100	100		100	100	100	100	100		145	145	145	145	145		230	230	230	230	230		275	275	275	275	275		315	315	315	315	315	
IMPULSE WITHSTAND, KV	250	250	250	250	250		250	250	250	250	250		350	350	350	350	350		550	550	550	550	550		650	650	650	650	650		750	750	750	750	750	
RADIO INFLUENCE VOLTAGE																																				
TEST VOLTAGE, KV	30	30	30	30	30		30	30	30	30	30		44	44	44	44	44		73	73	73	73	73		88	88	88	88	88		103	103	103	103	103	
MAX RIV-MICROVOLTS AT 1000KHZ	200	200	200	200	200		200	200	200	200	200		200	200	200	200	200		200	200	200	200	200		200	200	200	200	200		500	500	200	500	200	

	ANST TR 308 EQUIV NOTE 1	ITEM NUMBER 7					ANST TR 316 EQUIV NOTE 1	ITEM NUMBER 8					ANST TR 369 EQUIV NOTE 1	ITEM NUMBER 9 (TAPERED)					ANST TR 373 EQUIV NOTE 1	ITEM NUMBER 10 (TAPERED)					ANST TR 391 EQUIV NOTE 1	ITEM NUMBER 11 (TAPERED)					MIN REQT	ITEM NUMBER 12 (TAPERED)					
CATALOG NUMBER		NGK-LOCKE	LAPP	NEWELL	VICTOR		NGK-LOCKE	LAPP	NEWELL	VICTOR		NGK-LOCKE	LAPP	NEWELL	VICTOR		NGK-LOCKE	LAPP	NEWELL	VICTOR		NGK-LOCKE	LAPP	NEWELL	VICTOR		NGK-LOCKE	LAPP	NEWELL	VICTOR			NGK-LOCKE	LAPP	NEWELL	VICTOR	
		PH090221	J303050C -70	047925- 3071	1728-32		PH105221	J50439F -70	047927- 3072	1729-32		PE13022	J311908A -70	047862- 3072	1603-35		PE14722	J310875 -70	047848- 3071	1614		PE18032	J300744A -70	047854- 3075	1640		PE20532	J310877 -70	47855- 3071	N/A							
PHYSICAL DATA																																					
LEAKAGE DISTANCE, IN	165	165	210	165	165		198	198	213	198	198		231	231	260	231	231		264	264	300	264	264		330	330	400	330	330		396	396	450	432			
PORCELAIN DIAMETER, IN		9.25	12	11.75	10		9.25	12	11.75	10		10.4375/ 9.25	14.125/ 12	12.5/ 11.75/ 10.5	9.5/10		10.4375/ 9.25	14.125/ 12	12.5/ 11.75/ 10.5	10		10.4375/ 9.6875/ 9.25	14.125/ 11.5	12.5/ 11.75/ 10.5	10		10.4375/ 9.6875/ 9.25	14.125/ 12	12.5/ 11.75								
MECHANICAL VALUES																																					
CANTILEVER STRENGTH, LB	1450	1450	1450	1450	1450		1250	1250	1250	1250	1250		2050	2050	2050	2050	2050		1750	1750	1800	1750	1750		1400	1400	1400	1400	1400		1200	1200	1215	1200			
TENSILE STRENGTH, LB	25000	25000	25000	25000	25000		25000	25000	25000	25000	25000		20000	25000	20000	20000	20000		20000	25000	25000	20000	20000		20000	20000	25000	20000	25000		20000	20000	25000	25000			
TORSIONAL STRENGTH, IN-LB	90000	90000	90000	90000	90000		90000	90000	90000	90000	90000		40000	90000	60000	60000	40000		40000	90000	90000	60000	40000		40000	60000	90000	60000	100000		60000	60000	90000	90000			
COMPRESSION STRENGTH, LB	75000	90000	90000	90000	75000		75000	90000	90000	90000	75000		60000	90000	60000	60000	60000		60000	90000	75000	60000	60000		60000	60000	90000	60000	90000		60000	60000	75000	90000			
ELECTRICAL VALUES																																					
CRITICAL IMPULSE FLASHOVER, POS, KV	1010	1010	1010	1010	1010		1210	1210	1210	1210	1210		1410	1410	1410	1410	1410		1610	1610	1610	1610	1610		2000	2000	2000	2000	2000		2370	2420	2370	2420			
LOW FREQUENCY WET WITHSTAND, KV	385	385	385	385	385		455	455	455	455	455		525	525	525	525	525		590	590	590	590	590		710	710	710	710	710		830	830	830	830			
IMPULSE WITHSTAND, KV	900	900	900	900	900		1050	1050	1050	1050	1050		1300	1300	1300	1300	1300		1470	1470	1470	1470	1470		1800	1800	1800	1800	1800		2050	2050	2050	2050			
RADIO INFLUENCE VOLTAGE																																					
TEST VOLTAGE, KV	146	146	146	146	146		146	146	146	146	146		220	220	220	220	220		220	220	220	220	220		318	318	318	318	318		318	350	318	350			
MAX RIV-MICROVOLTS AT 1000KHZ	500	500	200	500	200		500	500	200	500	200		1000	1000	200	1000	1000		1000	1000	1000	1000	1000		2000	2000	200	2000	2000		2000	2000	2000	2000			

UPRIGHT STACKING POST INSULATORS (NOTE 1)

NOTES

1. EQUIVALENT STACKING POST INSULATORS SHALL MEET THE REFERENCED ANSI TR NUMBER ELECTRICAL AND MECHANICAL STRENGTH CHARACTERISTICS. HARDWARE CAPS SHALL BE IN ACCORDANCE WITH DRAWING 31 1081.
2. ALL POST INSULATOR ASSEMBLIES ARE HIGH STRENGTH EXCEPT ITEMS (9 AND 10) ARE EXTRA-HIGH STRENGTH AND (11 AND 12) ARE STANDARD STRENGTH.

REFERENCE DRAWINGS

STACKING POST INSULATORS ----- 31 1081
STACKING POST INSULATORS -
UNDERHUNG M & E RATINGS ----- 31 1088

DRAWING IS NO LONGER USED AT WAPA FOR NEW CONSTRUCTION.
SEE DRAWING 31 1084.

FOR INFORMATION ONLY

B

8-7-26
A7-KB

DRAWING IS NO LONGER USED AT WAPA FOR NEW CONSTRUCTION. SEE DRAWING 31 1084.

A

5-14-09
A3-OP

REVISED ANSI COLUMN HEADINGS TO REFER TO ADDED NOTE 1

UNITED STATES DEPARTMENT OF ENERGY
WESTERN AREA POWER ADMINISTRATION
HEADQUARTERS - GOLDEN, COLORADO

SUBSTATION STANDARDS

STACKING POST INSULATORS

UPRIGHT M & E RATINGS

DESIGNED D.R. TORGERSON

DRAWN A.J. ARMSTRONG

CHECKED R.A. JOHNSON

RECOMMENDED R.H. RICHARDSON

APPROVED G.C. WEGNER

ACT. DIRECTOR, DIVISION OF
SUBSTATION DESIGN

A

JANUARY 24, 1990

31

1087

CATALOG NUMBER	ANSI TR 267 EQUIV NOTE 1	ITEM NUMBER 13					ANSI TR 267 EQUIV NOTE 1	ITEM NUMBER 14					ANSI TR 278 EQUIV NOTE 1	ITEM NUMBER 15					ANSI TR 287 EQUIV NOTE 1	ITEM NUMBER 16					ANSI TR 289 EQUIV NOTE 1	ITEM NUMBER 17					ANSI TR 295 EQUIV NOTE 1	ITEM NUMBER 18				
	NGK-LOCKE	LAPP	NEWELL	VICTOR		NGK-LOCKE		LAPP	NEWELL	VICTOR		NGK-LOCKE		LAPP	NEWELL	VICTOR		NGK-LOCKE		LAPP	NEWELL	VICTOR		NGK-LOCKE		LAPP	NEWELL	VICTOR		NGK-LOCKE		LAPP	NEWELL	VICTOR		
		PX0315	J54796A	47163-3070	1711			PX0315	J54796A	47163-3070	1711			PX0316	J48405B	47169-3070	1715			PX0286	J310918-70	47921-3072	1725-34			PX0313	J310914-70	47922-3071	1726-34			PX0307	J310921-70	47923-3071	1727-34	
PHYSICAL DATA																																				
LEAKAGE DISTANCE, IN	43	43	49	44.5	43		43	43	49	44.5	43		72	72	77	72	72		99	99	99	99	99		116	116	116	116	116		132	132	144	132	132	
PORCELAIN DIAMETER, IN	10	7.875	12	11.75	10		10	7.875	12	11.75	10		11	8.6875	12	11.75	10			9.25	12	11.75	10			9.25	12	11.75	10		9.6875	12	11.75	10		
MECHANICAL VALUES																																				
CANTILEVER STRENGTH, LB	4000	4000	5300	5200	4000		4000	4000	5300	5200	4000		3000	3000	3870	4000	3000		2900	2000	2600	2600	2600		2200	2450	2200	2450	2200		1850	2000	2050	2000	1850	
TENSILE STRENGTH, LB	25000	25000	25000	25000	25000		25000	25000	25000	25000	25000		25000	25000	25000	25000	25000		25000	25000	25000	25000	25000		25000	25000	25000	25000	25000		25000	25000	25000	25000	25000	
TORSIONAL STRENGTH, IN-LB	20000	20000	90000	90000	20000		20000	20000	90000	90000	20000		40000	40000	90000	90000	40000		90000	90000	90000	90000	90000		90000	90000	90000	90000	90000		90000	90000	90000	90000	90000	
COMPRESSION STRENGTH, LB	60000	60000	90000	90000	60000		60000	60000	90000	90000	60000		60000	60000	90000	90000	60000		75000	90000	90000	90000	75000		75000	90000	75000	90000	75000		75000	90000	75000	90000	75000	
ELECTRICAL VALUES																																				
CRITICAL IMPULSE FLASHOVER, POS, KV	280	280	280	280	280		280	280	280	280	280		390	390	390	390	390		610	610	610	610	610		710	710	710	710	710		810	810	810	810	810	
LOW FREQUENCY WET WITHSTAND, KV	100	100	100	100	100		100	100	100	100	100		145	145	145	145	145		230	230	230	230	230		275	275	275	275	275		315	315	315	315	315	
IMPULSE WITHSTAND, KV	250	250	250	250	250		250	250	250	250	250		350	350	350	350	350		550	550	550	550	550		650	650	650	650	650		750	750	750	750	750	
RADIO INFLUENCE VOLTAGE																																				
TEST VOLTAGE, KV	30	30	30	30	30		30	30	30	30	30		44	44	44	44	44		73	73	73	73	73		88	88	88	88	88		103	103	103	103	103	
MAX RIV-MICROVOLTS AT 1000KHZ	200	200	200	200	200		200	200	200	200	200		200	200	200	200	200		200	200	200	200	200		200	200	200	200	200		500	500	200	500	200	

	ANSI TR 308 EQUIV NOTE 1	ITEM NUMBER 19					ANSI TR 316 EQUIV NOTE 1	ITEM NUMBER 20					ANSI TR 369 EQUIV NOTE 1	ITEM NUMBER 21					ANSI TR 373 EQUIV NOTE 1	ITEM NUMBER 22					ANSI TR 391 EQUIV NOTE 1	ITEM NUMBER 23					MIN REQT	ITEM NUMBER 24				
CATALOG NUMBER		NGK-LOCKE	LAPP	NEWELL	VICTOR		NGK-LOCKE	LAPP	NEWELL	VICTOR		NGK-LOCKE	LAPP	NEWELL	VICTOR		NGK-LOCKE	LAPP	NEWELL	VICTOR		NGK-LOCKE	LAPP	NEWELL	VICTOR		NGK-LOCKE	LAPP	NEWELL	VICTOR			NGK-LOCKE	LAPP	NEWELL	VICTOR
		PX0309	J301597-70	047925-3072	1728-33			PX0310	J310924-70	047927-3071	1729-33			PX0311	J310925-70	048149-3072	1634-34			PX0312	J310927-70	047504-3070	1615			PX0306	J310919-70	048191-3071	1641			PX0305	J310920-70	047503-3071	N/A	
PHYSICAL DATA																																				
LEAKAGE DISTANCE, IN	165	165	202	165	165		198	198	213	198	198		231	231	260	231	231		264	264	300	264	264		330	330	400	330	330		396	396	450	432		
PORCELAIN DIAMETER, IN		9.25	12	11.75	10			9.25	12	11.75	10			10.4375/9.25	14.13/12	12.5/11.75/10.5	9.5/10			10.4375/9.25	14.125/12	12.5/11.75/10.5	10		10.4375/9.6875/9.25	12/12.19/14.13	12.5/11.75/10.5	10			10.4375/9.6875/9.25	14.125/12	12.5/11.75			
MECHANICAL VALUES																																				
CANTILEVER STRENGTH, LB	1450	1450	1450	1450	1450		1250	1250	1250	1250	1250		2050	2050	2050	2050	2050		1750	1750	1800	1750	1750		1400	1400	1400	1400	1400		1200	1200	1215	1200		
TENSILE STRENGTH, LB	25000	25000	25000	25000	25000		25000	25000	25000	25000	25000		20000	25000	20000	20000	20000		20000	25000	25000	20000	20000		20000	20000	25000	20000	25000		20000	20000	25000	25000		
TORSIONAL STRENGTH, IN-LB	90000	90000	90000	90000	90000		90000	90000	90000	90000	90000		40000	90000	60000	60000	40000		40000	90000	90000	60000	40000		40000	60000	90000	60000	100000		60000	60000	90000	90000		
COMPRESSION STRENGTH, LB	75000	90000	90000	90000	75000		75000	90000	90000	90000	75000		60000	90000	60000	60000	60000		60000	90000	75000	60000	60000		60000	60000	90000	60000	90000		60000	60000	75000	90000		
ELECTRICAL VALUES																																				
CRITICAL IMPULSE FLASHOVER, POS, KV	1010	1010	1010	1010	1010		1210	1210	1210	1210	1210		1410	1410	1410	1410	1410		1610	1610	1610	1610	1610		2000	2000	2000	2000	2000		2370	2420	2370	2420		
LOW FREQUENCY WET WITHSTAND, KV	385	385	385	385	385		455	455	455	455	455		525	525	525	525	525		590	590	590	590	590		710	710	710	710	710		830	830	830	830		
IMPULSE WITHSTAND, KV	900	900	900	900	900		1050	1050	1050	1050	1050		1300	1300	1300	1300	1300		1470	1470	1470	1470	1470		1800	1800	1800	1800	1800		2050	2050	2050	2050		
RADIO INFLUENCE VOLTAGE																																				
TEST VOLTAGE, KV	146	146	146	146	146		146	146	146	146	146		220	220	220	220	220		220	220	220	220	220		318	318	318	318	318		318	350	318	350		
MAX RIV-MICROVOLTS AT 1000KHZ	500	500	200	500	200		500	500	200	500	200		1000	1000	1000	1000	1000		1000	1000	1000	1000	1000		2000	2000	2000	2000	2000		2000	2000	2000	2000		

UNDERHUNG STACKING POST INSULATORS (NOTE 1)

NOTES

1. EQUIVALENT STACKING POST INSULATORS SHALL MEET THE REFERENCED ANSI TR NUMBER ELECTRICAL AND MECHANICAL STRENGTH CHARACTERISTICS. HARDWARE CAPS SHALL BE IN ACCORDANCE WITH DRAWING 31 1081.
2. ALL POST INSULATOR ASSEMBLIES ARE HIGH STRENGTH EXCEPT ITEMS (21 AND 22) ARE EXTRA-HIGH STRENGTH AND (23 AND 24) ARE STANDARD STRENGTH.

REFERENCE DRAWINGS

STACKING POST INSULATORS ----- 31 1081
STACKING POST INSULATORS -
UPRIGHT M & E RATINGS ----- 31 1087

DRAWING IS NO LONGER USED AT WAPA FOR NEW CONSTRUCTION.
SEE DRAWING 31 1084.

FOR INFORMATION ONLY

B

8-7-26
A7-KB

DRAWING IS NO LONGER USED AT WAPA FOR NEW CONSTRUCTION. SEE DRAWING 31 1084.

A

5-14-09
A3-OP

REVISED ANSI COLUMN HEADINGS TO REFER TO ADDED NOTE 1

UNITED STATES DEPARTMENT OF ENERGY
WESTERN AREA POWER ADMINISTRATION
HEADQUARTERS - GOLDEN, COLORADO

SUBSTATION STANDARDS

STACKING POST INSULATORS

UNDERHUNG M & E RATINGS

DESIGNED D.R. TORGERTSON

DRAWN A.J. ARMSTRONG

CHECKED R.A. JOHNSON

RECOMMENDED R.H. RICHARDSON

APPROVED G.C. WEGNER

DIRECTOR, DIVISION OF SUBSTATION DESIGN

A

JANUARY 24, 1990

31

1088

ITEM NO.	ITEM DESCRIPTION	PART NUMBER (OR EQUAL)	MANUFACTURER (OR EQUAL)	QUANTITY
1	FIBER OPTIC SPLICE ENCLOSURE	SB01	ACA (AFL)	1
2	3-PIECE EXTERNAL COIL BRACKET	CB-44-3AL	ACA (AFL)	1
3	TOS			
4	STRUCTURE DOWNLEAD CLAMP	SEE NOTE 3	ACA (AFL)	AS REQD
5	GROUND BONDING CLAMP		ACA (AFL)	1
6	5/8" MACHINE BOLT & LOCK WASHER			4
7	OPGW SPLICE ENCLOSURE CONNECTOR	OPTICAL GROUND WIRE CONNECTOR KIT	ACA (AFL)	1
8	LFMC COMPATIBLE SPLICE ENCLOSURE CONNECTOR	BCK 287/302F FOR 24/48 FIBER CABLE BCK 350/365F FOR 72 FIBER CABLE	ACA (AFL)	1
9	STAR-TECK BODY	STE050DATA	ABB	1
10	REDUCING BUSHING 1" TO 1/2"			1
11	SEGMENTED CONDUIT SEALING BUSHING	CSBE-200P-1SEG	OZ/GEDNEY	1

NOTES

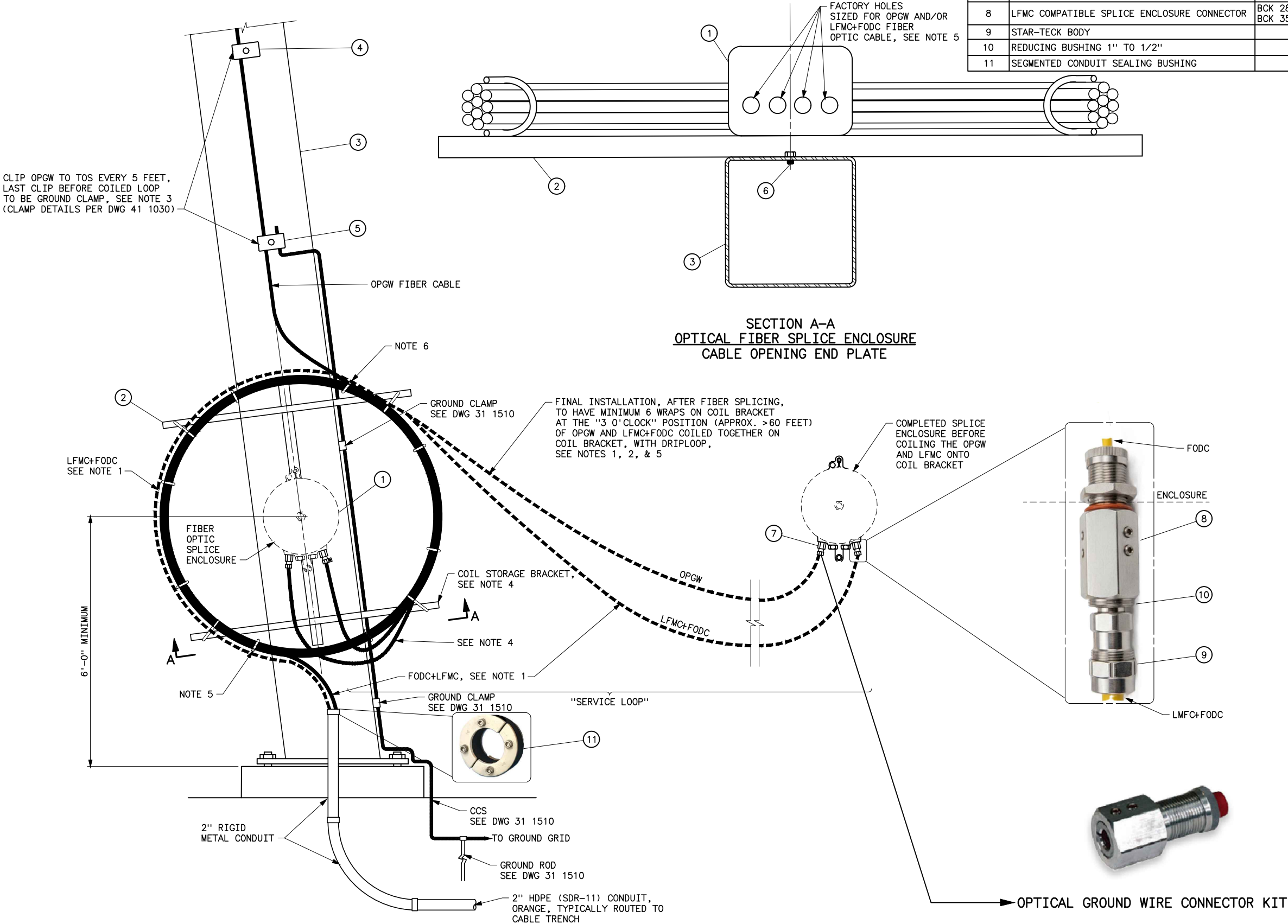
1. LFMC=LIQUIDTIGHT FLEXIBLE METAL CONDUIT
FODC=FIBER OPTIC DUCT CABLE
LFMC+FODC=CABLE MANUFACTURED WITH FODC INSIDE LFMC.
2. REMOVE 25 FEET OF OPGW CABLE DAMAGED DURING STRINGING OPERATIONS. FINAL INSTALLATION SPARE CABLE TO BE COILED IS 6 WRAPS (APPROX. 60 FEET) LFMC+FODC & OPGW AT "3 O'CLOCK" POSITION. RETAIN SUFFICIENT LENGTH OF OPGW AND LFMC+FODC FOR SPLICING OPERATION (APPROX 20 FEET), OR AS DIRECTED BY THE COR FOR ACCESS BY THE SPLICE VAN. LENGTHS ARE MINIMUM.
3. OPGW SHALL BE SECURELY BONDED TO THE GROUND CLAMP AND THE GROUND CLAMP SECURELY BONDED TO THE STEEL STRUCTURE. ON TUBULAR STRUCTURES, DRILL AND TAP HOLE FOR SECURING GROUND BONDING CLAMP TO STRUCTURE. ON LATTICE STRUCTURES, DRILL HOLE AND SECURE GROUND BONDING CLAMP TO STRUCTURE USING NUT AND LOCK WASHER. SPRAY GALVANOX IN NEW HOLE TO PREVENT RUST. SEE DRAWING 41 1030 FOR FIBER OPTIC CABLE DOWNLEAD CLAMP AND BONDING CLAMP.
4. PERMANENTLY ATTACH CABLE COIL BRACKET AND LFMC GROUND WIRE TO TOS. DRILL AND TAP TOS WALL TO ACCEPT 5/8" MACHINE BOLT FOR COIL BRACKET AND LFMC GROUND WIRE. SPRAY GALVANOX IN NEW THREADED HOLES TO PREVENT RUST.
5. FIBER OPTIC CABLES SHALL ENTER THE BOTTOM OF THE SPLICE ENCLOSURE WITH DRIP LOOPS. DRIP LOOPS ALLOW FOR CABLE SLACK NEEDED TO PROPERLY POSITION SPLICE ENCLOSURE ON COIL BRACKET. UNUSED ENTRANCE HOLES SHALL BE SEALED WATERTIGHT. CABLE MANUFACTURER'S MINIMUM BEND RADIUS, SHALL NOT BE EXCEED AT ANY TIME.
6. FIBER CABLE COIL TO BE SECURED USING PANDUIT, STAINLESS STEEL, MLT-H SERIES CABLE TIES, OR EQUIVALENT. COIL TO BE SECURED WHERE CABLE ENTERS AND EXITS COIL.

REFERENCE DRAWING

TRANSMISSION LINE STANDARDS
FIBER OPTIC CABLE MOUNTING
DOWNLEAD CLAMPS AND BANDS _____ 41 1030

E	7-27-26 A7-KV	REVISED FODC+LMFC CONNECTOR, ADDED ITEM 11.
D	11-20-19 A7-TE	REVISED FIBER OPTIC SPLICE ENCLOSURE, UPDATED NOTES, ADDED CONNECTOR DETAIL
C	9-27-19 A7-TE	ADDED HDPE AND LFMC CABLE.
B	12-17-18 A7-SR	REMOVED COPPER CLAD CABLE AND DETAILS A AND B.
A	10-18-16 A7-JAM	GENERAL REVISIONS TO DRAWING, MATERIAL AND NOTES.

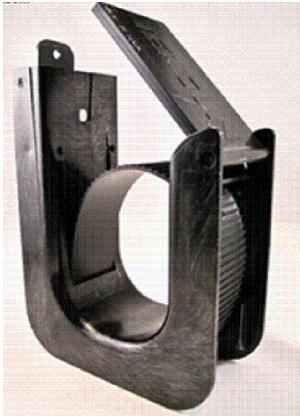
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS FIBER OPTIC CABLE MOUNTING		
DESIGNED JOHN FLEURY	APPROVED ROSS CLARK ELECTRICAL ENGINEERING MANAGER	
NOVEMBER 1, 2010	31	1097



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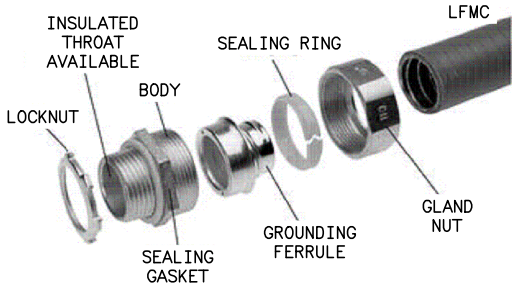
ITEM NO.	ITEM DESCRIPTION	PART NUMBER (OR EQUAL)	MANUFACTURER (OR EQUAL)	QUANTITY
1	LIQUIDTIGHT CONDUIT FITTING WITH GROUND LUG (CORROSION RESISTANT MATERIAL AND COMPATIBLE WITH ITEM 8 AND LFMC IN PROJECT SPECIFICATION)	1" EXAMPLE: LT100G-SA	CROUSE-HINDS	1



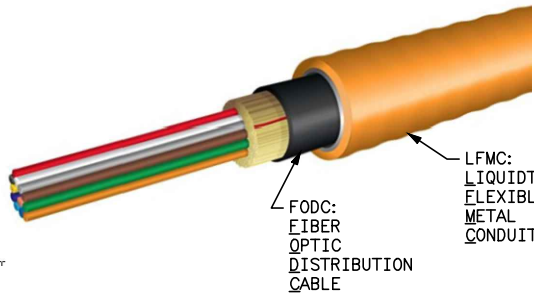
CABLE HANGERS (4 EACH)



LFMC CONNECTOR
GROUND LUG
SEE NOTES 2 & 3



REMOVE LFMC (ARMOR) FROM FODC
SEE NOTE 1



EXPLANATION

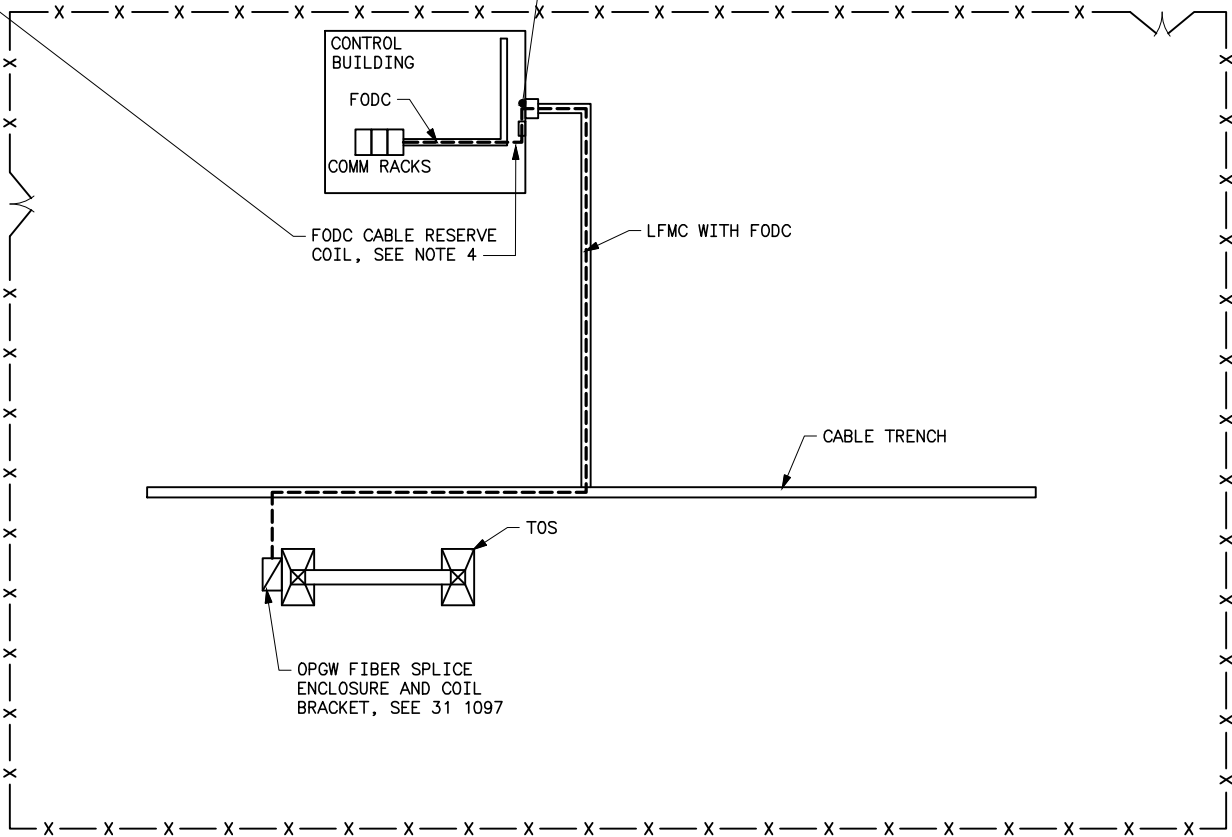
☐ FIBER OPTIC SPLICE BOX

NOTES

1. REMOVE LFMC (LIQUIDTIGHT FLEXIBLE METAL CONDUIT/ARMOR) FROM FODC AT BUILDING ENTRY (APPROX 10 FEET AFTER ENTRY), LEAVING SUFFICIENT LENGTH OF FODC (FIBER OPTIC DISTRIBUTION CABLE) FOR RESERVE COIL (30'), ROUTING TO COMMUNICATION RACK AND FOR SPLICING.
2. TERMINATE END OF LFMC (INSIDE BUILDING) WITH LFMC GROUNDING CONNECTOR, (INCLUDING GROUND LUG), AS SHOWN IN THE DRAWING.
3. GROUND LFMC CONNECTOR TO STATION GROUND WITH #4 OR #6 AWG.
4. COIL RESERVE FODC, APPROXIMATELY 30 FEET, WITH LFMC REMOVED, ON WALL USING 4 CABLE HANGERS, (EXAMPLE SHOWN) AND ROUTE REMAINING FODC TO COMM RACKS FOR SPLICING.

REFERENCE DRAWING

SUBSTATION STANDARDS
FIBER OPTIC CABLE MOUNTING_____ 31 1097



EXAMPLE SUBSTATION WITH TOS & CABLE TRENCH

B	7-27-26 A7-KB	REMOVED FIBER SPLICE ENCLOSURE DUE TO REDUNDANCY
A	11-20-19 A7-TE	REVISED COIL BRACKET DETAILS.
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS FIBER OPTIC CABLE ARMORED CABLE INSTALLATION		
DESIGNED T. ERIKSON _____ APPROVED STEVE ROCK ELECTRICAL ENGINEERING MANAGER		
SEPTEMBER 26, 2019	31	1099

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ITEM	DESCRIPTION
A. MAJOR EQUIPMENT (NOTE 1)	
AA	SURGE ARRESTER
AC	COUPLING CAPACITOR VOLTAGE TRANSFORMER
AF	FUSE OR FUSE DISCONNECTING SWITCH
AG	VOLTAGE REGULATOR
AJ	POWER CIRCUIT BKR, RECLOSER, OR CIRCUIT SWITCHER
AK	POWER TRANSFORMER
AL	REACTOR
AL	METERING OUTFIT
AP	SERIES OR SHUNT CAPACITOR BANK
AQ	CURRENT TRANSFORMER
AR	RESISTOR
AT	COMMUNICATION EQUIP, WAVE TRAP, OR LINE INDUCTOR
AV	VOLTAGE TRANSFORMER
AW	LOAD INTERRUPTER SWITCH
AY	DISCONNECTING SWITCH
AZ	GROUND SWITCH/GROUND BLADES
B. STATION SERVICE MATERIAL	
BA	STATION SERVICE TRANSFORMER
BB	UNIT SUBSTATION
BC	DISTRIBUTION PANELBOARD (NOTE 4)
BD	POTHEAD
BE	WEATHER (ENTRANCE) HEAD
BF	PHOTOELECTRIC CONTROL DEVICE
BG	DUPLEX RECEPTACLE, 20 AMP, 125V, SINGLE POLE
BH	
BJ	RECEPTACLE (NOTE 4)
BK	SAFETY SWITCH (NOTE 4)
BL	CABLE TERMINATOR W/PAD TYPE TERM. CONNECTOR
C. RIGID METAL CONDUIT, ACCESSORIES, & MISC	
CA	3/4-INCH
CB	1-INCH
CC	1 1/2-INCH
CD	2-INCH
CE	2 1/2-INCH
CF	3-INCH
CG	4-INCH
CH	6-INCH
CJ	EXPANSION FITTING
CK	DUCT PLUG
CL	COUPLING
CM	RIGID METAL CONDUIT (NOTE 4)
CN	WATERPROOF, FLEXIBLE METAL CONDUIT (NOTE 4)
D. POLYVINYL CHLORIDE (PVC) CONDUIT (NOTE 7)	
DA	1-INCH
DB	1 1/2-INCH
DC	2-INCH
DD	2 1/2-INCH
DE	3-INCH
DF	4-INCH
DG	6-INCH
DH	EXPANSION FITTING
DJ	DUCT PLUG
DL	PVC CONDUIT (NOTE 4)
E. TERMINAL BOXES AND ENCLOSURES	
EA	TERMINAL BOX TYPE "A" (31 1085)
EB	
EC	TERMINAL BOX TYPE "C" (31 1085)
ED	TERMINAL BOX TYPE "D" (31 1085)
EF	TERMINAL BOX TYPE "F" (31 1085)
EG	TERMINAL BOX TYPE "G" (31 1086)
EH	TERMINAL BOX TYPE "H" (31 1086)
EJ	TERMINAL BOX TYPE "J" (31 1085)
EK	TERMINAL BOX TYPE "K" (31 1086)
EL	WEATHER TIGHT NEMA 4 ENCLOSURE (NOTE 4)
F. INSULATED COPPER CABLE (ABOVE 600V)	
FA	3-1/C-1 AWG (34.5KV)
FB	1-3/C-1 AWG (34.5KV)
FC	3-1/C-1 AWG (25KV)
FD	1-3/C-1 AWG (25KV) MV105
FE	3-1/C-1 AWG (15KV)
FF	1-3/C-1 AWG (15KV)
FG	INSULATED COPPER CABLE (ABOVE 600V) (NOTE 4)
FH	INSULATED COPPER CABLE (600V) (NOTE 4)
FI	
FJ	

ITEM	DESCRIPTION
G. BARE COPPER CABLE & MISC CONDUCTOR	
GA	4/0 AWG
GB	2/0 AWG
GC	4 AWG
GD	500 KCMIL
GE	BARE COPPER CABLE (NOTE 4)
GF	FLEXIBLE BRAID (NOTE 4)
GG	7 NO. 4 AWG COPPER COVERED STEEL
H. ALL-ALUMINUM BARE CONDUCTOR (NOTE 8)	
HA	3500 KCMIL, BLUEBONNET
HB	3000 KCMIL, TRILIUM
HC	2500 KCMIL, LUPINE
HD	2000 KCMIL, COWSLIP
HE	1590 KCMIL, COREOPSIS
HF	1431 KCMIL, CARNATION
HG	1272 KCMIL, NARCISSUS
HH	1113 KCMIL, MARGOLD
HJ	1033.5 KCMIL, BLUEBELL
HK	954 KCMIL, MAGNOLIA
HL	795 KCMIL, ARBUTUS
HM	636 KCMIL, ORCHID
HN	556.5 KCMIL, DAHLIA
HP	477 KCMIL, COSMOS
HQ	397.5 KCMIL, CANNA
HS	336.4 KCMIL, TULIP
HT	266.8 KCMIL, DAISY
HU	ALL ALUMINUM BARE CONDUCTOR (NOTE 4)
HV	1/0 AWG
HW	
J. BARE ALUMINUM CABLE STEEL REINFORCED (ACSR)	
JA	2156 KCMIL, BLUEBIRD
JB	1780 KCMIL, CHUKAR
JC	1272 KCMIL, BITTERN
JD	1192.5 KCMIL, BUNTING
JE	1113 KCMIL, FINCH
JF	1033.5 KCMIL, CURLEW
JG	954 KCMIL, CARDINAL
JH	795 KCMIL, DRAKE
JJ	636 KCMIL, GROSBEAK
JK	556.5 KCMIL, DOVE
JL	477 KCMIL, HAWK
JM	397.5 KCMIL, IBIS
JN	336.4 KCMIL, LINNET
JP	266.8 KCMIL, PARTRIDGE
JQ	BARE ALUMINUM CABLE STEEL REINF (ACSR) (NOTE 4)
JR	ALUMINUM CABLE STEEL SUPPORTED (ACSS) (NOTE 4)
K. STANDARD-PIPE-SIZE (SPS) TUBE BUS & MISC CONDUCTOR	
KA	1-INCH
KB	1 1/2-INCH
KC	2-INCH
KD	2 1/2-INCH
KE	3-INCH
KF	4-INCH
KG	5-INCH
KH	6-INCH
KJ	
KL	
KM	ALUMINUM PIPE (NOTE 4)
L. LIGHTING ITEMS	
LA	LIGHTING UNIT, BRACKET TYPE (31 1073)
LB	LIGHTING UNIT, POLE TYPE (31 1073)
LC	LED FLOODLIGHT FIXTURE (POLE) (BRACKET) (31 1078)
LF	NEMA 4 JUNCTION BOX
LG	LIGHTING UNIT (NOTE 4)
M. BARE STEEL STRAND CABLE AND FITTINGS	
MA	3/8-INCH, HIGH STRENGTH, 7 STRAND
MB	1/2-INCH, HIGH STRENGTH, 7 STRAND
MC	___INCH, HIGH STRENGTH, __ STRAND (NOTE 4)
MD	DEAD END
ME	COMPRESSION DEAD END
MF	STRAIN CLAMP
MG	Y-CLEVIS EYE
MH	PAD-TYPE TERMINAL CONNECTOR (NOTE 6)
MI	OPGW (NOTE 4)
MN	GROUNDING STIRRUP

ITEM	DESCRIPTION
N. HOT LINE BUS FITTINGS (31 1007)	
NA	90° TUBE/CABLE-TO-PAD TEE CONNECTOR (DETAIL A)
NB	30° TUBE/CABLE-TO-PAD TEE CONNECTOR (DETAIL B)
NC	STUD-TO-PAD TERMINAL (DETAIL C)
ND	JUMPER, PAD-TYPE, TERMINAL CONNECTOR (DETAIL D)
NE	STAND-OFF INSULATOR ASSEMBLY (DETAIL E)
NF	WELDED END PAD-TYPE COUPLER (DETAIL F)
NG	90° STUD-TO-PAD TERMINAL (DETAIL G)
NH	PAD-TO-PAD (DETAIL H)
P. HIGH TEMPERATURE FITTINGS	
PA	DEAD END (SINGLE TONGUE) (DOUBLE TONGUE) (NOTE 4)
PB	PAD-TYPE TERMINAL CONNECTOR
PC	COUPLER
PD	TEE CONNECTOR, CABLE TO PAD
PE	
Q. ACCESSORIES FOR CABLE BUS (NOTE 8)	
QA	DEAD END (SINGLE TONGUE) (DOUBLE TONGUE) (NOTE 6)
QB	PAD-TYPE TERMINAL CONNECTOR (NOTE 6)
QC	STUD-TYPE TERMINAL CONNECTOR (NOTE 6)
QD	TEE CONNECTOR (NOTE 6)
QE	PARALLEL GROOVE CLAMP
QF	BUS SUPPORT CLAMP
QG	BUNDLE SPACER (8-INCH) (NOTE 4)
QH	COUPLER (NOTE 6)
QJ	SUSPENSION CLAMP
QK	TEE CONNECTOR, CABLE TO PAD (NOTE 6)
QL	STUD-TYPE TERMINAL CONNECTOR TO PAD
QM	BUNDLED SPACER TAP PAD (8-INCH) (NOTE 10)
QN	GROUNDING STIRRUP
R. ACCESSORIES FOR TUBE BUS	
RA	BUS SUPPORT (FIXED) (SLIP) (EXPANSION) (NOTE 2)
RB	COUPLER (FIXED) (EXPANSION) (NOTES 2,6)
RC	TEE CONNECTOR, TUBE-TO-TUBE (NOTE 6)
RD	TEE CONNECTOR, TUBE-TO-PAD (NOTE 6)
RE	TERM CONN,PAD-TYPE (FIXED) (EXPANSION) (NOTES 2,6)
RF	TERM CONN,STUD-TYPE (FIXED) (EXPANSION) (NOTES 2,6)
RG	VERTICAL TUBE SUPPORT
RH	CORONA BELL
RJ	END PLUG
RK	VEE TAP CONNECTOR (10° TYPE) (15° TYPE)
RL	TEE CONNECTOR (10° TYPE) (15° TYPE)
RM	SUSPENSION CLAMP
RN	GROUNDING STIRRUP
S. WELDED TYPE FITTINGS FOR TUBE BUS	
SA	BUS SUPPORT (FIXED) (SLIP) (EXPANSION) (NOTE 2)
SB	BUS SUPPORT (VERTICAL TUBE)
SC	TEE CONNECTOR, TUBE-TO-TUBE
SD	TERM CONN, TUBE-TO-PAD (FIXED) (EXPANSION) (NOTE 2)
SE	
SF	TEE CONNECTOR, TUBE-TO-PAD
SG	A-FRAME ASSEMBLY
SH	VEE CONNECTOR (15° LEGS)
SJ	BRANCH CONNECTOR (15° TYPE)
SK	ELBOW CONNECTOR, 90°
SL	ELBOW CONNECTOR, 45°
SM	GROUNDING STUD
T. CONNECTORS FOR TUBE-TO-CABLE BUS OR MISC	
TA	TEE CONNECTOR
TB	END CONNECTOR/COUPLER
TC	PAD TO PAD (FIXED) (EXPANSION) (NOTE 2)
TD	PAD TO PAD GROUNDING STIRRUP
U. INSULATOR ASSEMBLIES AND ACCESSORIES	
UA	ASSEMBLY "A" (31 1020) (NOTE 3)
UB	TURNBUCKLE (NOTE 4)
UC	ASSEMBLY "C" (31 1020) (NOTE 3)
UD	ASSEMBLY "D" (31 1020) (NOTE 3)
UE	ASSEMBLY "E" (31 1020) (NOTE 3)
UF	ASSEMBLY "F" (31 1020) (NOTE 3)
UG	ASSEMBLY "G" (31 1020) (NOTE 3)
UH	SOCKET-CLEVIS
UI	ASSEMBLY "I" (31 1020) (NOTE 3)
UJ	BALL-CLEVIS
UK	ASSEMBLY "H" (31 1020) (NOTE 3)
UL	SPRING STRAIN BUS ASSEMBLY (NOTE 4)
UM	MISCELLANEOUS HARDWARE (NOTE 4)
UN	SUSPENSION INSULATOR DISC, 5 3/4 X 10 (NOTE 3)
UP	YOKE PLATE (NOTE 4)

ITEM	DESCRIPTION
U. INSULATOR ASSEMBLIES AND ACCESSORIES (CONT)	
UQ	Y CLEVIS-EYE
UR	CLEVIS-CLEVIS
US	ANCHOR SHACKLE
UT	EXTENSION LINK/STRAP (NOTE 4)
UW	ASSEMBLY "W" (31 1020) (NOTE 3)
UY	ASSEMBLY "Y" (31 1020) (NOTE 3)
V. POST INSULATORS (EXTRA HIGH STRENGTH)	
VA	2050KV BIL (TP)
VB	1800KV BIL (TP)
VC	1550KV BIL (TP)
VD	1470KV BIL, TR 373 (TP)
VE	1300KV BIL, TR 369 (TP)
VF	1050KV BIL, TR 362
VG	900KV BIL
VH	750KV BIL
VJ	650KV BIL
VK	550KV BIL
VL	350KV BIL
VM	250KV BIL
VN	200KV BIL
VP	150KV BIL
VQ	110KV BIL
VR	95KV BIL
W. POST INSULATORS (HIGH STRENGTH)	
WA	2050KV BIL (TP)
WB	1800KV BIL (TP)
WC	1550KV BIL, TR 379 (TP)
WD	1470KV BIL, TR 371 (TP)
WE	1300KV BIL, TR 367 (TP)
WF	1050KV BIL, TR 316
WG	900KV BIL, TR 308
WH	750KV BIL, TR 295
WJ	650KV BIL, TR 289
WK	550KV BIL, TR 287
WL	350KV BIL, TR 278
WM	250KV BIL, TR 267
WN	200KV BIL, TR 231
WP	150KV BIL, TR 227
WQ	110KV BIL, TR 225
WR	95KV BIL, TR 222
WS	BOLT CIRCLE ADAPTER (NOTE 11)
X. POST INSULATORS, (STANDARD STRENGTH)	
XA	2050KV BIL (TP)
XB	1800KV BIL, TR 391 (TP)
XC	1550KV BIL (TP)
XD	1470KV BIL, TR 330 (TP)
XE	1300KV BIL, TR 324 (TP)
XF	1050KV BIL, TR 312
XG	900KV BIL, TR 304
XH	750KV BIL, TR 291
XJ	650KV BIL, TR 288
XK	550KV BIL, TR 286
XL	350KV BIL, TR 216
XM	250KV BIL, TR 214
XN	200KV BIL, TR 210
XP	150KV BIL, TR 208
XQ	110KV BIL, TR 205
XR	95KV BIL, TR 202
XS	HEIGHT ADAPTER (NOTE 4)
XT	900KV BIL, TR 27 CAP AND PIN
Y. OPERATING PLATFORMS	
YA	SWITCH OPERATING PLATFORM, SINGLE
YB	SWITCH OPERATING PLATFORM, DOUBLE
YC	EQUIPMENT CABINET PLATFORM
YD	TRANSFORMER CABINET PLATFORM
Z. CABLE TRENCH, PULL BOX, AND MATERIALS	
ZA	SINGLE TYPE "C" CABLE TRENCH
ZB	DOUBLE TYPE "C" CABLE TRENCH
ZC	
ZD	

EXPLANATION

SS-----STANDARD STRENGTH
HS-----HIGH STRENGTH
EHS-----EXTRA-HIGH STRENGTH
TP-----TAPERED

NOTES

1. EACH PIECE OF EQUIPMENT IS ASSIGNED AN ITEM FIXED, SLIP, EXPANSION IDENTIFIER AND A UNIQUE EQUIPMENT DESIGNATION. THE ITEM IDENTIFIERS SIMPLY INDICATE EQUIPMENT TYPE WITHOUT REGARD TO RATINGS. THE UNIQUE EQUIPMENT DESIGNATIONS ALONG WITH ASSOCIATED RATINGS AND PROCUREMENT DATA ARE LISTED ON THE SWITCHING DIAGRAM.

2. THE NUMBER OF UNITS SHALL BE DETERMINED BY THE INSULATOR COORDINATION TABLE ON DRAWING 31 1004 UNLESS OTHERWISE INDICATED ON THE PLAN OR SECTION DRAWINGS.

3. THE SIZE, RATING, LENGTH, HOLE SIZES, ETC ARE SHOWN ON THE PLAN OR SECTION DRAWINGS.

4. CONNECTORS SHALL BE COMPRESSION AND INCLUDE CORONA FREE SHIELDING TO FITTINGS 230KV AND ABOVE.

5. UNDER SIMILAR CONDITIONS, THE MATERIALS SPECIFIED FOR ONE PHASE ARE THE SAME FOR ADJACENT PHASES UNLESS OTHERWISE SPECIFIED.

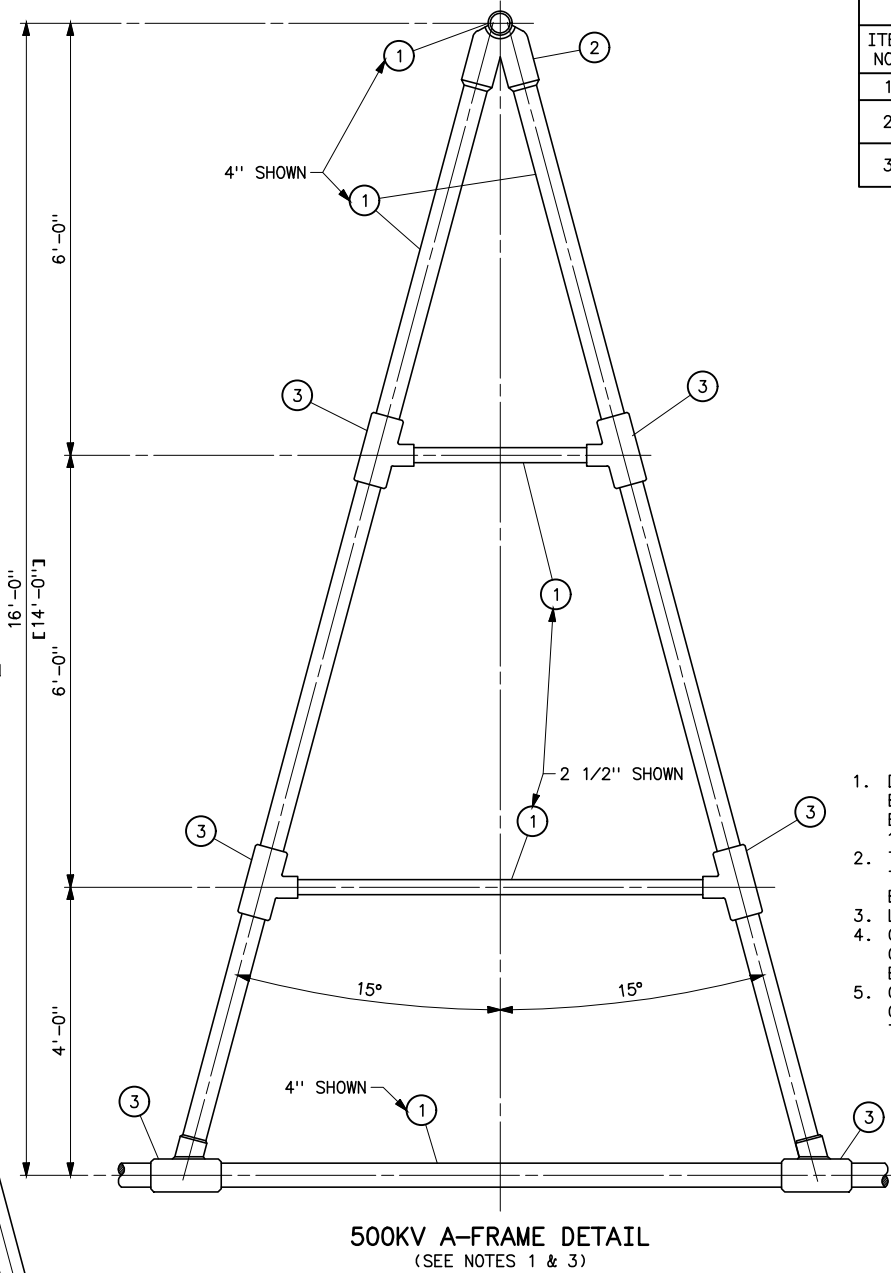
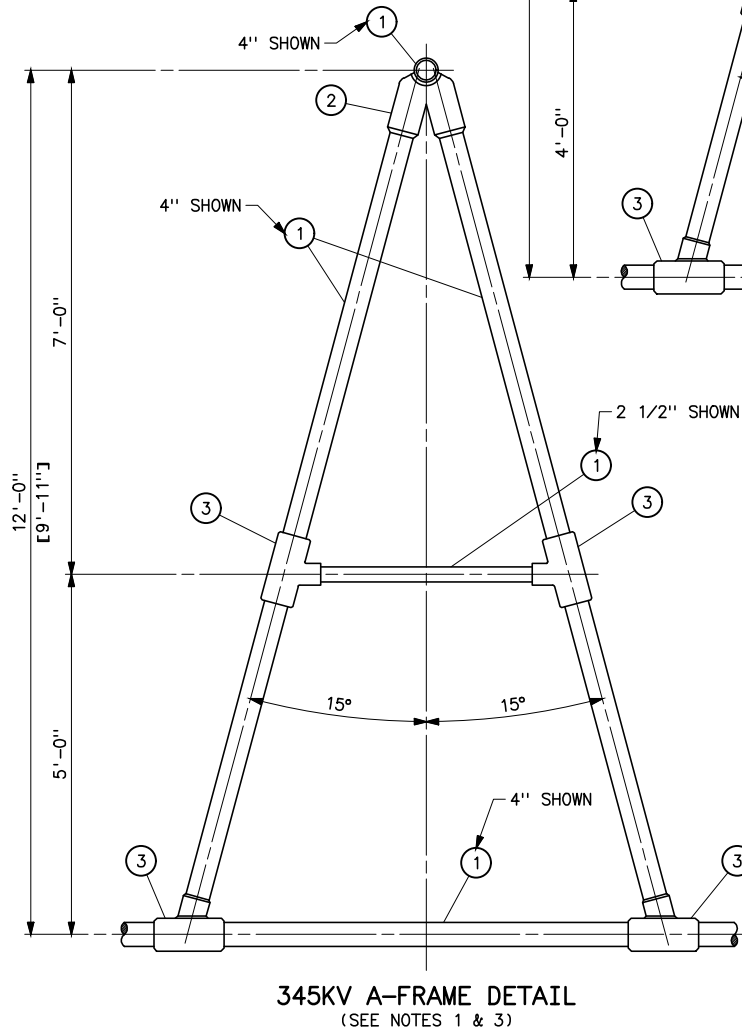
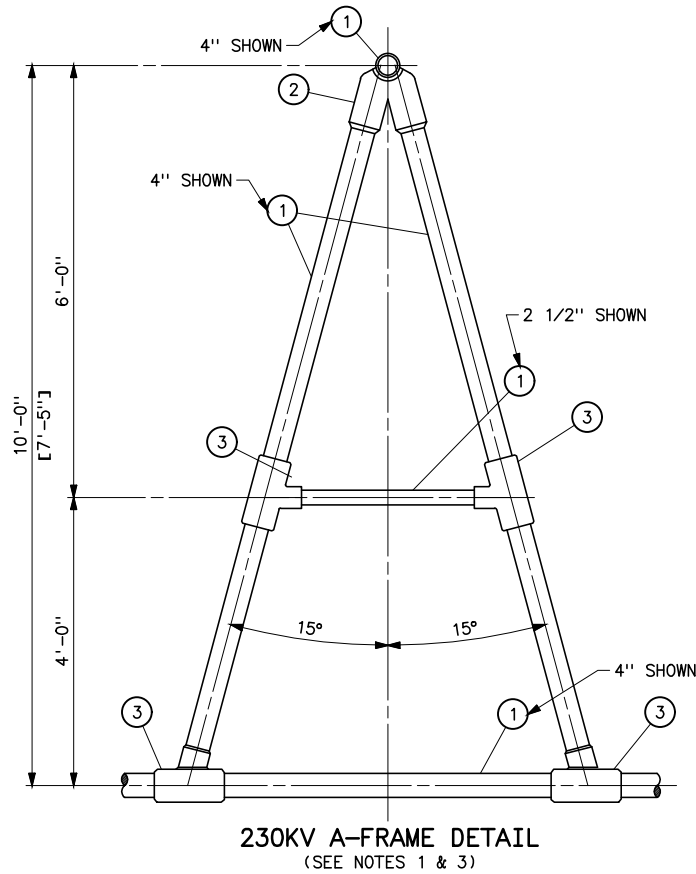
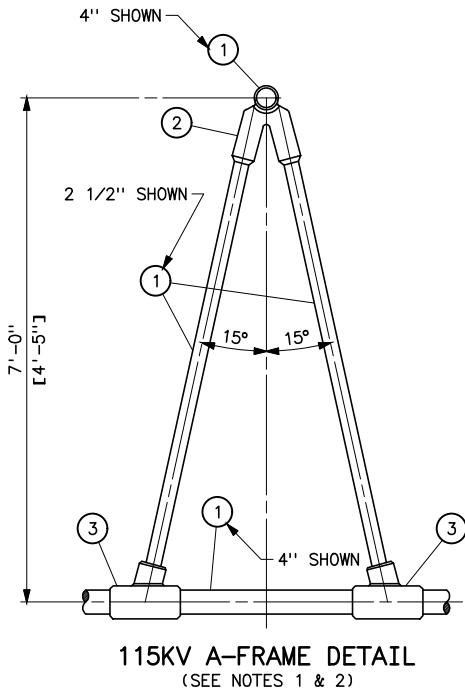
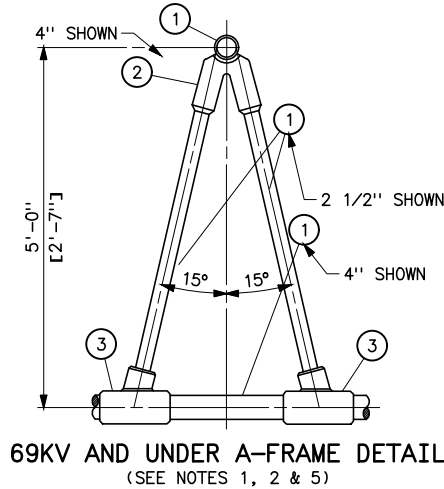
6. PVC SCHEDULE 40 AND SCHEDULE 80 SHALL BE USED IN ACCORDANCE WITH NEMA PUBLICATIONS NO. TC2 AND TC3. 90 DEGREE CONDUIT BENDS INTO CABLE TRENCH MAY BE PVC SCHEDULE 40, ALL OTHER 90 DEGREE CONDUIT BENDS SHALL BE METAL.

7. DUPLEX, TRIPLEX (TRI), QUADRUPE (QUAD) TYPE INDICATED ON PLAN OR SECTION DRAWINGS. FITTINGS SHALL MATCH CONDUCTOR(S) PER PHASE.

8. CONTRACTOR SHALL INCLUDE APPROPRIATE DAMPING CABLE FOR RIGID BUS.

9. LAP BOLT CIRCLE ADAPTER, 5" TO 10-3/8", HEIGHT 1-7/8", OR EQUAL.

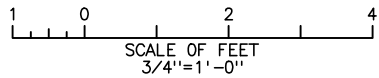
I	4-17-26 A7-HMK	REVISED NOTES
H	2-23-21 A7-RMJ	REVISED POST INSULATORS, NOTES, LIGHTING UNITS, PLATFORMS, AND MERGED HEIGHT ADAPTERS.
G	11-1-10 A7-RMJ	REMOVED ITEMS ED, EM, LC, LD, & LE. ADDED ITEMS U10 & U11. REVISED ITEM EL.
F	8-17-09 A7-RMJ	REVISED SECTION HEADINGS FOR D, H, J. REVISED BJ, BL, DA-DE, DH, DJ, GG, JQ, QA, TB, XT AND NOTE 7. ADDED NOTE 8.
E	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.
D	5-22-00 A3-RMC	ADDED WM, WN, AND WO
C	5-14-99 A3-OP	REVISED DESCRIPTION IN V. POST INSULATOR TABLE
B	8-15-97 A3-OP	ADDED RN, SK, SL, AND SM. REVISED AJ AND AK.
A	4-1-97 A3-OP	MINOR REVISIONS. ADDED BL, CL, LF, PF, QJ, QK, QL, AND UL. REVISED AJ, PB, VP, AND WK.
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS		
EQUIPMENT AND MATERIAL		
INDEX		
DESIGNED RICARDO MORENO JR. _____ APPROVED ROSS W. CLARK ELECTRICAL ENGINEERING MANAGER		
C _A E	NOVEMBER 8, 1996	31 1100

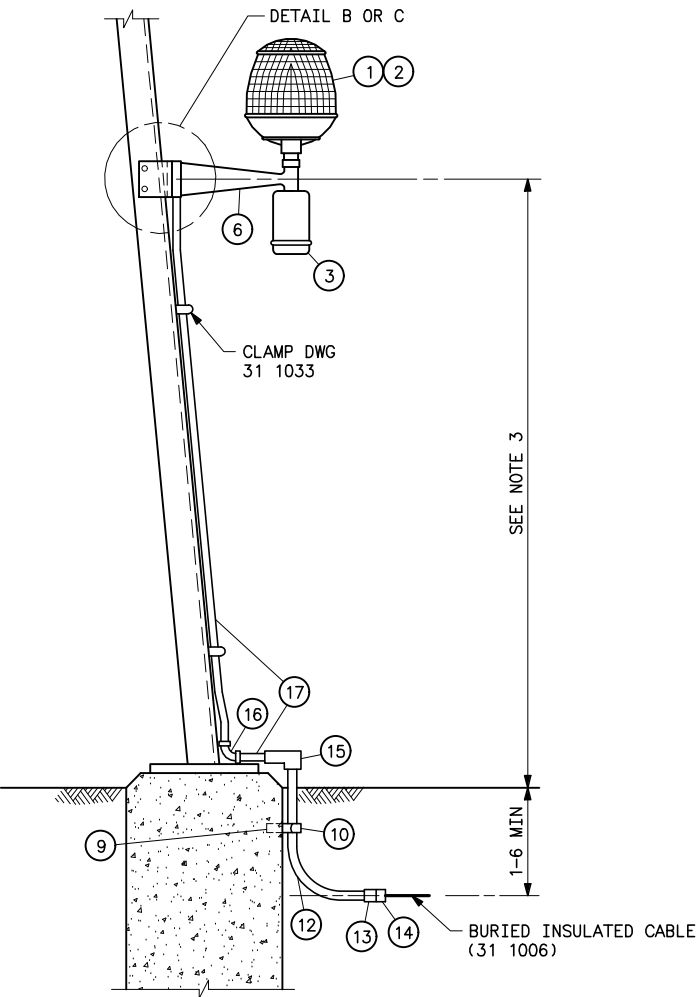


REFERENCE MATERIALS	
ITEM NO.	DESCRIPTION
1	SCH 40 ALUMINUM TUBE
2	30° SPLIT A-FRAME OR V-CONNECTOR, DMC POWER PLK1600D OR EQUAL (SEE NOTE 4)
3	15° SPLIT TEE OR A-FRAME BRANCH CONNECTOR, DMC POWER PLK1500D OR EQUAL (SEE NOTE 4)

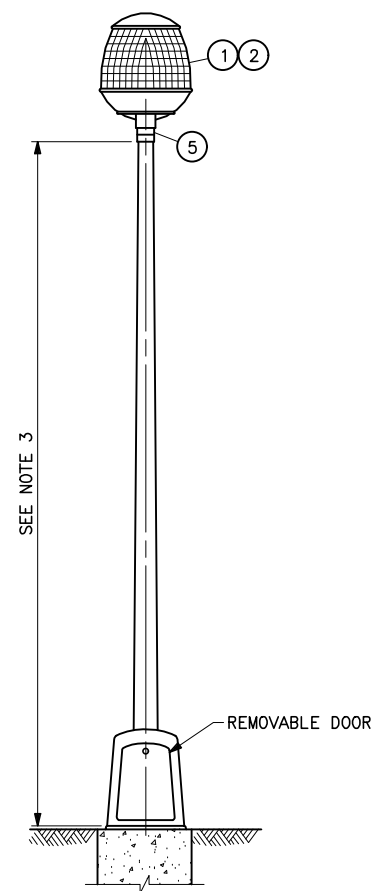
- NOTES
1. DESIGNER NOTE: MINIMUM HEIGHT IN BRACKETS ARE BASED ON 3,300 FOOT ELEVATION. ABOVE THIS ELEVATION, ADDITIONAL SPACING AT A RATE OF 3% PER 1,000 FEET MUST BE ADDED.
 2. THE AMPERAGE OF THE LEGS SHALL BE THE SUM OF THE TWO LEGS TOGETHER AND SHALL NOT BE LESS THAN THE BUS.
 3. LEG DIAMETER SHALL MATCH BUS DIAMETER.
 4. COMPRESSION CONNECTORS ARE PREFERRED. WELDED CONNECTORS ARE ACCEPTABLE. CONTRACTOR MAY CHOOSE BETWEEN INSIDE OR OUTSIDE WELDED FITTINGS.
 5. COMPRESSION SPLIT TEE OR A-FRAME BRANCH CONNECTORS MAY NOT WORK FOR AN A-FRAME SHORTER THAN 6'-0",

A	7-27-26 A7-KB	REVISED LOWER BUS TO UPPER BUS CLEARANCE.
	UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO	
	SUBSTATION STANDARDS A-FRAME 30° BUS DETAILS	
DESIGNED RICARDO MORENO		APPROVED KYLE VAUGHN ELECTRICAL ENGINEERING MANAGER
A	APRIL 17, 2026	31 1131

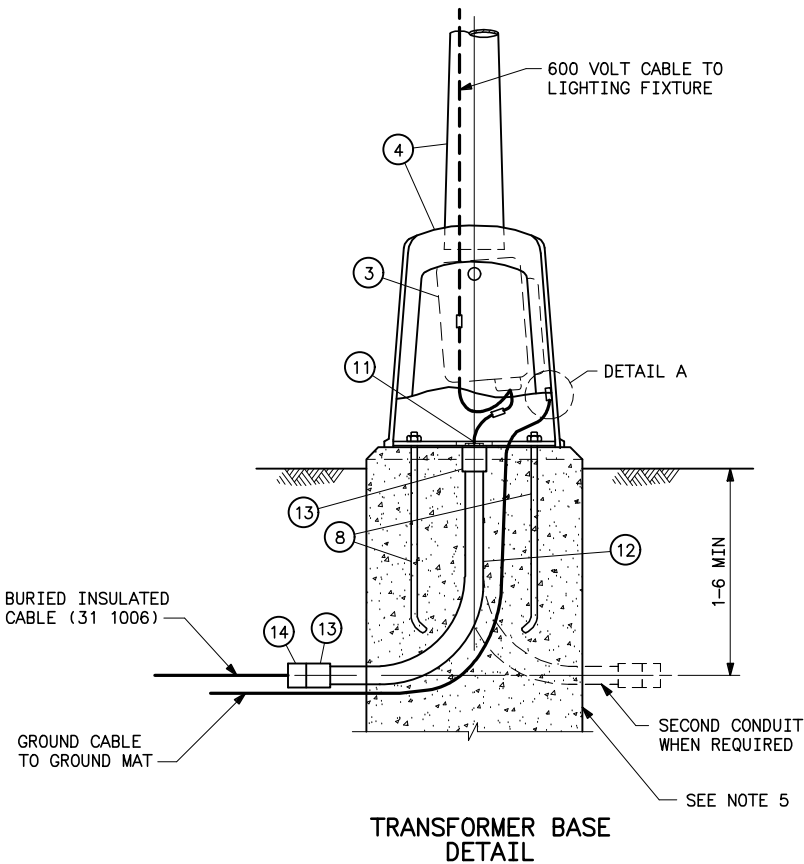




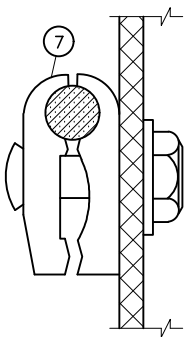
BRACKET TYPE LIGHTING UNIT



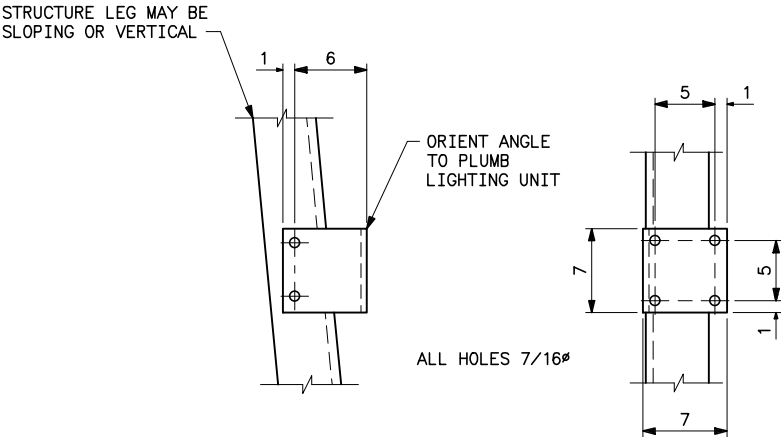
TAPERED POLE TYPE LIGHTING UNIT



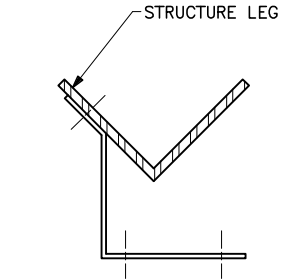
TRANSFORMER BASE DETAIL



DETAIL A



DETAIL B
PARALLEL FACE MOUNTING ADAPTER
MATERIAL 1/4 IN. PLATE



DETAIL C
CORNER MOUNTING ADAPTER
(MATERIAL, DEPTH AND DRILLING
SAME AS DETAIL B)

ITEM	DESCRIPTION
1	OUTDOOR SUBSTATION LIGHTING FIXTURE (SEE NOTE 1)
2	LAMP (SEE NOTE 1)
3	BALLAST-REGULATED OUTPUT TYPE, HIGH POWER FACTOR (SEE NOTE 1)
4	TAPERED ALUMINUM POLE WITH TRANSFORMER BASE (SEE NOTE 1)
5	ADAPTOR FOR 3 IN. POLE TO 1 1/2 IN. FIXTURE SLIP FIT
6	MOUNTING BRACKET (SEE NOTE 1)
7	GROUND CONNECTOR (BURNDY TYPE GB OR EQUAL)
8	ANCHOR RODS, NUTS, LOCKWASHERS AND FLATWASHERS-GALVANIZED STEEL (SEE NOTE 1)
9	3/8 IN. EXPANSION ANCHOR
10	1-INCH CLAMP AND CLAMP BACK
11	1 IN. CHASE NIPPLE
12	1 IN. GALVANIZED RIGID STEEL CONDUIT (SEE NOTE 4)
13	1 IN. CONDUIT COUPLING
14	WATER TIGHT CONNECTOR-GROUSE HINDS TYPE CGB OR EQUAL, OR PLASTIC CHASE NIPPLE (SIZE AS REQD)
15	1 IN "LB" TYPE CONDUIT FITTING
16	3/4 IN. BUSHED ELBOW
17	3/4 IN. GALVANIZED RIGID STEEL CONDUIT (SEE NOTE 4)

NOTES

- SEE SPECIFICATIONS PARAGRAPHS FOR COMPLETE REQUIREMENTS FOR FIXTURE, LAMP, BALLAST, AND POLE OR MOUNTING BRACKET.
- DETERMINE BOLT SIZE, LENGTH, LOCATION AND PROJECTION FROM POLE MANUFACTURER'S REQUIREMENTS.
- SEE SPECIFICATIONS FOR MOUNTING HEIGHT ABOVE FINISHED GRADE.
- CONDUIT IN CONTACT WITH EARTH SHALL HAVE CORROSION PROTECTION IN ACCORDANCE WITH THE SPECIFICATIONS.
- SEE FOUNDATION GENERAL PLAN FOR LOCATION AND DETAIL OF CONCRETE FOOTINGS.
- CONNECT CABLE SHIELD TO GROUND CABLE WHEN SHIELDED CABLE IS PROVIDED.

DRAWING IS NO LONGER USED AT WAPA FOR NEW CONSTRUCTION. SEE DRAWING 31 1091 FOR NEW FLOOD LIGHT MOUNTING DETAILS.
FOR INFORMATION ONLY

E	8-7-26 A7-KB	DRAWING IS NO LONGER USED AT WAPA FOR NEW CONSTRUCTION. SEE DRAWING 31 1091 FOR NEW FLOOD LIGHT MOUNTING DETAILS.
D	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.
C	5-14-99 A3-OP	REDRAWN.
SUPERSEDES DWG NO. 40-D-7005		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS LIGHTING FIXTURE		
DESIGNED BUREC _____ APPROVED ROSS M. CLARK ELECTRICAL ENGINEERING MANAGER		
C A	E MAY 18, 1979	31 1073

- EXPLANATION
- LED FLOODLIGHT MOUNTED ON STRUCTURE 25'-0" ABOVE GROUND
 - BURIED SCHEDULE 40 PVC CONDUIT
 - CABLE RISER IN CONDUIT

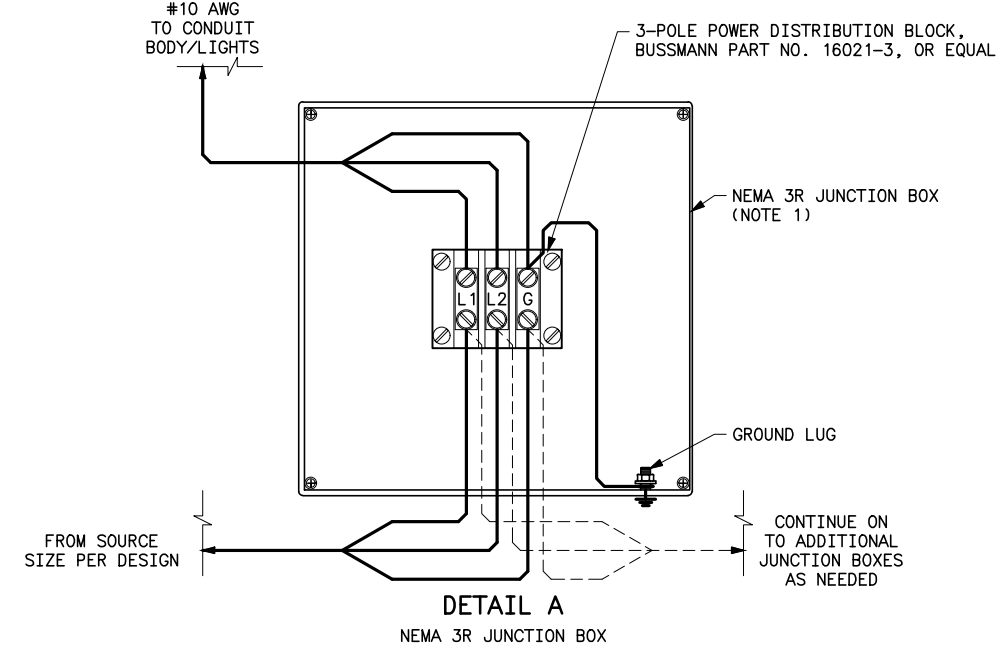
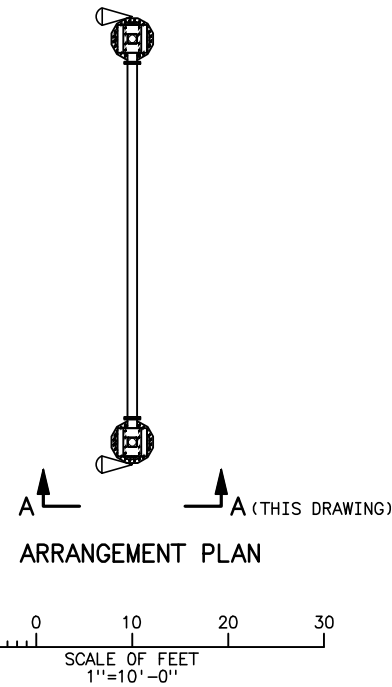
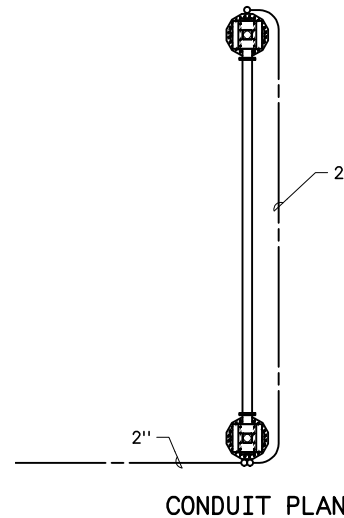
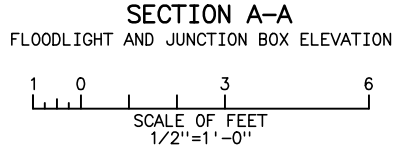
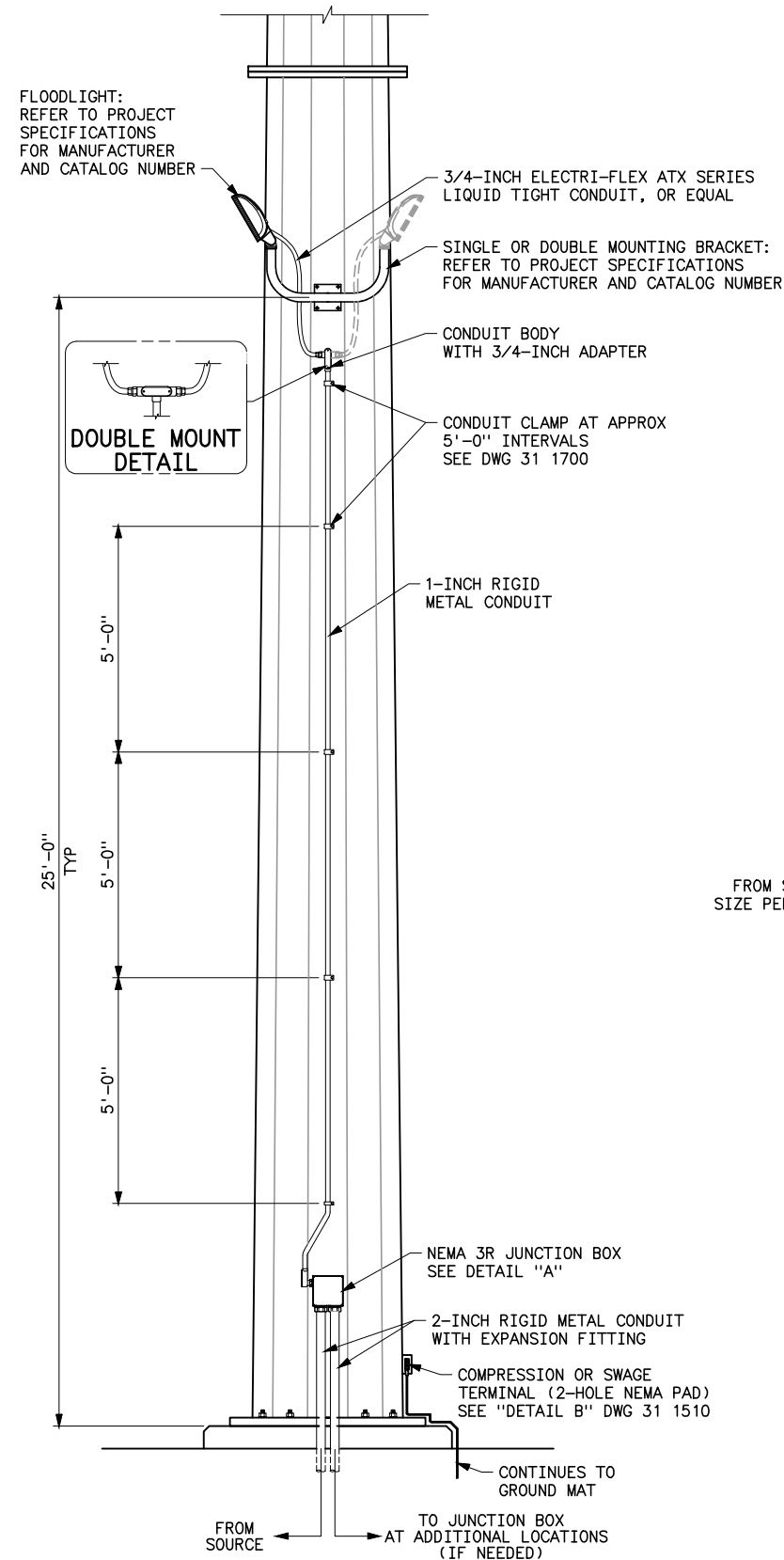
NOTES

- JUNCTION BOXES SHALL BE RATED NEMA 3R AND SIZED. MINIMUM 8X884 INCHES WITH STAND-OFF BACKING PLATE, SAGINAW CAT# SCE-808CHNF WITH OPTIONAL ACCESSORIES BACKING PLATE CAT# SCE-8PB OR EQUAL.
- CONDUITS SHALL COME IN THROUGH THE BOTTOM OR SIDE OF JUNCTION BOXES. AVOID COMING IN THROUGH THE TOP TO HELP PREVENT WATER LEAKAGE.

REFERENCE DRAWINGS

- GROUNDING PLANS - TYPICAL DETAILS----- 31 1510
CONDUIT INSTALLATION - DETAILS----- 31 1700

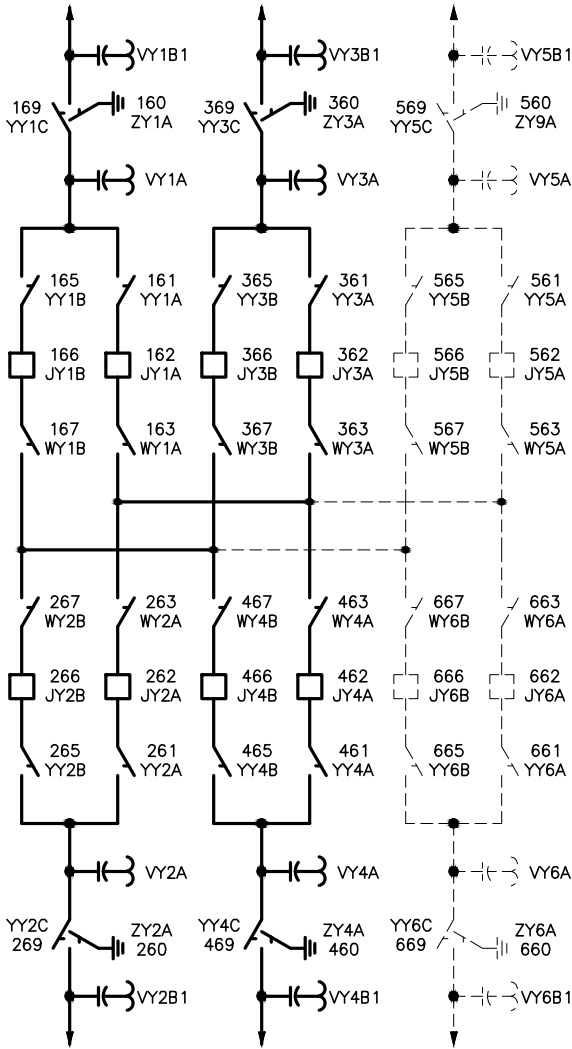
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS FLOODLIGHT AND JUNCTION BOX DETAILS		
DESIGNED B. LINGLE	APPROVED K. VAUGHN ELECTRICAL ENGINEERING MANAGER	
C _{AE}	APRIL 17, 2026	31 1091



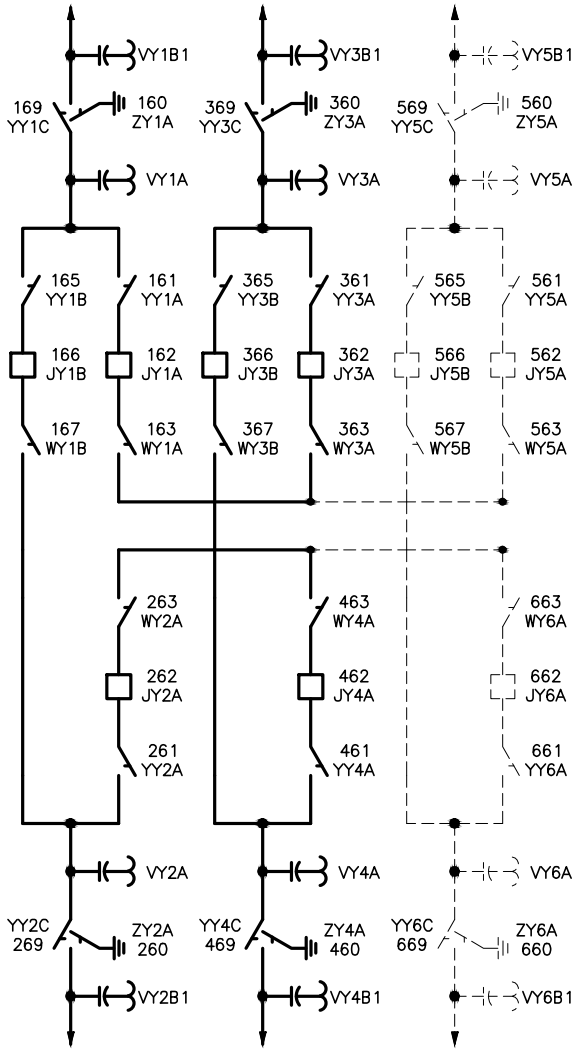
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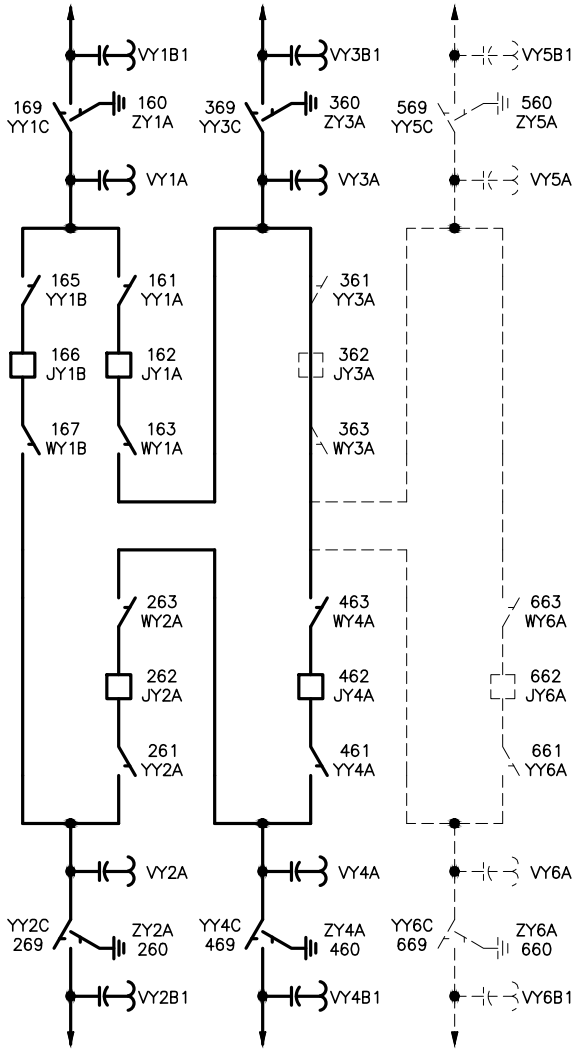
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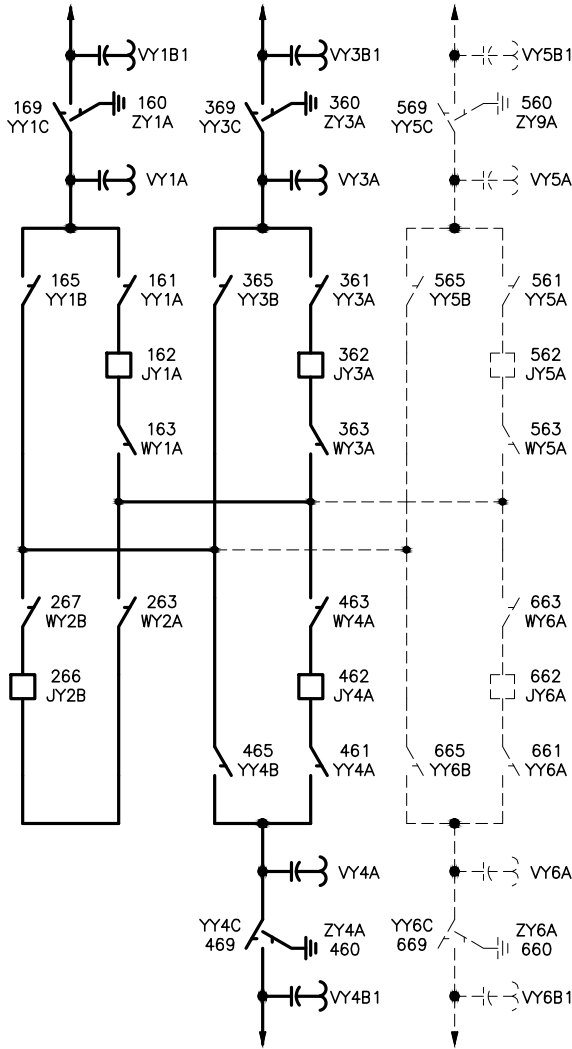
DOUBLE BREAKER DOUBLE BUS
OUTSIDE TAKEOFF



BREAKER AND A HALF
OUTSIDE TAKEOFF



RING BUS - FUTURE BREAKER AND A HALF
OUTSIDE TAKEOFF



MAIN AND TRANSFER BUS
OUTSIDE TAKEOFF

- NOTES**
1. THE INTENT OF ALL OUTSIDE TAKE OFF CONFIGURATIONS ARE TO BE FULLY DEVELOPED UP TO A DOUBLE BREAKER DOUBLE BUS DESIGN, EVEN THOUGH THEY MAY NEVER BE EXPANDED AS SUCH. DESIGNATIONS AND OPERATING NUMBERS SHOULD BE USED TO REFLECT THIS FINAL DESIGN.
 2. OPERATING NUMBERS AND DESIGNATIONS PROVIDED ARE FOR EXAMPLE ONLY. EQUIPMENT DESIGNATIONS SHALL AGREE WITH OPERATING NUMBERS. FINAL EQUIPMENT DESIGNATIONS SHALL BE DETERMINED AFTER OPERATING NUMBERS ARE DETERMINED BY THE REGIONAL OFFICE.

A	4-3-12 A7-RMJ	REVISED BKR & A HALF AND RING BUS LAYOUTS TO CONFORM TO OPERATING NUMBER STANDARDS.
	UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO	
	SUBSTATION STANDARDS SWITCHING DIAGRAM OPERATING NUMBERS BUS CONFIGURATIONS	
	DESIGNED RICARDO MORENO JR. _____	APPROVED ROSS M. CLARK ELECTRICAL ENGINEERING MANAGER _____
SEPTEMBER 15, 2009	31	0001-1

SWITCHING DIAGRAM LEGEND

	SINGLE POLE DISCONNECT SWITCH		TANDEM GANG OPERATED DISCONNECT W/ GROUND SWITCH		AUTO POWER TRANSFORMER WITH TERTIARY AND H.V. LOAD TAP CHANGER		3-PHASE, WYE GROUNDED NEUTRAL
	GANG OPERATED DISCONNECT SWITCH		CAPACITOR		STATION SERVICE TRANSFORMER		OWNERSHIP
	GANG OPERATED DISCONNECT SWITCH WITH GROUND BLADES		SHUNT CAPACITOR		PHASE SHIFTING TRANSFORMER		INDICATES UNDERGROUND INSTALLATION
	MOTOR OPERATED DISCONNECT SWITCH		SHUNT REACTOR		ZIG-ZAG GROUNDING TRANSFORMER		GROUND FAULT DETECTION SCHEME
	GANG OPERATED DISCONNECT SWITCH WITH ARCING HORN		REACTOR		COUPLING CAPACITOR VOLTAGE TRANSFORMER		SHUNT REACTOR SNUBBER CIRCUIT
	GANG OPERATED DISCONNECT SWITCH WITH WHIP		POWER FUSE DISCONNECT		2-WINDING VOLTAGE TRANSFORMER		SURGE ARRESTOR
	NON-FAULT INTERRUPTING DEVICE-MOUNTED ON CLIP END OF MANUALLY OPERATED DISCONNECT SWITCH-TYPICALLY, VACUUM BOTTLES MOUNTED		LOAD BREAK ELBOW		CURRENT TRANSFORMER		REGULATOR BYPASS SWITCH (ONE OPERATING NUMBER FOR 3-SWITCH COMBINATION)
	NON-FAULT INTERRUPTING DEVICE-MOUNTED ON CLIP END OF GANG OPERATED DISCONNECT SWITCH-TYPICALLY, VACUUM BOTTLES MOUNTED		INTERUPTER		WAVE TRAP		WATT HOUR METER
	NON-FAULT INTERRUPTING DEVICE-MOUNTED ON CLIP END OF MOTOR OPERATED DISCONNECT SWITCH-TYPICALLY, VACUUM BOTTLES MOUNTED		INTERRUPTER WITH VISIBLE MOTOR OPERATED DISCONNECT SWITCH		KEY INTERLOCK		ELECTRICAL INTERLOCK
	NON-FAULT INTERRUPTING DEVICE-MOUNTED ON HINGE END OF MANUALLY OPERATED DISCONNECT SWITCH.		POWER CIRCUIT RECLOSER		INSULATOR WITH REMOVABLE JUMPER		(VV3A) 3 PHASE CCVT (VV3A1) 1 PHASE CCVT (AØ)
	NON-FAULT INTERRUPTING DEVICE-MOUNTED ON HINGE END OF GANG OPERATED DISCONNECT SWITCH.		POWER CIRCUIT BREAKER		* ATS: AUTOMATIC TRANSFER SWITCH MTS: MANUAL TRANSFER SWITCH		
	NON-FAULT INTERRUPTING DEVICE-MOUNTED ON HINGE END OF MOTOR OPERATED DISCONNECT SWITCH.		POWER CIRCUIT BREAKER DRAW OUT TYPE		OPENED JUMPERS		
	NON-FAULT INTERRUPTING MOTOR OPERATED CENTER BREAK DISCONNECT SWITCH		LOW VOLTAGE, AIR CIRCUIT BREAKER		POWER FUSE - DRAWOUT TYPE		
	CENTER BREAK, GANG OPERATED SWITCH		LOW VOLTAGE, AIR CIRCUIT BREAKER, DRAW OUT TYPE				
	CENTER BREAK, GANG OPERATED SWITCH WITH GROUND BLADES		POWER TRANSFORMER-TWO WINDING				
	DOUBLE BREAK, CENTER PIVOT, GANG OPERATED DISCONNECT SWITCH		POWER TRANSFORMER-TWO WINDING WITH GROUNDING CONNECTION				
	AUTOMATIC HIGH SPEED GROUNDING SWITCH		POWER TRANSFORMER-TWO WINDING WITH LOAD TAP CHANGER				
	MANUAL, GANG OPERATED GROUNDING SWITCH		POWER TRANSFORMER-THREE WINDING				
	3-WAY GANG OPERATED LOAD BREAK TYPICALLY VACUUM BOTTLES MOUNTED		AUTO POWER TRANSFORMER WITH TERTIARY				

UNITED STATES DEPARTMENT OF ENERGY
WESTERN AREA POWER ADMINISTRATION
HEADQUARTERS - LAKEWOOD, COLORADO

SUBSTATION STANDARDS

SWITCHING DIAGRAM
SYMBOL LEGEND

DESIGNED KYLE VAUGHN _____ APPROVED _____
ELECTRICAL ENGINEERING MANAGER

APRIL 17, 2026

31

0001-3

GENERAL NOTES

UNLESS OTHERWISE SHOWN ON THE DESIGN DRAWINGS, THE DETAILS AND NOTES SHOWN ARE TYPICAL FOR ALL DRAWINGS THAT REFER TO THIS DRAWING. SEE NOTE 1.

SYMBOLS

- 1. BARS SHOWN THUS  8 @ 1'-0" OR  6 @ 7 1/2", INDICATE A GROUP OF THE SAME SIZE BARS EQUALLY SPACED.
- 2.  AN OPEN CIRCLE AT THE END OF A BAR INDICATES A BEND WITH THE BAR TURNED AWAY FROM THE OBSERVER.
- 3.  A CLOSED CIRCLE AT THE END OF A BAR INDICATES A BEND WITH THE BAR TURNED TOWARD THE OBSERVER.
- 4. SPLICE SHOWN THUS  INDICATES A LAPPED SPLICE, NOT A BEND IN THE BAR. FOR MINIMUM LENGTH OF LAP, SEE TABLE 3.

DIMENSIONS

- 1. THICKNESS SHOWN FOR WALLS AND SLABS ON OR ADJACENT TO UNDISTURBED SOIL OR ROCK ARE MINIMUM DIMENSIONS.
- 2. DIMENSIONS ARE TO THE CENTER LINES OF THE BARS OR JOINTS, UNLESS OTHERWISE SHOWN.
- 3. CLEAR COVER DIMENSIONS ARE MARKED CLR.

COVER (SEE NOTES 1, 2)

- 1. THE FOLLOWING CONCRETE COVER SHALL CLR COVER BE PROVIDED FOR REINFORCEMENT: (IN.)
 - a. CONCRETE CAST AGAINST AND PERMANENTLY EXPOSED TO SOIL OR ROCK ----- 3"
 - b. CONCRETE EXPOSED TO SOIL, ROCK OR WEATHER:
 - 6 THROUGH 18 BARS ----- 2"
 - 5 BAR AND SMALLER ----- 1 1/2"
 - c. CONCRETE NOT EXPOSED TO WEATHER OR IN CONTACT WITH SOIL OR ROCK:
 - (1) SLAB, WALLS, JOISTS:
 - 14 AND 18 BARS ----- 1 1/2"
 - 11 BAR AND SMALLER ----- 3/4"
 - (2) BEAMS, COLUMNS:
 - PRIMARY REINFORCEMENT TIES, STIRRUPS, SPIRALS, AND HOOPS ----- 1 1/2"
- 2. REINFORCEMENT PARALLELING CONSTRUCTION JOINTS SHALL HAVE A MINIMUM OF 2 INCHES CLEAR COVER, UNLESS OTHERWISE SHOWN.

REFERENCES

- 1. UNLESS OTHERWISE SHOWN, FOLLOW RECOMMENDATIONS ESTABLISHED WITHIN LATEST EDITIONS OF AMERICAN CONCRETE INSTITUTE'S "DETAILING MANUAL (ACI SP-66)" AND THE CONCRETE REINFORCING STEEL INSTITUTE. REFER TO THESE DOCUMENTS FOR ANY QUESTIONS.

STANDARD HOOKS

- 1. 180° HOOKS SHALL HAVE 180° BENDS AND EXTENSIONS OF 4-BAR DIAMETERS, BUT NOT LESS THAN 2 1/2 INCHES PARALLEL TO THE MAIN LEG OF THE BAR.
- 2. 90° HOOKS SHALL HAVE A 90° BEND AND AN EXTENSION OF AT LEAST 12-BAR DIAMETERS.
- 3. 90° HOOKS FOR STIRRUP AND TIE ANCHORAGE ONLY SHALL HAVE A 90° BEND PLUS AN EXTENSION OF AT LEAST 6-BAR DIAMETERS, BUT NOT LESS THAN 3 INCHES, FOR 5 & SMALLER BARS, AT LEAST 12-BAR DIAMETERS FOR 6 & LARGER, BUT NOT LESS THAN 3 INCHES AT THE FREE END OF THE BAR.
- 4. 135° HOOKS FOR STIRRUP AND TIE ANCHORAGE ONLY SHALL HAVE A 135° BEND PLUS AN EXTENSION OF AT LEAST 6-BAR DIAMETERS, BUT NOT LESS THAN 3 INCHES AT THE FREE END OF THE BAR.
- 5. MINIMUM INSIDE BEND DIAMETERS ARE TO BE AS SPECIFIED IN TABLE 2, TYP.

REINFORCEMENT DOWELS

- 1. DOWELS INDICATED ON THE DRAWING SHALL HAVE AN EMBEDMENT EQUAL TO L_d AND A PROJECTION EQUAL TO THAT REQUIRED FOR LAP SPLICING A BAR OF THE SAME DIAMETER.

PLAIN DOWELS

- 1. UNLESS OTHERWISE SHOWN, PLAIN DOWELS ACROSS CONTRACTION JOINTS SHALL BE SMOOTH BARS UNIFORMLY COATED WITH A FILM OF OIL BEFORE CONCRETE PLACEMENT. VISCOSITY OF THE OIL SHALL HAVE A SAE RATING OF NOT LESS THAN 250.

ACCESSORIES (SEE NOTE 1)

- 1. UNLESS OTHERWISE INDICATED, BAR SUPPORTS, SPACERS, AND OTHER ACCESSORIES ARE NOT SHOWN ON THE DESIGN DRAWINGS. THE RECOMMENDATIONS OF ACI SP-66 OR OTHER APPROVED SUPPORTING SYSTEMS MAY BE USED.

CHAMFER

- 1. CHAMFER EDGES OF PERMANENTLY EXPOSED CONCRETE SURFACES WITH A 45° BEVEL, 3/4 INCH x 3/4 INCH.

EMBEDDED MATERIALS

- 1. BEFORE PLACING CONCRETE, ALL EMBEDDED ITEMS SHALL BE IN POSITION AND SECURELY FASTENED IN PLACE. SEE NOTE 3.
- 2. SEE DESIGN DRAWINGS FOR REQUIRED EMBEDDED ITEMS.

PLACING

- 1. REINFORCEMENT OF SMALL OPENINGS (MAX 1'-6") IN WALLS AND SLABS MAY BE SPREAD APART NOT MORE THAN 1 1/2 TIMES THE BAR SPACING.
- 2. REINFORCEMENT MAY BE ADJUSTED Laterally TO MAINTAIN A CLEAR DISTANCE OF AT LEAST 1 INCH BETWEEN THE REINFORCEMENT AND KEYS, WATERSTOPS, ANCHOR BOLTS, FORM TIES, CONDUITS, AND OTHER EMBEDDED MATERIAL. IN HEAVILY REINFORCED AREAS, RELOCATION OF THE EMBEDDED MATERIAL MUST BE CONSIDERED.
- 3. IN NO CASE SHOULD BARS BE BENT TO GREATER THAN 6 TO 1 SLOPE.
- 4. REINFORCEMENT PARALLEL TO ANCHOR BOLTS OR OTHER EMBEDDED MATERIAL SHALL BE PLACED TO MAINTAIN A CLEAR DISTANCE OF AT LEAST 4/3 TIMES THE MAXIMUM SIZE AGGREGATE.

SPACING (SEE NOTE 1)

- 1. UNLESS OTHERWISE SHOWN, THE FIRST AND LAST BARS IN WALLS AND SLABS, STIRRUPS IN BEAMS, AND TIES IN COLUMNS ARE TO START AND END AT A MAXIMUM OF ONE HALF OF THE ADJACENT BAR SPACING.

JOINTS (SEE NOTE 1)

- 1. ALL CONSTRUCTION JOINTS (CJ), EXPANSION JOINTS (EJ) AND CONTROL JOINTS (SCJ, TCJ) SHALL BE PROVIDED WHERE SHOWN ON THE DESIGN DRAWINGS.
- 2. ALL OPTIONAL CONSTRUCTION JOINTS (OCJ) ARE TO REDUCE THE VOLUME OF PLACEMENTS OR TO FACILITATE CONSTRUCTION. IF OCJ ARE PROVIDED, THEY SHALL BE ONLY AT THE LOCATIONS SHOWN.
- 3. ADDITIONAL JOINTS MAY BE USED IF APPROVED BY THE COR AND ENGINEER.

SPLICES

- 1. UNLESS OTHERWISE SHOWN, THE MINIMUM LENGTH OF LAP FOR SPLICING PARALLEL BARS IN TENSION SHALL BE AS GIVEN IN TABLE 3, CLASS B.
- 2. UNLESS OTHERWISE SHOWN, THE MINIMUM LENGTH OF LAP FOR CIRCULAR COLUMN AND DRILLED PIER TIES SHALL BE AS GIVEN IN TABLE 5.
- 3. SPLICES SHALL BE STAGGERED, TO GIVE 24 INCHES CLEAR BETWEEN ENDS OF ADJACENT SPLICES, IF BARS ARE SPACED CLOSER THAN 6 INCHES OR 6 BAR DIAMETERS.
- 4. FOR NONCONTACT SPLICES IN FLEXURAL MEMBERS, THE TRANSVERSE CENTER-TO-CENTER SPACING OF SPLICED BARS SHALL NOT EXCEED 1/5th THE REQUIRED LAP SPLICE LENGTH OR 6".
- 5. FOR CONTACT LAP SPLICES, MINIMUM CLEAR SPACING BETWEEN CONTACT LAP SPLICE AND ADJACENT SPLICES OR BARS SHALL BE AT LEAST THE GREATEST OF 1", 1-BAR DIAMETER, OR 4/3 TIMES THE MAXIMUM SIZE AGGREGATE.
- 6. WHEN REINFORCING BARS OF DIFFERENT SIZE ARE TO BE SPLICED, THE LENGTH OF LAP SHALL BE GOVERNED BY THE SMALLER DIAMETER BAR.
- 7. SPLICES ARE TO BE MADE SO THAT THE GIVEN DISTANCES TO FACE OF CONCRETE WILL BE MAINTAINED.

BENT BARS

- 1. UNLESS OTHER RADIUS BENDS ARE INDICATED ON THE DESIGN DRAWINGS, ALL REINFORCEMENT REQUIRING BENDING SHALL BE BENT COLD, AND AROUND A PIN HAVING A DIAMETER AS SPECIFIED IN TABLE 2.
- 2. FIELD BENDING OF REINFORCEMENT PARTIALLY EMBEDDED IN CONCRETE SHALL NOT BE PERMITTED, UNLESS SHOWN IN THE CONSTRUCTION DOCUMENTS. SEE NOTE 3.

TABLE 1 – REINFORCING BARS – SIZE DESIGNATIONS AND NOMINAL DIMENSIONS

BAR SIZE		NOMINAL DIMENSIONS		
ENGLISH	METRIC	DIAMETER (IN)	AREA (IN ²)	WEIGHT (LB/FT)
3	£10J	0.375	0.11	0.376
4	£13J	0.500	0.20	0.668
5	£16J	0.625	0.31	1.043
6	£19J	0.750	0.44	1.502
7	£22J	0.875	0.60	2.044
8	£25J	1.000	0.79	2.670
9	£29J	1.128	1.00	3.400
10	£32J	1.270	1.27	4.303
11	£36J	1.410	1.56	5.313
14	£43J	1.693	2.25	7.65
18	£57J	2.257	4.00	13.60

TABLE 2 – PIN DIAMETERS (INCHES)

BAR NO.	3	4	5	6	7	8	9	10	11	14	18
STANDARD BENDS	2 1/4"	3	3 3/4"	4 1/2"	5 1/4"	6	9 1/8"	10 1/4"	11 3/8"	17"	22 5/8"
STIRRUP AND TIE BENDS	1 1/2"	2	2 1/2"	4 1/2"	5 1/4"	6	–	–	–	–	–

TABLE 3 – DEVELOPMENT LENGTH (L_d) AND LAP LENGTH (INCHES)

BAR SIZE	SEE FOOTNOTES 1 THRU 6											
	F'c =3000 PSI				F'c =4000 PSI				F'c =5000 PSI			
	L _d OR CLASS	A	LAP	CLASS B	L _d OR CLASS	A	LAP	CLASS B	L _d OR CLASS	A	LAP	CLASS B
ENGLISH	TOP BARS	OTHER BARS	TOP BARS	OTHER BARS	TOP BARS	OTHER BARS	TOP BARS	OTHER BARS	TOP BARS	OTHER BARS	TOP BARS	OTHER BARS
3	22	17	28	22	19	15	24	19	17	13	22	17
4	29	22	37	29	25	19	33	25	23	17	29	23
5	36	28	47	36	31	24	41	31	28	22	36	28
6	43	33	56	43	37	29	49	37	34	26	43	34
7	63	48	81	63	54	42	71	54	49	38	63	49
8	72	55	93	72	62	48	81	62	56	43	72	56
9	81	62	105	81	70	54	91	70	63	48	81	63
10	91	70	118	91	79	61	102	79	70	54	92	70
11	101	78	131	101	87	67	113	87	78	60	102	78
14	121*	93*	–	–	105*	81*	–	–	94*	72*	–	–
18	161*	124*	–	–	140*	108*	–	–	125*	96*	–	–

FOOTNOTES FOR TABLE 3

- 1. MINIMUM DEVELOPMENT LENGTH IS 12".
- 2. (*) LAP SPLICES ARE NOT PERMITTED FOR BARS LARGER THAN NO. 11.
- 3. L_d CALCULATED IAW ACI 318 25.4.2.3. PROVISIONS OF ACI 318 SECTION 25.4.2.4 TO CALCULATE A SHORTER DEVELOPMENT LENGTH SHALL REQUIRE PRIOR APPROVAL BY THE COR AND ENGINEER.
- 4. L_d VALUES PROVIDED IN TABLE 3 ARE BASED ON THE FOLLOWING ASSUMPTIONS. L_d FOR CONDITIONS OTHER THAN THOSE LISTED BELOW SHALL BE DETERMINED BY THE ENGINEER IAW ACI 318 SECTION 25.
 - a. NORMAL WEIGHT CONCRETE AND GRADE 60 REINFORCING BARS.
 - b. UNCOATED OR ZINC-COATED (GALVANIZED) REINFORCEMENT.
 - c. $\Psi_T = 1.3$ FOR TOP BARS (GREATER THAN 12" OF CONCRETE BELOW HORIZONTAL REINFORCEMENT) AND $\Psi_T = 1.0$ FOR OTHER BARS.
 - d. VALUES IN TABLE 3 ARE FOR DEFORMED BARS IN TENSION.
- 5. TABLE 3 VALUES ARE APPLICABLE IF:
 - a. CLEAR SPACING OF BARS BEING DEVELOPED OR LAP SPLICED IS GREATER THAN 1-BAR DIAMETER, CLEAR COVER IS GREATER THAN 1-BAR DIAMETER, AND STIRRUPS OR TIES IN THE DEVELOPMENT LENGTH ARE GREATER THAN CODE MINIMUM
 - b. OR, CLEAR SPACING OF BARS BEING DEVELOPED OR LAP SPLICED IS GREATER THAN 2-BAR DIAMETERS AND CLEAR COVER IS AT LEAST 1-BAR DIAMETER.
 - c. OTHERWISE, THE VALUES OF TABLE 3 SHALL BE MULTIPLIED BY 1.5.
- 6. CLASS A LAP SPLICE = 1.0 X L_d. CLASS B LAP SPLICE= 1.3 X L_d.

TABLE 4 – MINIMUM HOOK EMBEDMENT DEPTH (E) (INCHES)

BAR SIZE	SEE FOOTNOTES 1 AND 2		
ENGLISH	F'c =3000 PSI	F'c =4000 PSI	F'c =5000 PSI
3	6	6	6
4	6	6	6
5	8	8	7
6	11	10	9
7	14	13	12
8	16	15	14
9	20	18	17
10	23	22	21
11	27	26	24
14	71	66	63
18	109	102	98

FOOTNOTES FOR TABLE 4

- 1. MINIMUM HOOK DEVELOPMENT LENGTH SHOULD NOT BE LESS THAN THE LARGER OF 8-BAR DIAMETERS OR 6".
- 2. L_{dh} VALUES PROVIDED IN TABLE 4 ARE BASED ON THE FOLLOWING ASSUMPTIONS. L_{dh} FOR CONDITIONS OTHER THAN THOSE LISTED BELOW SHALL BE DETERMINED IAW ACI 318 SECTION 25.
 - a. NORMAL WEIGHT CONCRETE AND GRADE 60 REINFORCING BARS.
 - b. UNCOATED OR ZINC-COATED (GALVANIZED) REINFORCEMENT.
 - c. $\Psi_0 = 1.0$. FOR NO. 11 BARS AND SMALLER, A FACTOR OF 0.7 MAY BE APPLIED TO THE VALUES IN THE TABLE IF THE COVER PROVISIONS OF ACI 318 TABLE 25.4.3.2 ARE MET.
 - d. $\Psi_R = 1.0$. FOR NO. 11 BARS AND SMALLER, A FACTOR OF 0.8 MAY BE APPLIED TO THE VALUES IN THE TABLE IF THE CONFINING REINFORCEMENT PROVISIONS OF ACI 318 TABLE 25.4.3.2 ARE MET.

ABBREVIATIONS

BF = BOTTOM FACE
TF = TOP FACE
NF = NEAR FACE
FF = FAR FACE
EF = EACH FACE
BL = BOTTOM LAYER
TL = TOP LAYER
ML = MIDDLE LAYER
NS = NEAR SIDE
FS = FAR SIDE
ES = EACH SIDE
EW = EACH WAY
OCEW = ON CENTER EACH WAY
CJ = CONSTRUCTION JOINT (01 2004-2)
OCJ = OPTIONAL CONSTRUCTION JOINT
VCJ = VERTICAL CONSTRUCTION JOINT
CRJ = CONTRACTION JOINT
CTJ = CONTROL JOINT
EJ = EXPANSION JOINT (01 2004-2)
WJ = WEAKENED JOINT
SCJ = SAWCUT CONTROL JOINT (01 2004-2)
TCJ = TOOLED-IN CONTROL JOINT (01 2004-2)
HP = HIGH POINT
LP = LOW POINT
WP = WORKING POINT
EL = ELEVATION
WS = WATERSTOP
= SIZE OF DEFORMED BAR
o = PLAIN ROUND BAR
WWF = WELDED WIRE FABRIC
SP = SPACE OR SPACES
EQL SP = EQUALLY SPACED, EQUAL SPACES
D = NOMINAL DIAMETER OF REINFORCING BAR
CLR = CLEAR
CTR = CENTER OR CENTERS
L_d = DEVELOPMENT LENGTH
IAW = IN ACCORDANCE WITH
COR = CONTRACTING OFFICER REPRESENTATIVE

NOTES

- 1. REFER TO CONCRETE STANDARD DRAWINGS 01 2006-1, -2 AND -3 FOR BUILDING SLABS-ON-GROUND – SPECIFICATIONS, NOTES, PLANS & DETAILS.
- 2. TOP SURFACE OF EARTH MATERIALS, INCLUDING BUT NOT LIMITED TO COMPACTED GRAVEL AND GRANULAR FILL, SHALL NOT BE CONSIDERED EQUIVALENT TO A FORMED SURFACE.
- 3. VIOLATION OF THIS REQUIREMENT SHALL RESULT IN REJECTION WITHOUT EXCEPTION.

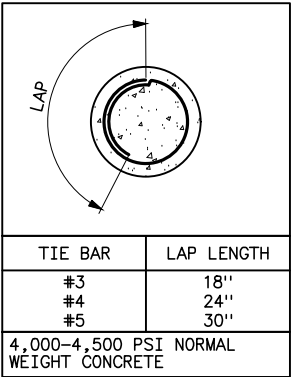
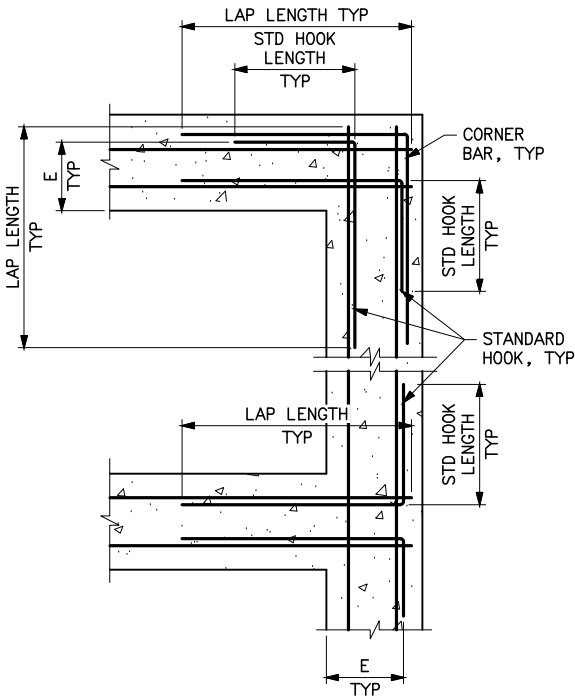
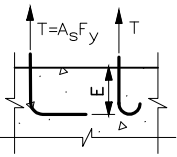


TABLE 5 – CIRCULAR TIE LAPS FOR DRILLED PIERS & COLUMNS



TYPICAL CORNER & INTERSECTION DETAILS

D	10-8-20 A7-JAS	REVISIONS COORDINATED WITH NOTE 1 AND UPDATED REINFORCEMENT STDS PER ACI 318-19 & ACI 318R-19.
C	11-1-17 A7-JAS	MINOR REVISIONS-SPLICE NOTES 1 & 2, CIRCULAR TIE TABLE 5, JOINT ABBREVIATIONS.
B	9-27-16 A7-RBP	UPDATED REINFORCEMENT STANDARDS WITH ACI 318-14 CODE.
A	9-11-13 A7-GMF	UPDATE REINFORCEMENT STANDARDS WITH ACI 318-08 CODE

SUPERSEDES DWG NO. 01 2004A

UNITED STATES DEPARTMENT OF ENERGY
WESTERN AREA POWER ADMINISTRATION
CORPORATE SERVICES OFFICE – LAKEWOOD, COLORADO

CONCRETE STANDARDS
GENERAL OUTLINE AND
REINFORCEMENT NOTES

DESIGNED J.A. SCHREIBER APPROVED DOUGLAS HANSON
CIVIL ENGINEERING MANAGER

AUGUST 1, 2006	01	2004-1
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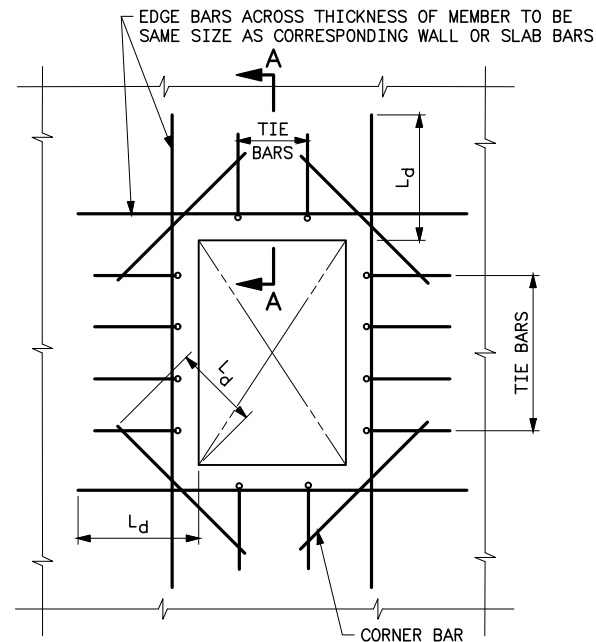
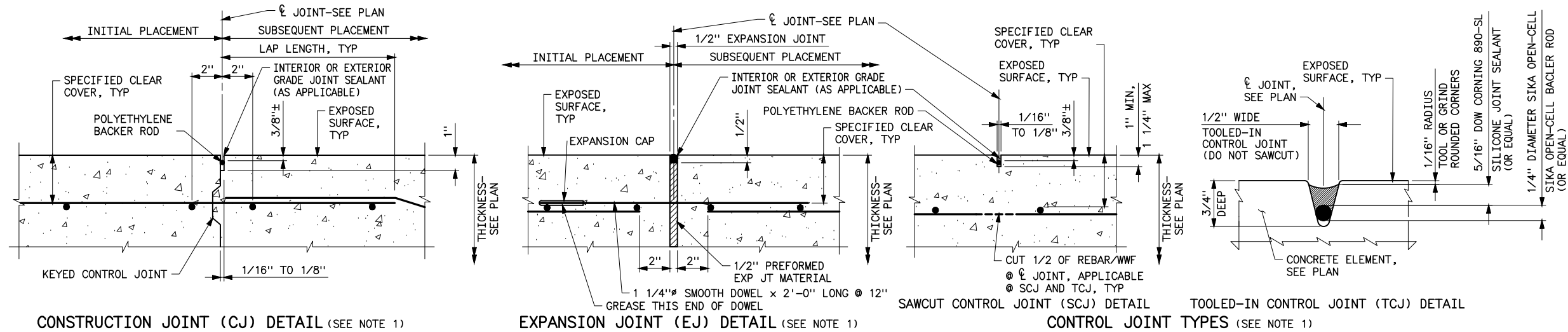
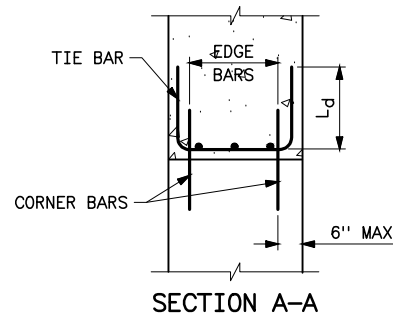


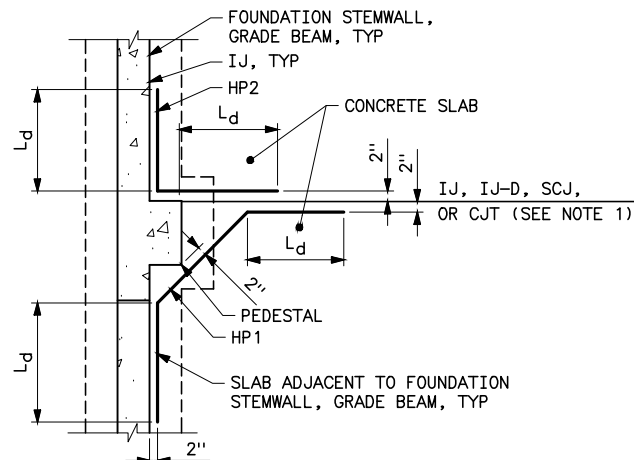
TABLE FOR REINFORCEMENT AROUND OPENINGS			
MEMBER THICKNESS	TIE BARS	EDGE BARS	CORNER BARS
LESS THAN 10"	NONE	1-ML	1-#4, ML
10" THRU 1'-6"	NONE	1-EF	1-#4, EF
1'-7" THRU 3'-0"	#4 @ 1'-0"	3 - EQL SP	1-#6, EF
OVER 3'-0"	#6 @ 1'-0"	SP @ 1'-0"	1-#8, EF

1. OMIT EDGE AND TIE BARS ALONG SIDES OF OPENINGS WHERE DIMENSION IS LESS THAN 1'-6".
2. OMIT CORNER BARS AT SIDES OF OPENINGS ADJACENT TO FLOORS, WALLS, OR BEAMS.
3. CORNER BARS REQUIRED IF EITHER DIMENSION OF OPENING IS GREATER THAN 1'-6".
4. USE CORNER BARS IN FACE OF RECESSES DEEPER THAN 4" IF EITHER DIMENSION OF RECESS IS GREATER THAN 1'-6".

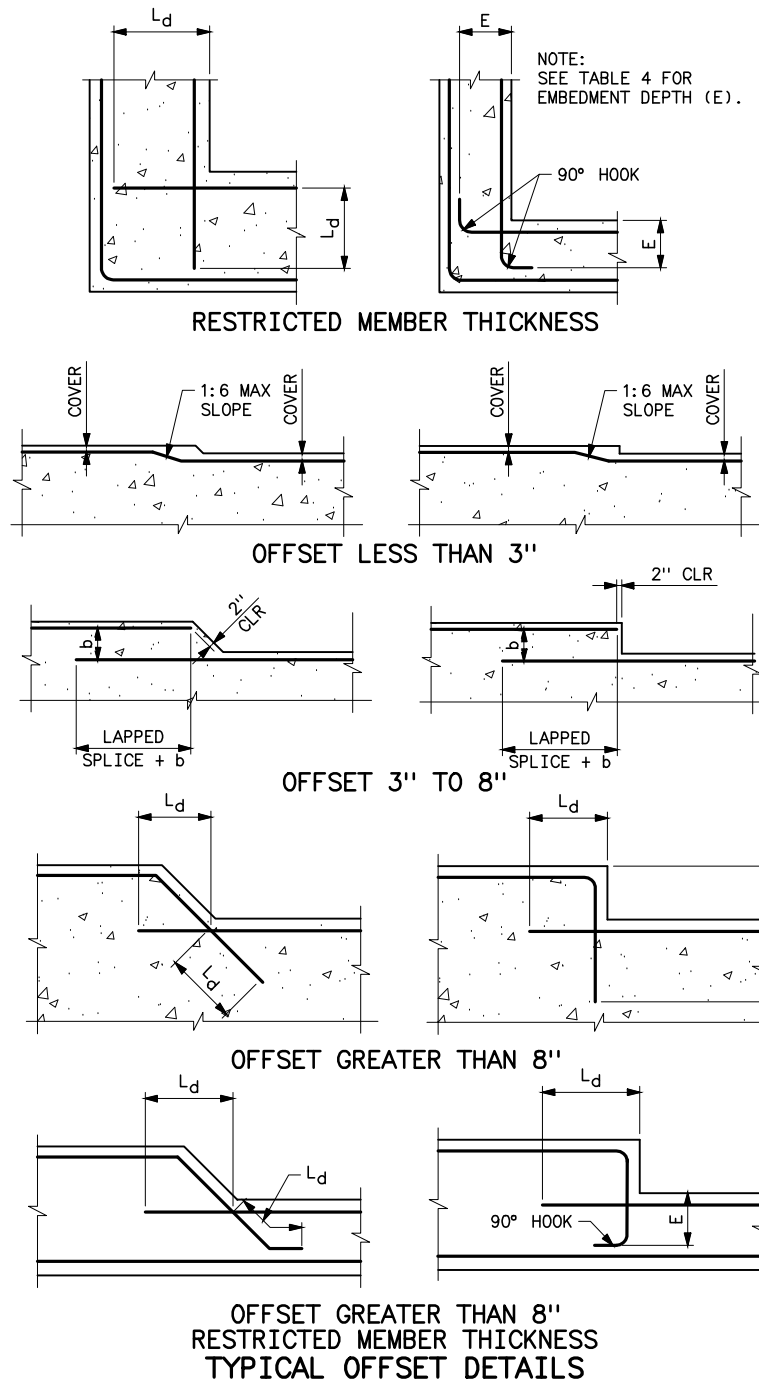
ADDITIONAL REINFORCEMENT AROUND OPENINGS



HAIRPIN BAR SCHEDULE	
HP1	
HP2	
HP3	
HP4	

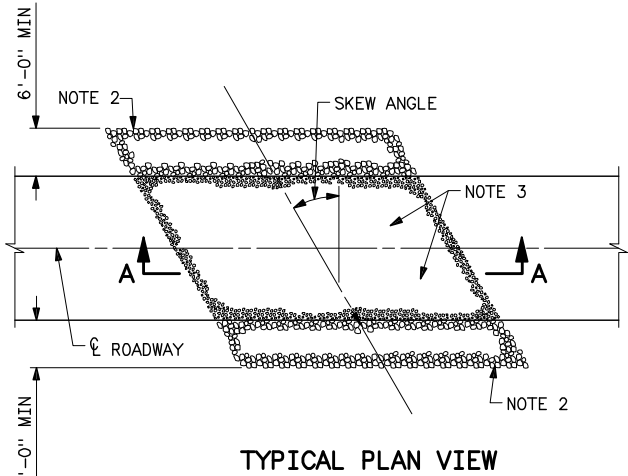
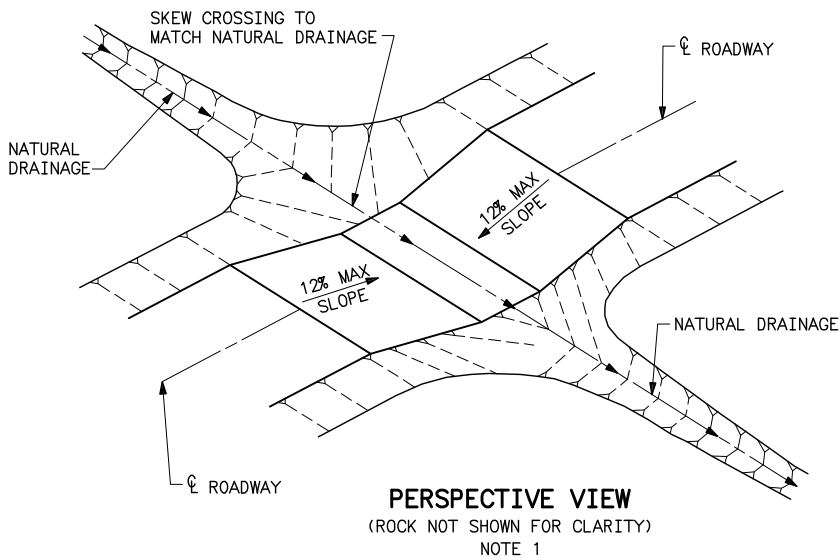


SLAB HAIRPIN BAR DETAILS (FOR BUILDINGS, SEE NOTE 1)



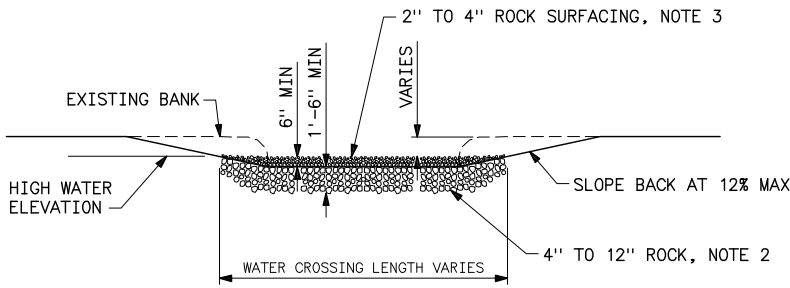
NOTE
1. REFER TO CONCRETE STANDARD DRAWINGS 01 2006-1, -2 AND -3 FOR BUILDING SLABS-ON-GROUND - SPECIFICATIONS, NOTES, PLANS & DETAILS.

D	10-8-20 A7-JAS	REVISIONS COORDINATED WITH NOTE 1 AND UPDATED REINFORCEMENT STDS PER ACI 318-19 & ACI 318R-19.
C	11-1-17 A7-JAS	MINOR REVISIONS-CONTROL JOINT TYPES, JOINT EJSF, AND HAIRPIN DETAILS.
B	9-27-16 A7-RBP	UPDATED REINFORCEMENT STANDARDS WITH ACI 318-14 CODE.
A	9-17-13 A7-GF	MINOR REVISIONS.
SUPERSEDES DWG NO. 01 2004A (IN PART)		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
CONCRETE STANDARDS GENERAL OUTLINE AND REINFORCEMENT NOTES		
DESIGNED J.A. SCHREIBER APPROVED D. HANSON ELECTRICAL ENGINEERING MANAGER		
C _A E	AUGUST 1, 2006	01 2004-2



NOTES

1. EXCAVATE FOR WATER CROSSING TO TOP OF ROCK SURFACING AT NATURAL DRAINAGE ELEVATION.
2. PLACE 18-INCH LAYER OF 4" TO 12" ROCK FOR LOWER LAYER OF WATER CROSSING AND FOR 6'-0" MINIMUM WIDTH BY WATER CROSSING LENGTH OF UPSTREAM AND DOWNSTREAM SIDES OF CROSSING.
3. PLACE 6" UPPER LAYER OF 2" TO 4" ROCK SURFACING OVER 18" LOWER LAYER OF 4" TO 12" ROCK ON WATER CROSSING LENGTH BY ROADWAY LENGTH.



SECTION A-A

B A	9-12-12 A7-DH	CORRECTED SPELLING ERROR.
	7-15-03 A7-DH	REVISED TITLE BLOCK ONLY.
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
STANDARD DESIGNS SITWORK TYPICAL WATER CROSSING		
DESIGNED BOBBY G. HAGLER — — — — — APPROVED DOUGLAS HANSON CIVIL ENGINEERING MANAGER		
C A	FEBRUARY 27, 1995	01 2005

BUILDING CONCRETE SLABS-ON-GROUND SPECIFICATIONS & NOTES

1. GENERAL:

SPECIFICATIONS, NOTES, PLANS AND DETAILS ON THIS 3-SHEET SET ARE PRIMARY REQUIREMENTS APPLICABLE FOR ALL BUILDING CONCRETE SLABS-ON-GROUND. EXCEPTIONS TO THESE DRAWINGS, IF APPLICABLE, ARE SHOWN IN PROJECT-SPECIFIC DRAWINGS AND SPECIFICATIONS. WAPA CONSTRUCTION STANDARD 3 – CONCRETE APPLIES.

2. REFERENCE DOCUMENTS:

- a. WAPA CONSTRUCTION STANDARD 3 – CONCRETE.
- b. ACI 117-10 AND ACI 117R-10 – SPECIFICATION FOR TOLERANCES FOR CONCRETE CONSTRUCTION AND MATERIALS AND COMMENTARY.
- c. ACI 201.2R-16 – GUIDE TO DURABLE CONCRETE.
- d. ACI 224.3R-95 (REAPPROVED 2013) – JOINTS IN CONCRETE CONSTRUCTION.
- e. ACI 224.4R-13 – GUIDE TO DESIGN DETAILING TO MITIGATE CRACKING.
- f. ACI 302.1R-15 – GUIDE TO CONCRETE FLOOR AND SLAB CONSTRUCTION.
- g. ACI 318-19 AND ACI 318R-19 – BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE AND COMMENTARY.
- h. ACI 360R-10 – GUIDE TO DESIGN OF SLABS-ON-GROUND.
- i. ACI 439.5R-18 – GUIDE TO SPECIFICATION, MANUFACTURE, AND CONSTRUCTION USE OF WELDED WIRE REINFORCEMENT.
- j. ASTM E1745-17 – STANDARD SPECIFICATION FOR PLASTIC WATER VAPOR RETARDERS USED IN CONTACT WITH SOIL OR GRANULAR FILL UNDER CONCRETE SLABS.

3. TOLERANCES:

+/-1/4" VARIATION FROM LEVEL OR SPECIFIED FINISHED GRADE TOP OF CONCRETE ELEVATION; +1/4" SLAB THICKNESS.

4. EMBEDDED ITEMS:

"STABBING DOWELS" IS NOT ALLOWED. ALL EMBED ITEMS SHALL BE POSITIVELY ANCHORED AT THEIR REQUIRED POSITION PRIOR TO CONCRETE PLACEMENT. WET-SETTING OR "STABBING" OF ITEMS INTO CONCRETE DURING PLACEMENT IS NOT ALLOWED. VIOLATION OF THESE PROVISIONS WILL RESULT IN REJECTION WITHOUT EXCEPTION.

5. AGGREGATE:

- a. 1" TO 1 1/2" NOMINAL MAXIMIZE-SIZE AGGREGATE.
- b. SUBMIT DATA SHOWING THAT SAND AND COARSE AGGREGATE MEET THE REQUIREMENTS OF ASTM C33 AND ASTM 1778. AGGREGATE MUST HAVE BEEN TESTED WITHIN ONE YEAR PRIOR TO USE. SUBMIT DATA, INCLUDING SOURCE LOCATION AND POTENTIAL REACTIVITY TEST RESULTS, PRIOR TO OBTAINING AGGREGATE.

6. PERFORMANCE- AND DURABILITY-BASED CONCRETE MIX DESIGN REQUIREMENTS:

- a. WAPA ENGINEER-OF-RECORD SHALL BE SOLELY-RESPONSIBLE FOR SPECIFYING APPLICABLE CATEGORY (F0 OR F2) FOR EACH PROJECT.
- b. UNLESS NOTED OTHERWISE, CLASS F FLY ASH SHALL BE INCORPORATED INTO CONCRETE MIX DESIGN PER CONSTRUCTION STANDARD 3 – CONCRETE. WAPA ENGINEER-OF-RECORD SAHLL BE SOLELY RESPONSIBLE FOR DETERMINING IF IT IS ACCEPTABLE TO WAIVE REQUIREMENT FOR INCLUDING FLY ASH. FOR SULPHATE MITIGATION, USE TYPE V CEMENT, TYPE IIA CEMENT WITH CLASS F FLY ASH, OR TYPE II CEMENT IF ASTM C452 TEST RESULTS PROVE IT WILL MITIGATE SULFATE ATTACK. FOR ASR MITIGATION, USE CLASS F OR N FLY ASH, OR BLAST-FURNACE SLAG.
- c. WATER SHALL NOT BE ADDED TO MIX TRUCKS UNLESS BATCH TICKETS WERE SIGNED AT BATCH PLANT INDICATING THAT WATER HAD BEEN WITHHELD AT PLANT. VIOLATION OF THIS PROVISION SHALL RESULT IN REJECTION WITHOUT EXCEPTION.
- d. DESIGN TABLE:

6" CONCRETE SLAB-ON-GROUND	CATEGORY F0: CONCRETE NOT EXPOSED TO FREEZE/THAW CYCLES	CATEGORY F2: CONCRETE EXPOSED TO FREEZE/THAW CYCLES
f'c: MINIMUM 28-DAY COMPRESSIVE STRENGTH	4,000 PSI	4,500 PSI
W/CM: MAXIMUM WATER/CEMENTITIOUS MATERIALS RATIO	0.55	0.45
AIR CONTENT	5.5 ± 1.5% (4%-7%)	6.5 ± 1.5% (5%-8%)
MAXIMUM SLUMP AT PLACEMENT	5"	5"

7. CONSOLIDATION REQUIREMENTS:

VIBRATORY SCREED FOR LOW SLUMP CONCRETE (3" OR LESS); INTERNAL VIBRATION (STICK) FOR HIGH SLUMP CONCRETE (GREATER THAN 3"); FOLLOWED BY HAND SCREED.

8. FINISH REQUIREMENTS:

HARD STEEL-TROWELED FINISHING IS NOT PERMITTED BECAUSE REQUIRED AIR CONTENT EXCEEDS 3%. IN ALL CASES, WAIT FOR BLEED WATER TO EVAPORATE BEFORE FINISHING, DO NOT PUSH BLEED WATER BACK DOWN INTO SLAB, AND DO NOT SPRINKLE WATER ON SURFACE TO AID IN FINISHING.

- a. EXTERIOR SIDEWALKS, EQUIPMENT PADS, ENTRY PADS: BROOM FINISH PERPENDICULAR TO SLOPE.

- b. EXTERIOR APRONS: BROOM FINISH PERPENDICULAR TO SLOPE.
- c. INTERIOR VEHICLE BAY SLABS (MAINTENANCE FACILITIES, ETC.): WOOD OR MAGNESIUM FLOAT.
- d. INTERIOR FLOOR SLABS (OFFICE AREAS, ETC.): WOOD OR MAGNESIUM FLOAT.

9. CURING REQUIREMENTS:

CURE SLABS-ON-GROUND A MINIMUM OF 7 DAYS. CURING COMPOUNDS MAY BE USED ON INTERIOR FLOOR SLABS-ON-GROUND THAT ARE TO RECEIVE FINISH MATERIALS (INCLUDING EPOXY) PROVIDED THEY ARE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS, AND ARE COMPLETELY REMOVED PRIOR TO INSTALLING FINISH.

10. STRUCTURAL WELDED WIRE REINFORCEMENT (WWR):

WWR 6X6-D5.5XD5.5, CONFORM WITH ACI 439.5R, PROVIDE IN FLAT SHEETS ONLY (COMPACTED ROLLS OR COILS NOT ACCEPTABLE), DEFORMED WIRE, POSITIVELY SUPPORTED USING SPECIFIED BOLSTER SYSTEM. PROVIDE 18" (3 SQUARES) MINIMUM LAP SLICE LENGTH.

11. BOLSTER SUPPORTS FOR WWR:

- a. GENERAL: TOP SURFACE OF COMPACTED BASE GRANULAR FILL MATERIAL SHALL NOT BE CONSIDERED EQUIVALENT TO A FORMED SURFACE REGARDING CLEARANCES ABOVE EARTH. WWR CLEARANCES SHALL BE AS SPECIFIED AND SHOWN IN DETAILS; AND SHALL BE AS MEASURED FROM BOTTOM OF WWR TO BOTTOM SURFACE OF CONCRETE SLAB. ALL SLAB REINFORCEMENT SHALL BE POSITIVELY SUPPORTED AT CORRECT POSITION USING BOLSTER SYSTEM PRIOR TO CONCRETE PLACEMENT; VIOLATION OF THIS PROVISION WILL RESULT IN REJECTION WITHOUT EXCEPTION. UNDER NO CIRCUMSTANCES WILL IT BE ACCEPTABLE TO "PULL" WWR INTO POSITION DURING CONCRETE PLACEMENT; VIOLATION WILL RESULT IN REJECTION WITHOUT EXCEPTION.
- b. MAIN 6" SLAB-ON-GROUND SECTIONS (UNLESS SPECIFIED OTHERWISE): EQUAL TO DAYTON SUPERIOR 3-1/2" TALL x 5' LONG CONTINUOUS HIGH CHAIR WITH PLATE (CHCP-TYPE, PART NUMBER 74924) WITH CONTINUOUS 5' LONG TOP WIRE AND (2) 1" WIDE x 5' LONG CONTINUOUS STEEL BASE PLATES (1 PER LEG); SPACE SUPPORTS AT 24" MAXIMUM.
- c. PERIMETER 12" DEEP TURN DOWN SECTIONS IN EXTERIOR APRONS, SIDEWALKS, ENTRY AND EQUIPMENT SLABS-ON-GROUND: EQUAL TO DAYTON SUPERIOR 9 1/2" TALL x 5' LONG CONTINUOUS HIGH CHAIR (CHC-TYPE, PART NUMBER 121104) WITH CONTINUOUS 5' LONG TOP WIRES.

12. HAIRPIN BARS HP#:

PREVENT DIAGONAL SLAB CRACKS FROM FORMING AT RE-ENTRANT CORNERS OF SLABS-ON-GROUND, TYPICAL AT FLOOR TRENCH AND PEDESTAL LOCATIONS AND ELSEWHERE AS SHOWN ON PROJECT-SPECIFIC DRAWINGS. PROVIDE SLAB HAIRPIN BARS (01 2004-2) POSITIONED 1-1/2" CLEAR FROM EDGE OF RE-ENTRANT CORNERS, AND SET BARS ON TOP OF NORMAL SLAB REINFORCEMENT (WWR).

13. IJ – ISOLATION JOINTS:

- a. 36' ABSOLUTE MAXIMUM SPACING BETWEEN IJ'S AND IJ-D'S, 2 TO 1 MAXIMUM ASPECT RATIO.
- b. PLACE SLAB-ON-GROUND SECTIONS BETWEEN IJ'S AND IJ-D'S IN A CHECKERBOARD PATTERN.
- c. PROVIDE SEALER AND PREFORMED JOINT FILLER MATERIALS.
- d. IJ-D: WHERE INDICATED FOR POSITIVE LOAD TRANSFER ACROSS JOINTS BETWEEN ADJACENT SLAB SECTIONS, PROVIDE 3/4" DIAMETER x 14" LONG EPOXY-COATED SMOOTH DOWEL BARS WITH ONE SIDE LIGHTLY GREASED, SPACED AT 12" ON CENTER, POSITIONED SUCH THAT CENTERLINE IS MID-DEPTH OF SLAB THICKNESS, STARTING 12" FROM INTERSECTING JOINTS.
- e. IJ-D: WHERE INDICATED TO PREVENT VERTICAL DISPLACEMENT AT EXTERIOR APRON AND ENTRY SLABS ADJACENT TO PERSONNEL AND OVERHEAD DOORS. PROVIDE 3/4" DIAMETER x 14" LONG EPOXY-COATED SMOOTH DOWEL BARS WITH SIDE EMBEDDED IN SLAB LIGHTLY GREASED, SPACED AT 12" ON CENTER, POSITIONED SUCH THAT CENTERLINE IS MID-DEPTH OF THICKENED SLAB SECTION, STARTING 12" FROM INTERSECTING JOINTS.

14. SCJ – SAW-CUT CONTRACTION (CONTROL) JOINTS:

- a. 12' ABSOLUTE MAXIMUM SPACING BETWEEN SCJ'S. AS MUCH AS POSSIBLE, MAINTAIN SQUARE PATTERN BETWEEN SCJ'S; MAXIMUM 2 TO 1 ASPECT RATIO.
- b. USE EARLY-ENTRY DRY-CUT METHOD TO A DEPTH OF 1" MINIMUM, 1-1/4" MAXIMUM; WIDTH OF SAW-CUT APPROXIMATELY 1/8". TYPICAL WAITING PERIOD FOR THIS METHOD WILL VARY FROM 1-HOUR IN HOT WEATHER TO 4-HOURS IN COLD WEATHER AFTER COMPLETING THE FINISHING OF THE SLAB IN THAT JOINT LOCATION. SAW-CUTTING SHOULD BE PERFORMED BEFORE CONCRETE STARTS TO COOL, AS SOON AS THE CONCRETE SURFACE IS FIRM ENOUGH NOT TO BE TORN OR DAMAGED BY THE BLADE, AND BEFORE RANDOM DRYING-SHRINKAGE CRACKS CAN FORM IN THE CONCRETE SLAB.
- c. CUT ALTERNATE SLAB BARS SUCH THAT HALF THE NUMBER OF BARS CROSSES THE SCJ, LEAVING A 6" GAP THAT COINCIDES WITH THE CENTERLINE OF THE SCJ.
- d. PROVIDE JOINT SEALANT MATERIALS.

15. CJT – CONSTRUCTION JOINTS:

SLAB REINFORCEMENT (WWR) SHALL EXTEND FROM INITIAL INTO SUBSEQUENT POUR, AND SHALL BE LAP SPLICED (18" / 3 SQUARES MINIMUM) WITH REINFORCEMENT IN SUBSEQUENT POUR. PROVIDE JOINT SEALANT MATERIALS.

16. PREFORMED JOINT FILLER MATERIALS AND SEALANTS:

- a. EXTERIOR: MATERIAL EQUAL TO W.R. MEADOWS ASPHALT EXPANSION / CONTRACTION JOINT FILLER CONFORMING TO ASTM D994, THICKNESS AS SHOWN ON DRAWINGS.
- b. INTERIOR VEHICLE BAYS: MATERIAL EQUAL TO W.R. MEADOWS FIBRE EXPANSION / CONTRACTION JOINT FILLER CONFORMING TO ASTM D 1751, THICKNESS AS SHOWN ON DRAWINGS. HOLD PRODUCT DOWN TO LEAVE ROOM FOR COMPATIBLE SEALANT.
- c. INTERIOR FLOOR SLABS: MATERIAL EQUAL TO W.R. MEADOWS CERAMAR FLEXIBLE FOAM CLOSED-CELL EXPANSION / CONTRACTION JOINT FILLER CONFORMING TO ASTM D 7174, THICKNESS AS SHOWN ON DRAWINGS; OR EQUAL TO NOMAFLEX CLOSED-CELL EXTRUDED POLYPROPYLENE JOINT FILLER CONFORMING TO ASTM D 545 AND D 1751. HOLD PRODUCT DOWN TO LEAVE ROOM FOR COMPATIBLE SEALANT.
- d. JOINT SEALANT SHALL BE COMPATIBLE WITH SPECIFIED JOINT FILLER MATERIALS, AND SHALL BE INTERIOR OR EXTERIOR GRADE CONSISTENT WITH SPECIFIED LOCATIONS.

17. COMPACTED BASE GRANULAR FILL MATERIAL:

CONFORM TO REQUIREMENTS IN ACI 302.1R. COMPACTIBLE, EASY TO TRIM, GRANULAR FILL, WITH ABILITY TO REMAIN STABLE AND SUPPORT CONSTRUCTION TRAFFIC. USE A CLEAN, DENSLEY-GRADED MATERIAL WITH 100% PASSING THE 1-1/2" SIEVE AND LESS THAN 12% PASSING THE NO. 200 SIEVE. NO MORE THAN 3% CLAY OR FRIABLE PARTICLES. PREFERRED INSTALLATION METHOD IS BY USE OF VIBRATORY ROLLER OR PLATE COMPACTOR FOR COMPACTING BASE GRANULAR FILL MATERIAL. PROOF ROLLING PER ACI 302.1R SECTION 6.1.1 IS HIGHLY RECOMMENDED TO BE PERFORMED PRIOR TO INSTALLATION OF SLAB TO VERIFY THAT RUTTING OR PUMPING DO NOT OCCUR. FINISHED GRADE TOLERANCE OF BASE GRANULAR FILL MATERIAL AS MEASURED FROM BOTTOM OF SLAB IS +0 INCHES / -3/4 INCHES.

18. GEOTEXTILE FABRIC:

PROVIDE GEOTEXTILE FABRIC WHEN SPECIFIED ON PROJECT-SPECIFIC DOCUMENTS. GEOTEXTILE FABRIC SHALL BE A WOVEN, BLACK POLYPROPYLENE FABRIC AND HAVE A FILL TENSILE STRENGTH NOT LESS THAN 200 POUNDS, FILL ELONGATION NOT MORE THAN 20 PERCENT, BURST STRENGTH NOT LESS THAN 450 PSI, AND PUNCTURE STRENGTH NOT LESS THAN 75 POUNDS. INSTALL GEOTEXTILE FABRIC IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS.

19. VAPOR RETARDER (BARRIER):

PROVIDE VAPOR RETARDER FOR INTERIOR FLOOR SLABS BENEATH GRANULAR FILL MATERIAL WHEN SPECIFIED ON PROJECT-SPECIFIC DOCUMENTS. MATERIAL SHALL CONFORM TO ASTM E1745 CLASS A, HAVE A MAXIMUM PERM RATING 0.018, A MINIMUM MIL THICKNESS OF 15, MINIMUM TENSILE STRENGTH OF 84, AND MINIMUM PUNCTURE RESISTANCE OF 4135. MATERIAL SHALL BE EQUAL TO W.R. MEADOWS PERMINATOR HP 15 MIL UNDERSLAB VAPOR BARRIER (HIGH PUNCTURE RESISTANCE). ALL JOINTS/SEAMS, BOTH SIDE AND END, SHALL BE OVERLAPPED 6" MINIMUM, AND TAPED USING W.R. MEADOWS 4" WIDE PERMINATOR TAPE (OR EQUAL); USE SAME MATERIAL FOR ATTACHMENT TO FOUNDATION WALLS. ALL REPAIRS SHALL BE MADE USING ORIGINAL MATERIALS.

20. SUBGRADE MATERIAL:

SUBGRADE MATERIAL BENEATH COMPACTED BASE GRANULAR FILL SHALL BE PREPARED IN STRICT ACCORDANCE WITH GEOTECHNICAL ENGINEERING REPORT. THIS INCLUDES BUT IS NOT LIMITED TO OVEREXCAVATION REQUIREMENTS.

REFERENCE DRAWINGS

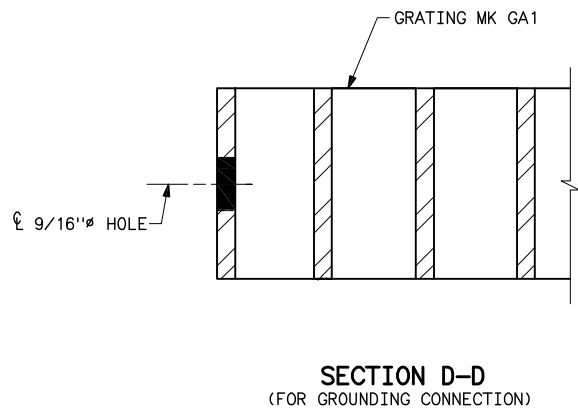
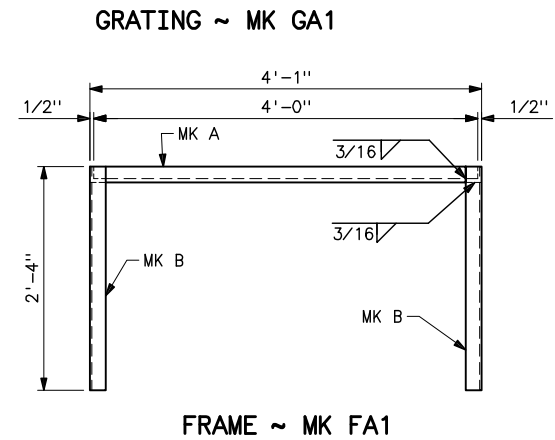
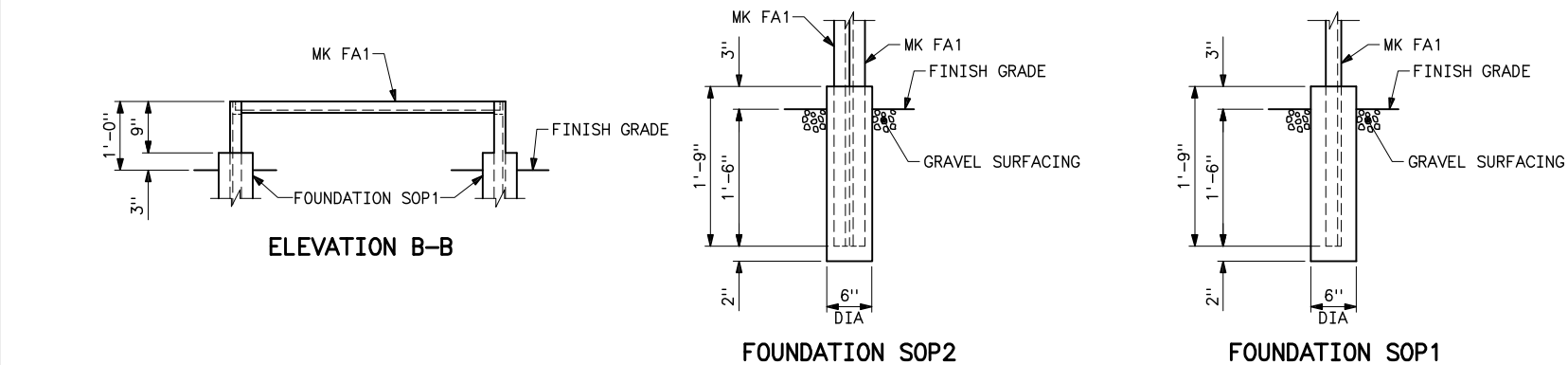
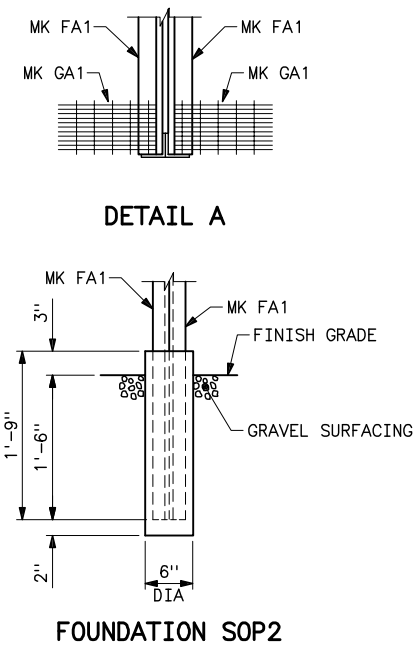
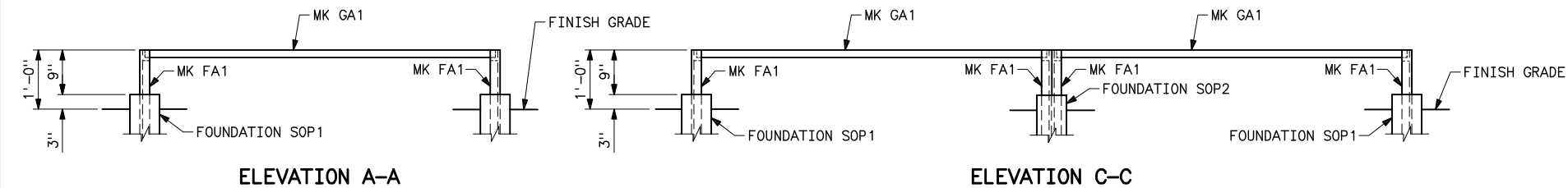
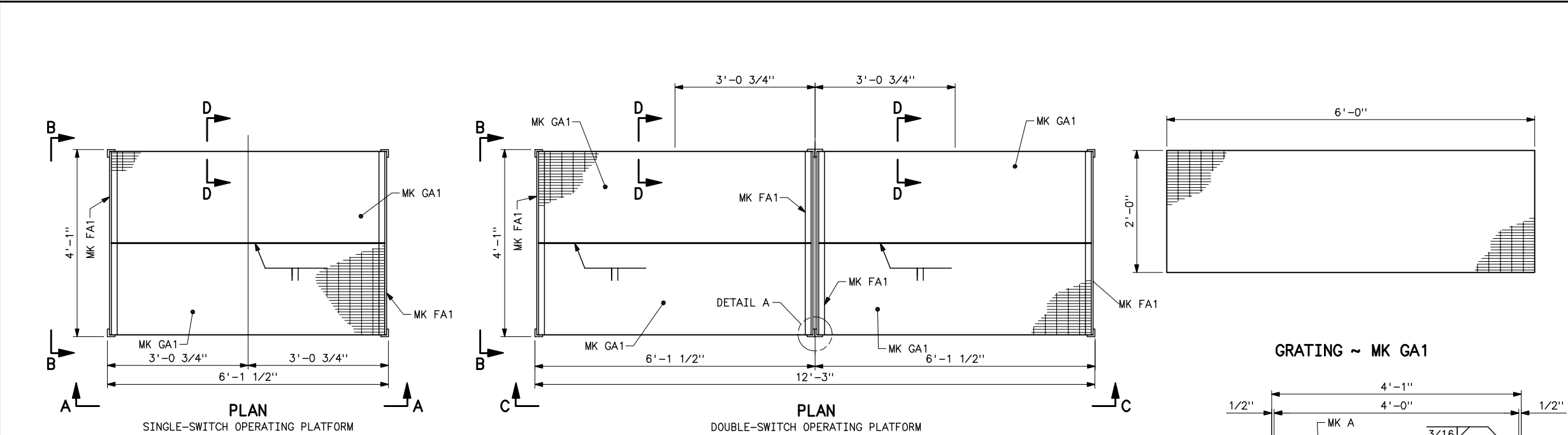
CONCRETE STANDARDS – BUILDING SLABS-ON-GROUND SPECIFICATIONS, NOTES, PLANS & DETAILS (SHEET 2 OF 3) -----01 2006-2
CONCRETE STANDARDS – BUILDING SLABS-ON-GROUND SPECIFICATIONS, NOTES, PLANS & DETAILS (SHEET 3 OF 3) -----01 2006-3

B	7-25-2024 A7-RCG	EDITED NOTE 17.
A	1-11-23 A7-JAS	EDITORIAL CORRECTION TO NOTE 6c.
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS – LAKEWOOD, COLORADO		
CONCRETE STANDARDS BUILDING SLABS-ON-GROUND SPECIFICATIONS, NOTES, PLANS & DETAILS (SHEET 1 OF 3)		
DESIGNED J. SCHREIBER ----- APPROVED GINA CRAWFORD CIVIL ENGINEERING MANAGER -----		
A	MARCH 12, 2020	01 2006-1

XREF(S):



Plotted By: denton Jul 12, 2011- 3:00pm
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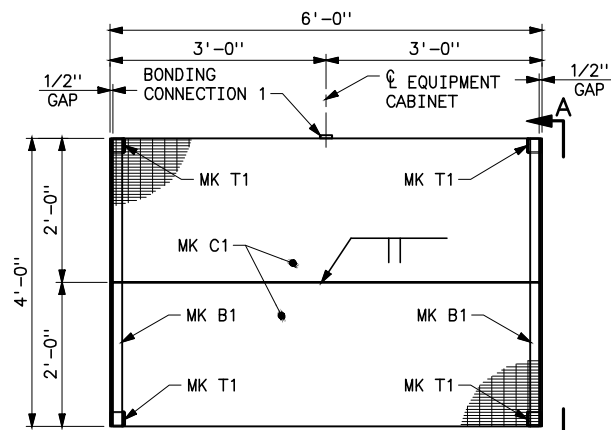
BILL OF MATERIAL				
MARK NO.	DESCRIPTION	LENGTH (FT-IN)	NO. REQUIRED	BLACK WT (LBS)
SINGLE-SWITCH OPERATING PLATFORM				
FA1	FRAME		2	---
A	L 1 3/4x1 3/4x1/4	4'-0"	2	22.2
B	L 1 3/4x1 3/4x1/4	2'-4"	4	25.8
GA1	SERRATED GRATING, 1 1/2x3/16 BARS, 1 3/16" C TO C, 2'-0" WIDE	6'-0"	2	259.2
TOTAL WEIGHT ONE PLATFORM				307.2
DOUBLE SWITCH OPERATING PLATFORM				
FA1	FRAME		4	---
A	L 1 3/4x1 3/4x1/4	4'-0"	4	44.4
B	L 1 3/4x1 3/4x1/4	2'-4"	8	51.6
GA1	SERRATED GRATING, 1 1/2x3/16 BARS, 1 3/16" C TO C, 2'-0" WIDE	6'-0"	4	518.4
TOTAL WEIGHT ONE PLATFORM				614.4

- NOTES
1. GALVANIZE MATERIAL AFTER FABRICATION.
 2. FABRICATED MATERIAL SHALL BE STRAIGHT, TRUE, AND FREE FROM TWISTS AND WARPS.
 3. WELDS ARE TYPICAL FOR SIMILAR CONDITIONS.
 4. ATTACH GRATING TO FRAMES WITH STANDARD CLIPS.

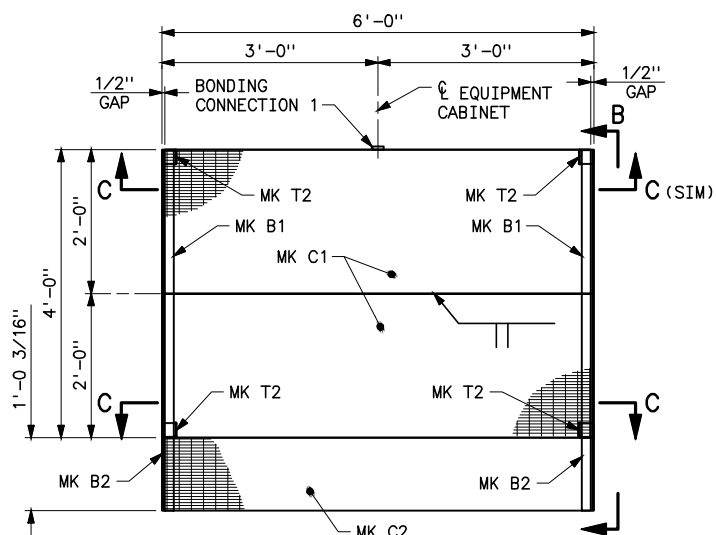
REFERENCE DRAWING

SWITCH OPERATING PLATFORMS-
ELECTRICAL DESIGN AND DETAILS _____ 31 1075

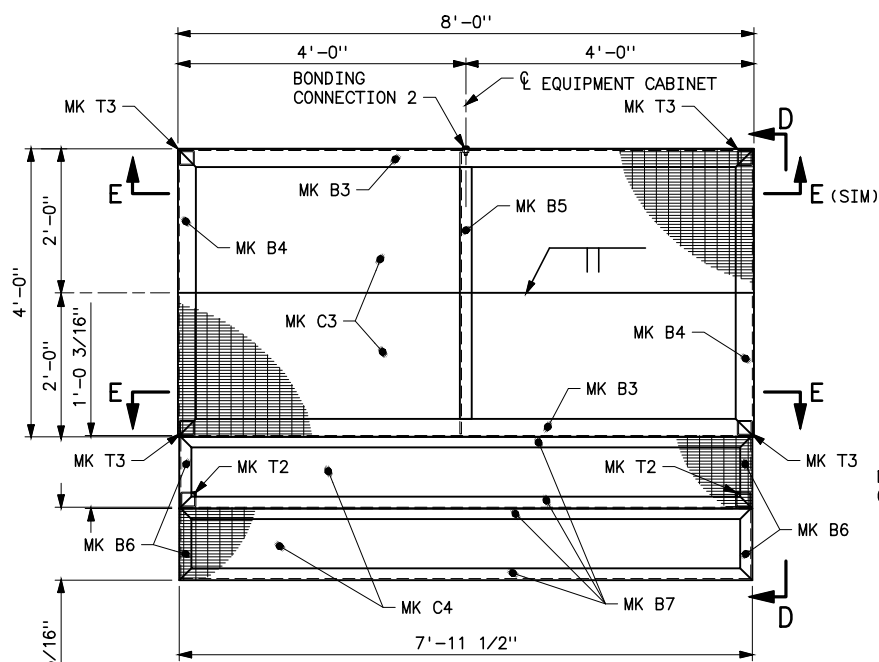
B	7-5-11 A7-DDD	MADE DRAWING A MODEL SPACE/PAPER SPACE DRAWING.
A	7-15-03 A7-DH	REVISED TITLE BLOCK ONLY.
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS SWITCH OPERATING PLATFORMS STEEL DESIGN AND DETAILS		
DESIGNED <u>W.L. SOPER</u> APPROVED <u>DON WARNER</u> DIRECTOR, DIVISION OF SUBSTATION DESIGN		
DATE	FEBRUARY 1, 1990	31 2014



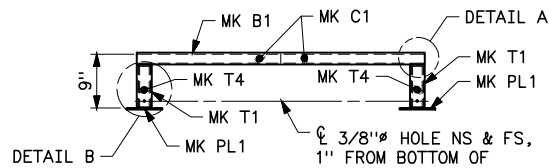
PLAN
EQUIPMENT CABINET PLATFORM - TYPE I



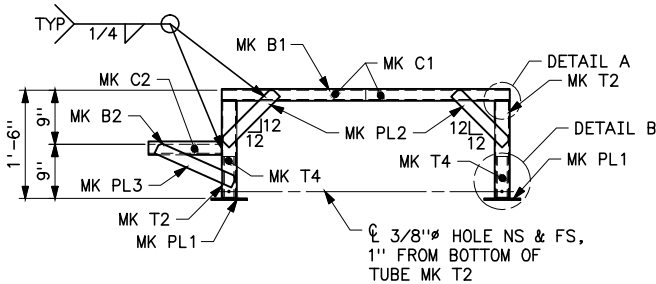
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EQUIPMENT CABINET PLATFORM - TYPE II



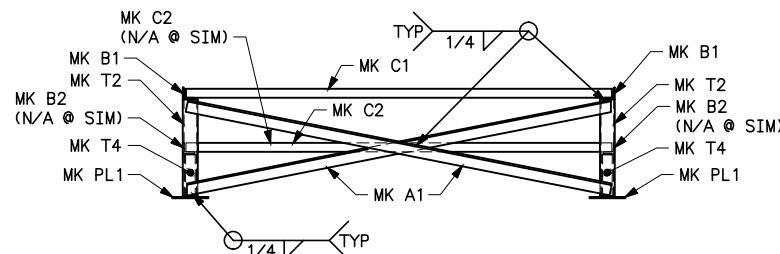
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EQUIPMENT CABINET PLATFORM - TYPE III



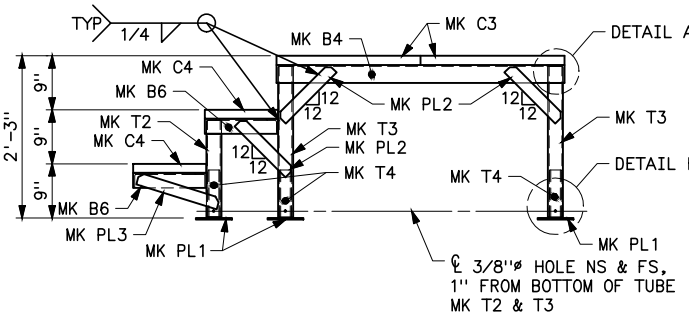
ELEVATION A-A
FRAME ~ MK FR1



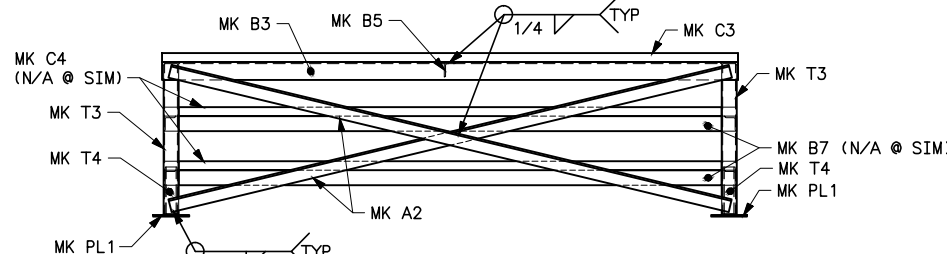
ELEVATION B-B
FRAME ~ MK FR2



SECTION C-C
SECTION C-C SIM

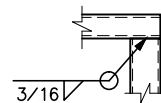


ELEVATION D-D
FRAME ~ MK FR3

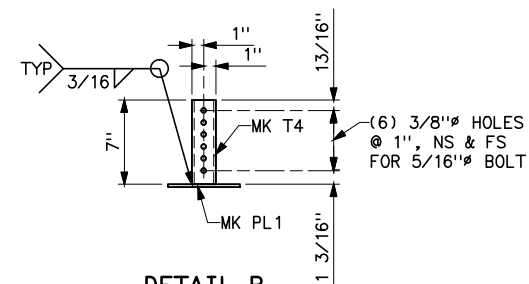


SECTION E-E
SECTION E-E SIM

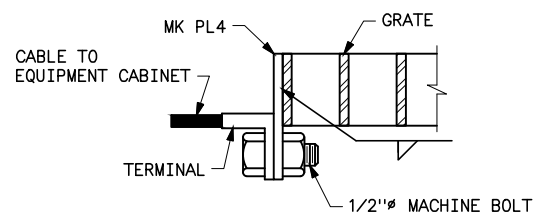
BILL OF MATERIAL			
EQUIPMENT CABINET PLATFORM - TYPE I			
MARK NO.	DESCRIPTION	LENGTH	NO. REQUIRED
FR1	FRAME		
T1	HSS 2 1/2x2 1/2x3/16	0'-7 1/8"	4
T4	HSS 2x2x1/4	0'-7"	4
B1	L 2x2x1/4	4'-0"	2
PL1	PL 6x6x1/4	-	4
PL4	PL 2x2 5/8x3/16	-	1
C1	SERRATED GRATING 1 1/2"x3/16" BARS, 1 3/16" C TO C, 2'-0" WIDE	5'-11"	2
	SELF-TAPPING CLIPS FOR GRATING	-	10
	5/16"x3 1/2" BOLT	-	4
APPROXIMATE TOTAL WEIGHT ONE PLATFORM - 325			



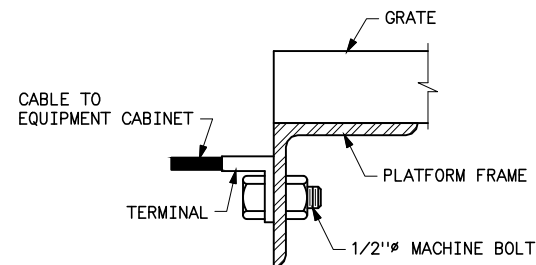
DETAIL A



DETAIL B



BONDING CONNECTION 1



BONDING CONNECTION 2

NOTES

1. GALVANIZE MATERIAL AFTER FABRICATION.
2. STRUCTURAL STEEL: ASTM A36.
3. FABRICATED MATERIAL SHALL BE STRAIGHT, TRUE, AND FREE FROM TWISTS AND WARPS.
4. WELD ARE TYPICAL FOR SIMILAR CONDITIONS.
5. ATTACH GRATING TO FRAMES WITH STANDARD CLIPS.
6. GRATING FOR STEPS SHALL BE WELDED TO FRAMES.
7. DO NOT CONNECT EQUIPMENT CABINET PLATFORM DIRECTLY TO GROUND MAT.
8. LLV=LONG LEG VERTICAL.

BILL OF MATERIAL			
EQUIPMENT CABINET PLATFORM - TYPE II			
MARK NO.	DESCRIPTION	LENGTH	NO. REQUIRED
FR2	FRAME		
T2	HSS 2 1/2x2 1/2x3/16	1'-4 1/8"	4
T4	HSS 2x2x1/4	0'-7"	4
A1	L 2x2x1/4	6'-0"	4
B1	L 2x2x1/4	4'-0"	2
B2	L 2x2x1/4	1'-0 3/16"	2
PL1	PL 6x6x1/4	-	4
PL2	PL 2x12x1/4	-	4
PL3	PL 2x14x1/4	-	2
PL4	PL 2x2 5/8x3/16	-	1
C1	SERRATED GRATING 1 1/2"x3/16" BARS, 1 3/16" C TO C, 2'-0" WIDE	5'-11"	2
C2	SERRATED GRATING, 1 1/2"x3/16" BARS, 1 3/16" C TO C, 12 3/16" WIDE	5'-11"	1
	SELF-TAPPING CLIPS FOR GRATING	-	20
	5/16"x3 1/2" BOLT	-	4
APPROXIMATE TOTAL WEIGHT ONE PLATFORM - 495			

EQUIPMENT CABINET PLATFORM - TYPE III			
MARK NO.	DESCRIPTION	LENGTH	NO. REQUIRED
FR3	FRAME		
T2	HSS 2 1/2x2 1/2x3/16	1'-4 1/8"	2
T3	HSS 2 1/2x2 1/2x3/16	2'-1 1/8"	4
T4	HSS 2x2x1/4	0'-7"	6
A2	L 2x2x1/4	8'-0"	4
B3	L 3x3x1/4	8'-0"	2
B4	L 3x3x1/4	4'-0"	2
B5	L 2 1/2x2x1/4 (LLV)	3'-11 1/2"	1
B6	L 2 1/2x2x1/4 (LLV)	1'-0 3/16"	4
B7	L 2 1/2x2x1/4 (LLV)	7'-11 1/2"	4
PL1	PL 6x6x1/4	-	6
PL2	PL 2x12x1/4	-	6
PL3	PL 2x14x1/4	-	2
C3	SERRATED GRATING 1 1/2"x3/16" BARS, 1 3/16" C TO C, 2'-0" WIDE	8'-0"	2
C4	SERRATED GRATING 1 1/2"x3/16" BARS, 1 3/16" C TO C, 12 3/16" WIDE	7'-11 1/2"	2
	SELF-TAPPING CLIPS FOR GRATING	-	35
	5/16"x3 1/2" BOLT	-	6
APPROXIMATE TOTAL WEIGHT ONE PLATFORM - 1000			

F	9-27-16 A7-JAS	CHANGED THE WORDING GROUNDING CONNECTION TO BONDING CONNECTION.
E	7-31-13 A7-JAS	MINOR CORRECTIONS & CLARIFICATIONS.
D	4-11-13 A7-JM	REVISED EQUIPMENT PLATFORM TYPE III.
C	9-12-12 A7-JM	REVISED AND REDRAWN.
B	2-16-11 A3-CTG	REVISED MARK F1. GROUNDING DETAIL AND WEIGHT IN TABLE.

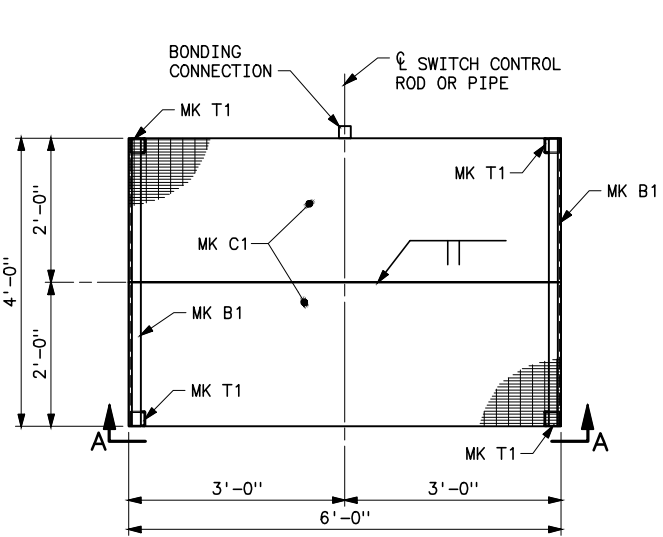
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UNITED STATES DEPARTMENT OF ENERGY
WESTERN AREA POWER ADMINISTRATION
CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO

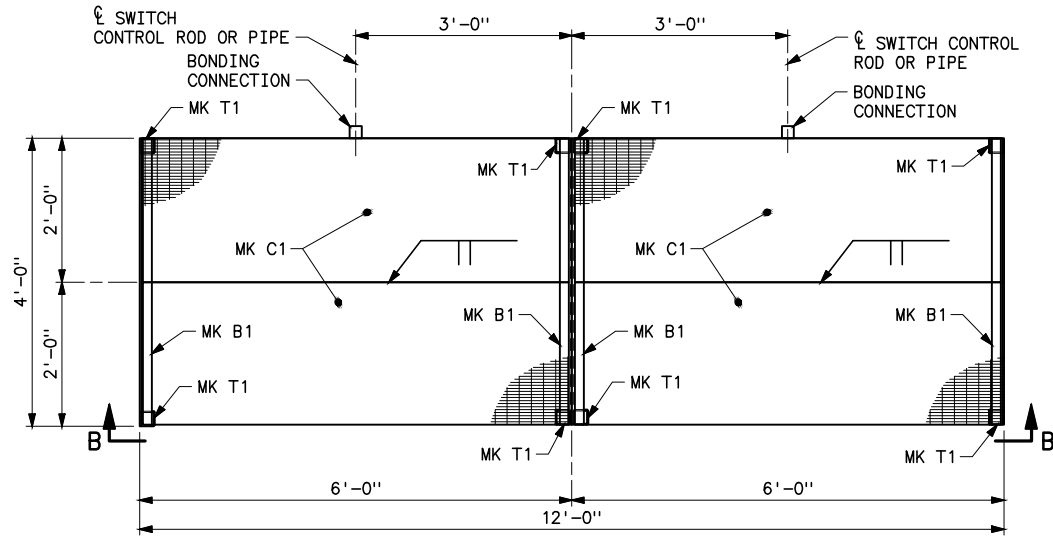
SUBSTATION STANDARD EQUIPMENT CABINET PLATFORMS STEEL DESIGN AND DETAILS

DESIGNED CHARLIE GARCIA APPROVED DOUG HANSON
CIVIL ENGINEERING MANAGER

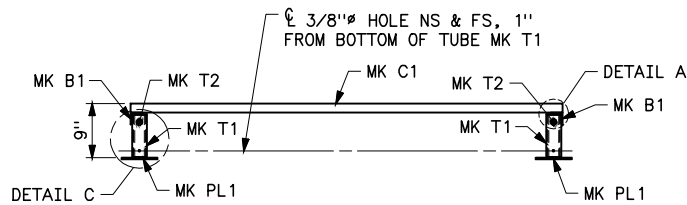
APRIL 28, 2003 31 2044



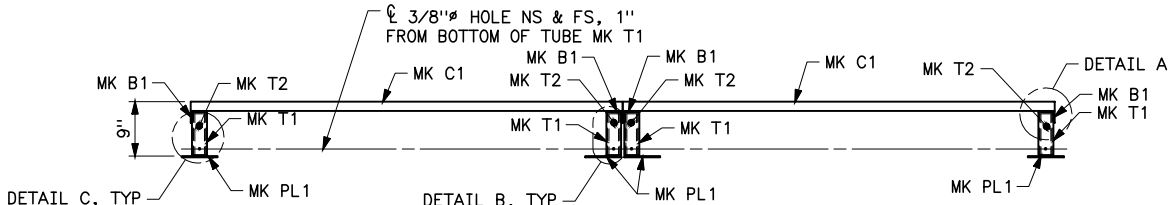
PLAN
SINGLE PLATFORM – TYPE I



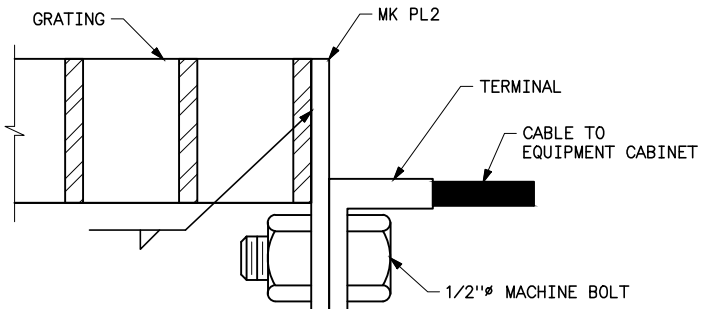
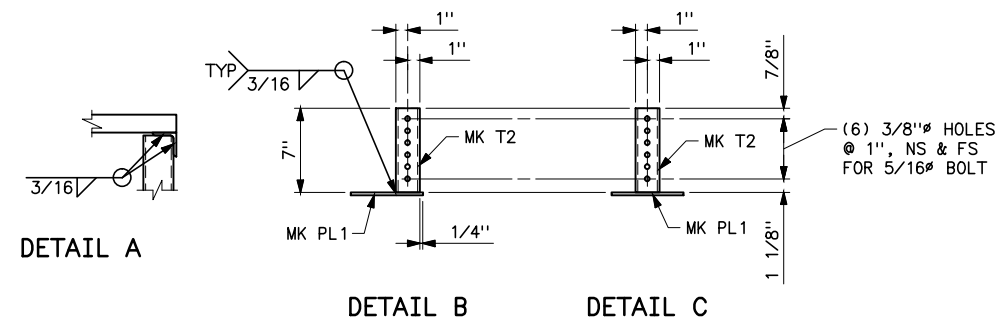
PLAN
DOUBLE PLATFORM – TYPE II



ELEVATION A-A
FRAME ~ MK FR1



ELEVATION B-B
FRAME ~ MK FR2



BONDING CONNECTION

BILL OF MATERIAL			
SINGLE PLATFORM – TYPE I			
MARK NO.	DESCRIPTION	LENGTH	NO. REQUIRED
FR1	FRAME		–
T1	TS 2 1/2x2 1/2x3/16	0'–7 1/8"	4
T2	TS 2x2x3/16	0'–7"	4
B1	L 2x2x1/4	4'–0"	2
PL1	PL 6x6x1/4	–	4
PL2	PL 2x2 5/8x3/16	–	1
C1	SERRATED GRATING 1 1/2"x3/16" BARS, 1 3/16" C TO C, 2'–0" WIDE	6'–0"	2
	SELF-TAPPING CLIPS FOR GRATING	–	10
	5/16"Øx3 1/2" BOLT	–	4
APPROXIMATE TOTAL WEIGHT ONE PLATFORM – 325			
DOUBLE PLATFORM – TYPE II			
MARK NO.	DESCRIPTION	LENGTH	NO. REQUIRED
FR2	FRAME		–
T1	TS 2 1/2x2 1/2x3/16	0'–7 1/8"	8
T2	TS 2x2x3/16	0'–7"	8
B1	L 2x2x1/4	4'–0"	4
PL1	PL 6x6x1/4	–	8
PL2	PL 2x2 5/8x3/16	–	2
C1	SERRATED GRATING 1 1/2"x3/16" BARS, 1 3/16" C TO C, 2'–0" WIDE	6'–0"	4
	SELF-TAPPING CLIPS FOR GRATING	–	20
	5/16"Øx3 1/2" BOLT	–	8
APPROXIMATE TOTAL WEIGHT ONE PLATFORM – 650			

- NOTES
1. GALVANIZE MATERIAL AFTER FABRICATION.
 2. STRUCTURAL STEEL: ASTM A36.
 3. FABRICATED MATERIAL SHALL BE STRAIGHT, TRUE, AND FREE FROM TWISTS AND WARPS.
 4. WELD ARE TYPICAL FOR SIMILAR CONDITIONS.
 5. ATTACH GRATING TO FRAMES WITH STANDARD CLIPS.
 6. DO NOT CONNECT SWITCH OPERATING PLATFORM DIRECTLY TO GROUND MAT.

E	9-27-16 A7-JAS	CHANGED THE WORDING GROUNDING CONNECTION TO BONDING CONNECTION.
D	7-31-13 A7-JAS	MINOR CORRECTIONS & CLARIFICATIONS.
C	4-11-13 A7-JM	REVISED AND REDRAWN.
B	9-12-12 A7-DH	MINOR REVISIONS.
A	7-15-03 A7-DH	REVISED TITLE BLOCK ONLY.
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE – LAKEWOOD, COLORADO		
SUBSTATION STANDARDS SWITCH OPERATING PLATFORMS STEEL DESIGN AND DETAILS		
DESIGNED CHARLIE GARCIA _____ APPROVED DOUG HANSON CIVIL ENGINEERING MANAGER _____		
A	APRIL 28, 2003	31 2045

BILL OF MATERIAL

MARK NO.	DESCRIPTION	LENGTH (FT-IN)	NO. REQUIRED	BLACK WT (LBS)
SINGLE SWITCH OPERATING PLATFORM-TYPE IV				
FA2	FRAME		3	
A1	L 1 3/4x1 3/4x1/4	4'-0"	2	22.2
A2	L 1 3/4x1 3/4x1/4	0'-6"	4	6.4
PL1	PL 8x8x1/4	-	4	27.2
GA1	SERRATED GRATING, 1 1/2x3/16 BARS, 1 3/16" C TO C, 2'-0" WIDE	6'-0"	2	259.2
TOTAL WEIGHT ONE PLATFORM				321.4

NOTES

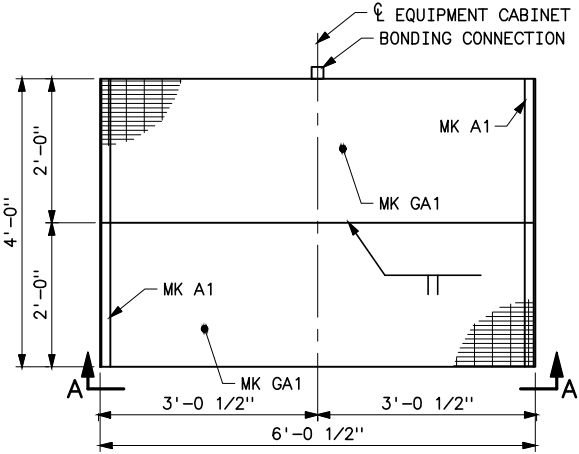
1. GALVANIZE MATERIAL AFTER FABRICATION.
2. FABRICATED MATERIAL SHALL BE STRAIGHT, TRUE, AND FREE FROM TWISTS AND WARPS.
3. WELD ARE TYPICAL FOR SIMILAR CONDITIONS.
4. ATTACH GRATING TO FRAMES WITH STANDARD CLIPS.
5. USE 4/0 AWG STRANDED COPPER CABLE TO BOND THE TWO PLATFORMS TOGETHER.

A	9-27-16 A7-JAS	CHANGED THE WORDING GROUNDING CONNECTION TO BONDING CONNECTION.
	UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO	
	SUBSTATION STANDARDS SWITCH OPERATING PLATFORMS STEEL DESIGN AND DETAILS	
	DESIGNED CHARLIE GARCIA	APPROVED DOUG HANSON CIVIL ENGINEERING MANAGER
CAE	JUNE 19, 2006	31 2046

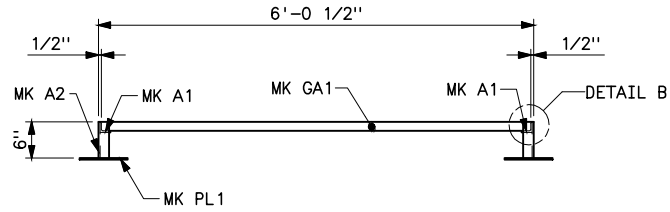
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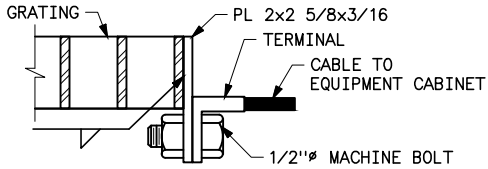
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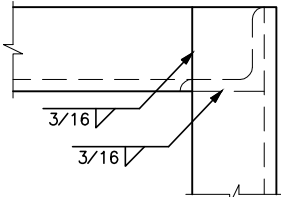
PLAN
SINGLE SWITCH OPERATING PLATFORM - TYPE IV



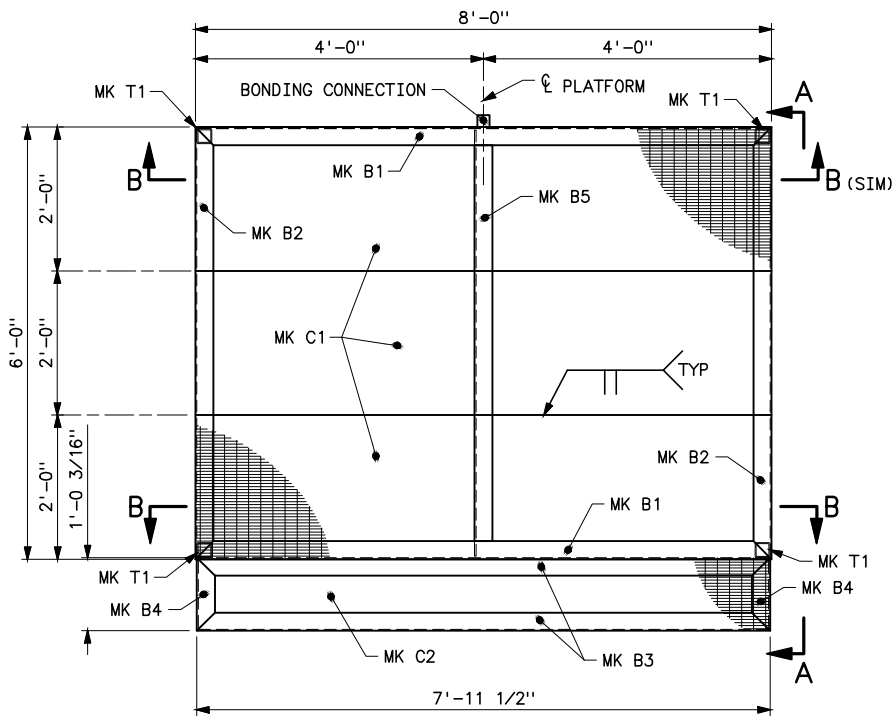
ELEVATION A-A
FRAME ~ MK FA2



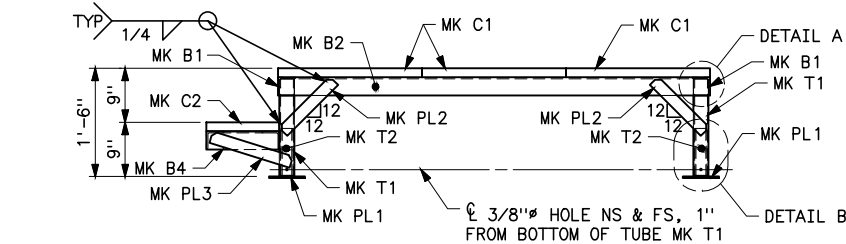
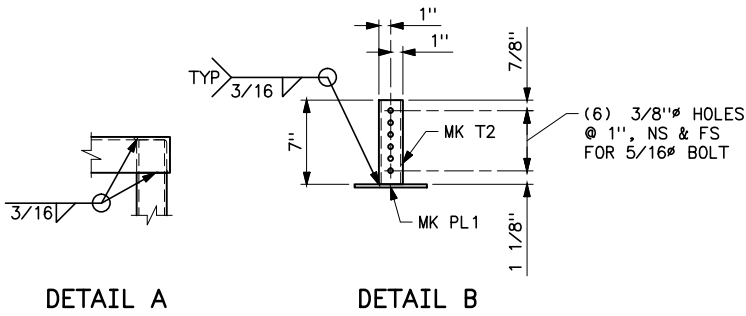
BONDING CONNECTION



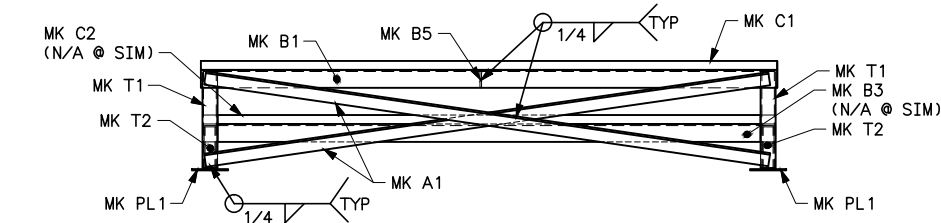
DETAIL B



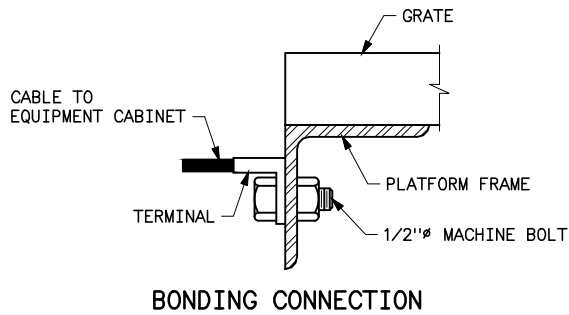
PLAN
TRANSFORMER PLATFORM - TYPE I



ELEVATION A-A
FRAME ~ MK FR1



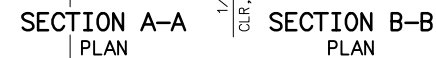
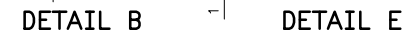
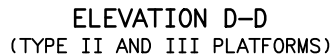
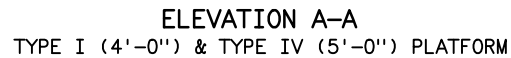
SECTION B-B
SECTION B-B SIM



TRANSFORMER PLATFORM - TYPE I			
MARK NO.	DESCRIPTION		NO. REQUIRED
FR1	FRAME		
T1	HSS 2 1/2x2 1/2x3/16	1'-4 1/8"	4
T2	HSS 2x2x3/16	0'-7"	4
A1	L 2x2x1/4	7'-11"	4
B1	L 3x3x1/4	8'-0"	2
B2	L 3x3x1/4	6'-0"	2
B3	L 3x3x1/4	7'-11 1/2"	2
B4	L 3x3x1/4	1'-0 3/16"	2
B5	L 2 1/2x2x1/4 (LLV)	5'-11 1/2"	1
PL1	PL 6x6x1/4	-	4
PL2	PL 2x12x1/4	-	4
PL3	PL 2x14x1/4	-	2
C1	SERRATED GRATING 1 1/2"x3/16" BARS, 1 3/16" C TO C, 2'-0" WIDE	8'-0"	3
C2	SERRATED GRATING 1 1/2"x3/16" BARS, 1 3/16" C TO C, 12 3/16" WIDE	7'-11 1/2"	1
	SELF-TAPPING CLIPS FOR GRATING	-	20
	5/16"Øx3 1/2" BOLT	-	4
APPROXIMATE TOTAL WEIGHT ONE PLATFORM - 1015			

- NOTES
1. GALVANIZE MATERIAL AFTER FABRICATION.
 2. STRUCTURAL STEEL: ASTM A36.
 3. FABRICATED MATERIAL SHALL BE STRAIGHT, TRUE, AND FREE FROM TWISTS AND WARPS.
 4. WELD ARE TYPICAL FOR SIMILAR CONDITIONS.
 5. ATTACH GRATING TO FRAMES WITH STANDARD CLIPS.
 6. GRATING FOR STEPS SHALL BE WELDED TO FRAMES.
 7. DO NOT CONNECT PLATFORM DIRECTLY TO GROUND MAT.
 8. LLV=LONG LEG VERTICAL.

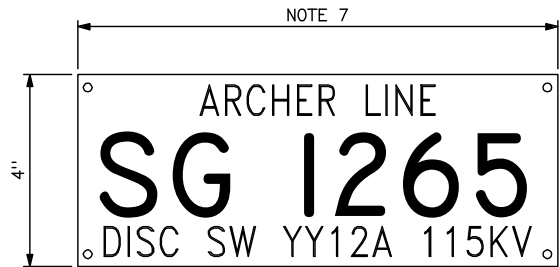
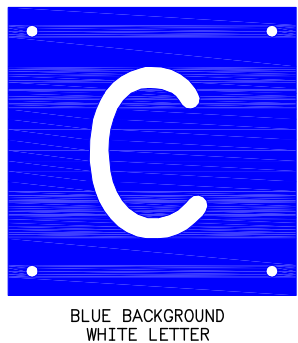
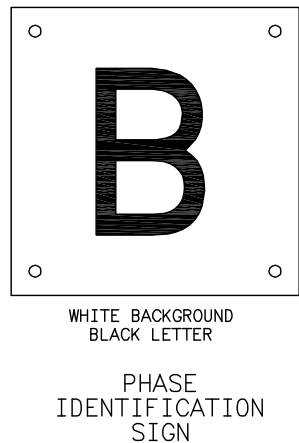
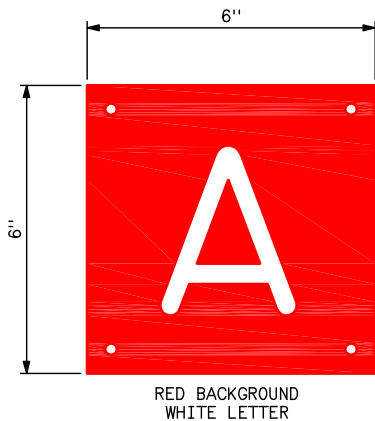
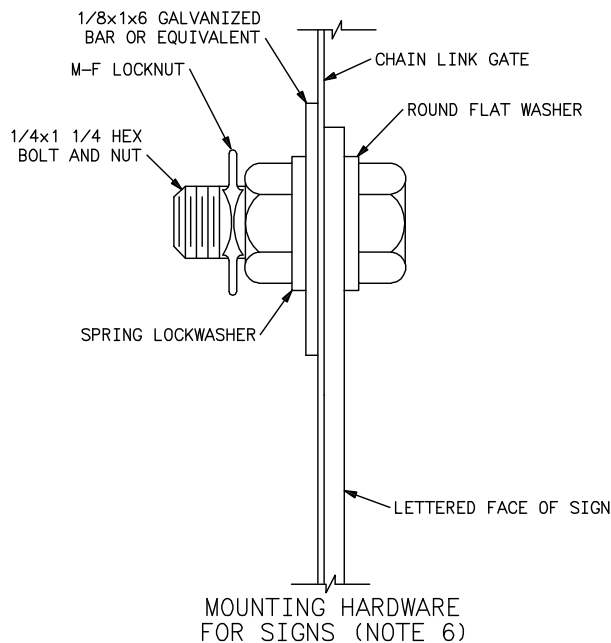
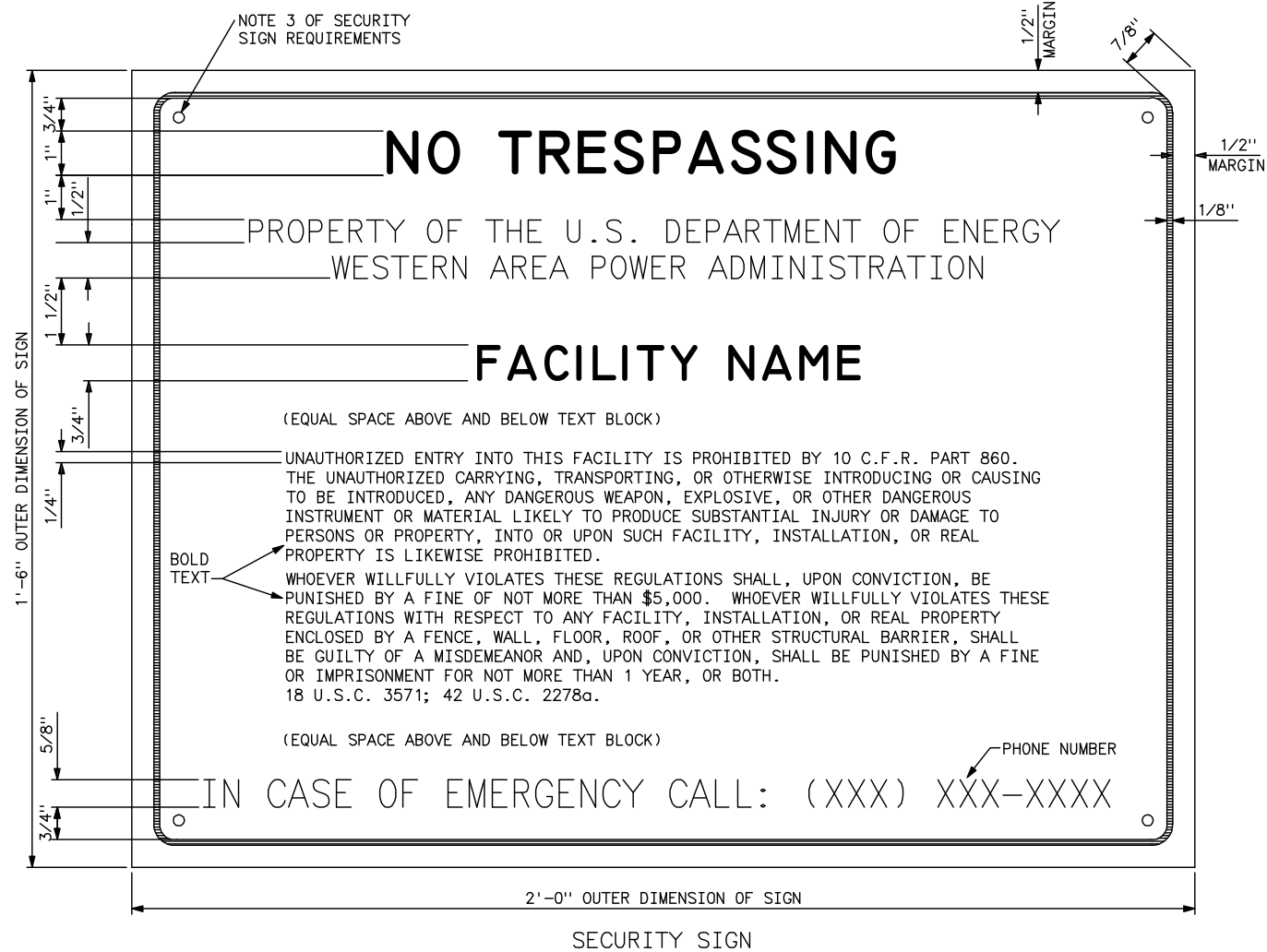
B	9-27-16 A7-JAS	CHANGED THE WORDING GROUNDING CONNECTION TO BONDING CONNECTION.
A	7-31-13 A7-JAS	MINOR CORRECTIONS & CLARIFICATIONS.
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARD TRANSFORMER PLATFORMS STEEL DESIGN AND DETAILS		
DESIGNED JACKIE McREE _____ APPROVED DOUG HANSON _____ CIVIL ENGINEERING MANAGER		
A	APRIL 11, 2013	31 2050



- ## NOTES
1. DESIGN BASIS: 100 PSF LL.
 2. GALVANIZE ALL MATERIALS AFTER FABRICATION.
 3. STRUCTURAL STEEL: ASTM A36 (PLATES & SHAPES),
ASTM A500 GRADE B (HSS TUBES).
 4. FABRICATED MATERIAL SHALL BE STRAIGHT, TRUE, AND FREE FROM
TWISTS AND WARPS.
 5. WELDS ARE TYPICAL FOR SIMILAR CONDITIONS.
 6. WELD GRATING TO FRAME.
 7. INCLUDE PROVISIONS FOR CONNECTING PLATFORMS TO BUILDING
GROUND.
 8. PROVIDE SOLID BAND AROUND ALL PERIMETER EDGES OF GRATING,
SEE DETAILS A & C.
 9. WHERE PLATFORM TYPES II & III ARE SPECIFIED TOGETHER TO
FORM A 6'x6' PLATFORM, CONNECT PLATFORMS TOGETHER ALONG 6'
LENGTH USING 1/2"Ø THRU-BOLTS AT HOLES PROVIDED IN 3" LEG
OF L 3x2x1/4.

BILL OF MATERIAL			
PLATFORM – TYPE I			
MARK NO.	DESCRIPTION		NO. REQUIRED
FR1	FRAME		1
	T1	HSS 2x2x3/16	0'–5"
	T2	HSS 2 1/2x2 1/2x3/16	0'–5 7/8"
	A1	L 2x2x1/4	4'–0"
	PL1	PL 1/4x6x6	–
C1	BAR GRATING, McNICHOLS OR EQUAL: GW SERIES, HOT-DIPPED GALVANIZED STEEL, SERRATED, WELDED. SIZE: 1"x1/8" BEARING BARS @ 1 3/16" BAR SPACING. CROSS BARS @ 4" SPACING, 1'–11 15/16" WIDE PANEL SECTIONS.		4'–0"
	5/16"Øx3 1/2" BOLT		–
APPROXIMATE TOTAL WEIGHT ONE PLATFORM – 170 LB			
PLATFORM – TYPE II			
MARK NO.	DESCRIPTION		NO. REQUIRED
FR2	FRAME		1
	T1	HSS 2x2x3/16	0'–5"
	T2	HSS 2 1/2x2 1/2x3/16	0'–5 7/8"
	A1	L 2x2x1/4	4'–0"
	A2	L 3x2x1/4 (LLV)	6'–0"
	PL1	PL 1/4x6x6	–
C2	BAR GRATING, McNICHOLS OR EQUAL: GW SERIES, HOT-DIPPED GALVANIZED STEEL, SERRATED, WELDED. SIZE: 1"x1/8" BEARING BARS @ 1 3/16" BAR SPACING. CROSS BARS @ 4" SPACING, 1'–11 15/16" WIDE PANEL SECTIONS.		4'–0"
	5/16"Øx3 1/2" BOLT		–
APPROXIMATE TOTAL WEIGHT ONE PLATFORM – 250 LB			
PLATFORM – TYPE III			
MARK NO.	DESCRIPTION		NO. REQUIRED
FR3	FRAME		1
	T1	HSS 2x2x3/16	0'–5"
	T2	HSS 2 1/2x2 1/2x3/16	0'–5 7/8"
	A2	L 3x2x1/4 (LLV)	6'–0"
	A3	L 2x2x1/4	2'–0"
	PL1	PL 1/4x6x6	–
C3	BAR GRATING, McNICHOLS OR EQUAL: GW SERIES, HOT-DIPPED GALVANIZED STEEL, SERRATED, WELDED. SIZE: 1"x1/8" BEARING BARS @ 1 3/16" BAR SPACING. CROSS BARS @ 4" SPACING, 1'–11 15/16" WIDE PANEL SECTIONS.		2'–0"
	5/16"Øx3 1/2" BOLT		–
APPROXIMATE TOTAL WEIGHT ONE PLATFORM – 170 LB			
COMBINED PLATFORM TYPES II & III (NOTE 9)			
DESCRIPTION			NO. REQUIRED
TYPE II PLATFORM			1
TYPE III PLATFORM			1
1/2"Ø CONNECTION BOLTS W/LOCKNUTS & WASHERS			2
APPROX TOTAL WEIGHT ONE TYPE II & III PLATFORM – 420 LB			
PLATFORM – TYPE IV			
MARK NO.	DESCRIPTION		NO. REQUIRED
FR4	FRAME		1
	T1	HSS 2x2x3/16	0'–5"
	T2	HSS 2 1/2x2 1/2x3/16	0'–5 7/8"
	A1	L 3x2x1/4	5'–0"
	PL1	PL 1/4x6x6	–
C1	BAR GRATING, McNICHOLS OR EQUAL: GW SERIES, HOT-DIPPED GALVANIZED STEEL, SERRATED, WELDED. SIZE: 1"x1/8" BEARING BARS @ 1 3/16" BAR SPACING. CROSS BARS @ 4" SPACING, 2'–5 15/16" WIDE PANEL SECTIONS.		5'–0"
	5/16"Øx3 1/2" BOLT		–
APPROXIMATE TOTAL WEIGHT ONE PLATFORM – 250 LB			

C	5-3-23 A7-RCG	CHANGED SERVICE BUILDING TO CONTROL BUILDING.
B	3-5-20 A7-JAS	ADDED TYPE IV (5'-0") PLATFORM AND LEGS TO 6'-0" PLATFORMS.
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS CONTROL BUILDING STRUCTURAL BUILDING ENTRY PLATFORMS		
DESIGNED J.A. SCHREIBER		DOUG HANSON CIVIL ENGINEERING MANAGER
C _A F	SEPTEMBER 27, 2016	31 2051

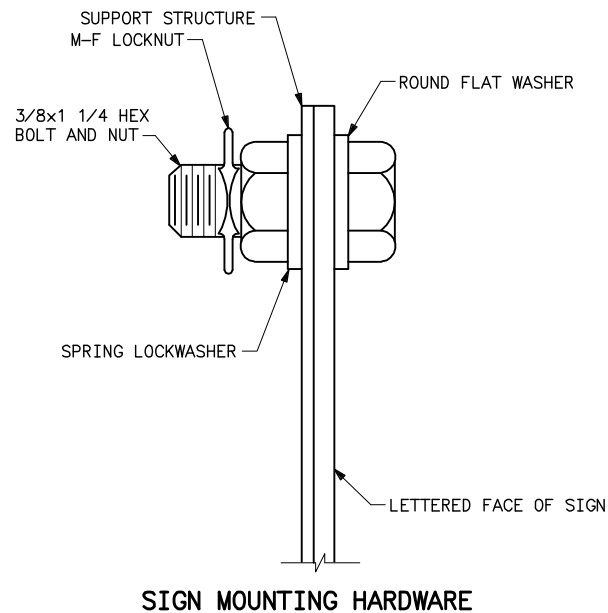
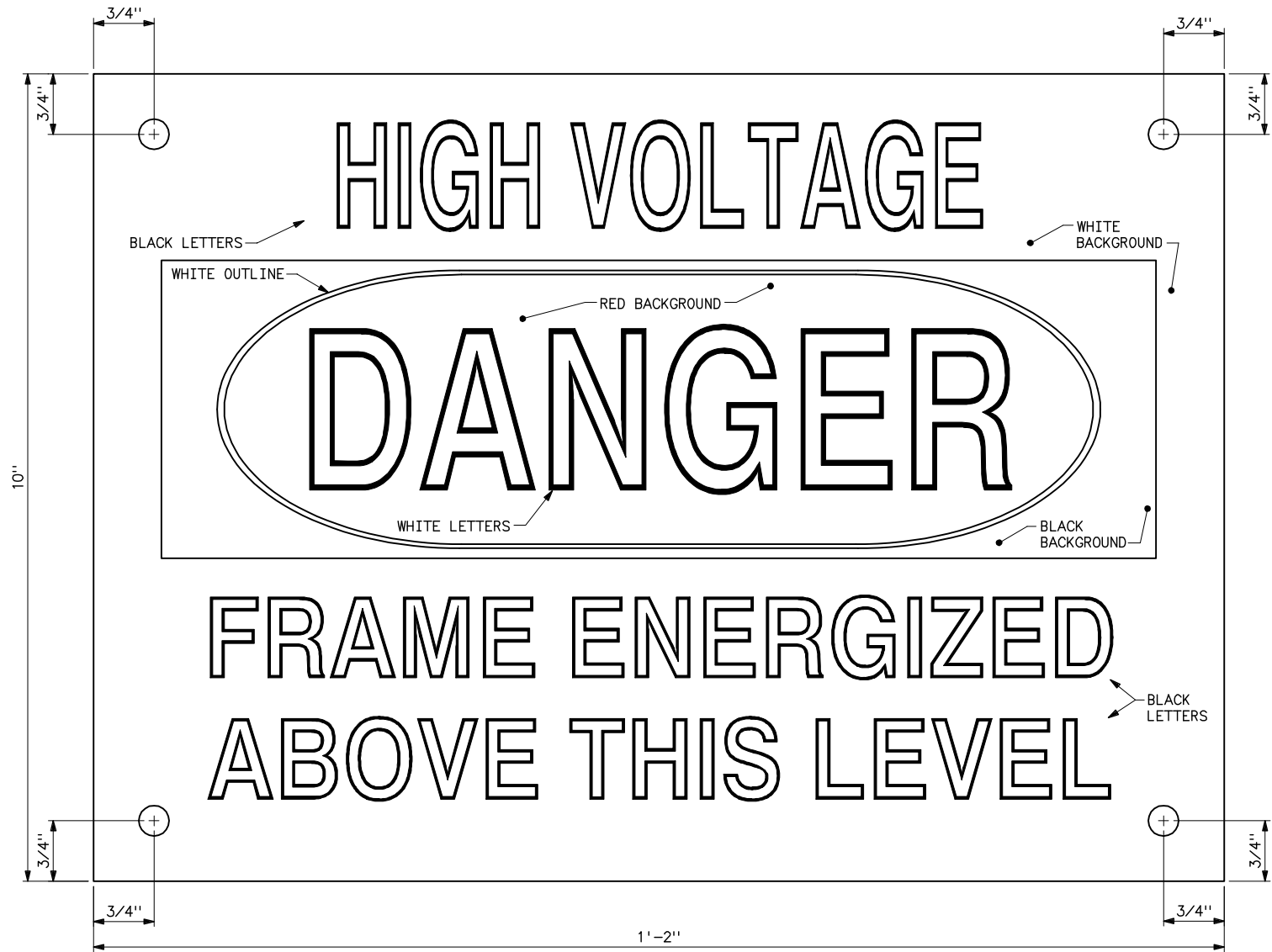


TYPICAL EQUIPMENT IDENTIFICATION SIGNS

- ### SECURITY SIGN REQUIREMENTS
1. MATERIAL SHALL BE NO. 16 US GAUGE SHEET STEEL WITH FUSED PORCELAIN FINISH 3/32-INCH THICK WITH BLACK CENTER AND GLOSSY FINISH WHITE SURFACES BOTH SIDES. BACKGROUND SHALL BE WHITE AND ALL TEXT SHALL BE BLACK.
 2. TEXT STYLE SHALL BE MEDIUM HELVETICA BLOCK TYPE EXCEPT WHERE BOLD IS SPECIFIED.
 3. THE CENTERLINE OF MOUNTING HOLES SHALL BE LOCATED 1-INCH FROM EACH EDGE AND SHALL BE FITTED WITH BRASS EYELETS. THE FINISHED HOLES SHALL BE SUITABLE FOR A 1/4-INCH BOLT. PROVIDE 1/8x1x6 INCH GALVANIZED STRAP OR OTHER SUITABLE HARDWARE TO FASTEN SIGNS ON GATES.

- ### EQUIPMENT IDENTIFICATION SIGN REQUIREMENTS
1. MATERIAL SHALL BE NO. 18 US GAUGE SHEET STEEL WITH FUSED PORCELAIN FINISH 3/32-INCH THICK WITH BLACK CENTER AND GLOSSY FINISH WHITE SURFACES BOTH SIDES. BACKGROUND TO BE WHITE WITH BLACK LETTERS FOR ALL SIGNS EXCEPT BACKGROUND TO BE RED WITH WHITE LETTERS FOR ALL GROUND SWITCH SIGNS, OR RED, WHITE OR BLUE FOR PHASE IDENTIFICATION SIGNS.
 2. THE SMALL CHARACTERS SHALL BE 5/8-INCH HIGH, 3/32-INCH STROKE, THE LARGE NUMERALS 1 3/4-INCH HIGH, 1/4-INCH STROKE ON THE EQUIPMENT IDENTIFICATION SIGNS. THE LARGE LETTER ON THE PHASE DESIGNATION SIGN SHALL BE 4-INCHES HIGH AND 1/4-INCH STROKE.
 3. THE NUMBER OF 5/8-INCH HIGH CHARACTERS PLUS THE NUMBER OF SPACES BETWEEN WORDS FOR THE FIRST AND THIRD LINES OF EQUIPMENT IDENTIFICATION SIGNS SHALL NOT EXCEED 21. USE ABBREVIATIONS AND/OR ACRONYMS AS NECESSARY TO STAY WITHIN THIS LIMIT.
 4. THE DESIGNATION AT THE BOTTOM OF THE EQUIPMENT IDENTIFICATION SIGN IS THE DESIGN DESIGNATION APPEARING ON CONTROL WIRING AND CABLE TAGS.
 5. MOUNTING HOLES SHALL BE LOCATED 1/2 INCH FROM EACH EDGE. MOUNTING HOLES IN PORCELAIN FINISH SIGNS SHALL BE FITTED WITH BRASS EYELETS. THE FINISHED HOLES SHALL BE SUITABLE FOR A 1/4-INCH BOLT.
 6. THE 1/8x1x6 BARS ARE NOT NORMALLY REQUIRED FOR MOUNTING IDENTIFICATION SIGNS.
 7. SIGN LENGTH WILL VARY FROM 8 TO 12 INCHES DEPENDING ON THE NUMBER OF LETTERS AND NUMBERS.

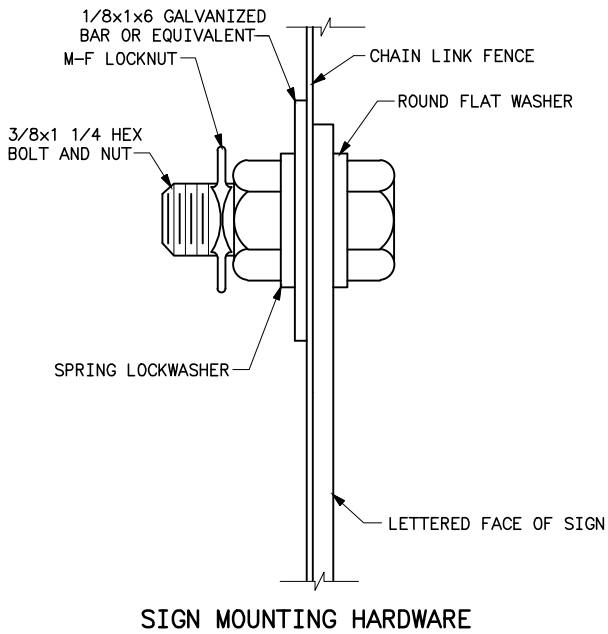
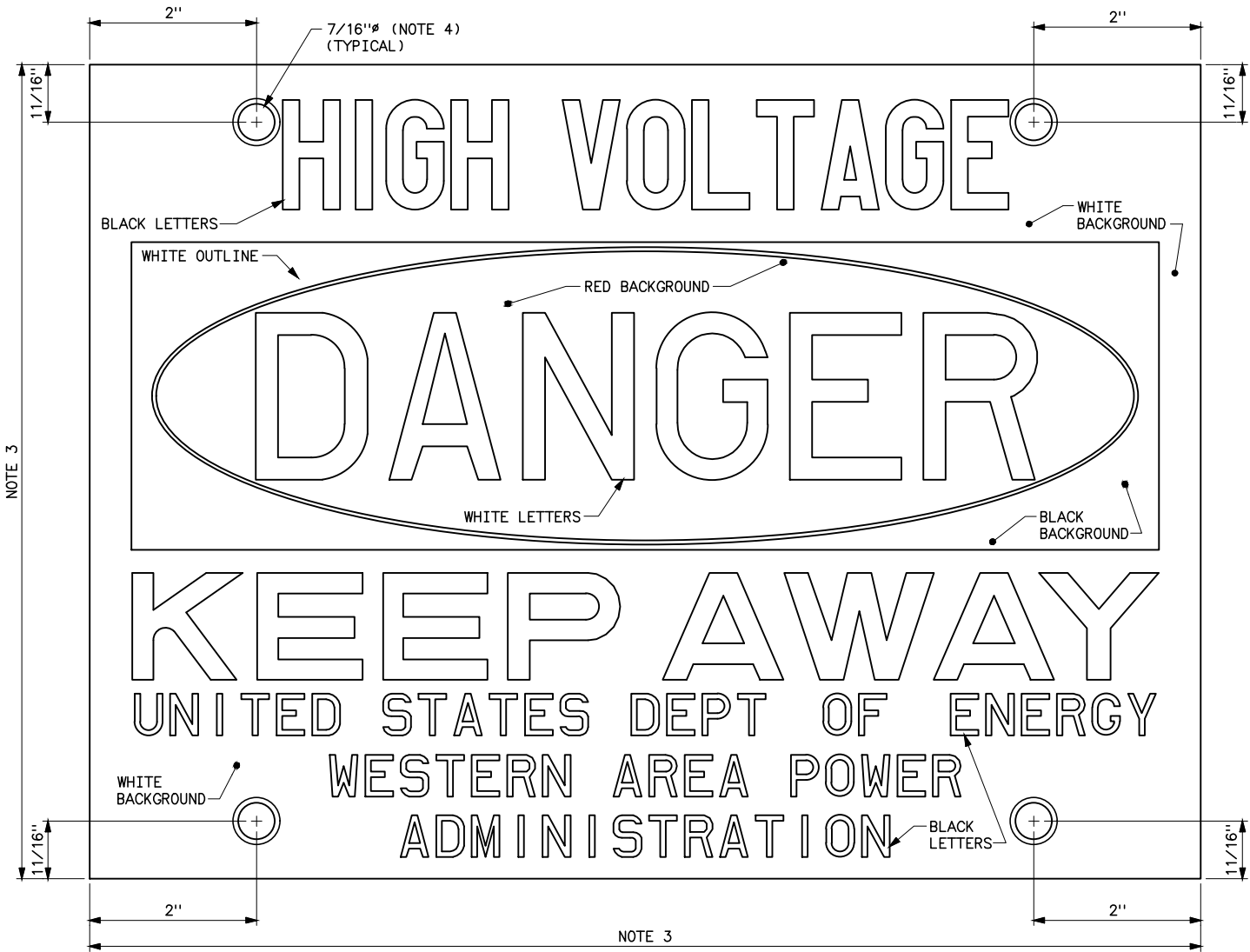
D	12-7-04 A7-RMC	ADDED NOTE 7 AND TRANSFORMER SIGN. REVISED PHASE SIGNS AND HARDWARE BOLT.
C	7-15-03 A7-DH	REVISED TITLE BLOCK ONLY.
B	5-28-99 A3-OP	REDRAWN, ADDED SECURITY SIGN, REVISED NOTES, AND REVISED TEXT ON EQUIPMENT ID SIGNS.
SUPERSEDES DWG NO. 40-D-5329		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS IDENTIFICATION AND SECURITY SIGNS		
DESIGNED	BUREC	APPROVED ROSS M. CLARK ELECTRICAL ENGINEERING MANAGER
DATE	APRIL 4, 1979	31 1000



NOTES

- 1. SIGNS SHALL BE MADE OF NO. 16 GAUGE SHEET STEEL.
- 2. FINISH SHALL BE PORCELAIN ENAMEL.
- 3. EACH SIGN SHALL HAVE TWO FINISHED HOLES LARGE ENOUGH TO TAKE 3/8 INCH BOLTS. HOLES IN SIGNS SHALL BE FITTED WITH BRASS EYELETS.
- 4. THE PORCELAIN ENAMEL SHALL BE IN ACCORDANCE WITH THE RECOMMENDED STANDARDS FOR MANUFACTURE OF PORCELAIN ENAMEL SIGNS (PEI:S-103) OF THE SIGN DIVISION OF THE PORCELAIN ENAMEL INSTITUTE, INC.
- 5. DIMENSIONS OF SIGN AND LETTERING AND BACKGROUND SHALL BE AS INDICATED.
- 6. SIZE OF LETTERING AND BACKGROUND SHALL BE PROPORTIONAL TO THOSE SHOWN.
- 7. ALL FERROUS HARDWARE SHALL BE GALVANIZED.

C	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.	
B	5-14-99 A3-OP	REDRAWN AND REVISED	
SUPERSEDES DWG NO. 40-D-6273			
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO			
SUBSTATION STANDARDS DANGER SIGN FOR SHUNT CAPACITORS			
DESIGNED C.J. DVORAK _____ APPROVED C.A. CABRAL _____ DIRECTOR, DIVISION OF ELECTRICAL DESIGN			
CAE	DECEMBER 1, 1981	31	1079



NOTES

1. SIGNS SHALL BE MADE OF POLYPROPYLENE PLASTIC OR NO. 16 US GAUGE SHEET STEEL WITH A PORCELAIN ENAMEL FINISH.
2. THE PORCELAIN ENAMEL SHALL BE IN ACCORDANCE WITH THE RECOMMENDED STANDARDS FOR MANUFACTURE OF PORCELAIN ENAMEL SIGNS (PEI:S-103) OF THE SIGN DIVISION OF THE PORCELAIN ENAMEL INSTITUTE, INC.
3. HEIGHT AND WIDTH DIMENSIONS MAY VARY FROM 10 TO 12 INCHES AND 14 TO 18 INCHES, RESPECTIVELY.
4. EACH SIGN SHALL HAVE FOUR FINISHED HOLES LARGE ENOUGH TO TAKE 3/8 IN. BOLTS. HOLES IN SIGNS SHALL BE FITTED WITH BRASS EYELETS.
5. SIZE OF LETTERING AND BACKGROUND SHALL BE PROPORTIONAL TO THOSE SHOWN.
6. ALL FERROUS HARDWARE SHALL BE GALVANIZED.
7. SIGNS SHALL BE FASTENED BY MEANS OF EITHER THE TOP OR THE BOTTOM TWO HOLES.

C	9-1-22 A7-RMJ	FIXED LOWER LEFT DIMENSION, ADDED MOUNTING HOLE DIA., ELIPSE REDRAWN.
B	10-5-20 A7-GC	ADDED POLYPROPYLENE PLASTIC MATERIAL OPTION.
A	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS DANGER SIGN		
DESIGNED C. CABRAL _____ APPROVED ROSS M. CLARK _____ ELECTRICAL ENGINEERING MANAGER		
C A/E	MAY 14, 1999	31 1089

Plotted By: denton Sep 01, 2022 2:12pm
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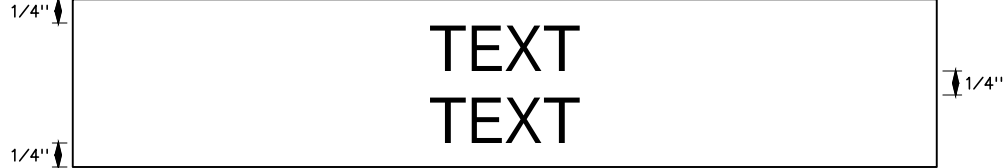
DETAIL A1

DIMENSIONS 9"x1-3/4"
TEXT HEIGHT 3/4"



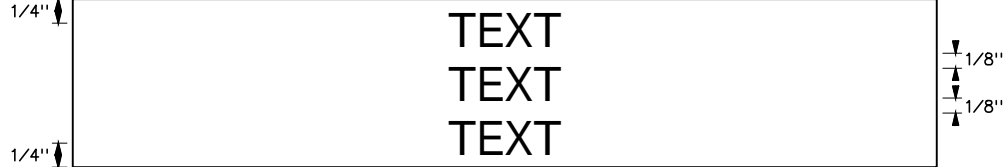
CENTER TEXT HORIZONTALLY AND VERTICALLY.

TEXT HEIGHT 1/2"



CENTER TEXT HORIZONTALLY AND VERTICALLY. POSITION VERTICALLY WITH 1/4" BETWEEN ROWS.

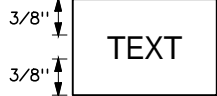
TEXT HEIGHT 3/8"



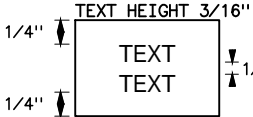
CENTER TEXT HORIZONTALLY AND VERTICALLY.

DETAIL A2

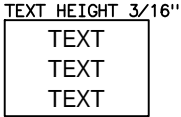
DIMENSIONS 1-1/2"x1"
TEXT HEIGHT 1/4"



CENTER TEXT HORIZONTALLY AND VERTICALLY.



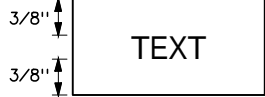
CENTER TEXT HORIZONTALLY. POSITION VERTICALLY WITH A 1/8" GAP BETWEEN ROWS.



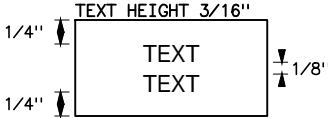
CENTER TEXT HORIZONTALLY. POSITION VERTICALLY WITH A 1/8" GAP BETWEEN ROWS.

DETAIL B1

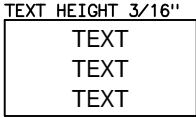
DIMENSIONS 2"x1"
TEXT HEIGHT 1/4"



CENTER TEXT HORIZONTALLY AND VERTICALLY.



CENTER TEXT HORIZONTALLY. POSITION VERTICALLY WITH A 1/8" GAP BETWEEN ROWS.



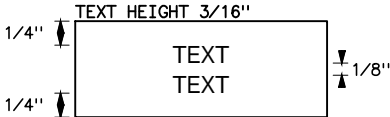
CENTER TEXT HORIZONTALLY. POSITION VERTICALLY WITH A 1/8" GAP BETWEEN ROWS.

DETAIL B2

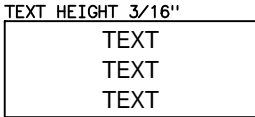
DIMENSIONS 2-5/8"x1"
TEXT HEIGHT 1/4"



CENTER TEXT HORIZONTALLY AND VERTICALLY.



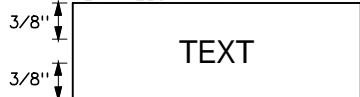
CENTER TEXT HORIZONTALLY. POSITION VERTICALLY WITH A 1/8" GAP BETWEEN ROWS.



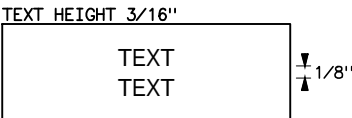
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DETAIL B3

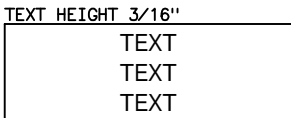
DIMENSIONS 3"x1"
TEXT HEIGHT 1/4"



CENTER TEXT HORIZONTALLY AND VERTICALLY.

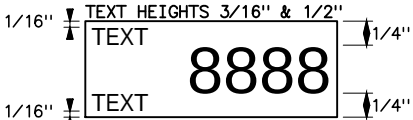


CENTER TEXT HORIZONTALLY. POSITION VERTICALLY WITH A 1/8" GAP BETWEEN ROWS.



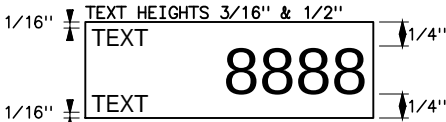
CENTER TEXT HORIZONTALLY. POSITION VERTICALLY WITH A 1/8" GAP BETWEEN ROWS.

DETAIL C1 (DIMENSIONS 2-5/8"x1")



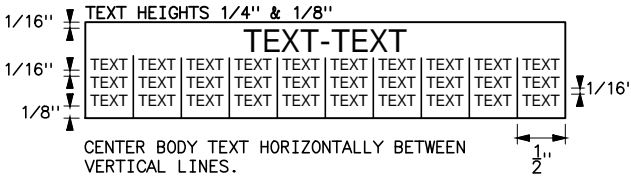
PLACE TEXT AS SHOWN WITH A 1/16" GAP FROM THE EDGES.

DETAIL C2 (DIMENSIONS 3"x1")

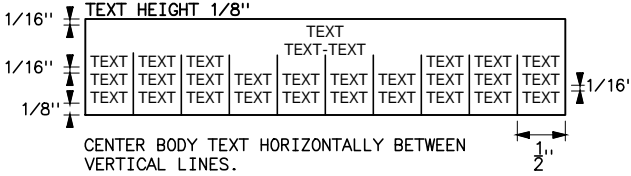


PLACE TEXT AS SHOWN WITH A 1/16" GAP FROM THE EDGES.

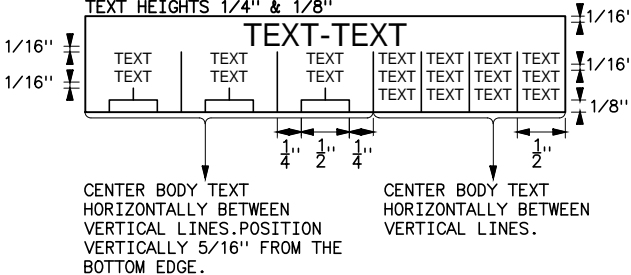
DETAIL D (DIMENSIONS 5"x1")



CENTER TITLE TEXT HORIZONTALLY.

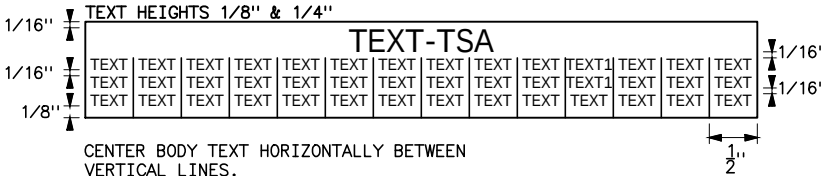


CENTER TITLE TEXT HORIZONTALLY.



CENTER TITLE TEXT HORIZONTALLY.

DETAIL E (DIMENSIONS 7"x1")



CENTER TITLE TEXT HORIZONTALLY.

NOTES

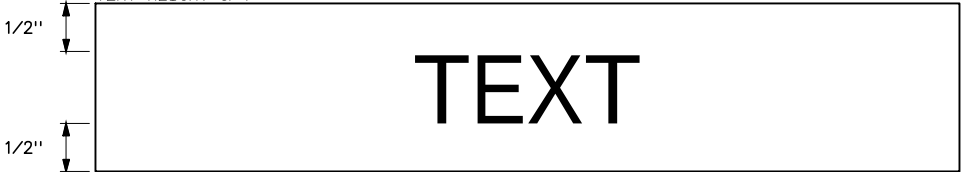
- NAMEPLATE MATERIAL CHARACTERISTICS
 - 1/8" EXTRUDED IMPACT ACRYLIC.
 - BEVELED EDGES.
 - BLACK SURFACE.
 - WHITE LETTERING.
 - FLAT, GROOVE-TYPE ENGRAVING.
 - TAHOMA FONT OR SIMILAR.
 - WILL NOT FADE WITH EXPOSURE TO UV.
- AFFIX NAMEPALTES TO SWITCHBOARD SURFACE WITH DOUBLE-SIDED ADHESIVE TAPE.
- SCALE TEXT WIDTH TO FIT WITHIN THE NAMEPLATE WHERE NECESSARY.
- NAMEPLATE AND TEXT DIMENSIONS ARE PROVIDED FOR NAMEPLATE CREATING DEVICES THAT REQUIRE MANUAL ENTRY.FOR DIGITAL SYSTEMS THAT IMPORT PDF OR DWG TYPE FILES,USE THE NAMEPLATE DRAWINGS PROVIDED BY WAPA.

B	4-17-26 A7-DWS	REVISED DETAIL OPTIONS;UPDATED NOTES	
A	8-9-23 A7-DWS	ADDED TYPE A2 FRONT NAMEPLATE	
SUPERSEDES DWG NO.31 4015A			
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO			
CONTROL STANDARDS NAMEPLATE DETAILS SWITCHBOARD FRONT (SH 1 OF 3)			
DESIGNED <u>DAMIAN W. SOWER</u> _____ APPROVED <u>DANIEL M. HAMAI</u> _____ SYSTEM CONTROL MANAGER			
C/A	MARCH 8, 2018	31	4015-1

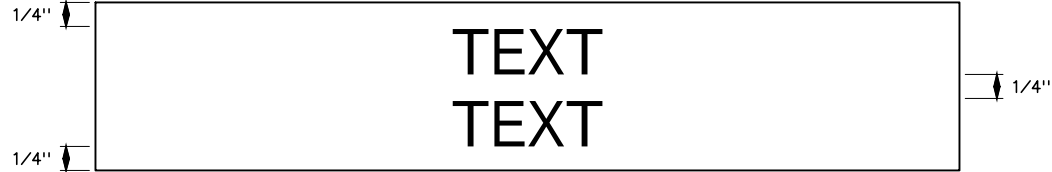
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SIDE SHEETS

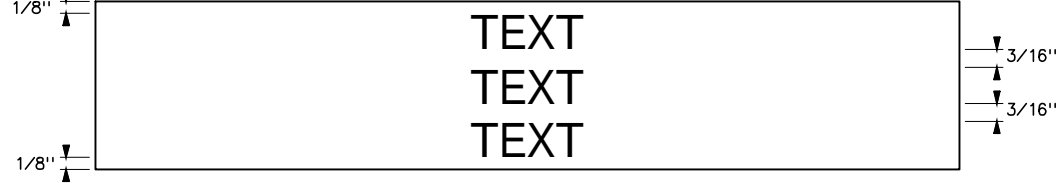
TITLE NAMEPLATES
DIMENSIONS 9"x1-3/4"
TEXT HEIGHT 3/4"



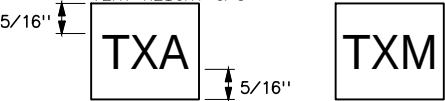
TEXT HEIGHT 1/2"



TEXT HEIGHT 3/8"



2-POLE DC POWER TERMINAL BLOCKS
DIMENSIONS 1-1/8"x1"
TEXT HEIGHT 3/8"



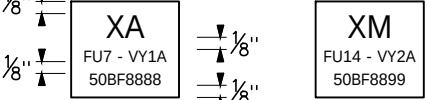
CENTER TEXT HORIZONTALLY
AND VERTICALLY.

12-POLE TERMINAL BLOCKS
DIMENSIONS 1-1/8"x1"
TEXT HEIGHT 3/8"



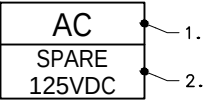
CENTER TEXT HORIZONTALLY
AND VERTICALLY

FUSE BLOCKS
DIMENSIONS 1-1/8"x1"
TEXT HEIGHTS 1/4" & 1/8"



CENTER TEXT HORIZONTALLY.
POSITION VERTICALLY WITH A
1/8" GAP BETWEEN ROWS.

DC CIRCUIT BREAKERS
DIMENSIONS 1-1/2"x1"
TEXT HEIGHTS 1/4" & 3/16"



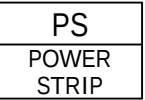
1. CENTER TEXT HORIZONTALLY
AND VERTICALLY.
2. CENTER TEXT HORIZONTALLY
WITH A 1/16" GAP BETWEEN ROWS.

GROUND BUS BAR
DIMENSIONS 1-1/2"x1"
TEXT HEIGHT 3/8"



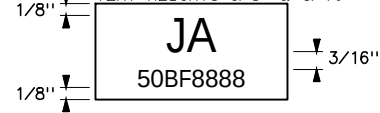
CENTER TEXT HORIZONTALLY
AND VERTICALLY

POWER STRIP
DIMENSIONS 1-1/2"x1"
TEXT HEIGHTS 1/4" & 3/16"



1. CENTER TEXT HORIZONTALLY
AND VERTICALLY.
2. CENTER TEXT HORIZONTALLY
WITH A 1/16" GAP BETWEEN ROWS.

TEST SWITCHES,RELAYS,LOCKOUTS,CONTROL SWITCHES
DIMENSIONS 2"x1"
TEXT HEIGHTS 3/8" & 3/16"



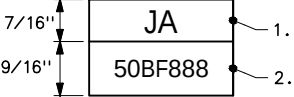
CENTER TEXT HORIZONTALLY.
POSITION VERTICALLY WITH A
3/16" GAP BETWEEN ROWS.

DIMENSIONS 2"x1"
TEXT HEIGHTS 3/8" & 3/16"

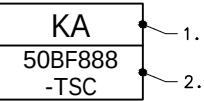


CENTER TEXT HORIZONTALLY.
POSITION VERTICALLY WITH A
3/16" GAP BETWEEN ROWS.

DIMENSIONS 1-1/2"x1"
TEXT HEIGHTS 1/4" & 3/16"



1. CENTER TEXT HORIZONTALLY
AND VERTICALLY.
2. CENTER TEXT HORIZONTALLY
AND VERTICALLY



1. CENTER TEXT HORIZONTALLY
AND VERTICALLY.
2. CENTER TEXT HORIZONTALLY
WITH A 1/16" GAP BETWEEN ROWS.

NOTES

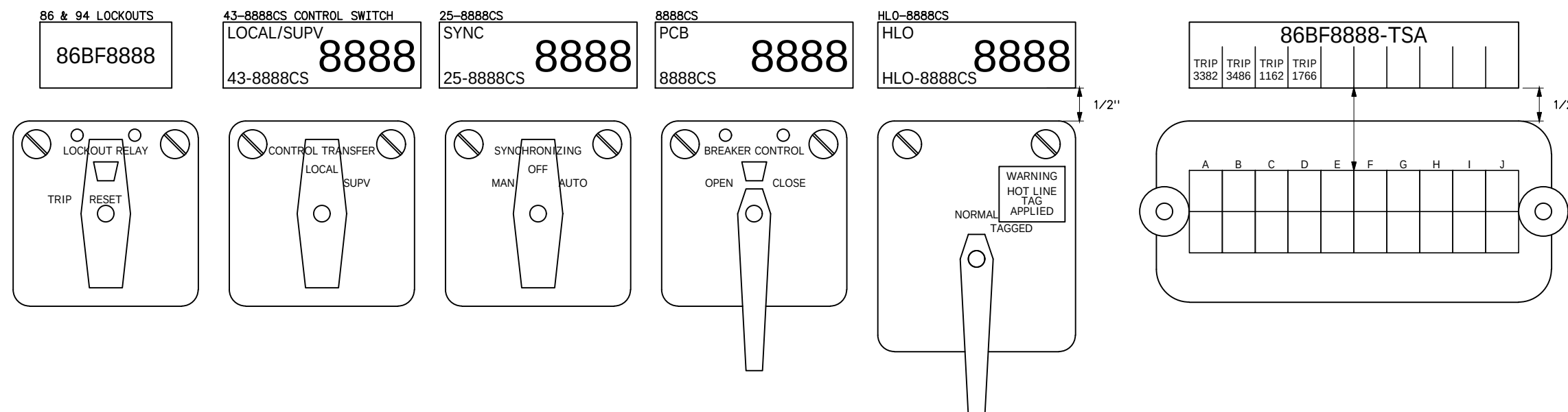
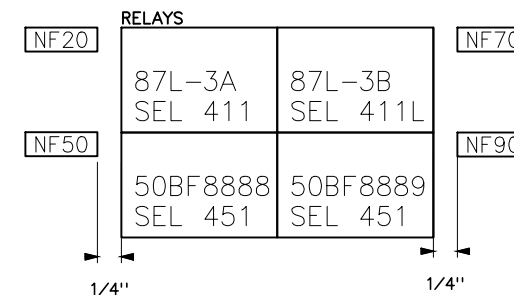
- NAMEPLATE MATERIAL CHARACTERISTICS
 - 1/8" EXTRUDED IMPACT ACRYLIC.
 - BEVELED EDGES.
 - BLACK SURFACE.
 - WHITE LETTERING.
 - FLAT,GROOVE-TYPE ENGRAVING.
 - TAHOMA FONT OR SIMILAR.
 - WILL NOT FADE WITH EXPOSURE TO UV.
- AFFIX NAMEPLATES TO SWITCHBOARD SURFACE WITH DOUBLE-SIDED ADHESIVE TAPE.
- SCALE TEXT WIDTH TO FIT WITHIN THE NAMEPLATE WHERE NECESSARY.
- NAMEPLATE AND TEXT DIMENSIONS ARE PROVIDED FOR NAMEPLATE CREATING DEVICES THAT REQUIRE MANUAL ENTRY.FOR DIGITAL SYSTEMS THAT IMPORT PDF OR DWG TYPE FILES,USE THE NAMEPLATE DRAWINGS PROVIDED BY WAPA.

B	4-17-26 A7-DWS	ADDED NAMEPLATE OPTIONS;UPDATED NOTES
A	8-9-23 A7-DWS	CREATED NEW DC BREAKER LAYOUT AND SIZE
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
CONTROL STANDARDS NAMEPLATE DETAILS SWITCHBOARD REAR (SH 2 OF 3)		
DESIGNED DANIAN W. SOWER _____ APPROVED DANIEL M. HAMAI _____ SYSTEM CONTROL MANAGER		
C A	MARCH 8, 2018	31 4015-2

The diagram illustrates the internal layout of three sub-panels: 50BF3882-TSA, 50BF3882-TSB, and 50BF3882-TSC. Each panel features a 2x10 grid of terminals labeled A through J. The TSA panel includes a terminal block with labels VAY, VBY, VCY, IAW IN, IAW OUT, IBW IN, IBW OUT, ICW IN, ICW OUT, and VNY. The TSB panel includes a terminal block with labels VAZ and VNZ. The TSC panel includes a terminal block with labels (+) VDC, 3882 52A, 3882 BFI, 3882 TCM1, 3882 TCM2, 21-38A ALM, 21-38B ALM, and (-) VDC. A 1/4" scale bar is provided for reference. A line labeled 'COVER' points to the bottom of the panels, and a line labeled '3U SUB-PANEL' points to the bottom of the entire assembly.

- CENTERED DIRECTLY ABOVE
THE BLACK DIVIDER BETWEEN
SWITCHES 'E' AND 'F'

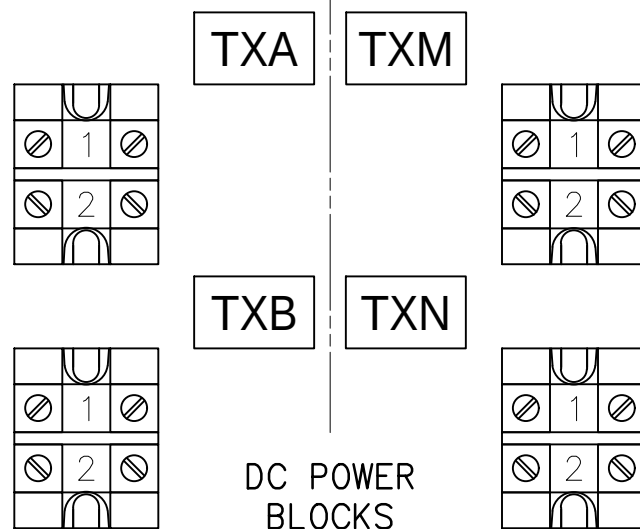
1. AVOID THE TEST SWITCH COVER OBSTRUCTING NAMEPLATE TEXT.
2. SIDE SHEET NAMEPLATE LOCATIONS ARE APPROXIMATE TO ALLOW ADJUSTMENTS FOR WIRE ROUTING.
3. CENTER SWITCHBOARD FRONT NAMEPLATES 1/2" DIRECTLY ABOVE ABOVE THE DEVICE.
4. CENTER THE 10-POLE TEST SWITCH NAMEPLATES DIRECTLY ABOVE THE BLACK PLASTIC DIVIDER BETWEEN SWITCHES 'E' & 'F', 1/2" ABOVE THE COVER.
5. USE THE DEVICE DESIGNATION TEXT FOUND ON THE SWITCHBOARD & SIDE SHEET WIRING DIAGRAMS IF REAR & SIDE SHEET NAMEPLATES DRAWINGS ARE NOT PROVIDED.
6. PLACE DC CIRCUIT BREAKER NAMEPLATES 1/2" BELOW THE BREAKER. ENSURE THAT THE ROW OF NAMEPLATES IS EVEN.
7. ADD ADHESIVE TAPE NAMEPLATES TO THE BACK OF THE CONTROL SWITCHES AND LOCKOUTS.



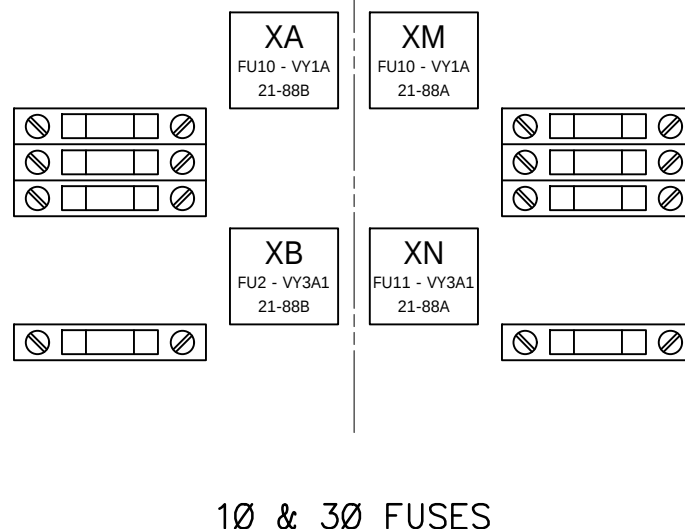
HB

HLO-8888CS

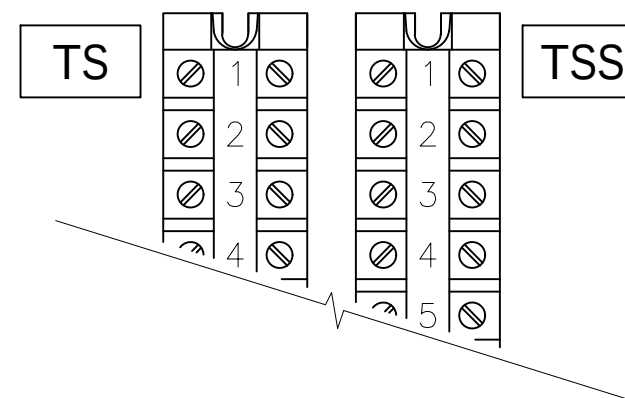
LEFT SIDE RIGHT SIDE



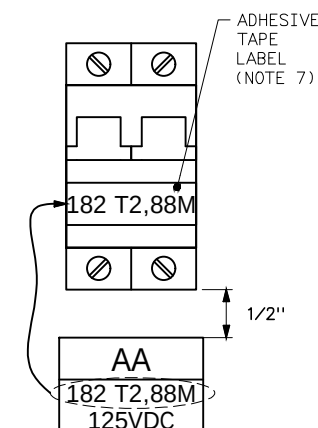
LEFT SIDE RIGHT SIDE



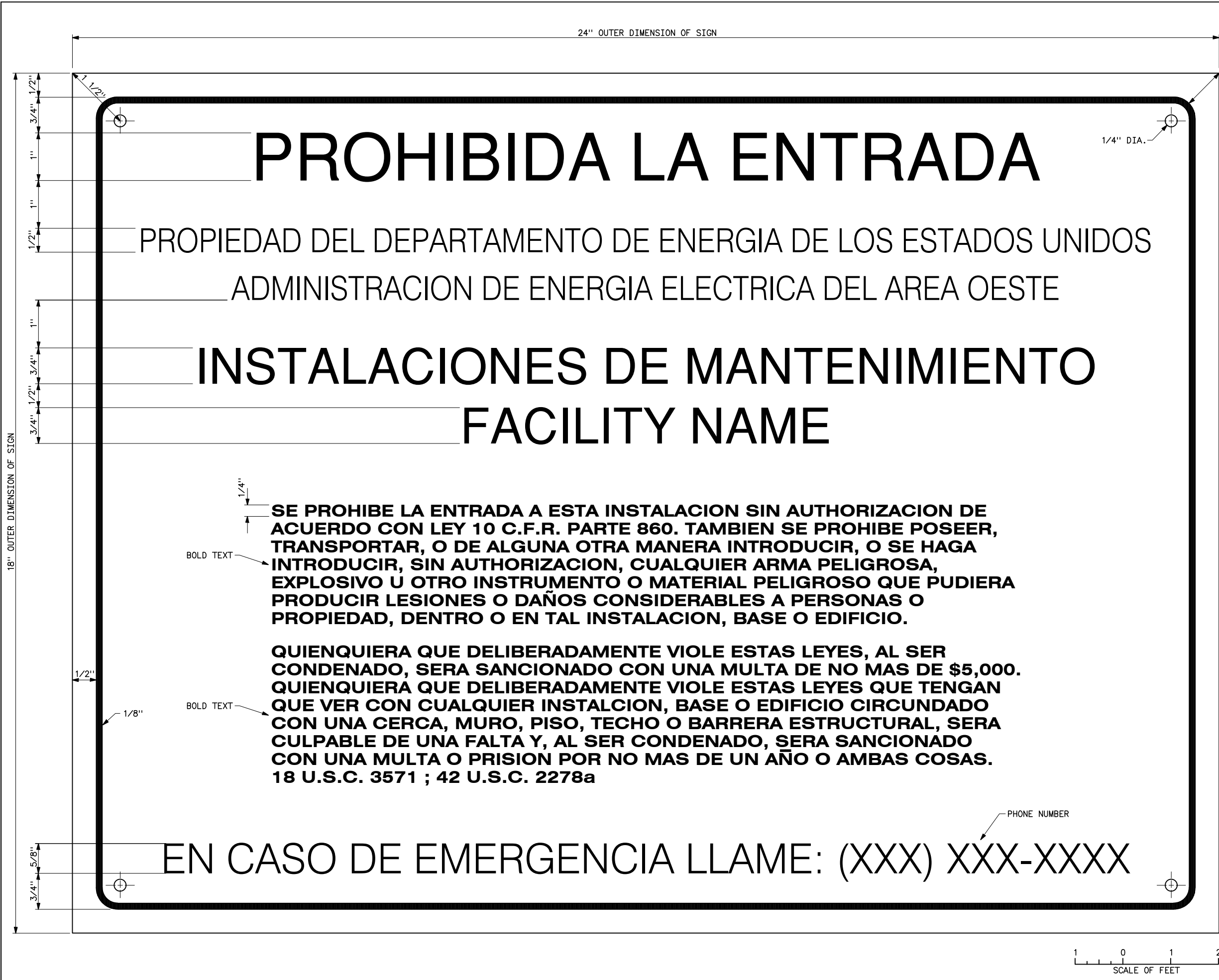
LEFT OR RIGHT SIDE



SWBD REAR
CIRCUIT BREAKER



B	4-17-26 A7-DWS	UPDATED DWG NOTES & CIRCUIT BREAKER DIAGRAM MINOR TEXT REVISIONS.
A	8-9-23 A7-DWS	REVISED LAYOUT OF CIRCUIT BREAKER FRONT/REAR NAMEPLATE LOCATIONS
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
CONTROL STANDARDS NAMEPLATE DETAILS LOCATIONS & POSITIONS (SH 3 OF 3)		
DESIGNED <u>DANIEL W. SOWER</u> _ _ _ _ _ APPROVED <u>DANIEL W. HAMAI</u> _ _ _ _ _ SYSTEM CONTROL MANAGER		
C	MARCH 8, 2018	31 4015-



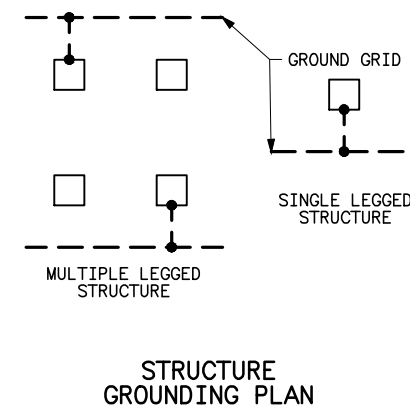
SECURITY SIGN REQUIREMENTS

- 1. MATERIAL SHALL BE NO. 18 US GAUGE SHEET STEEL WITH FUSED PORCELAIN FINISH 3/32-INCH THICK WITH BLACK CENTER AND GLOSSY FINISH WHITE SURFACES BOTH SIDES. BACKGROUND SHALL BE WHITE AND ALL TEXT SHALL BE BLACK.
- 2. TEXT STYLE SHALL BE MEDIUM HELVETICA BLOCK TYPE EXCEPT WHERE BOLD IS SPECIFIED.
- 3. THE CENTERLINE OF MOUNTING HOLES SHALL BE LOCATED 1 1/2-INCH FROM EACH EDGE AND SHALL BE FITTED WITH BRASS EYELETS. THE FINISHED HOLES SHALL BE SUITABLE FOR A 1/4-INCH BOLT. PROVIDE 1/8x1x6 INCH GALVANIZED STRAP OR OTHER SUITABLE HARDWARE TO FASTEN SIGNS ON GATES.

REFERENCE DRAWING

IDENTIFICATION AND SECURITY SIGNS_____31 1000

B	7-27-26 A7-KB	REVISED LANGUAGE.
A	12-2-16 A7-RMC	ADDED REFERENCE DRAWING FOR ENGLISH VERSION OF THIS SIGN.
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION DESERT SOUTHWEST REGION - PHOENIX, ARIZONA		
SUBSTATION STANDARDS PROHIBIDA LA ENTRADA SIGN		
DESIGNED W. G. T. - K. KENDALL APPROVED ROBERT O. JOHNSON MAINTENANCE ENGINEERING TEAM LEAD		
CAE	APRIL 29, 1999	31 1095



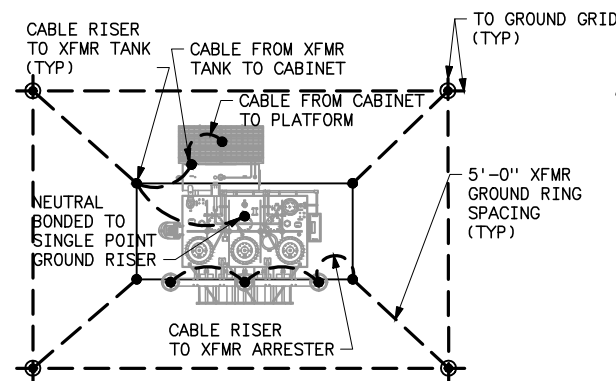
- ### EXPLANATION
- | | |
|---|---|
|  | COPPER GROUND CABLE (BURIED) |
|  | COPPER-CLAD STEEL GROUND CABLE (BURIED) |
|  | COPPER GROUND CABLE (EXPOSED) |
|  | COPPER GROUND CABLE (IN TRENCH) |
|  | FENCE |
|  | GROUND ROD |
|  | ELECTRICAL GROUNDING CONNECTION |
|  | GROUND CABLE RISER |

NOTES

1. ALL GROUNDING SHALL BE INSTALLED IN ACCORDANCE WITH THE SUBSTATION WORKING DRAWINGS. THE STANDARD SUBSTATION GROUNDING DRAWINGS AND THE STANDARD INSTALLATION SPECIFICATION SECTION ON GROUNDING.
2. GROUND CABLES ABOVE GRADE SHALL BE COPPER-CLAD STEEL (CCS) AND SIZED IN ACCORDANCE WITH CONSTRUCTION STANDARD 9. CCS SIZING VARIES BY MANUFACTURER.
3. THE CCS EQUIVALENT OF 4/0AWG BARE COPPER SHALL RUN DIRECTLY UP FROM THE GROUND GRID TO THE GROUND BLADES OF AIR SWITCHES.
4. PLACE GROUND RODS AT 20'-0" INTERVALS ON OUTER FENCE PERIMETER.
5. IF PAD MOUNTED TRANSFORMER IS REASONABLY LOCATED ADJACENT TO EXISTING SUBSTATION GROUND GRID, BOND 4/0 AWG CONDUCTOR FROM GROUND GRID TO TRANSFORMER TANK.
6. IF PAD MOUNTED TRANSFORMER IS NOT NEAR A SUBSTATION GROUND GRID, TWO GROUND RODS 6'-0" APART SHALL BE INSTALLED AND CONNECT TO THE TRANSFORMER TANK.
7. GROUNDING PAD MOUNTED TRANSFORMER IN SUBSTATION IS EQUIVALENT TO INSTRUMENT TRANSFORMER.

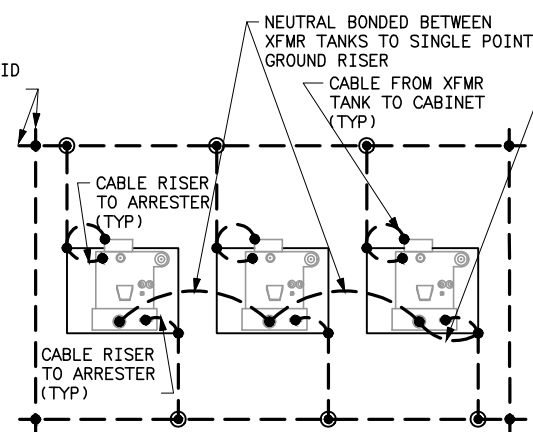
REFERENCE DRAWINGS

TYPICAL GROUNDING DETAILS-SHEET 1 OF 2	31	1058
TYPICAL GROUNDING DETAILS-SHEET 2 OF 2	31	1059
GROUNDING DETAILS	31	1060
CABLE TRENCH GROUNDING	31	1061
PIPE-BUS GROUNDING PLAN	31	1063
SWITCH OPERATING AND EQUIPMENT PLATFORMS- ELECTRICAL DESIGN AND DETAILS	31	1075
GROUND CABLE ON TUBULAR STEEL STRUCTURES- SUPPORT DETAILS	31	1077
FENCE GROUNDING CONNECTIONS DETAILS	31	1501
GROUNDING PLANS TYPICAL DETAILS	31	1510



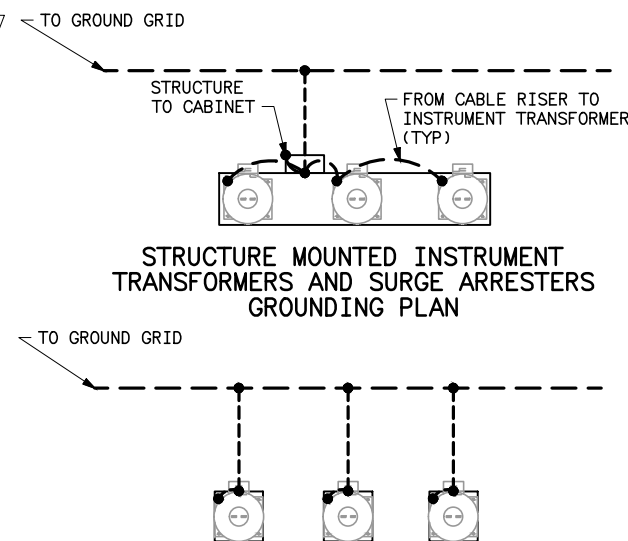
3-PHASE POWER TRANSFORMER GROUNDING PLAN NOTES

1. SEE 31 1510 FOR NEUTRAL BUSHING GROUNDING.
2. SIMILAR FOR 3 PH SHUNT REACTOR.

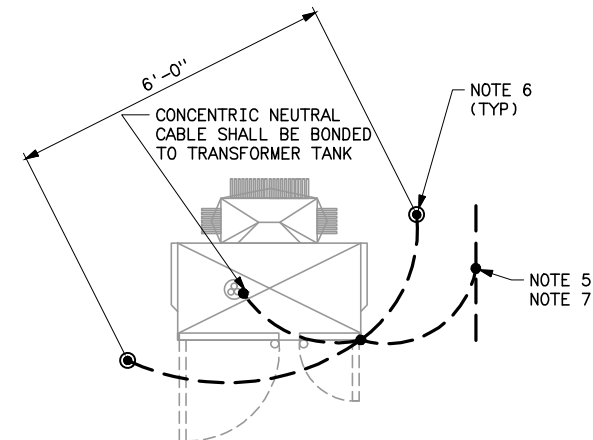


3 SINGLE-PHASE POWER TRANSFORMERS GROUNDING PLAN

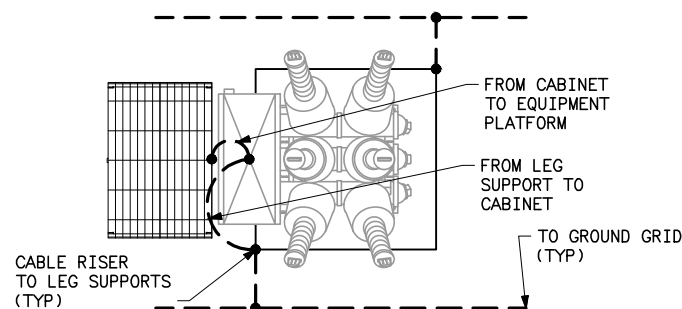
- ### NOTES
1. SEE 31 1510 FOR NEUTRAL BUSHING GROUNDING.
 2. SIMILAR FOR 1 PH SHUNT REACTORS.



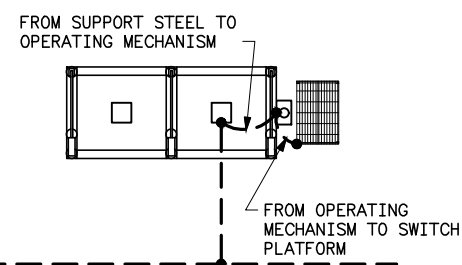
SEPARATELY MOUNTED INSTRUMENT TRANSFORMERS AND SURGE ARRESTERS GROUNDING PLAN



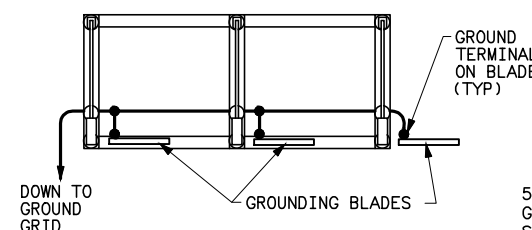
PAD MOUNTED TRANSFORMER
GROUNDING PLAN
(OUTSIDE SUBSTATION GROUND GRID)



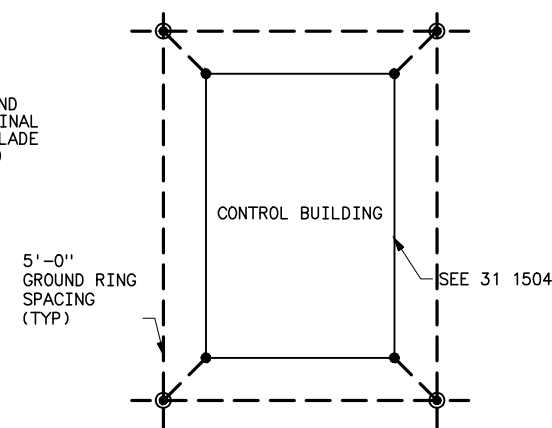
POWER CIRCUIT BREAKER GROUNDING PLAN



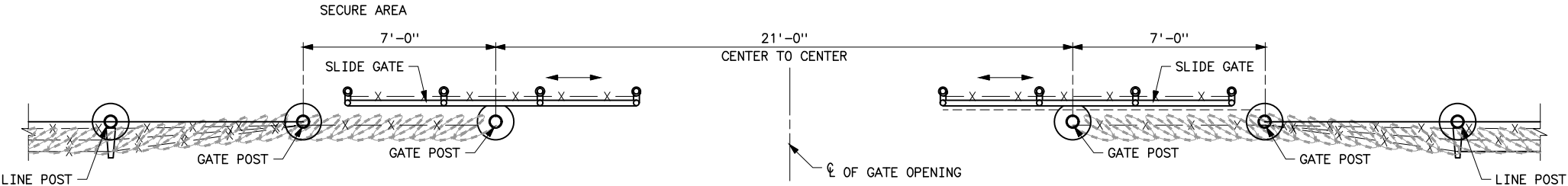
AIR SWITCH OPERATING PLATFORM GROUNDING PLAN



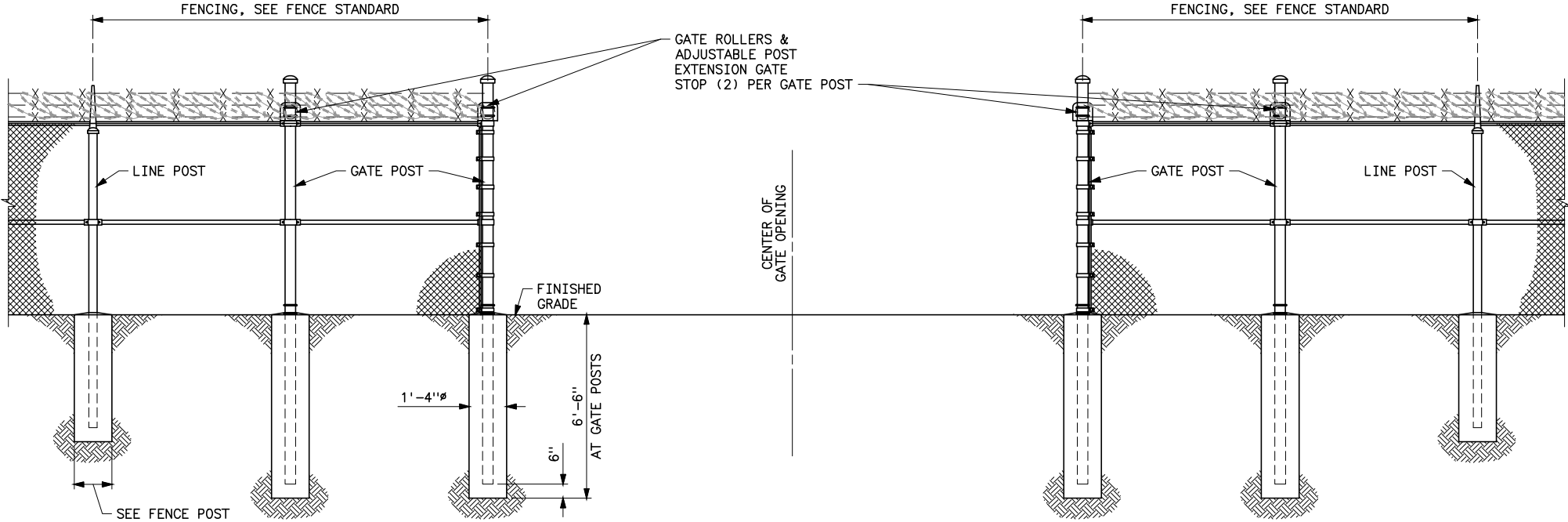
AIR SWITCH GROUNDING BLADE GROUNDING PLAN

SUBSTATION CONTROL BUILDING
GROUNDING PLAN

C	7-27-26 A7-KB	REVISED FOR EQUIPMENT PLAN INTEGRATION AND GROUNDING STANDARDS.
B	11-11-21 A7-RMJ	REVISED GATE DETAILS AND REFERENCE DRAWINGS.
A	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS GROUNDING PLANS EQUIPMENT GROUNDING		
DESIGNED <u>O. PERKINS</u> _____		APPROVED <u>ROSS M. CLARK</u> ELECTRICAL ENGINEERING MANAGER
C _A	MAY 14, 1999	31
		1500

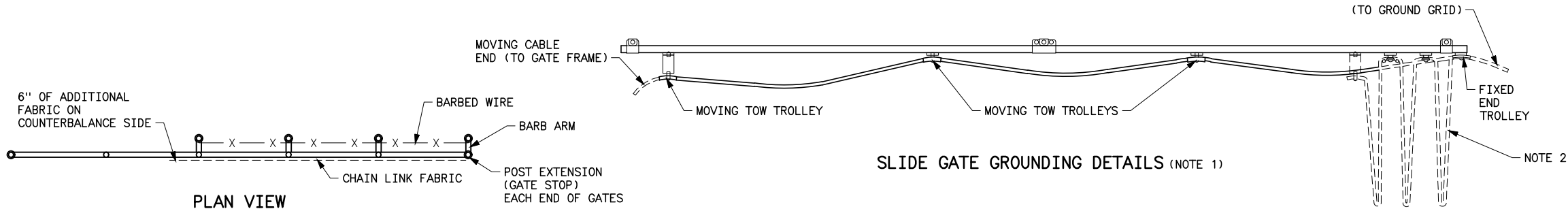


PLAN VIEW OF GATE OPENING

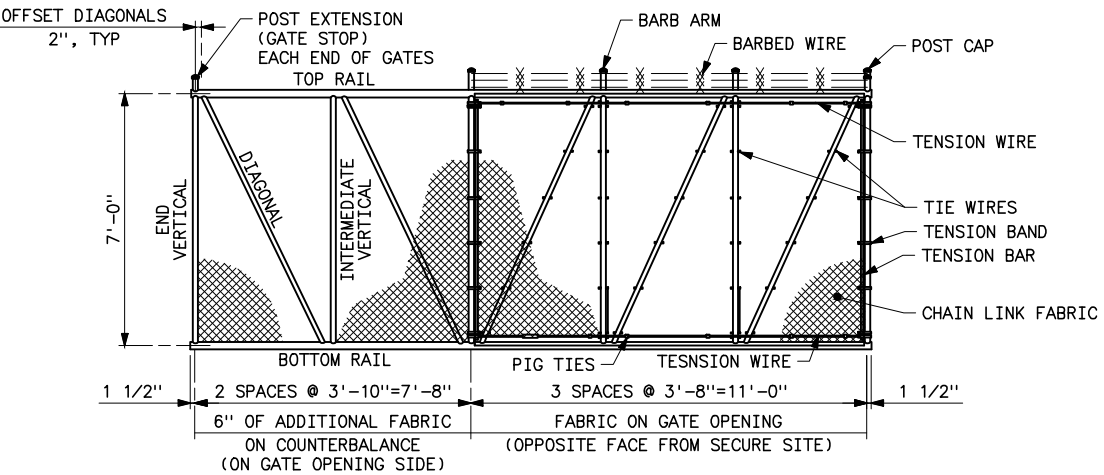


ELEVATION VIEW OF GATE OPENING (WITHOUT GATES)
(LOOKING TOWARD SECURE AREA)

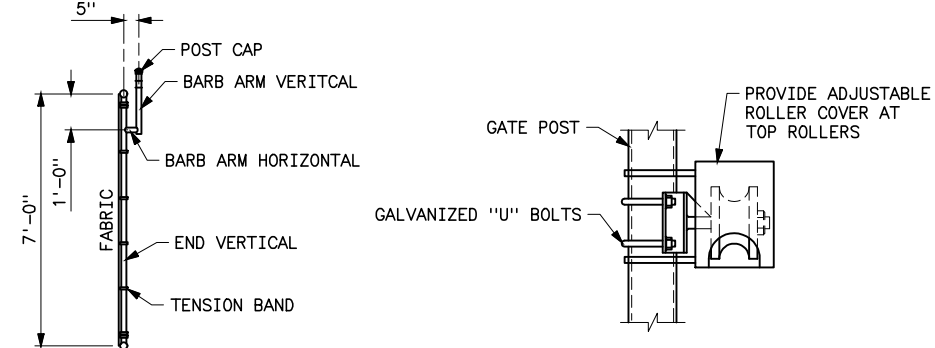
- NOTE**
1. GATE GROUNDING SYSTEM SHALL BE BURNDY SLIDING GATE GROUNDING SYSTEM CATALOG #BCR02302 OR EQUAL.
 2. FESTOON GROUNDING CABLE SHALL BE FINE STRANDED 4/0 AWG EDPM INSULATED WELDING CABLE WITH OUTSIDE DIAMETER RANGE OF 0.60"-0.94", OMNI CABLE CAT# B24/001 OR EQUAL.



SLIDE GATE GROUNDING DETAILS (NOTE 1)

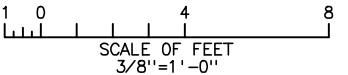


ELEVATION VIEW OF SIDE GATE
(LOOKING TOWARD SECURE AREA)



END VIEW OF SLIDE GATE

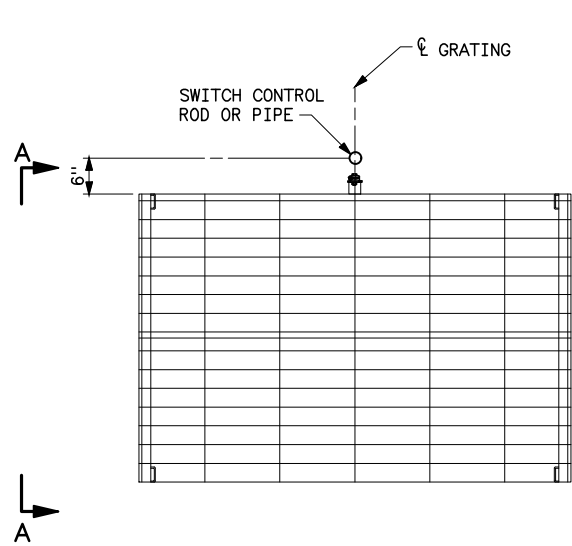
SLIDE GATE ROLLER



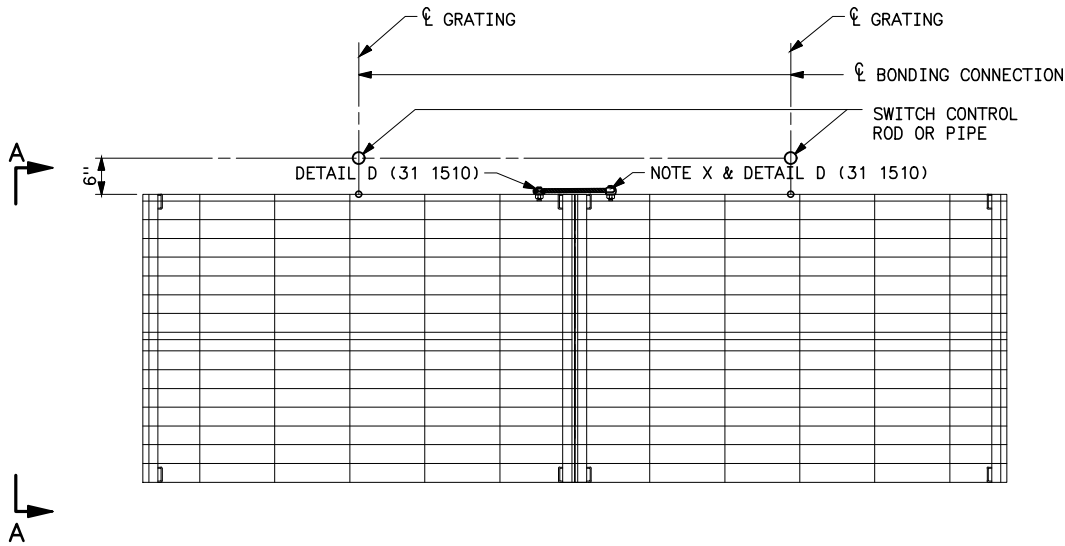
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS SLIDING GATE GENERAL REQUIREMENTS AND GROUNDING		
DESIGNED KYLE VAUGHN	APPROVED KYLE VAUGHN ELECTRICAL ENGINEERING MANAGER	
SEPTEMBER 8, 2026	31	1507

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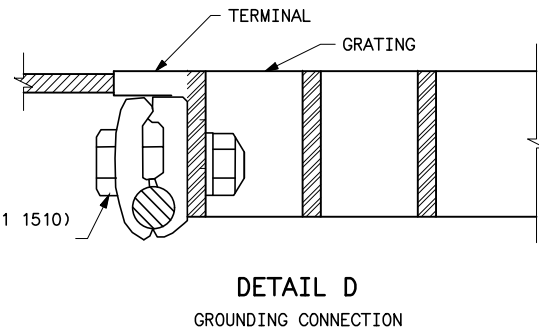
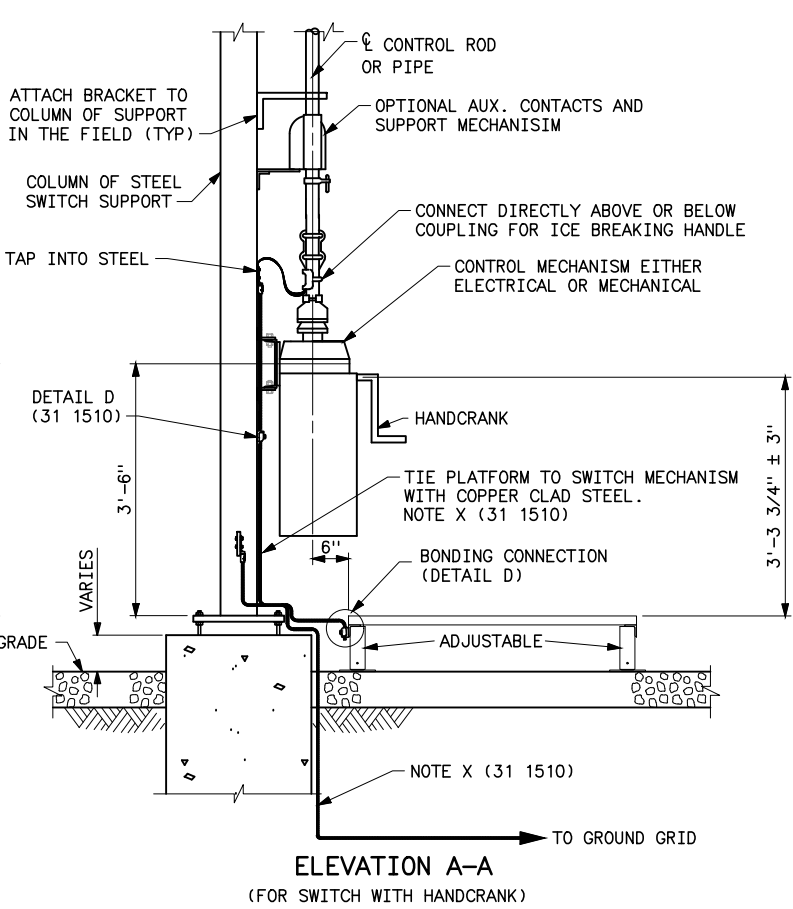
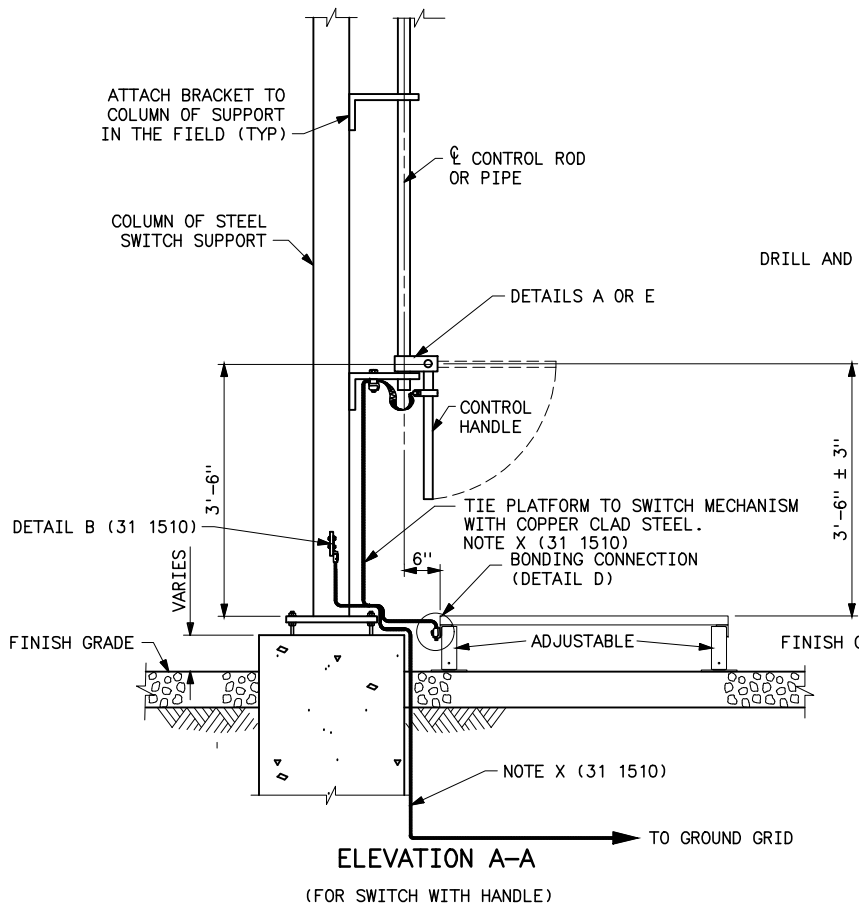
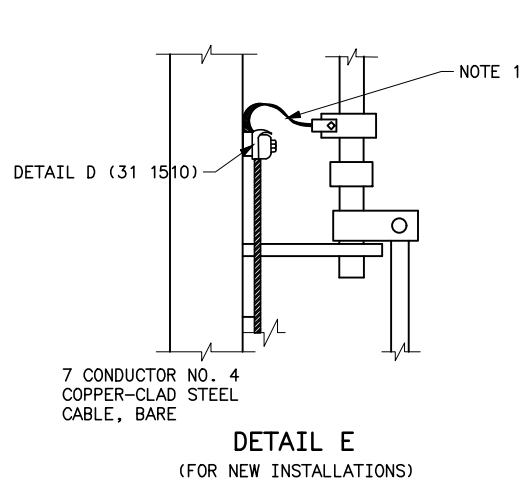
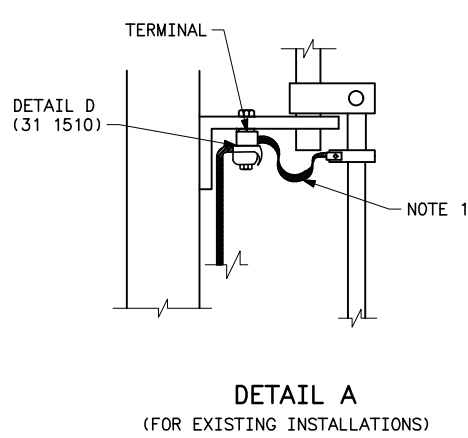
XREF(S):



PLAN
SINGLE PLATFORM INSTALLATION



PLAN
DOUBLE PLATFORM INSTALLATION



- NOTES**
1. A COPPER BRAID SHALL BE FURNISHED FOR BONDING EACH SWITCH OPERATING SHAFT, HANDLE, AND MECHANISM TO THE SWITCH SUPPORT STRUCTURE TO THE SWITCH-OPERATING PLATFORM, ACCORDING TO IEEE STD 80.
 2. COPPER CLAD STEEL TO BOND THE TWO PLATFORMS TOGETHER.
 3. ACTUAL LOCATION OF GROUNDING CONDUCTOR MAY VARY.

REFERENCE DRAWINGS

GROUNDING PLANS EQUIPMENT GROUNDING	31 1500
GROUNDING PLANS TYPICAL DETAILS	31 1510
EQUIPMENT CABINET PLATFORMS -	
STEEL DESIGN AND DETAILS	31 2044
SWITCH OPERATING PLATFORMS -	
STEEL DESIGN AND DETAILS	31 2045
EQUIPMENT CABINET PLATFORMS -	
STEEL DESIGN AND DETAILS	31 2048
TRANSFORMER PLATFORMS -	
STEEL DESIGN AND DETAILS	31 2050

L	3-9-26 A7-KB	REVISED DRAWINGS AND DETAILS TO INCLUDE BRAID INFO, A-A GROUNDING, AND PLATFORM GROUNDING.
K	9-27-16 A7-RMJ	NO GROUNDING CABLE CONNECTION CLARIFICATION. REVISED COPPER-CLAD STEEL SIZE.
J	9-11-13 A7-RMJ	REVISED PLATFORMS, SWITCH OPERATING HANDLE HEIGHTS, AND REF DWGS. REMOVED DETAIL D.
I	11-9-11 A7-RMJ	REVISED REFERENCE DRAWINGS.
H	7-30-09 A7-RC	ADDED COPPERWELD CABLE TO DRAWING
SUPERSEDES DWG NO. 40-D-4874		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATIONS STANDARDS SWITCH OPERATING AND EQUIPMENT PLATFORMS ELECTRICAL DESIGN AND DETAILS		
DESIGNED W.L. SOPER APPROVED DON WARNER FOR DIRECTOR, DIVISION OF SUBSTATION DESIGN		
A	MAY 18, 1979	31 1075

FIGURE 1

FIGURE 3

FIGURE 5

FIGURE 2

FIGURE 4

D	8-7-26 A7-KB	DRAWING IS NOT LONGER USED AT WAPA FOR NEW CONSTRUCTION.
C	11-9-11 A7-RM	ADDED NOTE 12 AND REVISED REFERENCE DRAWINGS.
B	5-14-99 A3-0P	REDRAWN AND MINOR REVISIONS.
FORMERLY DWG NO. 40-D-4334		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - GOLDEN, COLORADO		
SUBSTANTION STANDARDS TYPICAL GROUNDING DETAILS (SHEET 1 OF 2)		
DESIGNED BUREC _____ APPROVED ROSS M. CLARK _____ ELECTRICAL ENGINEERING MANAGER		
C _A -	MAY 18, 1979	31 1058

TYPICAL GROUND MAT DETAILS

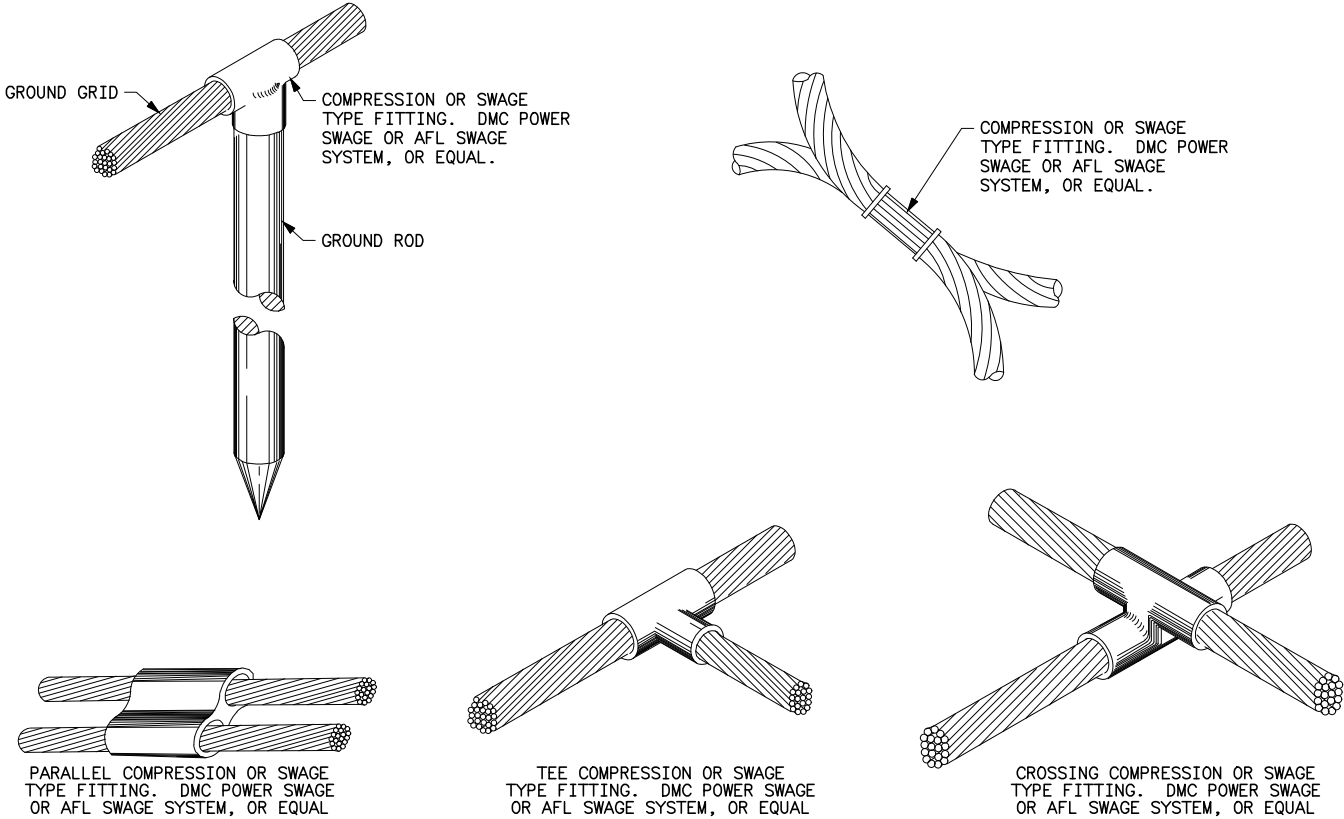


FIGURE 1

TYPICAL GROUNDING DETAILS FOR RAILING POST BASES AND HANDRAIL SUPPORTS

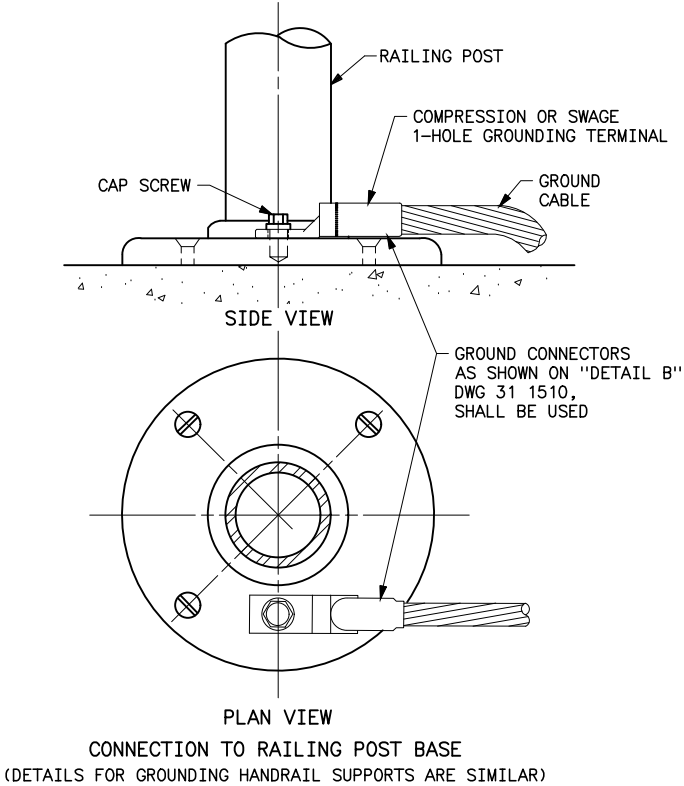


FIGURE 2

TYPICAL GROUNDING DETAILS FOR RAILS

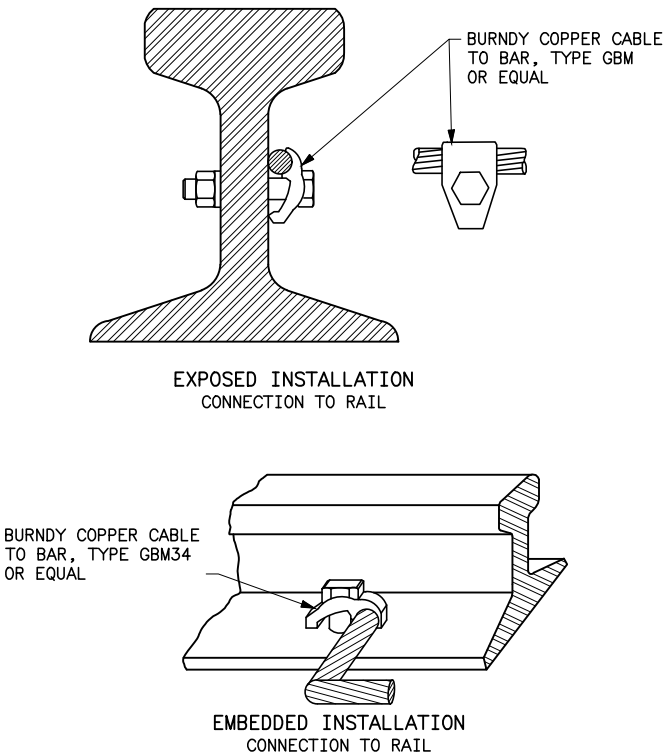


FIGURE 3

TYPICAL GROUNDING DETAILS FOR FLOOR FRAMES

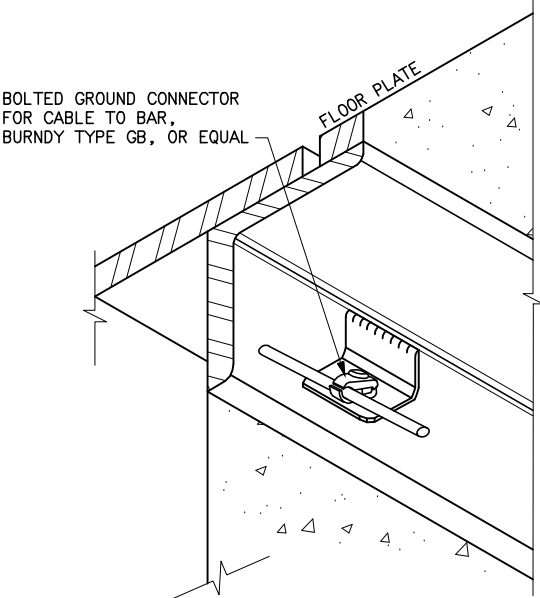


FIGURE 4

TYPICAL GROUNDING DETAILS FOR OIL TANK

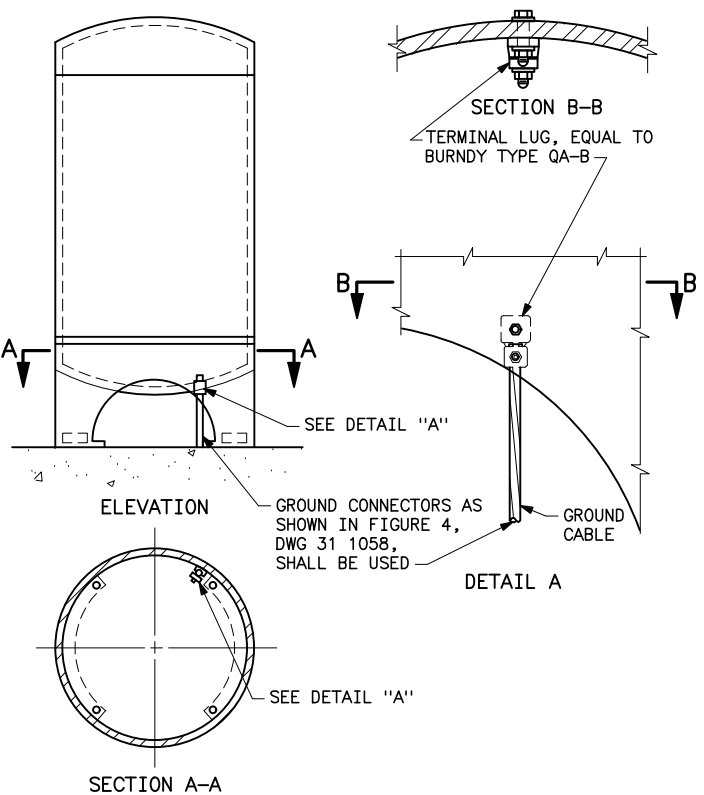


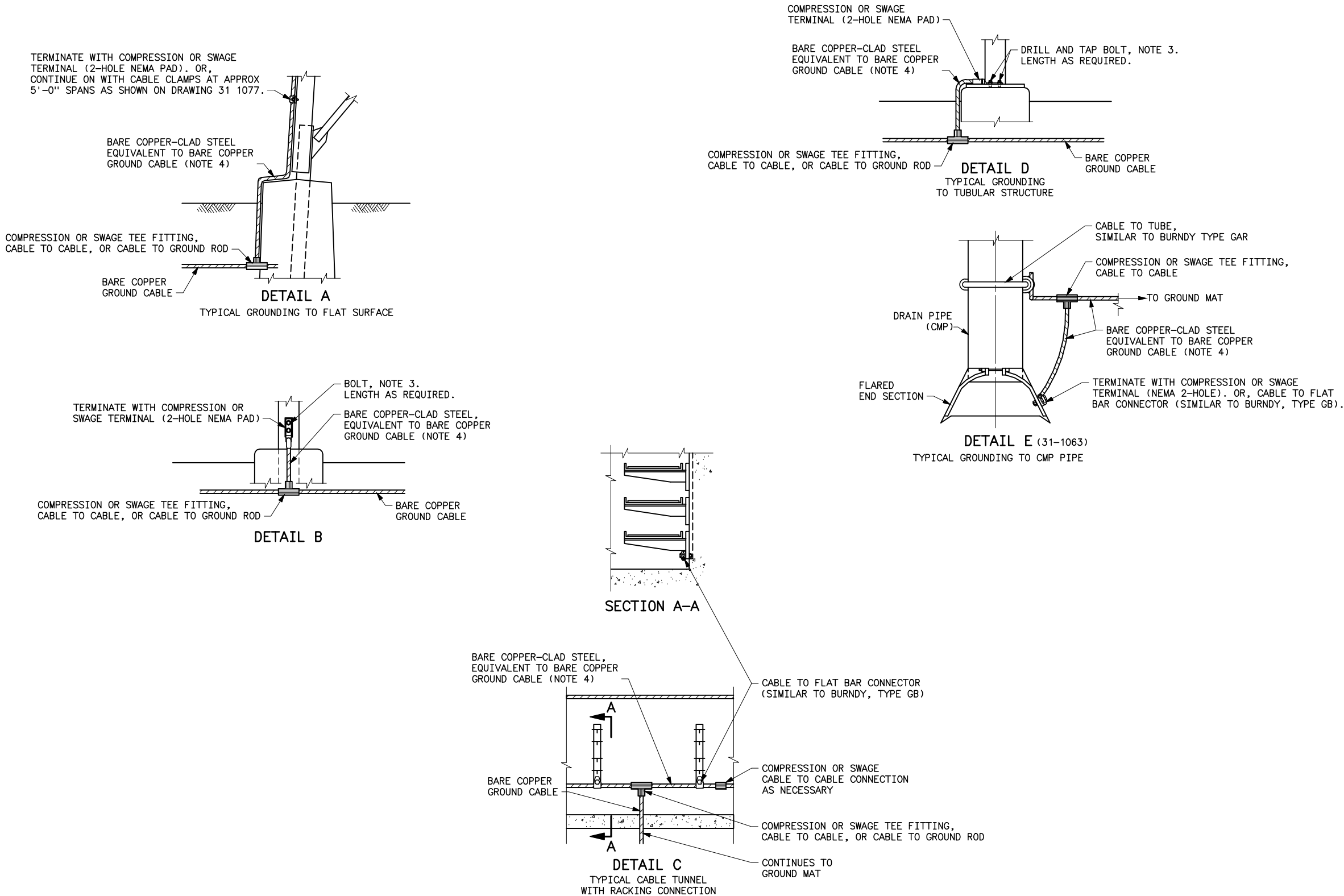
FIGURE 5

REFERENCE DRAWINGS

GROUNDING PLANS-EQUIPMENT GROUNDING -----31 1500
GROUNDING PLANS-TYPICAL DETAILS -----31 1510

D	4-17-26 A7-BL	REVISED GROUND MAT DETAILS. CHANGED WELDED FITTINGS TO COMPRESSION OR SWAGE WHERE APPLICABLE.
C	11-9-11 A7-RMJ	ADDED NOTE 2 AND REVISED REFERENCE DRAWINGS.
B	5-14-99 A3-OP	REDRAWN.
FORMERLY DWG NO. 40-D-4335		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - GOLDEN, COLORADO		
SUBSTATION STANDARDS TYPICAL GROUNDING DETAILS		
DESIGNED BUREC _____ APPROVED ROSS M. CLARK ELECTRICAL ENGINEERING MANAGER		
CA	MAY 18, 1979	31 1059

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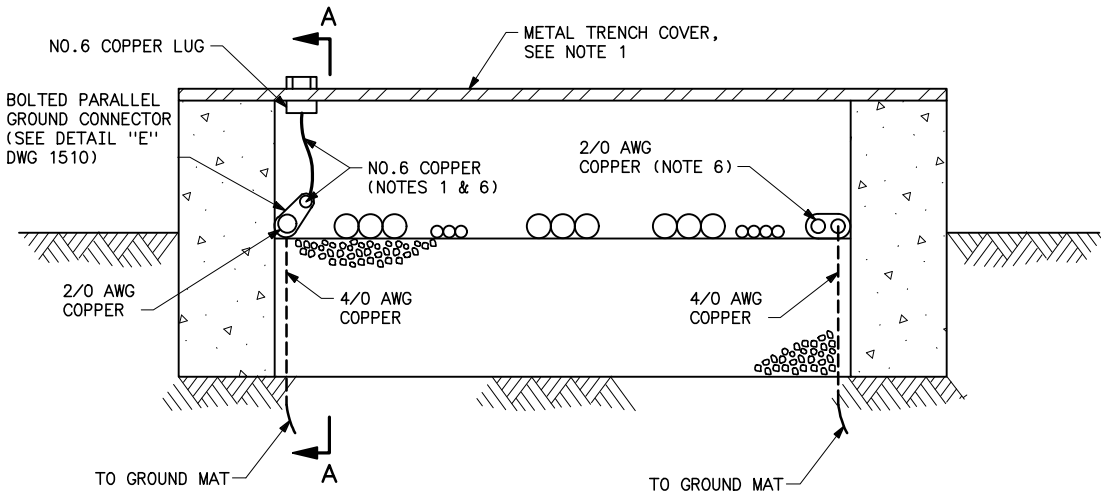
NOTES

1. ALL GROUND CABLES TO BE STUBBED OUT APPROXIMATELY WHERE INDICATED AND OF SUFFICIENT LENGTH TO BOLT TO EQUIPMENT WHEN INSTALLED.
2. ALL PAINT, ENAMEL, AND SCALE SHALL BE REMOVED FROM POINT OF CONTACT ON METAL SURFACES BEFORE APPLYING GROUND CONNECTIONS.
3. ALL BOLTS, MACHINE SCREWS, NUTS AND WASHERS USED IN MAKING GROUNDING CONNECTIONS SHALL BE 1. STAINLESS STEEL. SEE CONSTRUCTION STANDARD 9 FOR DETAILS.
4. GROUND CABLES ABOVE GRADE SHALL BE COPPER-CLAD STEEL (CCS) AND SIZED IN ACCORDANCE WITH CONSTRUCTION STANDARD 9. CCS SIZING VARIES BY MANUFACTURER; FOR EXAMPLE, THE CCS EQUIVALENT OF 4/0 AWG BARE COPPER IS 19-NO. 8 FOR AFL AND 19-NO. 9 FOR COPPERWELD.

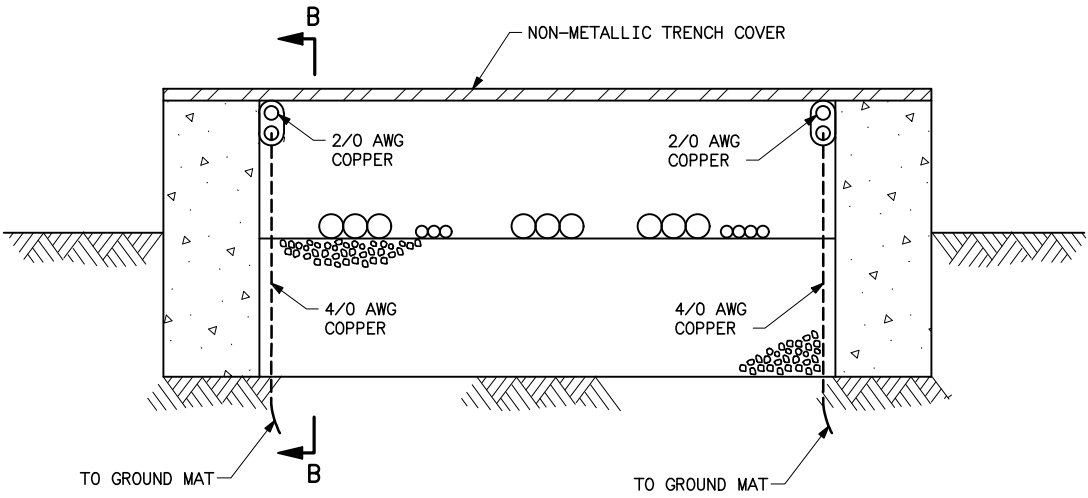
REFERENCE DRAWING

PIPE-BUS GROUNDING PLAN	31 1063
GROUNDING PLANS-EQUIPMENT GROUNDING	31 1500
GROUNDING PLANS-TYPICAL DETAILS	31 1510

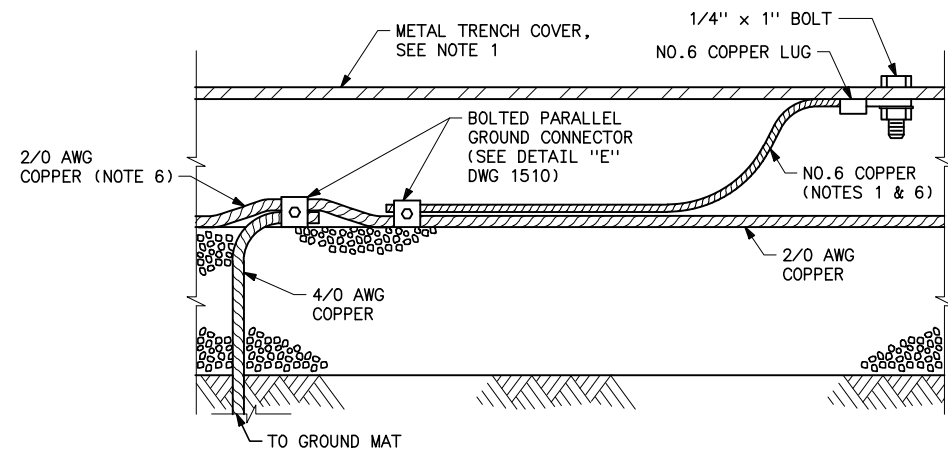
I	4-17-26 A7-BL	CHANGED WELDED CONNECTIONS TO SWAGE OR COMPRESSION.
H	9-27-16 A7-RMJ	REVISED COPPER-CLAD STEEL SIZE.
G	11-9-11 A7-RMJ	DELETED DETAIL I. REVISED REFERENCE MATERIAL. MINOR CORRECTIONS.
F	7-28-09 A7-RC	ADDED COPPERWELD BARE CABLE TO DRAWING
E	7-15-03 A7-RC	REVISED ITEM 4 MATERIALS AND TITLE BLOCK.
D	5-14-99 A3-OP	REDRAWN.
SUPERSEDES DWG NO. 40-D-4753		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS GROUNDING DETAILS		
DESIGNED BUREC _____ APPROVED ROSS M. CLARK ELECTRICAL ENGINEERING MANAGER		
C _{AE}	MAY 18, 1979	31 1060



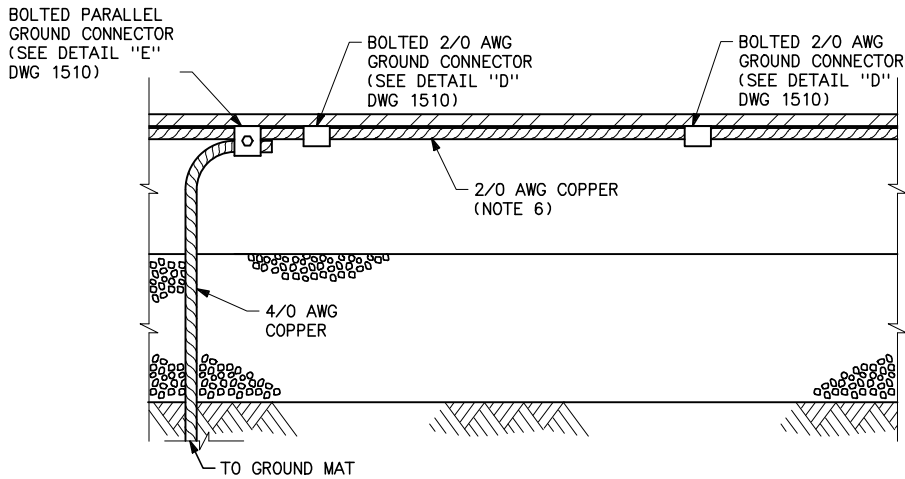
TRENCH WITH METAL COVER



TRENCH WITH NON-METALLIC COVER



SECTION A-A



SECTION B-B

NOTES

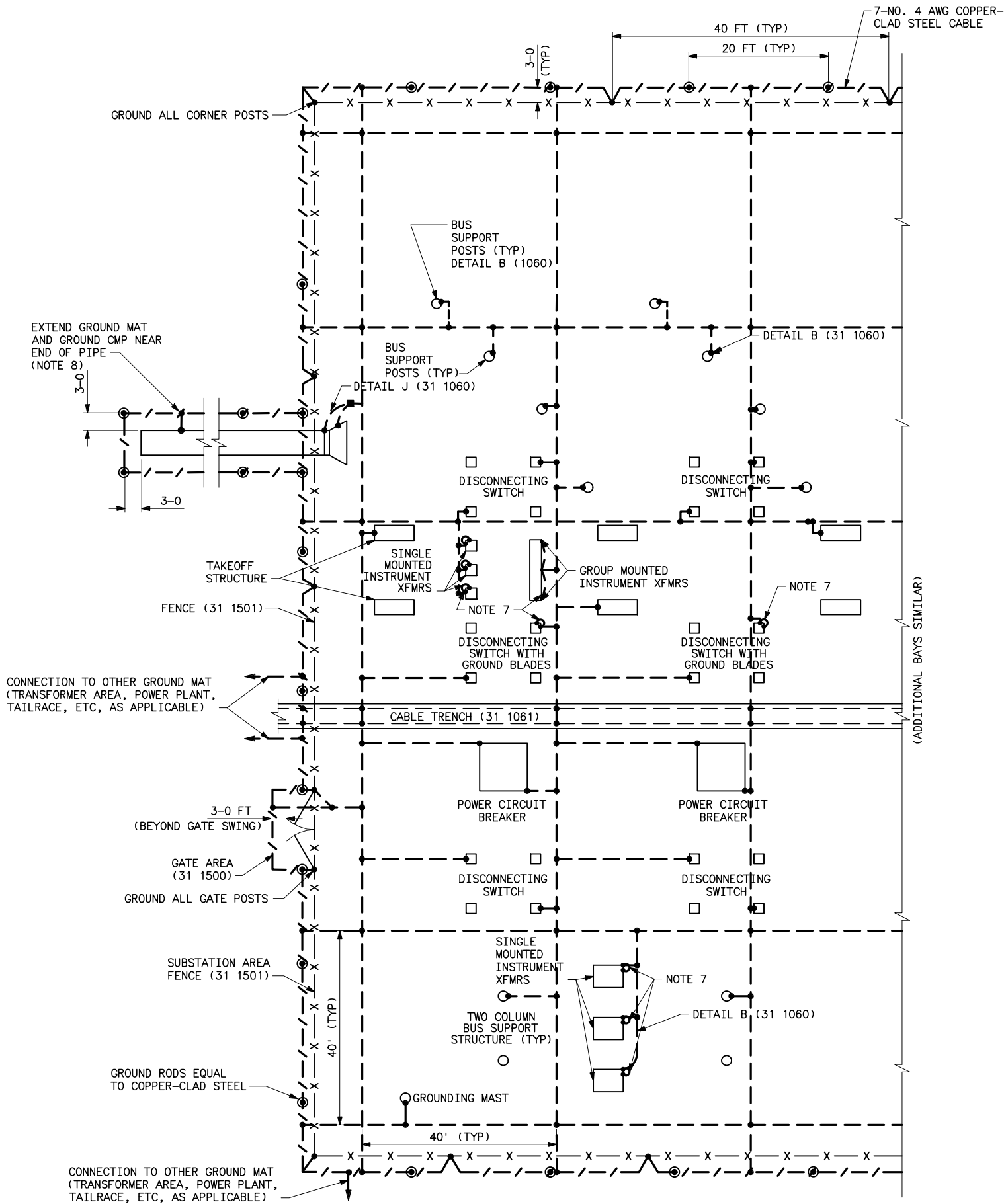
1. INSTALLATION OF THE NO. 6 COPPER GROUND CABLE IS REQUIRED ONLY WHEN TRENCH COVERS ARE MADE OF METAL.
2. THE NO. 6 AWG COPPER GROUND CABLES SHALL BE INSTALLED WITH ENOUGH SLACK TO ALLOW THE TRENCH COVERS TO BE REMOVED AND LIE FLAT WITHOUT INTERFERING WITH THE STEEL OR CONCRETE FOUNDATIONS WHERE POSSIBLE.
3. WHEN TWO OR MORE CABLE TRENCHES ARE LOCATED ADJACENT TO EACH OTHER, EACH TRENCH SHALL BE GROUNDED IN ACCORDANCE WITH THIS DRAWING.
4. CABLE CLIP SUPPORT LOCATED AT APPROXIMATELY 5 FOOT INTERVALS.
5. EACH CABLE TRENCH GROUND CONDUCTOR SHALL BE CONNECTED TO THE GROUND MAT WITH A 4/0 AWG BARE COPPER CABLE AT EVERY LOCATION THAT THE TRENCH CROSSES A BURIED GROUND CONDUCTOR.
6. GROUND CABLE INSIDE TRENCH SHALL BE COPPER-CLAD STEEL (CCS) AND SIZED IN ACCORDANCE WITH CONSTRUCTION STANDARD 9. CABLE SIZES SHOWN ARE FOR BARE COPPER AND SHALL BE USED TO SIZE THE CCS EQUIVALENT. CCS SIZING VARIES BY MANUFACTURER; FOR EXAMPLE, THE CCS EQUIVALENT OF 4/0 AWG BARE COPPER IS 19-NO. 8 FOR AFL AND 19-NO. 9 FOR COPPERWELD.

REFERENCE DRAWING

GROUNDING PLANS-EQUIPMENT GROUNDING-----31 1500
GROUNDING PLANS-TYPICAL DETAILS-----31 1510

G	3-12-26 A7-TC	REVISED MATERIAL CALLOUTS AND NOTES.
F	9-27-16 A7-RMJ	REVISED COPPER-CLAD STEEL SIZE.
E	11-9-11 A7-RMJ	ADDED NOTE 8 AND REFERENCE DRAWING.
D	7-29-09 A7-RC	ADDED COPPERWELD CABLE TO DRAWING.
C	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.
B	5-14-99 A3-OP	REDRAWN AND MINOR REVISIONS
SUPERSEDES DWG NO. 40-D-6182		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS CABLE TRENCH GROUNDING		
DESIGNED BUREC ----- APPROVED ROSS M. CLARK ELECTRICAL ENGINEERING MANAGER		
A	MAY 18, 1979	31 1061

Jul 27, 2026- 11:06am Plotted By: court S:\Projects\MT sc\StandardDrawings\Drawings\DesignReadyForFinal\Scripts\31-1063g.dwg Last Saved By: court IMAGES:



SUBSTATION
(TYPICAL BAYS)

EXPLANATION

- BURIED 7-NO. 4 AWG COPPER-CLAD STEEL CABLE
- BURIED COPPER GROUND CABLE
- GROUND CABLE RISER (NOTE 7)
- ELECTRICAL GROUND CONNECTION (NORMAL)
- GROUND ROD
- FENCE BOND JUMPER
- CMP CORRUGATED METAL PIPE

NOTES

- GROUND MAT AND RISER CABLE SIZES SHALL BE AS SHOWN ON THE PROJECT DRAWINGS.
- TAPS TO EQUIPMENT SHALL BE NOT SMALLER THAN NO. 4 AWG STRANDED COPPER CABLE.
- GROUND CABLES BURIED A MINIMUM DEPTH OF 18 INCHES.
- ALL MISCELLANEOUS METAL STRUCTURES TO BE CONNECTED TO GROUND MAT.
- COPPER GROUND CABLES MUST BE RUN DIRECTLY TO GROUND BLADES OF DISCONNECTING SWITCHES.
- GROUND CONDUCTORS SHALL NOT BE EMBEDDED IN EQUIPMENT AND TOWER FOOTINGS.
- GROUND CABLE RISERS CONNECT TO STRUCTURES AND CONTINUE TO EQUIPMENT TERMINAL BOXES AND GROUNDING TERMINALS OR, WHEN APPLICABLE, TO DISCONNECTING SWITCH GROUNDING BLADES. REFERENCE 31 1510.
- IF SUBSTATION DRAIN PIPE IS NON-METALLIC, EXTENSION OF THE GROUND GRID AND GROUND BONDS ARE NOT REQUIRED.

REFERENCE DRAWINGS

TYPICAL GROUNDING DETAILS (SH 1 OF 2)	31 1058
TYPICAL GROUNDING DETAILS (SH 2 OF 2)	31 1059
GROUNDING DETAILS	31 1060
CABLE TRENCH GROUNDING	31 1061
SWITCH OPERATING PLATFORM	31 1075
GROUND CABLE ON TUBULAR STRUCTURES -	
SUPPORT DETAILS	31 1077
GROUNDING PLANS-TYPICAL COMPONENTS	31 1500
FENCING GROUNDING CONNECTIONS DETAILS	31 1501
GROUNDING PLANS TYPICAL DETAILS	31 1510

H	7-27-26 A7-KB	REVISED FOR STANDARD DWG UPDATES.
G	9-27-16 A7-RMJ	REVISED COPPER-CLAD STEEL SIZE.
F	11-9-11 A7-RMJ	REVISED GROUNDING AND REFERENCE DRAWINGS.
E	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.
D	5-14-99 A3-OP	REDRAWN.

SUPERSEDES DWG NO. 40-D-5141

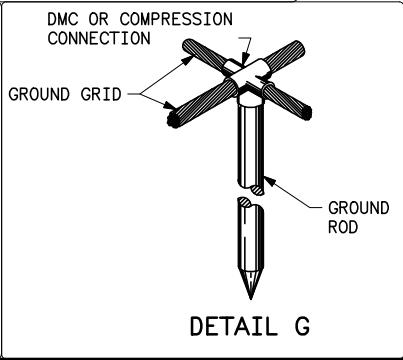
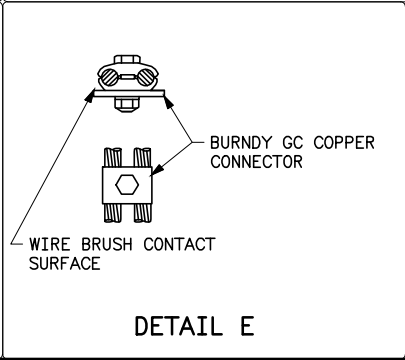
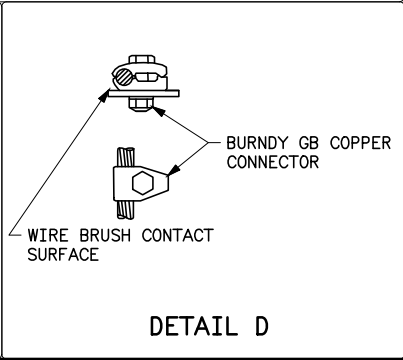
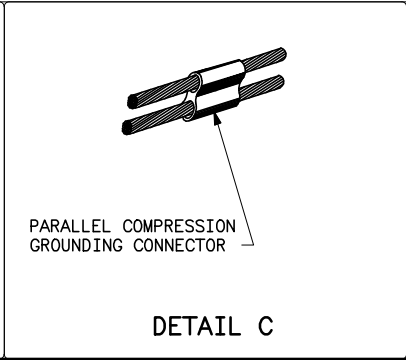
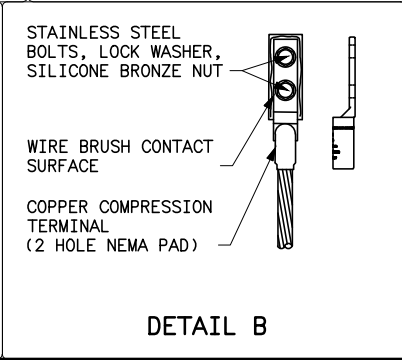
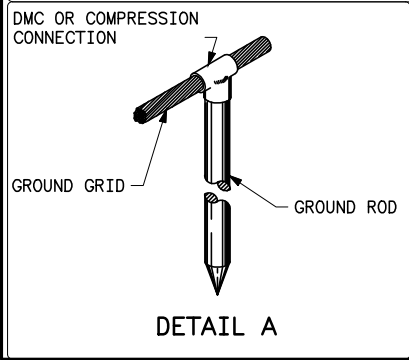
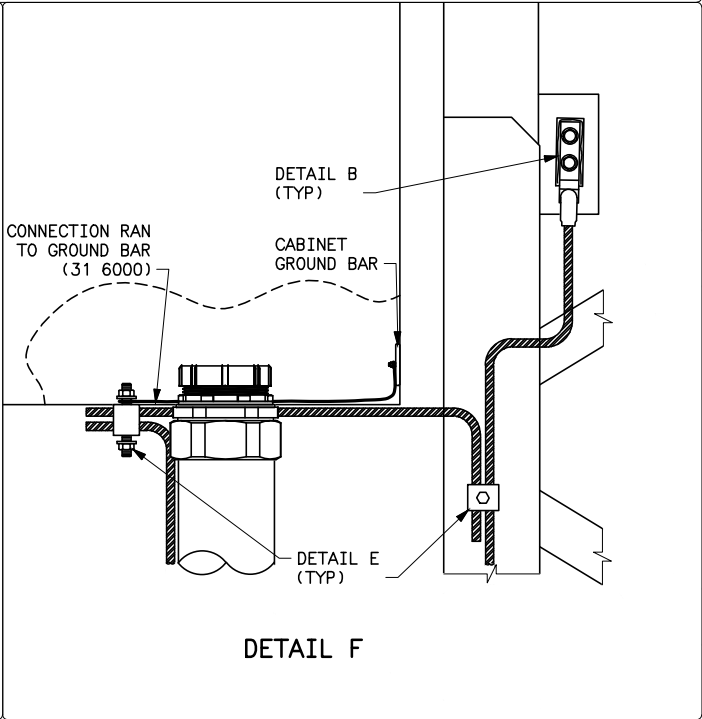
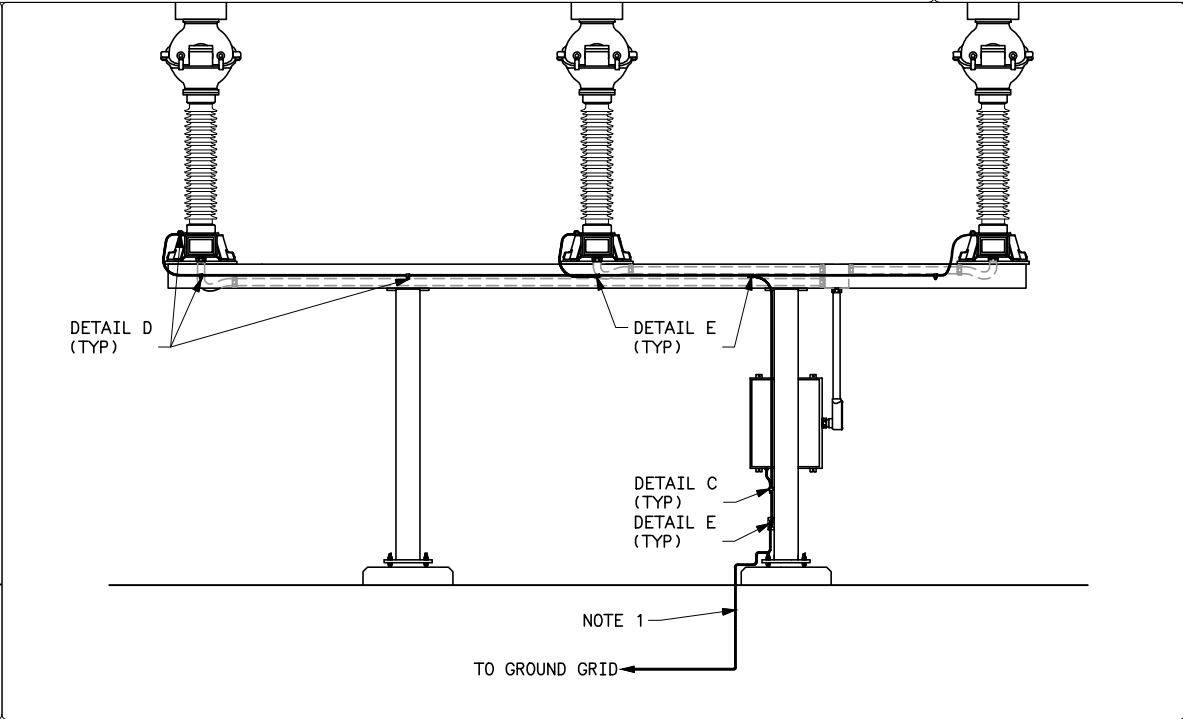
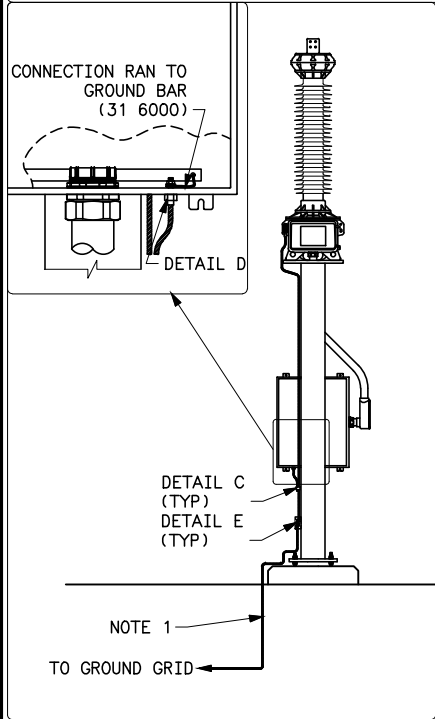
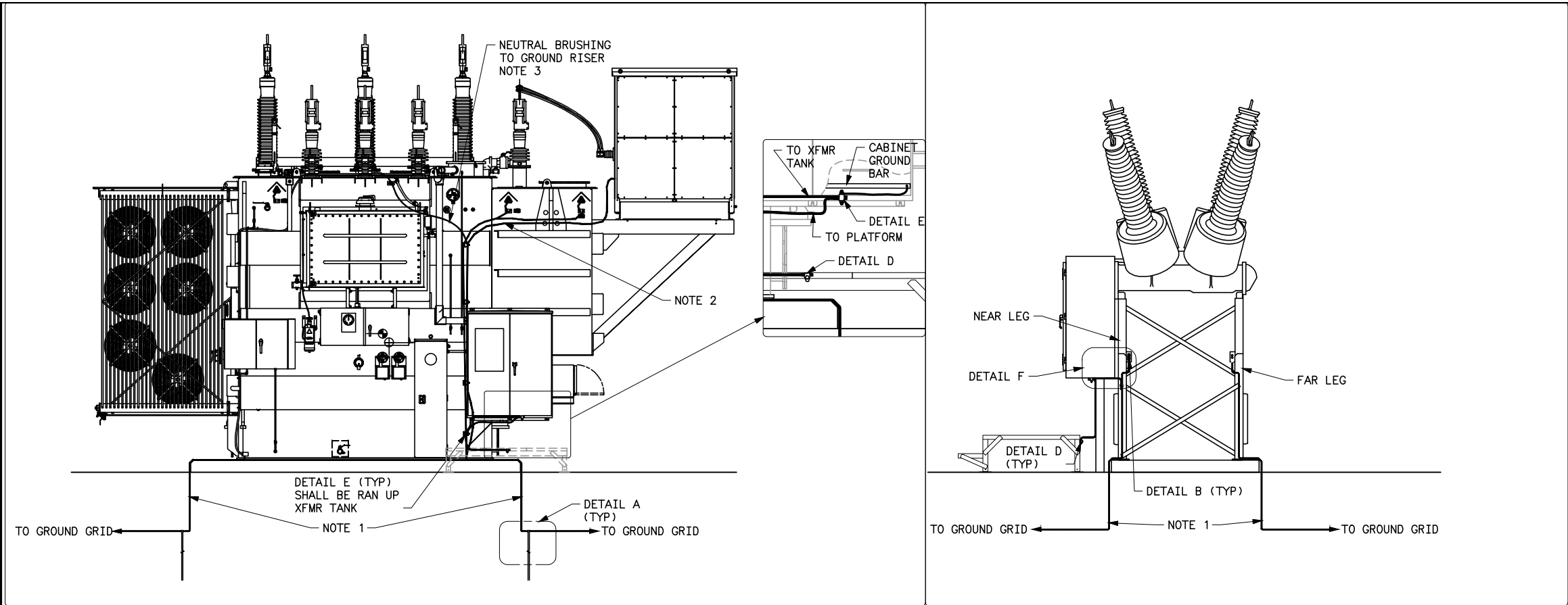
UNITED STATES DEPARTMENT OF ENERGY
WESTERN AREA POWER ADMINISTRATION
CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO

SUBSTATION STANDARDS
PIPE-BUS
GROUNDING PLAN

DESIGNED BUREC _____ APPROVED ROSS M. CLARK
ELECTRICAL ENGINEERING MANAGER

C A E	MAY 18, 1979	31	1063
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Plotted By: court Jul 27, 2026- 11:34am
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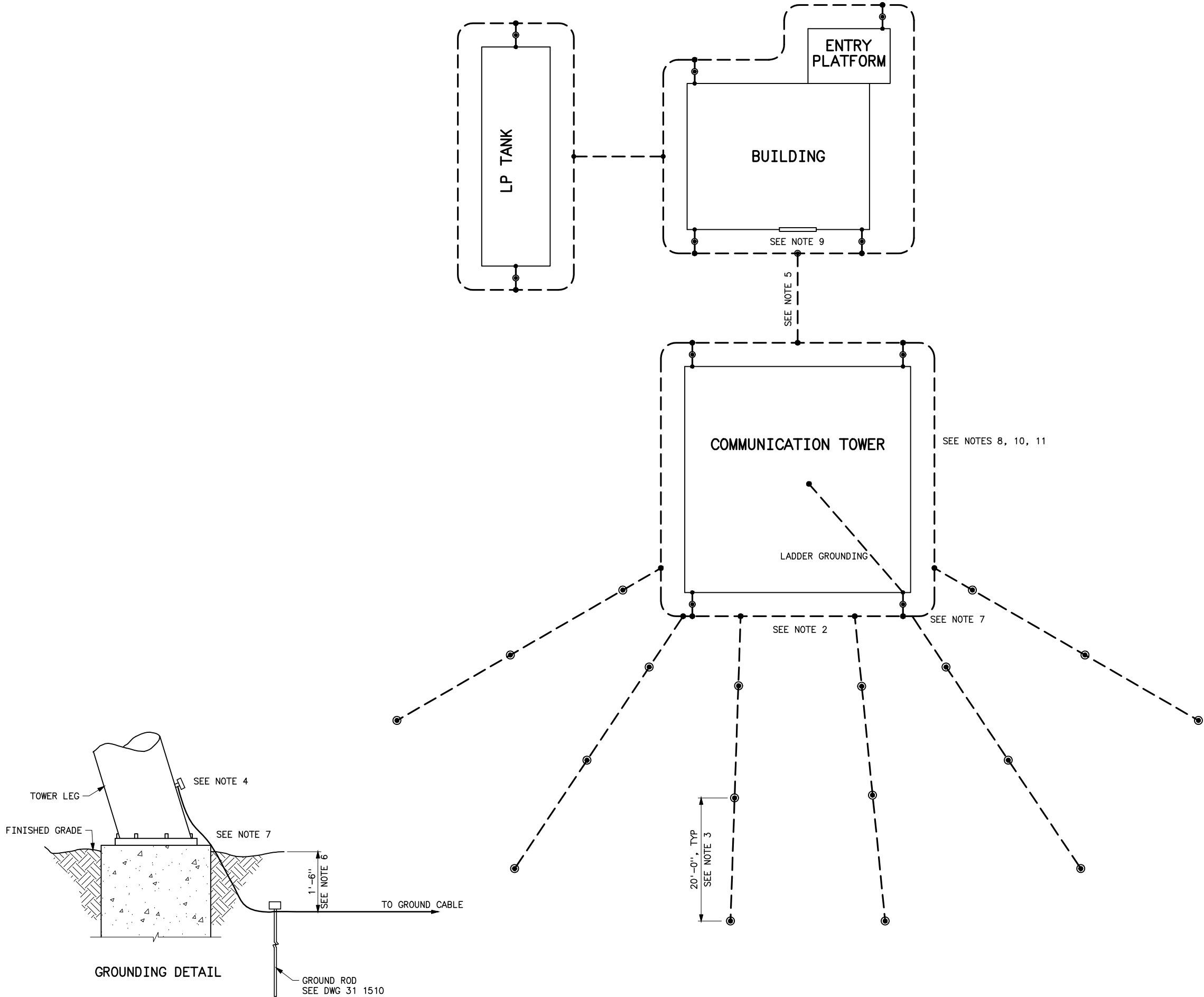
- NOTE**
1. GROUND CABLES ABOVE GRADE SHALL BE COPPER-CLAD STEEL (CCS) AND SIZED IN ACCORDANCE WITH CONSTRUCTION STANDARD 9. CCS SIZING VARIES BY MANUFACTURER; FOR EXAMPLE, THE CCS EQUIVALENT OF 4/0 AWG BARE COPPER IS 19-NO. 8 FOR AFL AND 19-NO.9 FOR COPPERWELD.
 2. POWER TRANSFORMER SHALL HAVE GROUND RISER TIED TO TANK GROUNDING.
 3. NEUTRAL SHALL BE BONDED AT SINGLE POINT TO GROUND RISER WITH JACKETED CABLE; PER MANUFACTURE REQUIREMENTS.

REFERENCE DRAWINGS

GROUNDING PLANS EQUIPMENT GROUNDING	31 1500
EQUIPMENT CABINET SHIELDED CABLE GROUNDING	31 6000

UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS GROUNDING PLANS		
TYPICAL DETAILS		
DESIGNED KENNETH BARNISH	APPROVED KYLE VAUGHN ELECTRICAL ENGINEERING MANAGER	
APRIL 17, 2026	31	1510

Plotted By: KBarnish Mar 13, 2026 8:52am
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NOTES

1. THIS DRAWING SHOWS TYPICAL ELEMENTS AND ATTACHMENT LOCATIONS TO COMPLETE THE GROUNDING SYSTEM FOR A COMMUNICATION SITE.
2. SIX 45-FOOT GROUNDING RADIALS SHALL BE CONNECTED TO THE TOWER GROUNDING RING. THE RADIALS SHALL BE DIRECTED AWAY FROM THE TOWER AT EVEN INTERVALS.
3. THE 10-FOOT GROUND RODS SHALL BE SPACED 20 FEET APART ALONG EVERY RADIAL.
4. ALL ELECTRICAL CONNECTIONS SHALL BE COMPRESSION OR SWAGE TYPE. SEE CONSTRUCTION STANDARD 9 FOR DETAILS.
5. 30-FOOT SPACING BETWEEN THE BUILDING AND THE MICROWAVE TOWER IS RECOMMENDED. IF THIS SPACING IS GREATER THAN 30-FEET, INSTALL A GROUND ROD IN THE MIDDLE OF THIS GROUNDING CONDUCTOR SECTION.
6. GROUNDING RINGS AND RADIALS SHALL BE BURIED 18-INCHES BELOW THE SURFACE OF THE GROUND.
7. ALWAYS MAINTAIN A MINIMUM BEND RADIUS OF 8-INCHES FOR ALL GROUND WIRES AND CONNECTIONS.
8. GROUNDING RING AROUND THE MICROWAVE TOWER SHALL HAVE A MINIMUM DIAMETER OF 10-FEET.
9. INSTALL A GROUND ROD BELOW WAVEGUIDE ENTRY PANEL OUTSIDE OF THE EQUIPMENT BUILDING.
10. GROUNDING RING AROUND MONOPOLES SHALL HAVE A MINIMUM OF FOUR GROUND RODS.
11. GROUNDING RINGS AND RODS SHALL BE INSTALLED A MINIMUM OF TWO FEET OUTSIDE OF TOWER FOUNDATIONS.
12. FENCE GROUNDS ARE NOT REQUIRED UNLESS IN THE VICINITY OF HIGH VOLTAGE POWER LINES. FENCE GROUNDS SHALL NOT BE BONDED TO THE BUILDING GROUND RING. SEE STANDARD DRAWING 31-1060.
13. FOR SITES WITH GEOLOGY CONSISTING OF ROCK OR LARGELY ROCK, TOWER GROUNDING RADIALS SHALL BE BURIED IN CONDUCTIVE CONCRETE.

LEGEND

- ---5/8"x10'-0" GROUND ROD
- NO. 4/0 AWG STRANDED BARE COPPER GROUND CABLE
- ---ELECTRICAL CONNECTION TO THE GROUND WIRE

REFERENCE DRAWINGS

SUBSTATION STANDARDS-GROUNDING DETAILS	31	1060
MICROWAVE TOWER GROUNDING	31	1503
GROUNDING-SUBSTATION DETAILS	31	1504
GROUNDING-REMOTE DETAILS	31	1505
GROUNDING PLANS TYPICAL DETAILS	31	1510

SUPERSEDES DWG NO. 41 7000A		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
COMMUNICATIONS STANDARD COMMUNICATION SITE GROUNDING TYPICAL PLAN		
DESIGNED SCOTT JOHNSON APPROVED DAN HAMAI SYSTEM CONTROL MANAGER		
DATE	OCTOBER 25, 2016	31 1502-1

NOTES

- 1. THIS DRAWING SHOWS TYPICAL ELEMENTS AND ATTACHMENT LOCATIONS TO COMPLETE THE GROUNDING SYSTEM FOR A SUBSTATION SITE.
- 2. ALL ELECTRICAL CONNECTIONS SHALL BE MADE USING SWAGE, CRIMP, OR EQUIVALENT PROCESS AS SHOWN ON DRAWING 31 1060.
- 3. INSTALL A GROUND ROD BELOW WAVEGUIDE ENTRY PANEL OUTSIDE OF THE EQUIPMENT BUILDING.
- 4. MICROWAVE TOWER LEGS SHALL BOND TO SEPARATE POINTS OF THE SUBSTATION GROUND GRID.
- 5. WAVEGUIDE SHALL BE GROUNDED AND BONDED TO SUBSTATION GROUND GRID.
- 6. FOR BUILDING RELATED GROUNDING REFERENCE STANDARD DRAWING 31 1504.
- 7. GROUND MUST BE BONDED TO COMMUNICATION TOWER LADDER AND KEPT EQUIPOTENTIAL TO THE TOWER STRUCTURE.

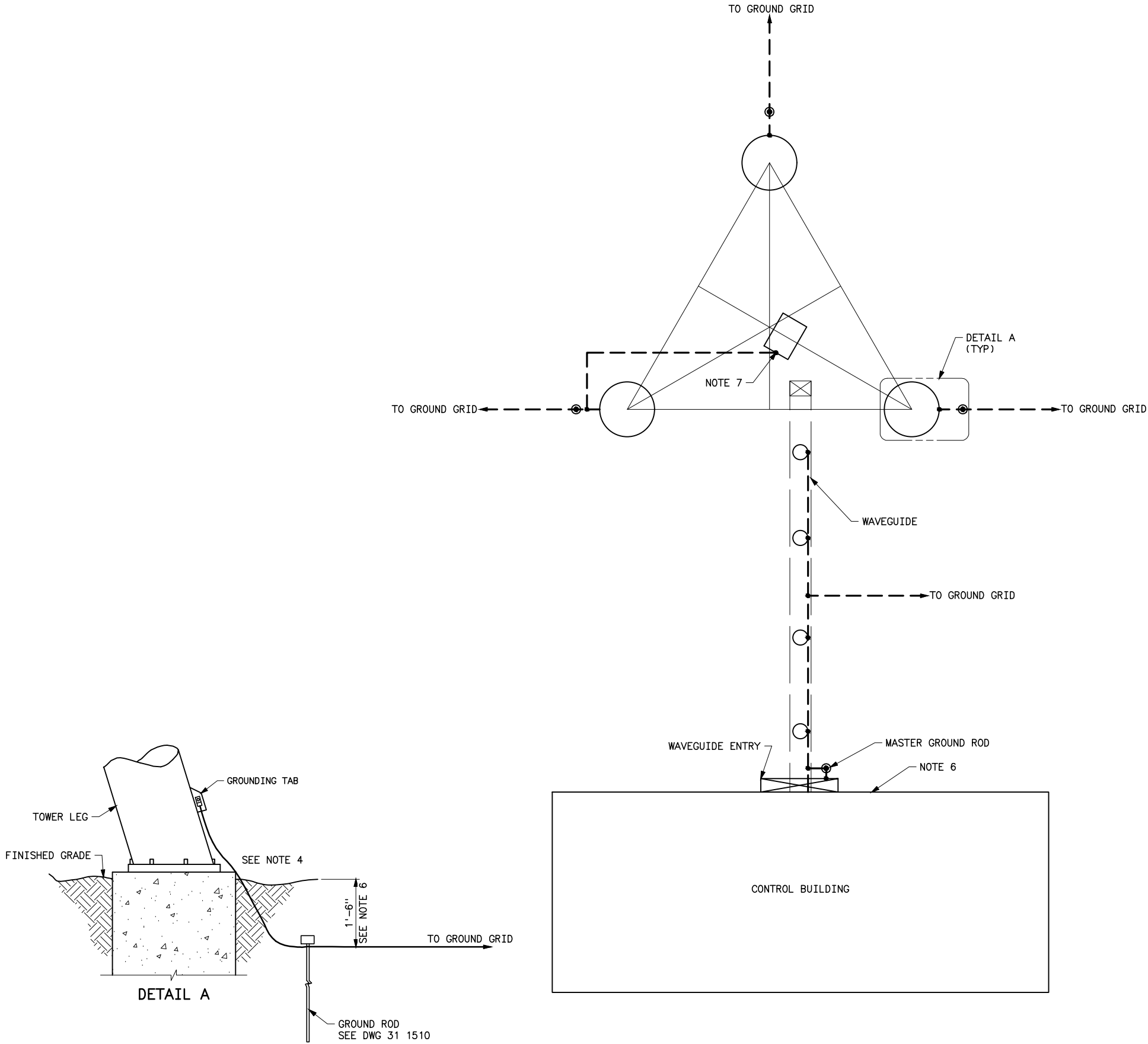
LEGEND

- ⊙ --- 5/8"x10'-0" GROUND ROD
- NO. 4/0 AWG STRANDED BARE COPPER GROUND CABLE
- --- ELECTRICAL CONNECTION TO THE GROUND WIRE

REFERENCE DRAWINGS

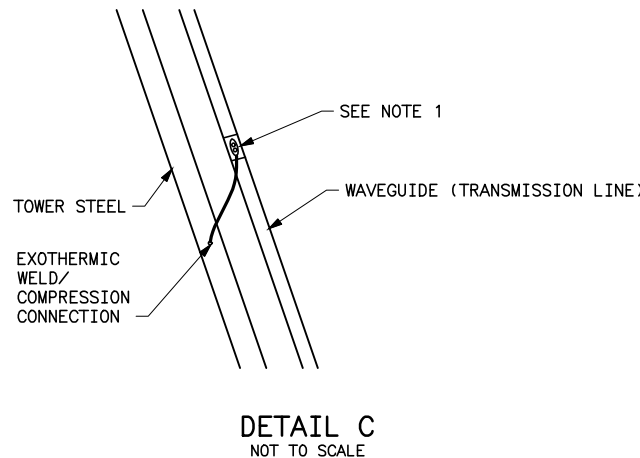
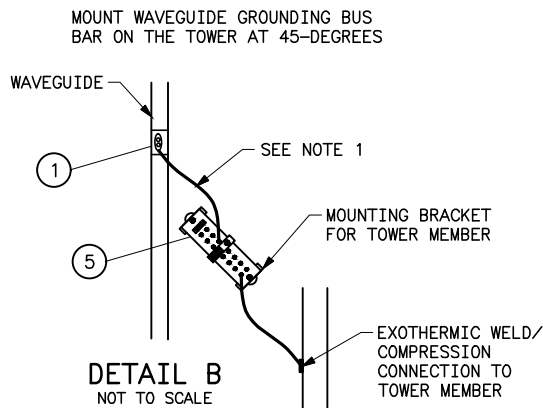
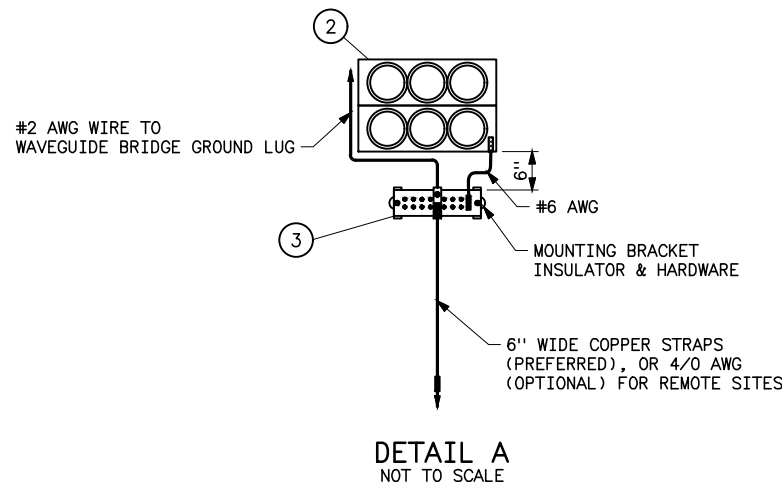
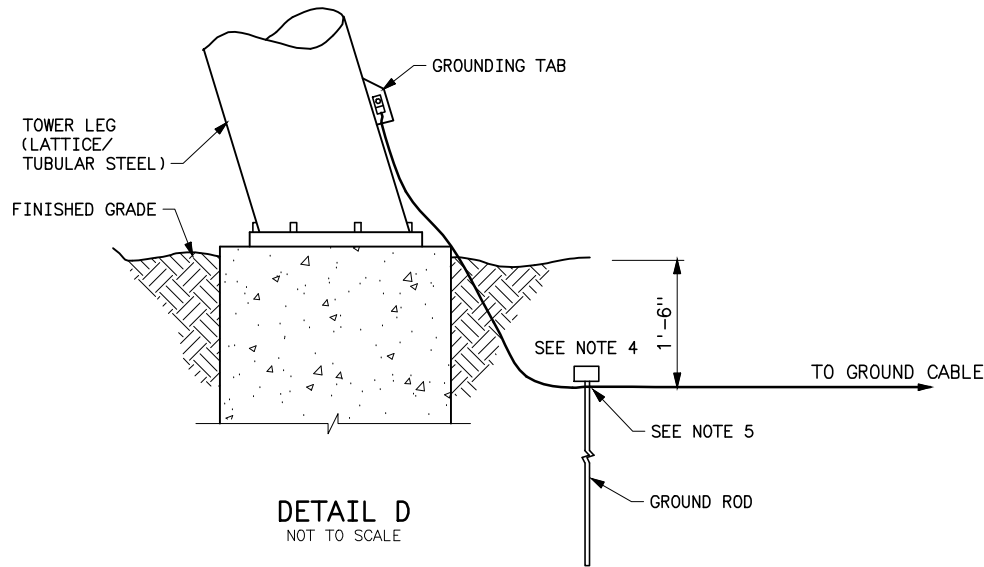
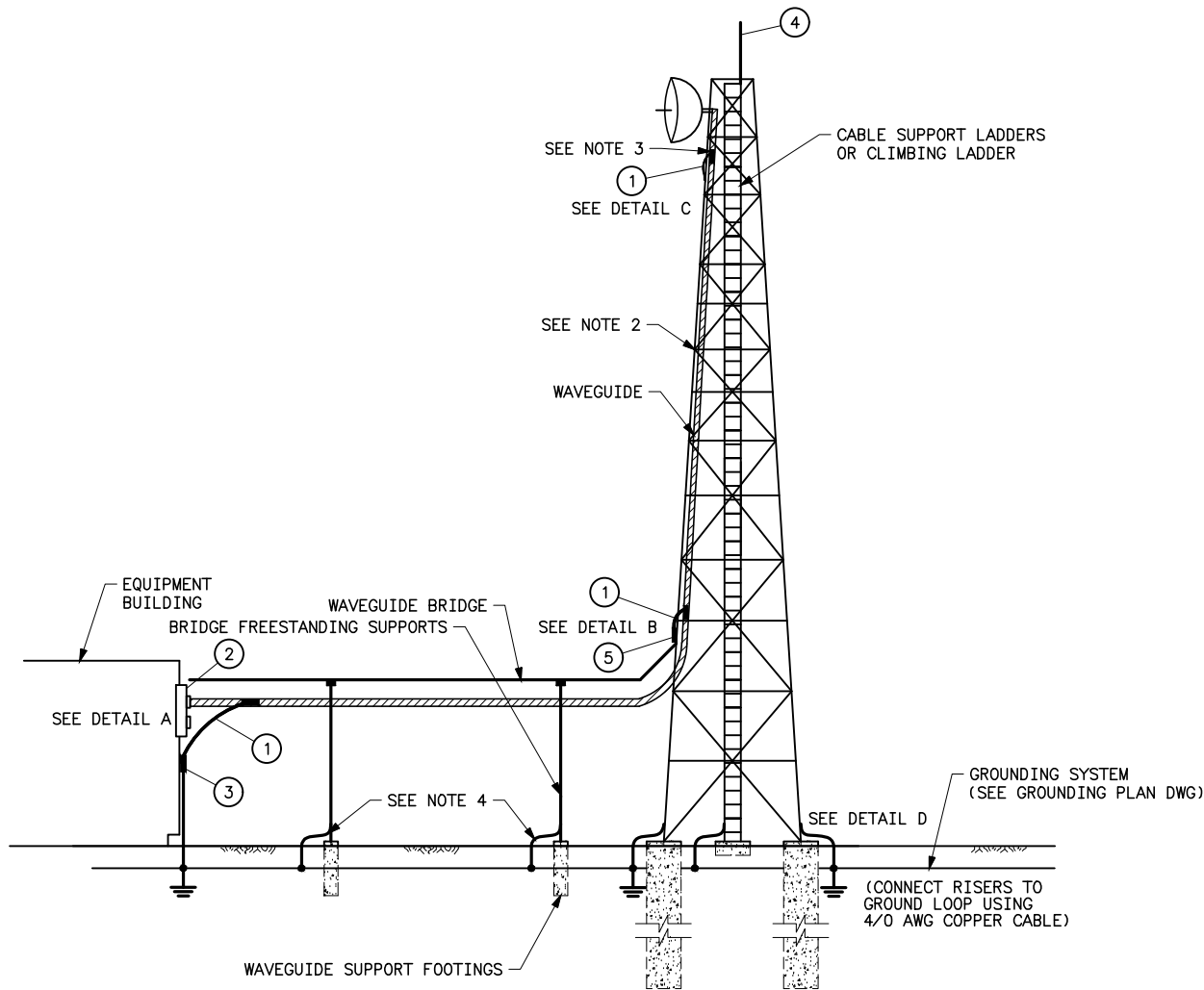
SUBSTATION STANDARDS-GROUNDING DETAILS	31 1060
MICROWAVE TOWER GROUNDING	31 1503
GROUNDING-SUBSTATION DETAILS	31 1504
GROUNDING-REMOTE DETAILS	31 1505
GROUNDING PLANS TYPICAL DETAILS	31 1510

Plotted By: KBarnish Mar 13, 2026 9:10am
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UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO			
STANDARD COMMUNICATIONS COMMUNICATION TOWER GROUNDING DETAILS FOR SUBSTATION LOCATED TOWERS			
DESIGNED KENNETH BARNISH		APPROVED KYLE VAUGHN ELECTRICAL ENGINEERING MANAGER	
March 13, 2026	31	1502-2	

REFERENCE MATERIALS	
ITEM NO.	DESCRIPTION
1	WAVEGUIDE GROUNDING KIT
2	WAVEGUIDE ENTRY PANEL
3	COPPER GROUND BAR WITH INSULATED WALL MOUNT
4	LIGHTNING ROD WITH TOWER BONDING KIT
5	COPPER GROUND BAR WITH TOWER MOUNTING BRACKET



NOTES

- GROUNDING KITS SHALL BE INSTALLED IN A DOWNWARD DIRECTION TOWARD THE EARTH.
- WAVEGUIDE SHALL BE GROUNDED EVERY 75-FOOT DOWN THE TOWER IN ADDITION TO THE LOCATIONS SHOWN ON THE DRAWING.
- LOCATE ONE WAVEGUIDE GROUND WITHIN 18-INCHES OF THE VERTICAL TRANSITION FROM THE ANTENNA.
- ALL GROUNDING CONDUCTORS SHALL MAINTAIN AN 8-INCH MINIMUM BEND RADIUS.
- ALL ELECTRICAL CONNECTIONS TO THE GROUND RODS, GROUNDING RING, AND TOWER STEEL SHALL BE MADE USING EXOTHERMIC WELD OR APPROVED COMPRESSION FITTING EQUIVALENT.

REFERENCE DRAWINGS

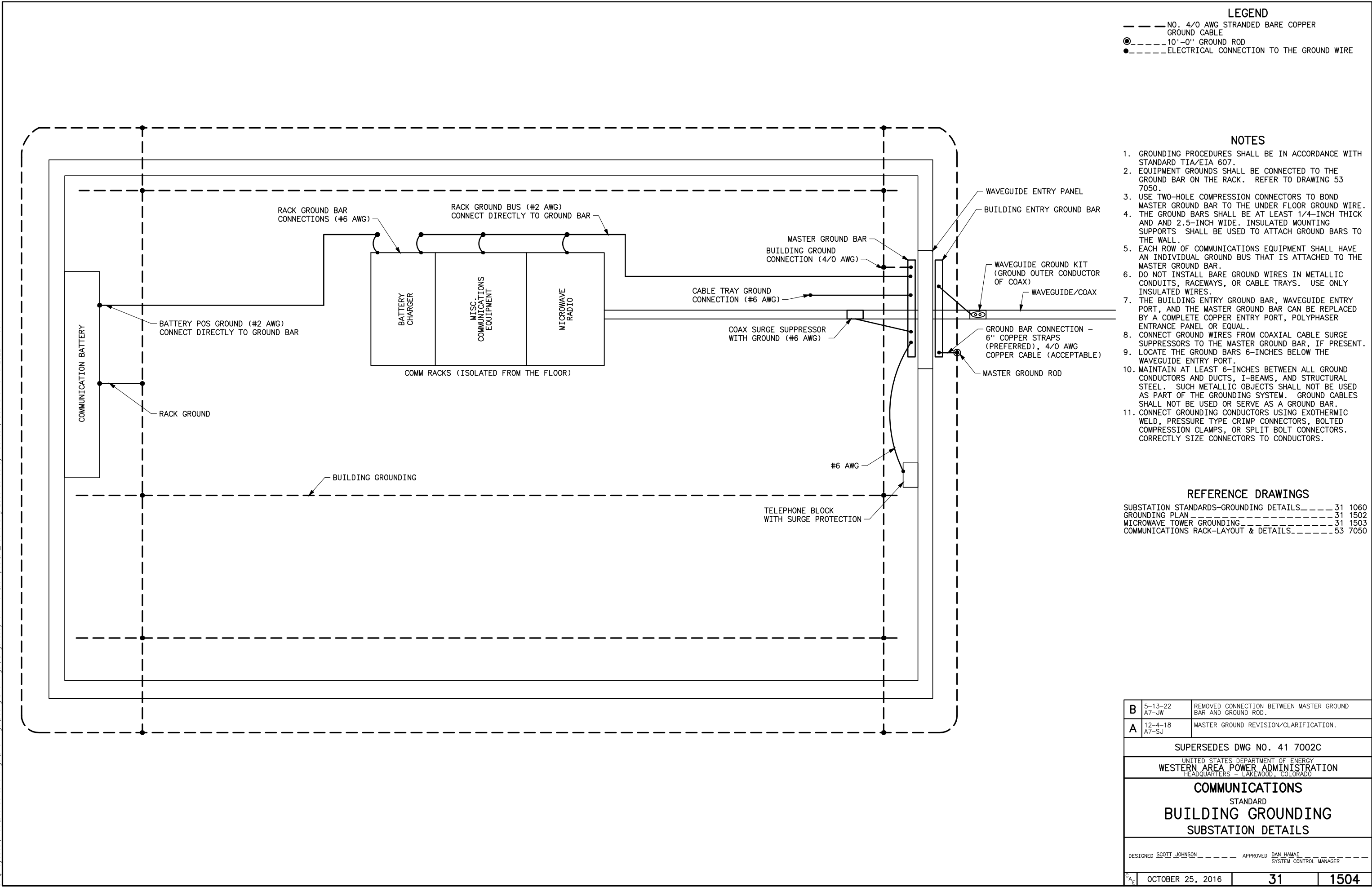
SUBSTATION STANDARDS-GROUNDING DETAILS	31	1060
GROUNDING PLAN	31	1502
GROUNDING-SUBSTATION DETAILS	31	1504
GROUNDING-REMOTE SITE DETAILS	31	1505

A	7-31-26 A7-SJ	MINOR REVISIONS.	
	SUPERSEDES DWG NO. 41 7001B		
	UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
	COMMUNICATIONS STANDARD COMMUNICATION TOWER GROUNDING DETAILS		
DESIGNED <u>SCOTT JOHNSON</u> _ _ _ _ _		APPROVED <u>DAN HAMAI</u> SYSTEM CONTROL MANAGER _ _ _ _ _	
C _A E	OCTOBER 25, 2016	31	1503

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LEGEND

- NO. 4/0 AWG STRANDED BARE COPPER
- GROUND CABLE
- 10'-0" GROUND ROD
- ELECTRICAL CONNECTION TO THE GROUND WIRE

NOTES

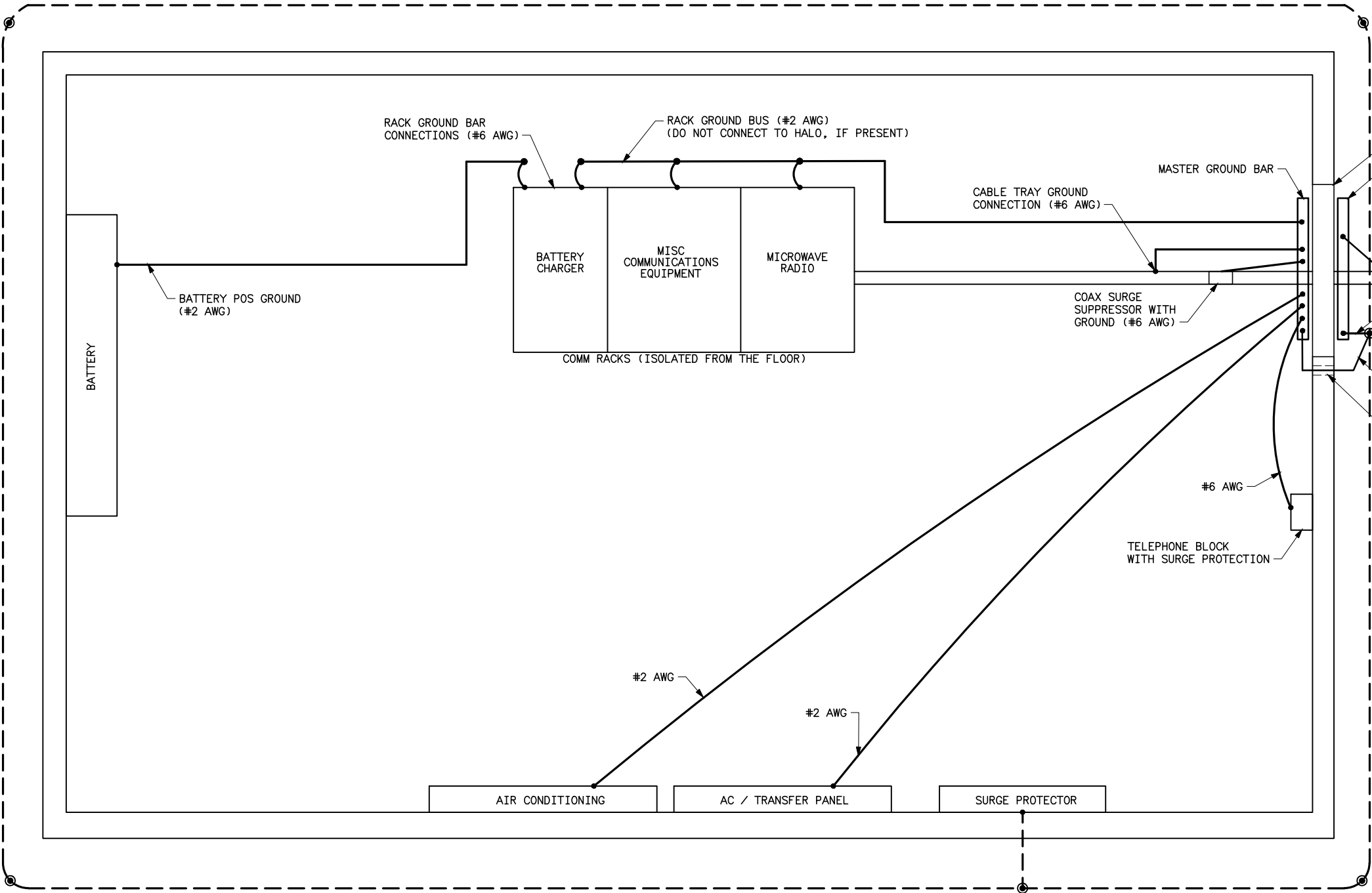
- GROUNDING PROCEDURES SHALL BE IN ACCORDANCE WITH STANDARD TIA/EIA 607.
- EQUIPMENT GROUNDS SHALL BE CONNECTED TO THE GROUND BAR ON THE RACK. REFER TO DRAWING 53 7050.
- USE TWO-HOLE COMPRESSION CONNECTORS TO BOND MASTER GROUND BAR TO THE UNDER FLOOR GROUND WIRE.
- THE GROUND BARS SHALL BE AT LEAST 1/4-INCH THICK AND 2.5-INCH WIDE. INSULATED MOUNTING SUPPORTS SHALL BE USED TO ATTACH GROUND BARS TO THE WALL.
- EACH ROW OF COMMUNICATIONS EQUIPMENT SHALL HAVE AN INDIVIDUAL GROUND BUS THAT IS ATTACHED TO THE MASTER GROUND BAR.
- DO NOT INSTALL BARE GROUND WIRES IN METALLIC CONDUITS, RACEWAYS, OR CABLE TRAYS. USE ONLY INSULATED WIRES.
- THE BUILDING ENTRY GROUND BAR, WAVEGUIDE ENTRY PORT, AND THE MASTER GROUND BAR CAN BE REPLACED BY A COMPLETE COPPER ENTRY PORT, POLYPHASER ENTRANCE PANEL OR EQUAL.
- CONNECT GROUND WIRES FROM COAXIAL CABLE SURGE SUPPRESSORS TO THE MASTER GROUND BAR, IF PRESENT.
- LOCATE THE GROUND BARS 6-INCHES BELOW THE WAVEGUIDE ENTRY PORT.
- MAINTAIN AT LEAST 6-INCHES BETWEEN ALL GROUND CONDUCTORS AND DUCTS, I-BEAMS, AND STRUCTURAL STEEL. SUCH METALLIC OBJECTS SHALL NOT BE USED AS PART OF THE GROUNDING SYSTEM. GROUND CABLES SHALL NOT BE USED OR SERVE AS A GROUND BAR.
- CONNECT GROUNDING CONDUCTORS USING EXOTHERMIC WELD, PRESSURE TYPE CRIMP CONNECTORS, BOLTED COMPRESSION CLAMPS, OR SPLIT BOLT CONNECTORS. CORRECTLY SIZE CONNECTORS TO CONDUCTORS.

REFERENCE DRAWINGS

SUBSTATION STANDARDS-GROUNDING DETAILS	31	1060
GROUNDING PLAN	31	1502
MICROWAVE TOWER GROUNDING	31	1503
COMMUNICATIONS RACK-LAYOUT & DETAILS	53	7050

B	5-13-22 A7-JW	REMOVED CONNECTION BETWEEN MASTER GROUND BAR AND GROUND ROD.
	12-4-18 A7-SJ	MASTER GROUND REVISION/CLARIFICATION.
SUPERSEDES DWG NO. 41 7002C		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
COMMUNICATIONS STANDARD BUILDING GROUNDING SUBSTATION DETAILS		
DESIGNED SCOTT JOHNSON APPROVED DAN HAMAI SYSTEM CONTROL MANAGER		
DATE	OCTOBER 25, 2016	31 1504

Plotted By: denton Dec 04, 2018- 12:42pm
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LEGEND

- 10'-0" GROUND ROD
- NO. 4/0 AWG STRANDED BARE COPPER GROUND CABLE
- ELECTRICAL CONNECTION TO THE GROUND WIRE

NOTES

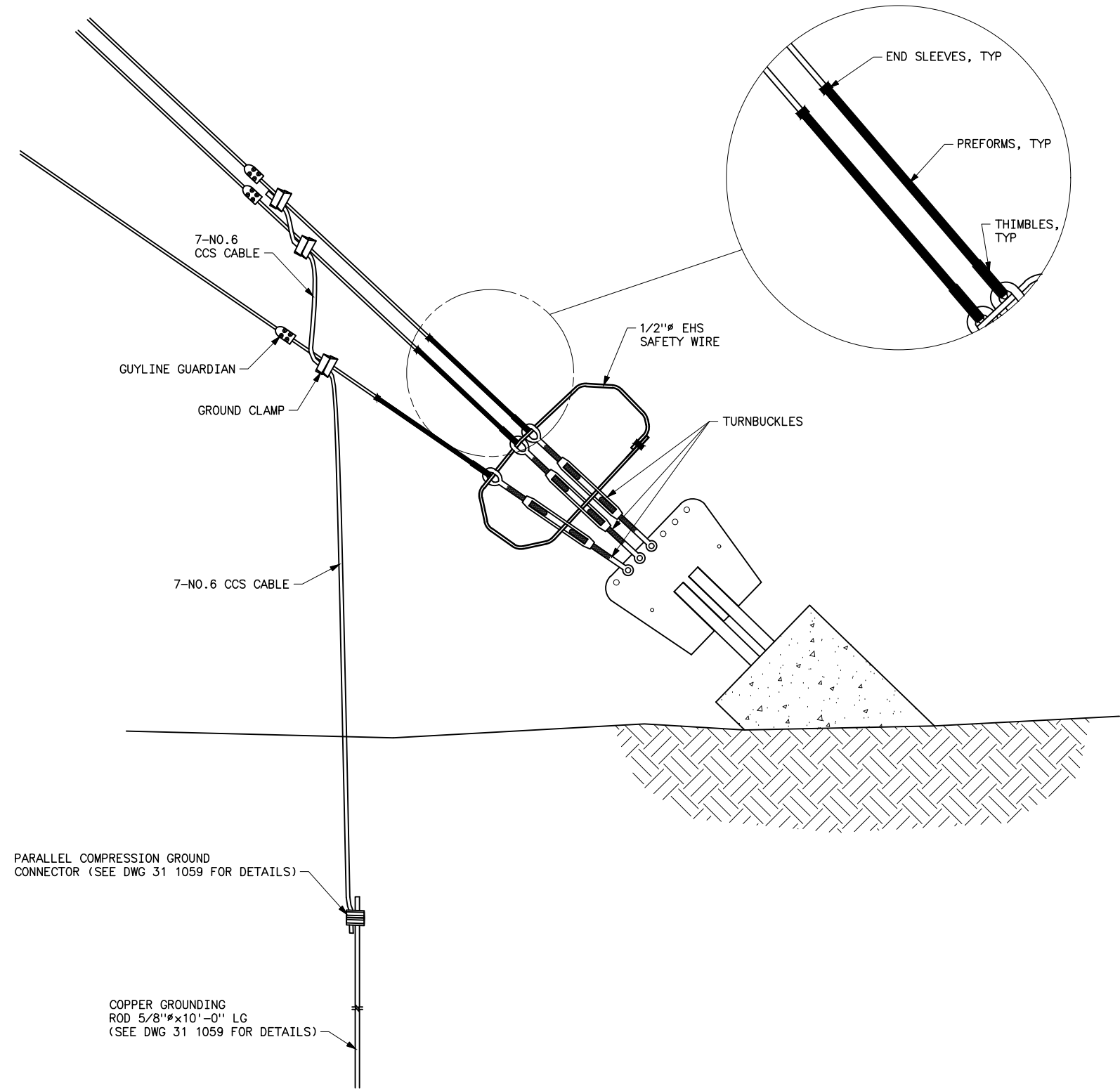
- GROUNDING PROCEDURES SHALL BE IN ACCORDANCE WITH STANDARD TIA/EIA 607.
- EQUIPMENT GROUNDS SHALL BE CONNECTED TO THE GROUND BAR ON THE RACK. REFER TO DRAWING 53 7050.
- THE GROUND BARS SHALL BE AT LEAST 1/4 INCH THICK AND 2.5-INCH WIDE. INSULATED MOUNTING SUPPORTS SHALL BE USED TO ATTACH GROUND BARS TO THE WALL.
- EACH ROW OF COMMUNICATIONS EQUIPMENT SHALL HAVE AN INDIVIDUAL GROUND BUS THAT IS ATTACHED TO THE MASTER GROUND BAR.
- DO NOT INSTALL BARE GROUND WIRES IN METALLIC CONDUITS, RACEWAYS, OR CABLE TRAYS. USE ONLY INSULATED WIRES.
- THE BUILDING ENTRY GROUND BAR, WAVEGUIDE ENTRY PORT, AND THE MASTER GROUND BAR CAN BE REPLACED BY A COMPLETE COPPER ENTRY PORT, POLYPHASER ENTRANCE PANEL OR EQUAL.
- CONNECT GROUND WIRES FROM COAXIAL CABLE SURGE SUPPRESSORS TO THE MASTER GROUND BAR IF PRESENT.
- LOCATE THE GROUND BARS 6-INCHES BELOW THE WAVEGUIDE ENTRY PORT.
- MAINTAIN AT LEAST 6-INCHES BETWEEN ALL GROUND CONDUCTORS AND DUCTS, I-BEAMS, AND STRUCTURAL STEEL. SUCH METALLIC OBJECTS SHALL NOT BE USED AS PART OF THE GROUNDING SYSTEM. GROUND CABLES SHALL NOT BE USED OR SERVE AS A GROUND BAR.
- CONNECT DOORS, DOORFRAMES, LOUVERS, ELECTRICAL PANELS, HVAC EQUIPMENT, TRANSFER SWITCHES, CONDUIT, CABLE TRAYS, AND BATTERY RACKS TO MASTER GROUND BAR OR CHASSIS/FRAME GROUND BAR THAT IS CONNECTED TO THE MASTER GROUND BAR.
- ENSURE THAT DISSIMILAR METALS ARE NOT CONNECTED TOGETHER WITHOUT USING LUGS OR SPLIT BOLTS DESIGNATED FOR THIS PURPOSE.
- CONNECT GROUNDING CONDUCTORS USING EXOTHERMIC WELD, PRESSURE TYPE CRIMP CONNECTORS, BOLTED COMPRESSION CLAMPS, OR SPLIT BOLT CONNECTORS. CORRECTLY SIZE CONNECTORS TO CONDUCTORS.
- IF A HALO GROUNDING SYSTEM IS PRESENT IN EXISTING BUILDINGS, IT SHOULD NOT BE DIRECTLY CONNECTED TO THE MASTER GROUND BAR OR BE USED WITH ANY EQUIPMENT.

REFERENCE DRAWINGS

SUBSTATION STANDARDS-GROUNDING DETAILS	31 1060
GROUNDING PLAN	31 1502
MICROWAVE TOWER GROUNDING	31 1503
COMMUNICATIONS RACK-LAYOUT & DETAILS	53 7050

A	12-4-18 A7-SJ	MASTER GROUND REVISION/CLARIFICATION.	
	SUPERSEDES DWG NO. 41 7003B		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO			
COMMUNICATIONS STANDARD BUILDING GROUNDING REMOTE SITE DETAILS			
DESIGNED <u>SCOTT JOHNSON</u> ----- APPROVED <u>DAN HAMAI</u> ----- SYSTEM CONTROL MANAGER			
C A E	OCTOBER 25, 2016	31	1505

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NOTES

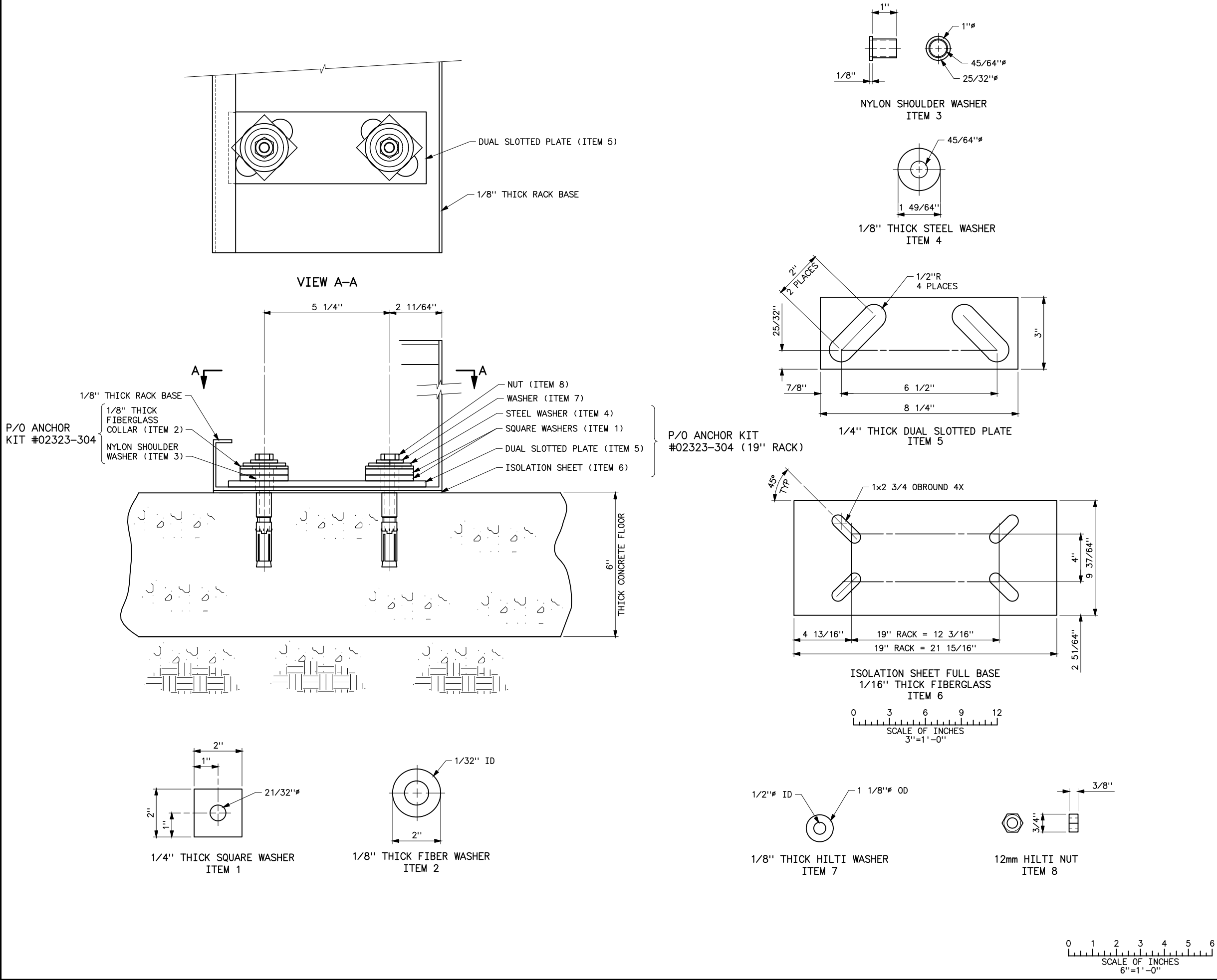
- 1. ALL GUY ATTACHMENT HARDWARE TO BE PROPERLY SIZED FOR EACH GUY STRAND.
- 2. GROUNDING ROD IS TO BE AT LEAST 4'-0" AWAY FROM GUY ANCHOR.
- 3. GROUND CLAMPS SHALL BE BRONZE, STAINLESS STEEL OR BRASS.

B	12-4-18 A7-TC	UPDATED GROUNDING SPECIFICATIONS.
	12-4-18 A7-SJ	CONNECTION REVISIONS.
SUPERSEDES DWG NO. 41 7006		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
COMMUNICATIONS STANDARD GUY TOWER GROUNDING ANCHOR GROUND DETAILS		
DESIGNED S. JOHNSON APPROVED DAN HAMAI SYSTEM CONTROL MANAGER		
C A _E	OCTOBER 25, 2016	31 1506

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NOTES

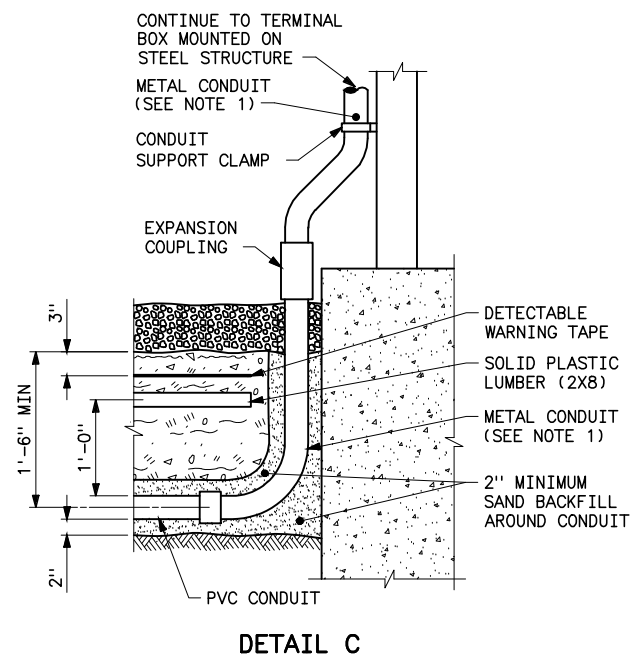
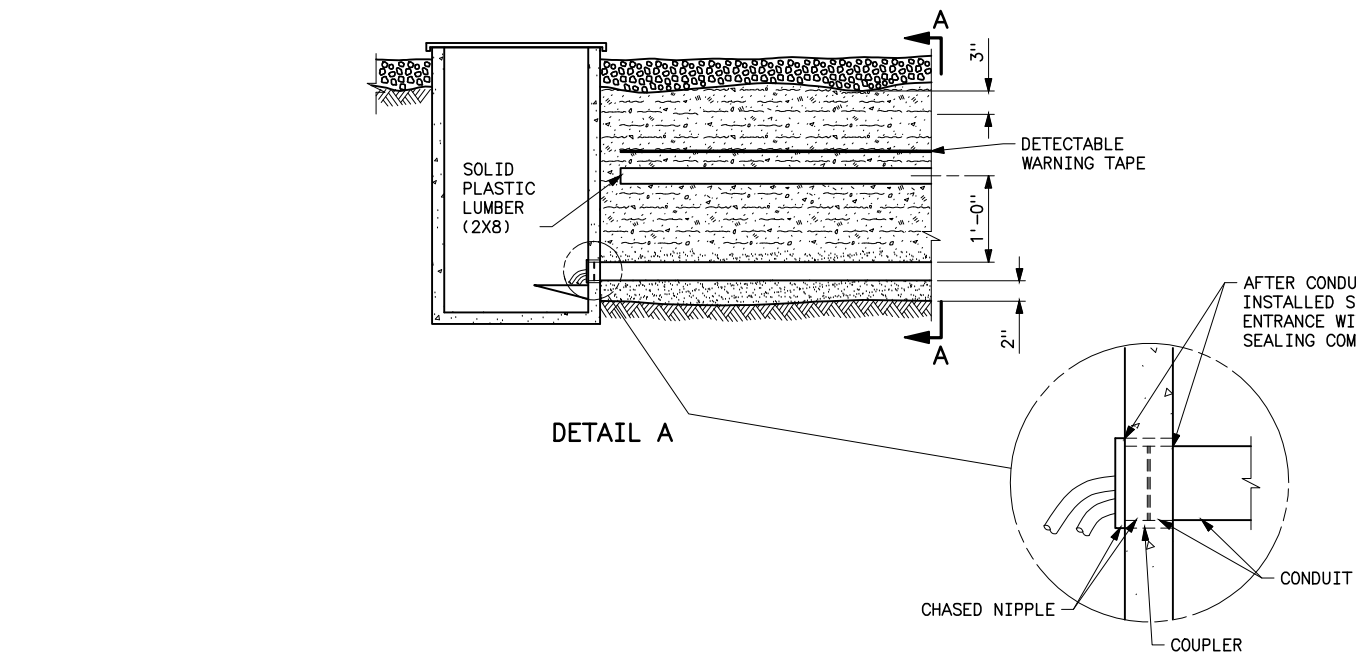
- ANCHOR KIT #02323-304 COMES WITH ANCHOR BOLTS USED TO MOUNT RACKS ON CONCRETE FLOORS.
- RACKS MOUNTED ON RAISED FLOORS, USE ISOLATED KIT #01464-01, HILTI ANCHOR #HSL-I-12M, AND 12MM THREADED ROD.
- EQUIVALENT RACKS FROM DIFFERENT MANUFACTURERS CAN BE USED WITH ACCEPTANCE FROM COR.

REFERENCE DRAWING

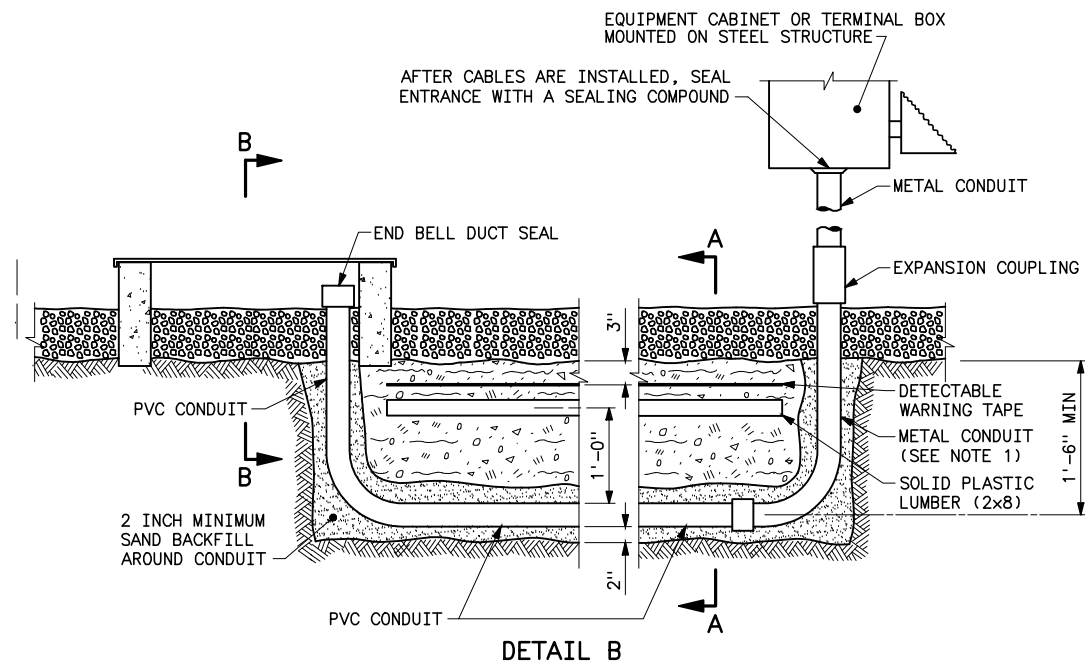
EQUIPMENT RACK - LAYOUT & DETAILS-----53 7050

A	7-31-26 A7-SJ	MINOR REVISIONS.
	SUPERSEDES DWG NO. 41 7005	
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
COMMUNICATIONS STANDARD EQUIPMENT RACK ANCHORING & GROUNDING DETAILS		
DESIGNED <u>SCOTT JOHNSON</u> _____ APPROVED <u>DAN HAMAI</u> _____ SYSTEM CONTROL MANAGER		
C A E	OCTOBER 14, 2016	53 7051

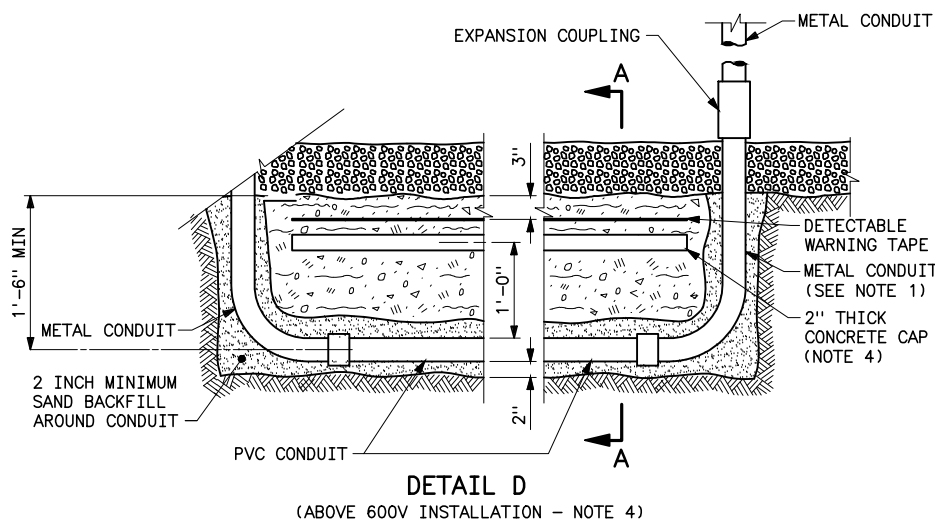
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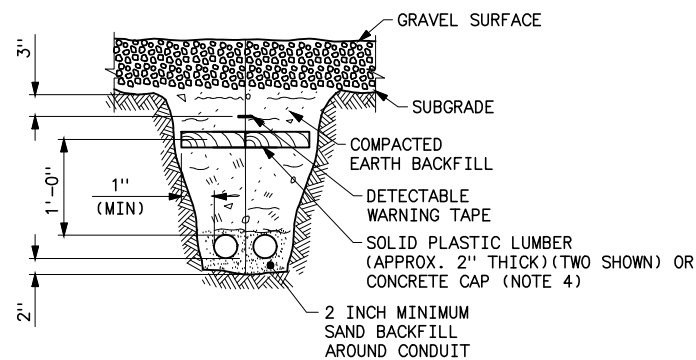
DETAIL C



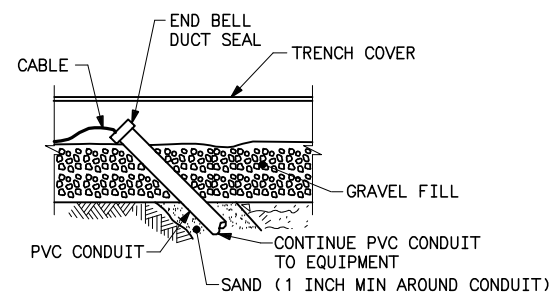
DETAIL B



DETAIL D
(ABOVE 600V INSTALLATION - NOTE 4)



SECTION A-A

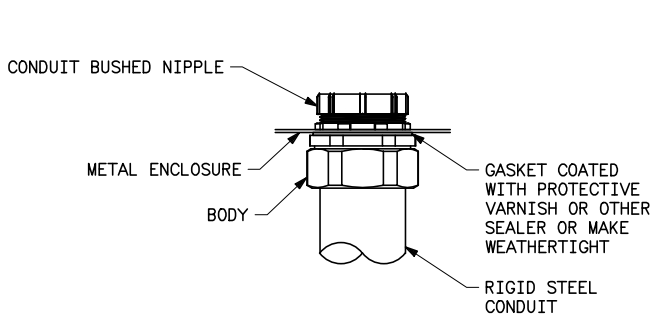


SECTION B-B

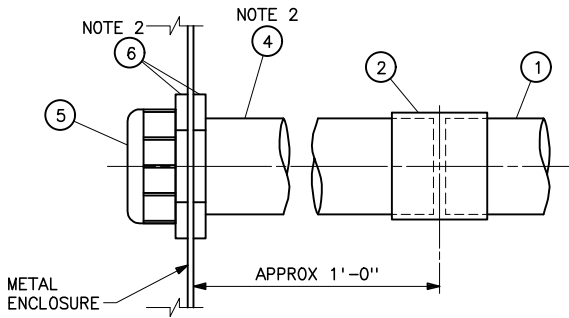
NOTES

1. FOR METAL CONDUIT THAT TERMINATES BELOW FINISHED GRADE, THE PORTION EXTENDING 6 INCHES ABOVE FINISHED GRADE AND ALL CONDUIT BELOW IT MUST BE PLASTIC-COATED OR TAPE-COVERED, AS SPECIFIED IN CONSTRUCTION STANDARD 9.
2. INSTALL DETECTABLE RED OR YELLOW POLYETHYLENE WARNING TAPE DIRECTLY ABOVE EACH CONDUIT RUN. TAPE SHALL BE LOCATED 12 INCHES BELOW FINISHED GRADE.
3. A STRUCTURAL GRADE PLASTIC LUMBER (2x8) SHALL BE INSTALLED 12 INCHES ABOVE THE CONDUIT. LUMBER SHALL PROJECT A MINIMUM 1-INCH OVER EACH SIDE OF CABLE OR CONDUIT RUN. MULTIPLE LUMBER LAID SIDE BY SIDE MAY BE USED TO ACHIEVE REQUIRED WIDTH.
4. A 2-INCH MINIMUM THICKNESS CONCRETE CAP SHALL BE INSTALLED 12 INCHES ABOVE ALL CONDUIT RUNS WITH INSULATED CABLE RATED ABOVE 600V. CAP WIDTH SHALL PROJECT A MINIMUM 1-INCH OVER EACH SIDE OF CONDUIT RUN, OR A MINIMUM 8-INCHES, WHICHEVER IS GREATER.
5. ALL NON-SHIELDED AC CABLES INSTALLED IN CONDUIT SHALL INCLUDE A DEDICATED BARE COPPER GROUNDING CONDUCTOR BONDED AT BOTH ENDS. WHERE CONDUIT ROUTES TO A CABLE TRENCH, THE GROUNDING CONDUCTOR SHALL BE BONDED TO THE TRENCH GROUND AT THE POINT OF CONDUIT EXIT AND TO THE GROUND BAR AT THE ASSOCIATED EQUIPMENT CABINET OR TERMINAL BOX. GROUNDING CONDUCTORS SHALL BE SIZED IN ACCORDANCE WITH APPLICABLE NEC REQUIREMENTS.

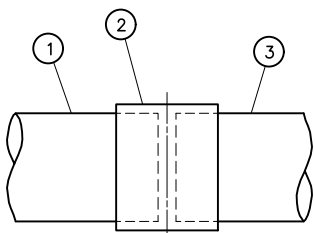
I	4-17-26 A7-BL	REMOVED BURIED INSULATED CABLE.
H	9-27-16 A7-RMJ	ADDED DETAIL E FOR ABOVE 600V CONDUIT, SECTION D-D, NOTE 6, & REVISED NOTE 4.
G	1-17-14 A7-RMJ	REVISED DETAIL A AND NOTE 1, NEW NOTE 5, AND OTHER MINOR REVISIONS.
F	3-17-10 G5-GB	ADDED DETECTABLE WARNING TAPE TO DETAILS AND MODIFIED NOTE 3 & ADDED NOTE 4
E	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY
D	5-14-99 A3-OP	REDRAWN. REVISED DETAIL D & NOTES
SUPERSEDES DWG NO. 40-D-5370		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS CONDUIT TYPICAL DETAILS		
DESIGNED BUREC _____ APPROVED ROSS M. CLARK ELECTRICAL ENGINEERING MANAGER		
C/AE	MAY 18, 1979	31 1006



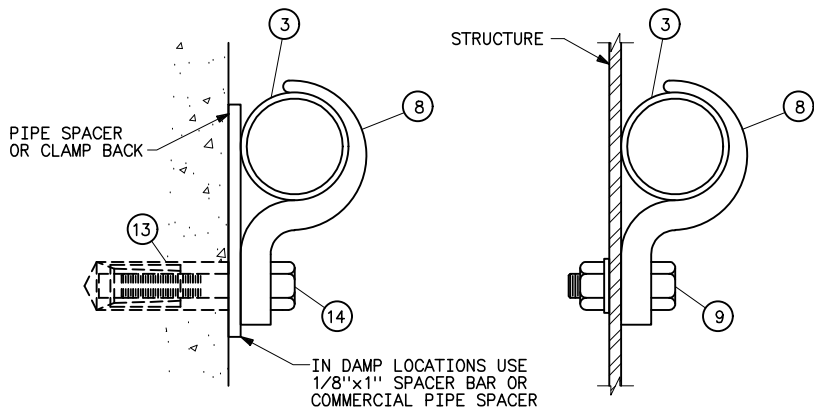
METALLIC CONDUIT TERMINATION
IN METAL ENCLOSURE
DETAIL A



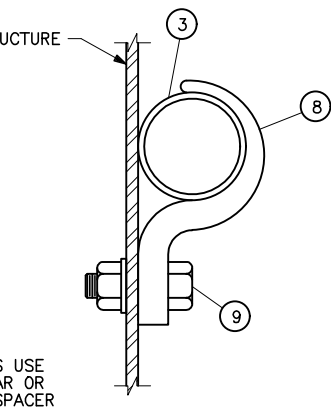
NON-METALLIC CONDUIT TERMINATION
IN METAL ENCLOSURE
DETAIL B



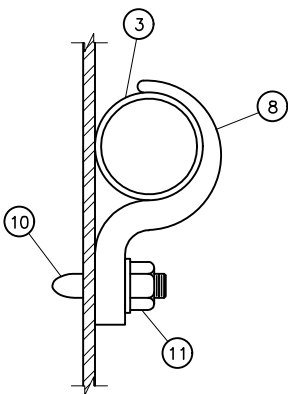
CONNECTING RIGID STEEL
AND PVC CONDUIT
DETAIL C



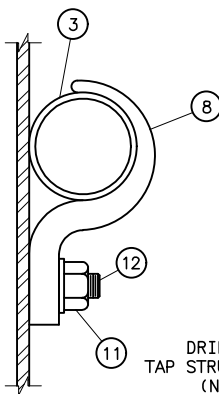
CONDUIT CLAMPING ON
CONCRETE SURFACE
DETAIL D



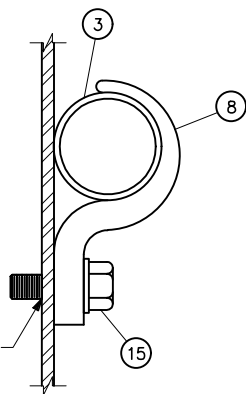
CONDUIT CLAMPING ON
METALLIC STRUCTURE
(BOTH SIDES ACCESSIBLE)
DETAIL E



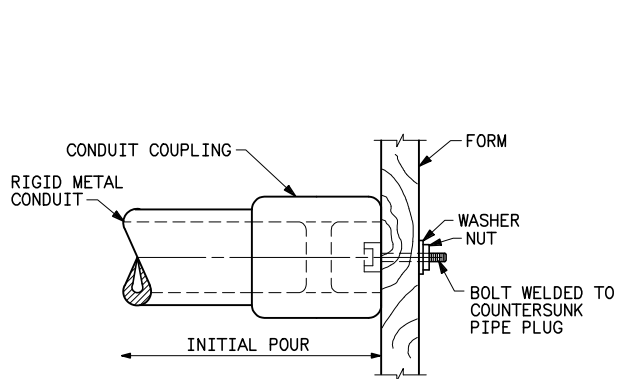
DETAIL F



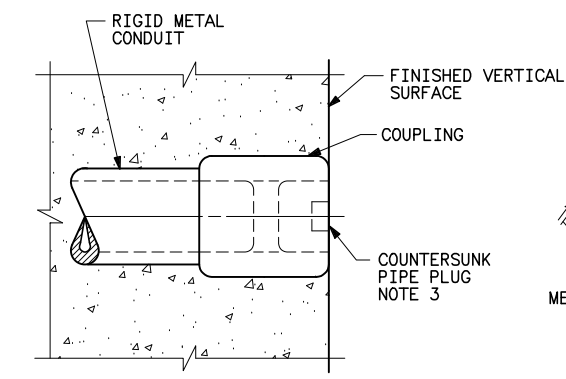
DETAIL G



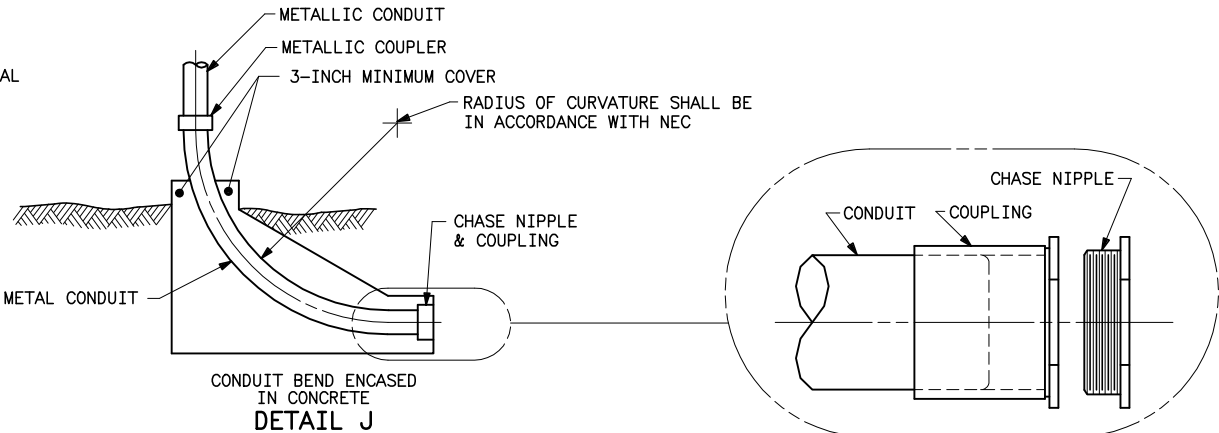
DETAIL K



IN FORM WORK
DETAIL H



PLUGGED AFTER FORM HAS BEEN REMOVED
DETAIL I



CONDUIT BEND ENCASED
IN CONCRETE
DETAIL J

REFERENCE MATERIALS

ITEM NO.	DESCRIPTION
1	POLYVINYL CHLORIDE (PVC) CONDUIT PER NEMA TC2
2	FEMALE ADAPTER, PVC TO RIGID STEEL CONDUIT, THREADED ON STEEL CONDUIT SIDE
3	RIGID STEEL CONDUIT PER UL6 AND ANSI C80-1
4	NIPPLE, RIGID STEEL CONDUIT
5	INSULATING BUSHING. REQUIRED PRIOR TO CABLE INSTALLATION
6	LOCKNUT, GALVANIZED STEEL
7	BONDNUT, GALVANIZED STEEL
8	CONDUIT CLAMP
9	MACHINE BOLT, NUT AND LOCKWASHER, GALV STEEL
10	POWDER DRIVEN THREADED STUD (3/8 INCH DIA)
11	MACHINE NUT AND LOCKWASHER, GALV STEEL
12	STUD BOLT, 1/2 INCH DIAMETER x LENGTH AS REQUIRED, END FLUX WELDED TO STRUCTURE
13	EXPANSION ANCHOR
14	MACHINE SCREW AND LOCKWASHER, GALV STEEL
15	MACHINE BOLT, GALV STEEL

NOTES

- UNLESS OTHERWISE SPECIFIED ON DRAWINGS, CONDUIT BENDS SHALL BE IN ACCORDANCE WITH NATIONAL ELECTRICAL CODE (NEC). 90 DEGREE BENDS INTO CABLE TRENCH MAY BE SCHEDULE 40 PVC, ALL OTHER 90 DEGREE CONDUIT BENDS SHALL BE METAL.
- USE ALUMINUM OR BRASS NIPPLE AND LOCKNUTS AND SLOT STEEL BOX BETWEEN KNOCKOUTS WHERE SINGLE PHASE CABLES ONLY ARE RUN IN ONE CONDUIT.
- REPLACE PLUG WITH CHASE NIPPLE BEFORE INSTALLING CABLE OR WIRE.
- SPRAY COLD GALVANIZING COMPOUND ON THREADS AFTER DRILLING AND TAPPING HOLE.

B	4-17-26 A7-HMK	ADDED DETAIL K
A	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.

SUPERSEDES DWG NO. 31-1027, 31-1028, 31-1033, 31-1034 AND (IN PART) 31-1077

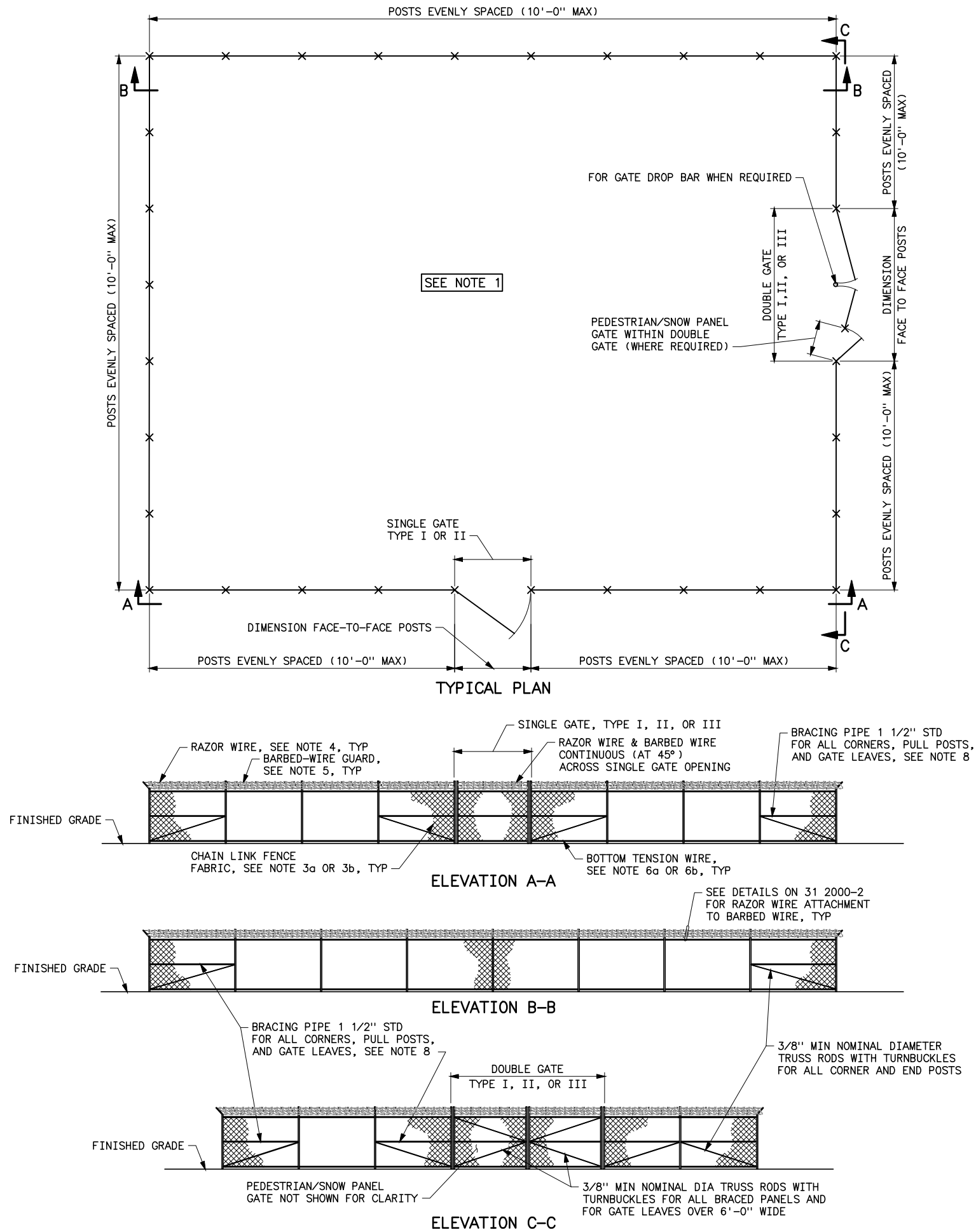
UNITED STATES DEPARTMENT OF ENERGY
WESTERN AREA POWER ADMINISTRATION
CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO

SUBSTATION STANDARDS
CONDUIT INSTALLATION
DETAILS

DESIGNED BUREC _____ APPROVED ROSS M. CLARK
ELECTRICAL ENGINEERING MANAGER

C	MAY 14, 1999	31	1700
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Plotted By: court Sep 08, 2026- 9: 25am
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NOTES

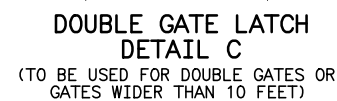
- SEE DRAWINGS AND SPECIFICATIONS FOR DESIGNATION OF FENCE AS "STANDARD CHAIN LINK FENCE" OR "HIGH SECURITY CHAIN LINK FENCE".
 - "STANDARD CHAIN LINK FENCE" SHALL CONSIST OF STANDARD CHAIN LINK FENCE FABRIC, GATES, AND GUARD OF THREE STRANDS OF BARBED WIRE.
 - "HIGH SECURITY CHAIN LINK FENCE" SHALL CONSIST OF HIGH SECURITY CHAIN LINK FENCE FABRIC, GATES, GUARD OF THREE STRANDS OF BARBED WIRE, ONE SPOOL OF SECURITY RAZOR / CONCERTINA TYPE WIRE ON TOP OF THE FENCE, AND THREE SPOOLS OF SECURITY RAZOR / CONCERTINA TYPE WIRE AT BASE (IF SPECIFIED). SECURE BOTTOM LOOP OF RAZOR/CONCERTINA WIRE TO BOTTOM ROW OF BARBED WIRE.
- SEE SPECIFIC "SITE PLAN", "GRADING PLAN", OR "GRADING AND PLOT PLAN" FOR OVERALL FENCE DIMENSIONS; AND SIZE, LOCATION, AND SWING OF GATES.
- CHAIN LINK FENCE FABRIC SHALL HAVE BARBED-SELVAGE TOP AND BOTTOM, EXCEPT THAT GATE FILLER FABRIC SHALL HAVE KNUCKLED SELVAGE AT BOTTOM.
 - STANDARD CHAIN LINK FENCE FABRIC: ASTM A 392, 2-INCH MESH, 11-GAGE NOMINAL WIRE DIAMETER AFTER COATING.
 - HIGH SECURITY CHAIN LINK FENCE FABRIC: ASTM A 392, 1-INCH MESH, 9-GAGE NOMINAL WIRE DIAMETER AFTER CLASS 1 (1.20 OZ / SF) ZINC COATING.
- SECURITY RAZOR / CONCERTINA TYPE WIRE:
 - ONE COIL OF 24-INCH DIAMETER ON TOP OF FENCE: SECURELY ATTACH TO TOP AND BOTTOM BARBED WIRE STRANDS AT 18-INCH MAXIMUM SPACING; MAXIMUM GAP OF 2-INCHES BETWEEN BOTTOM OF COIL AND TOP OF CHAIN LINK FENCE; TO WITHSTAND 200 LB (MINIMUM) PULL LOAD WITHOUT BECOMING DETACHED.
 - THREE COILS OF 30-INCH DIAMETER AT GROUND LEVEL (WHERE SPECIFIED): SECURELY ATTACH TO CHAIN LINK FABRIC, AND EACH OTHER, AT 18-INCH MAXIMUM SPACING, TO WITHSTAND 200 LB (MINIMUM) PULL LOAD WITHOUT BECOMING DETACHED.
- ZINC-COATED BARBED WIRE: TWELVE-GAGE WIRE WITH 14-GAGE, 4-POINT BARBS, ZINC-COATED. BARBED-WIRE GUARD TO BE MOUNTED ON 45-DEGREE CORNER AND LINE POSTS. FOR BARBED-WIRE GUARD ON DOUBLE GATE, SEE DETAIL A ON DWG. 31 2038.
- BOTTOM TENSION WIRE & GALVANIZED STEEL TIES:
 - FOR USE WITH STANDARD CHAIN LINK FENCE FABRIC: TWO 12 1/2-GAGE TWISTED, BARBLESS, ZINC-COATED STRANDS MAY BE SUBSTITUTED FOR 7-GAGE BOTTOM TENSION WIRE; ASTM F626, 12-GAGE NOMINAL WIRE TIE DIAMETER AFTER CLASS 3 (0.80 OZ/SF) ZINC COATING.
 - FOR USE WITH HIGH SECURITY CHAIN LINK FENCE FABRIC: ASTM A 392, 9-GAGE NOMINAL BOTTOM TENSION WIRE DIAMETER AFTER CLASS 1 (1.20 OZ / SF) ZINC COATING; ASTM F 626, 9-GAGE NOMINAL WIRE TIE DIAMETER AFTER CLASS 1 (1.20 OZ/SF) ZINC COATING.
- ON LONG RUNS, PROVIDE BRACED PULL POSTS AS REQUIRED FOR PROPER STRETCHING OF FABRIC.
- A ROLLED "I" SECTION WITH ROUNDED FLANGES, WEIGHING NOT LESS THAN 2.2 POUNDS PER LINEAR FOOT, MAY BE SUBSTITUTED FOR TOP RAILS AND BRACING.
- STANDARD H OR U-SECTIONS MAY BE SUBSTITUTED FOR PIPE FOR LINE POSTS ONLY, PROVIDED THAT THE SUBSTITUTED SECTION WEIGHS NOT LESS THAN 3.6 POUNDS PER LINEAR FOOT.
- TOP PORTION OF FENCE POST FOUNDATION SHALL BE FORMED ROUND A DISTANCE OF APPROXIMATELY 1'-0" BELOW SUBGRADE OR TO ROCK SURFACE, WHICHEVER OCCURS FIRST.
- FENCE POSTS, TOP RAILS, AND BRACES: ASTM F 1083, SCHEDULE 40 STEEL PIPE.
- ALL JOINTS BETWEEN TUBULAR GATE FRAME MEMBERS SHALL BE WELDED.
- GATES AND ACCESSORIES: EXCEPT AS SHOWN ON THE DRAWINGS, GATES AND ACCESSORIES SHALL BE IN ACCORDANCE WITH ASTM F 900. GATES SHALL BE SWING-TYPE WITH ZINC-COATED, ROUND TUBULAR FRAMES. THE ZINC COATING SHALL HAVE AN AVERAGE WEIGHT OF NOT LESS THAN 1.8 OUNCES PER SQUARE FOOT OF COATED SURFACE AREA. GATE FABRIC SHALL BE THE SAME AS THE FENCE FABRIC.

- EACH GATE LEAF SHALL BE EQUIPPED WITH ONE PAIR OF HINGES THAT WILL ALLOW A FULL GATE OPENING BETWEEN GATE POSTS. GATE HINGES SHALL BE OF THE SOCKET TYPE, STRUCTURALLY CAPABLE OF SUPPORTING THE GATE LEAF, AND HAVE LARGE BEARING SURFACES FOR CLAMPING OR BOLTING IN POSITION. HINGES SHALL ALLOW THE GATE TO BE EASILY OPENED AND CLOSED BY ONE PERSON, AND TO SWING A FULL 180 DEGREES WITHOUT TWISTING OR BINDING. FORKED LATCH MAY BE PROVIDED FOR THE SINGLE GATE LESS THAN 10 FEET WIDE. UNLESS NOTED OTHERWISE ON THE DRAWINGS, LATCH FOR DOUBLE GATE SHALL BE OF THE "DOUBLE GATE DROP ROD" TYPE OF FULL GATE HEIGHT, AND ARRANGED TO ENGAGE THE CENTER STOP. THE LATCH SHALL HAVE PROVISIONS FOR PADLOCKING; LOCKS SHALL BE ACCESSIBLE FROM BOTH SIDES OF GATE, AND FURNISHED WHEN SPECIFIED. THE LOCKING DEVICE SHALL BE CONSTRUCTED SO THAT THE CENTER DROP ROD OR PLUNGER BAR CANNOT BE RAISED WHEN LOCKED. GATE LATCH FOR GATE SHALL BE AS SHOWN ON DRAWING 31 2001.
- GATE KEEPER FOUNDATION SHALL BE PROVIDED FOR ALL DOUBLE GATE LEAFS, AND CONSIST OF A MECHANICAL DEVICE FOR SECURING THE FREE END OF THE GATE WHEN IN THE OPEN POSITION. LOCATION OF FOUNDATIONS SHALL BE AS DIRECTED, AND SHALL BE 3'-0" DEEP IN SOIL, OR "KEYED-IN" TO ROCK 1'-0" UNLESS OTHERWISE SPECIFIED.
- GATE HINGES, LATCHES, STOPS, KEEPERS, AND OTHER ACCESSORIES SHALL BE ZINC-COATED, STEEL, DUCTILE IRON, OR MALLEABLE IRON EXCEPT THAT WIRE TIES, CLIP BOLTS, AND NUTS MAY BE OF ALUMINUM ALLOY. MINIMUM WEIGHT OF THE ZINC COATING SHALL BE 1.2 OUNCES PER SQUARE FOOT OF SURFACE. BARBED WIRE GUARD AND RAZOR WIRE AT THE GATE TOP SHALL BE AS SHOWN ON THE DRAWINGS.
- CHAIN LINK FENCE ACCESSORIES: EXCEPT AS SHOWN ON THE DRAWINGS, FENCE ACCESSORIES SHALL BE IN ACCORDANCE WITH ASTM F 626. POST CAPS, RAIL ENDS, AND BARBED WIRE SUPPORT ARMS SHALL BE ZINC-COATED, STEEL, MALLEABLE IRON, OR DUCTILE IRON EXCEPT THAT POST CAPS AND RAIL ENDS MAY BE OF CAST IRON. RAIL SLEEVES, WIRE TIES AND CLIPS, CLIP BOLTS, NUTS, BRACE BANDS, TENSION BANDS, REINFORCING WIRE, AND TENSION BARS SHALL BE ZINC-COATED, STEEL EXCEPT THAT CLIP BOLTS AND NUTS MAY BE OF ALUMINUM ALLOY.

REFERENCE DRAWINGS

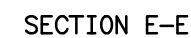
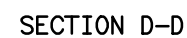
FENCE GROUNDING CONNECTIONS DETAILS	31 1501
SUBSTATION STANDARDS CHAIN-LINK FENCE GENERAL REQUIREMENTS	31 2000-2
CHAIN-LINK FENCE GATE LATCHES	31 2001
CHAIN-LINK FENCE SWING GATES	31 2038

B	9-8-26 A7-KB	REVISED FOR GATE LANGUAGE UPDATE.
	A	5-14-18 A7-FF
SUPERSEDES DWG NO. 31 2000G (IN PART)		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS CHAIN-LINK FENCE GENERAL REQUIREMENTS (SHEET 1 OF 2)		
DESIGNED JERRY SCHREIBER ——— APPROVED DOUG HANSON CIVIL ENGINEERING MANAGER		
SEPTEMBER 27, 2016	31	2000-1



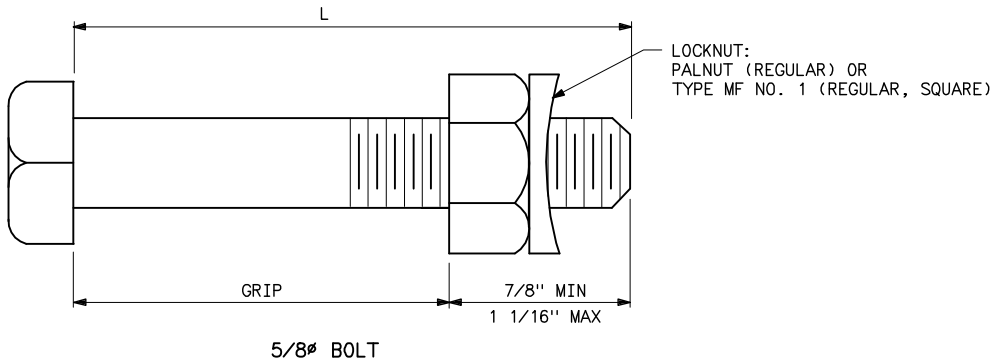
1. REFERENCE NOTES ARE ON 31 2000-1.
2. FORKED LATCH SHALL BE MALLEABLE STEEL, COMMERCIAL-GRADE TYPE SIGNED CAT# CL-FM OR EQUAL.
3. DROP ROD SHALL BE GALVANIZED STEEL, TYPE CHAIN LINK FITTINGS CAT# 36DROPKIT OR EQUAL.
4. DOUBLE GATE LATCH SHALL BE GALVANIZED STEEL, TYPE STRONG ARM CHAIN LINK DAC INDUSTRIES CAT# 4000 OR EQUAL.

FENCE GROUNDING CONNECTIONS DETAILS	31	1501
CHAIN-LINK FENCE GENERAL REQUIREMENTS		
(SHEET 1 OF 2)	31	2000-1
CHAIN-LINK FENCE GENERAL REQUIREMENTS		
(SHEET 2 OF 2)	31	2000-2
CHAIN-LINK FENCE SWING GATES	31	2038



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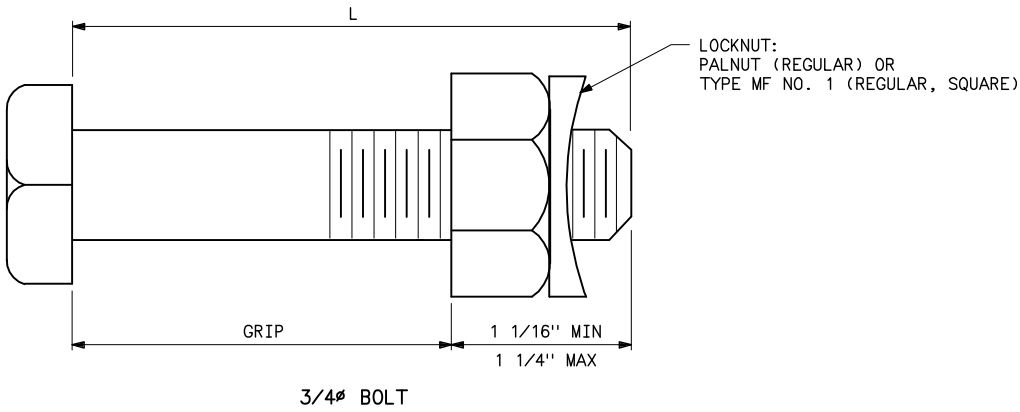


BOLT LENGTHS REQUIRED FOR VARIOUS GRIPS

L	1 1/4"	1 1/2"				1 3/4"				2"				2 1/4"				2 1/2"				2 3/4"				3"			
GRIP	3/8"	7/16"	1/2"	9/16"	5/8"	11/16"	3/4"	13/16"	7/8"	15/16"	1"	1 1/16"	1 1/8"	1 3/16"	1 1/4"	1 5/16"	1 3/8"	1 7/16"	1 1/2"	1 9/16"	1 5/8"	1 11/16"	1 3/4"	1 13/16"	1 7/8"	1 15/16"	2"	2 1/16"	2 1/8"

NOTE

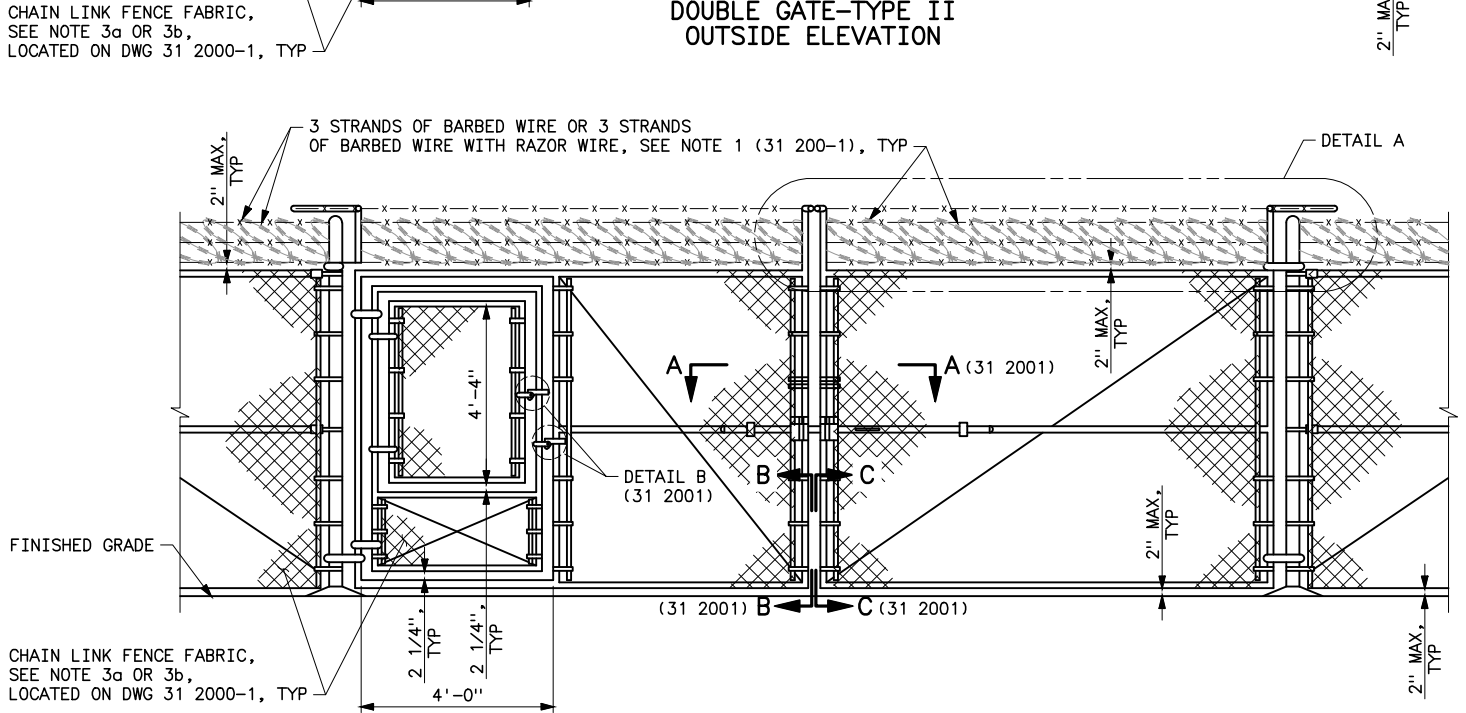
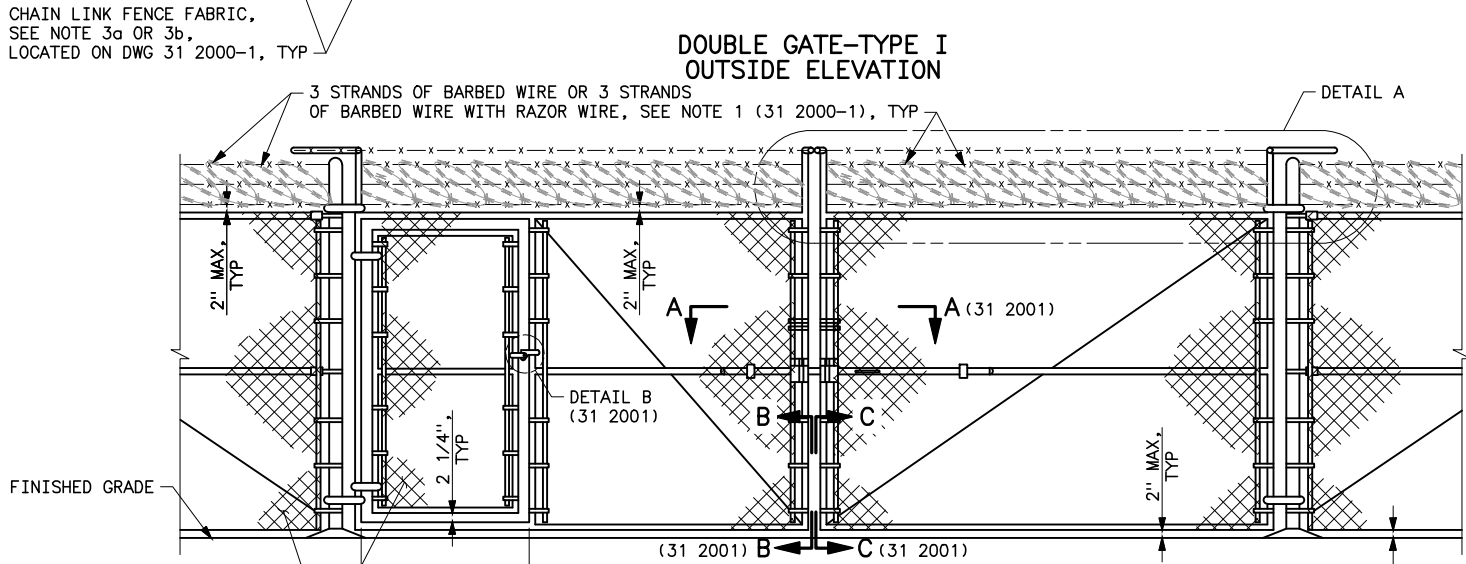
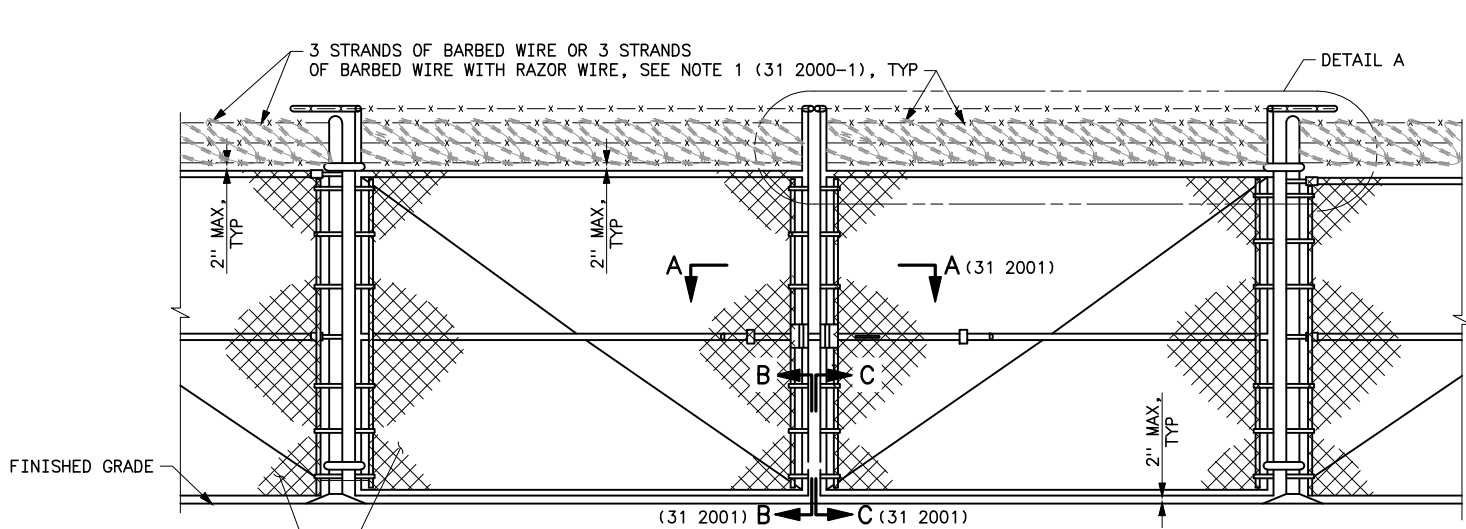
1. GRIP INCLUDES FILLS AND BEVEL WASHERS WHERE USED.



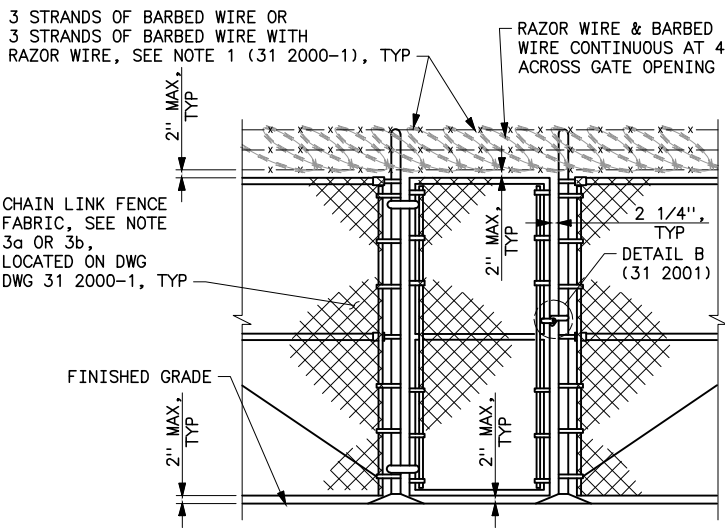
BOLT LENGTHS REQUIRED FOR VARIOUS GRIPS

L	1 1/2"		1 3/4"				2"				2 1/4"				2 1/2"				2 3/4"				3"				3 1/4"			
GRIP	3/8"	7/16"	1/2"	9/16"	5/8"	11/16"	3/4"	13/16"	7/8"	15/16"	1"	1 1/16"	1 1/8"	1 3/16"	1 1/4"	1 5/16"	1 3/8"	1 7/16"	1 1/2"	1 9/16"	1 5/8"	1 11/16"	1 3/4"	1 13/16"	1 7/8"	1 15/16"	2"	2 1/16"	2 1/8"	2 3/16"

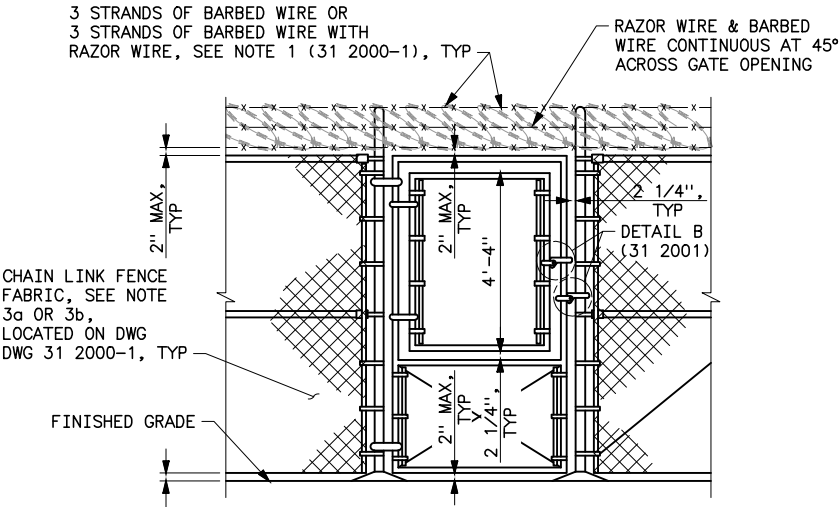
C	7-15-03 A7-DH	REVISED TITLE BLOCK ONLY.	
B	8-28-89 A2-GB	REDRAWN AND REVISED ON CAE.	
SUPERSEDES DWG NO. E40-D-5665			
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO			
SUBSTATION STANDARDS 5/8 & 3/4 DIA CONNECTION BOLTS			
DESIGNED <u>W.L. SOPER</u> _ _ _ _ _		APPROVED <u>GERALD D. BIRNEY</u> _ _ _ _ _ DIRECTOR, DIVISION OF SUBSTATION DESIGN	
CAE	APRIL 10, 1979	31	2002



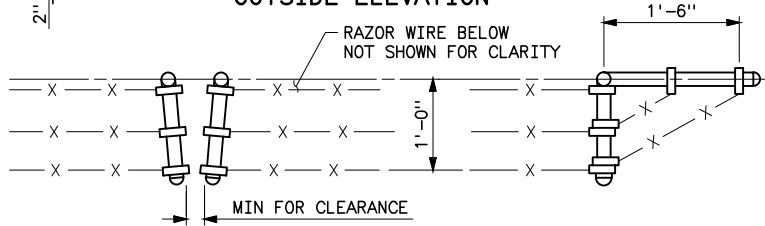
DOUBLE GATE-TYPE III OUTSIDE ELEVATION



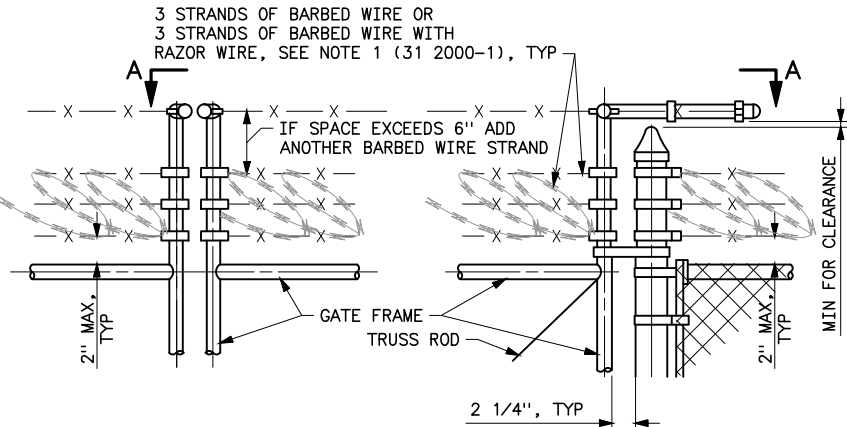
SINGLE GATE-TYPE I OUTSIDE ELEVATION



SINGLE GATE-TYPE II OUTSIDE ELEVATION



VIEW A-A



DOUBLE GATE BARBED WIRE & RAZOR WIRE GUARD DETAIL A

GATE FRAMES AND POSTS			
REQUIRED SIZES			
GATE FRAME (STD PIPE SIZES)	SIZE OF GATE OPENING		GATE POSTS (STD PIPE SIZES)
	SINGLE	DOUBLE	
1 1/2"	TO 6'-0"	TO 12'-0"	2 1/2"
	OVER 6'-0" TO 13'-0"	OVER 12'-0" TO 26'-0"	3 1/2"
	OVER 13'-0"	OVER 26'-0"	6"

NOTES

1. REFERENCE NOTES ARE ON 31 2000-1.
2. SEE DETAILS ON 31 2000-2 FOR RAZOR WIRE ATTACHMENT TO BARBED WIRE.

REFERENCE DRAWINGS

FENCE GROUNDING CONNECTIONS DETAILS	31 1501
CHAIN-LINK FENCE GENERAL REQUIREMENTS (SHEET 1 OF 2)	31 2000-1
CHAIN-LINK FENCE GENERAL REQUIREMENTS (SHEET 2 OF 2)	31 2000-2
CHAIN-LINK FENCE GATE LATCHES	31 2001

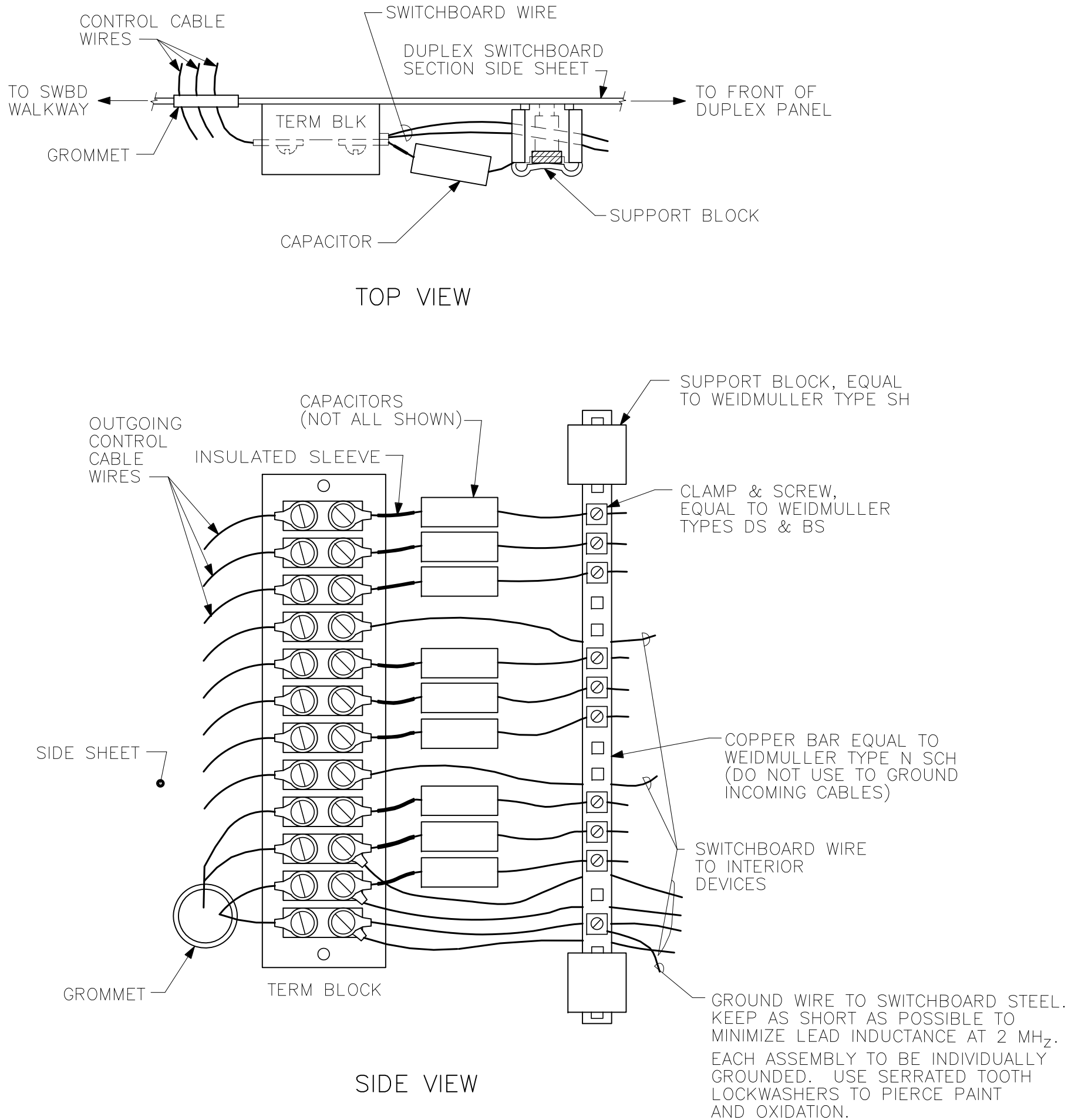
B	9-27-16 A7-JAS	GENERAL REVISIONS TO INCORPORATE OSEM WAPA ORDER 470.1H, 2016.
	7-15-03 A7-DH	REVISED TITLE BLOCK ONLY.
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS CHAIN-LINK FENCE SWING GATES		
DESIGNED ALONZO J. RUE JR. APPROVED GERALD D. BIRNEY DIRECTOR, DIVISION OF SUBSTATION		
A	FEBRUARY 28, 1991	31 2038

SPECIFICATIONS

1. CAPACITORS SHALL BE RATED AT 0.1 MFD, GREATER THAN OR EQUAL TO 600 WVDC, BE OF THE METALLIZED POLYESTER FILM TYPE, AND BE EQUAL TO TRW BRAND X663F OR X663FR, ELPAC BRAND ZDR104 OR ZDX104, OR ITT BRAND PMT-2R.
2. COPPER BARS SHALL BE CONSTRUCTED OF HARD-DRAWN COPPER AND SHALL BE USED FOR GROUNDING AND SUPPORT PURPOSES.
3. CONNECTORS FOR SOLID 18-22 GAUGE WIRES SHALL BE EQUAL TO AMP 250 SERIES PIDG, TIN PLATED BRASS, NUMBERS 61204, 61265, 60366, OR 42599.
4. THE USE OF SELF TAPPING SCREWS WILL NOT BE PERMITTED. MECHANICAL AND STRUCTURAL CONNECTIONS SHALL UTILIZE STANDARD MACHINE SCREWS AND BOLTS WITH NUTS AND SERRATED TOOTH LOCKWASHERS.
5. SHOWN ON THIS DRAWING IS ONE 12-POINT SUPPRESSOR ASSEMBLY. EACH 12-POINT ASSEMBLY IS DESIGNED WITH THE FOLLOWING CRITERIA:
 - A. MAINTAIN SELF-RESONATE FREQUENCY HIGHER THAN 1.5 MH_z BY KEEPING THE EQUIVALENT SERIES INDUCTANCE AS LOW AS POSSIBLE.
 - B. KEEPING THE RESISTANCE OF ALL ELECTRICAL CONNECTIONS TO A VALUE UNDER 0.1 OHM.
 - C. PERMIT ACCESSIBILITY TO TERMINAL BLOCK CONNECTIONS
6. REFER TO SPECIFIC SCHEMATIC AND WIRING DIAGRAMS FOR ACTUAL NUMBER AND LOCATION OF CAPACITORS.

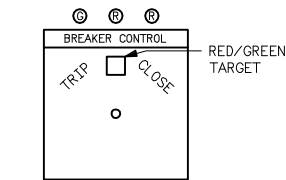
TOP VIEW

SIDE VIEW



C	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.	
B	9-16-87 A2-MKM	REDRAWN & REVISED	
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO			
SUBSTATION STANDARDS TYPICAL DUPLEX SWITCHBOARD SURGE SUPPRESSOR NETWORKS DETAIL LAYOUT			
DESIGNED _ _ _ _ _		APPROVED GERALD D. BIRNEY DIRECTOR, DIVISION OF SUBSTATION DESIGN	
C A _E	MARCH 14, 1979	31	4001 Return to Top

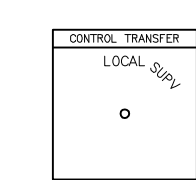
BREAKER CONTROL
182CS*



CONTACTS	POSITIONS			
	TRIP	NAT	NAC	CLOSE
1	1C			X
2	2C			X
3	3C			X
4	4C			X
5	5C	X		
6	6C	X		
7	7C	X		
8	8C	X	X	
9	9C	X	X	
10	10C	X	X	

BLACK, PISTOL GRIP HANDLE
SPRING RETURN TO CENTER
GREEN LAMP INDICATES
OPEN BREAKER
RED LAMP INDICATES
CLOSED BREAKER

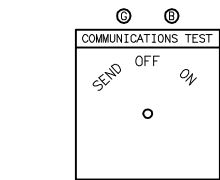
CONTROL TRANSFER
43-182CS*



CONTACTS	POSITIONS	
	LOCAL	SUPV
1	1C	X
2	2C	X
3	3C	X
4	4C	X
5	5C	X
6	6C	X
7	7C	X
8	8C	X

BLACK, OVAL HANDLE
ALL POSITIONS MAINTAINED

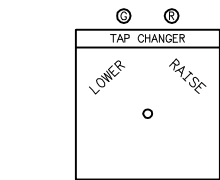
COMMUNICATIONS TEST
BCCS*



CONTACTS	POSITIONS			
	SEND	OFF	ON	
1	1C	X		
2	2C	X		
3	3C	X		
4	4C	X		
5	5C	X		
6	6C	X		
7	7C	X		
8	8C	X		
9	9C	X		
10	10C	X		
11	11C	X		
12	12C	X		

BLACK, OVAL HANDLE
ALL POSITIONS MAINTAINED
YELLOW LAMP INDICATES
TRIP SIGNAL
RED LAMP INDICATES
COMMUNACATION SYSTEM OK

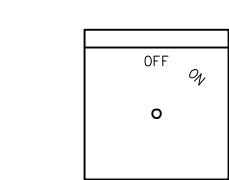
RAISE/LOWER CONTROL
84-KV1ACS*



CONTACTS	POSITIONS		
	LOWER	OFF	RAISE
1	1C	X	
2	2C	X	
3	3C	X	
4	4C	X	

BLACK, OVAL HANDLE
SPRING RETURN TO CENTER
GREEN LAMP GOES OFF AT
FULLY RAISED POSITION
RED LAMP GOES OFF AT
FULLY LOWERED POSITION

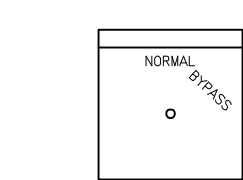
DIFFERENTIAL CONTROL
87TB1CS*



CONTACTS	POSITIONS	
	OFF	ON
1	1C	X
2	2C	X
3	3C	X
4	4C	X
5	5C	X
6	6C	X
7	7C	X
8	8C	X
9	9C	X
10	10C	X
11	11C	X
12	12C	X
13	13C	X
14	14C	X
15	15C	X
16	16C	X
17	17C	X
18	18C	X
19	19C	X
20	20C	X

BLACK, OVAL HANDLE
ALL POSITIONS MAINTAINED

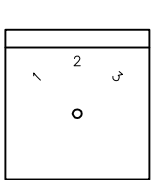
BREAKER BYPASS CONTROL
182BCS*



CONTACTS	POSITIONS	
	NOR	BYP
1	1C	X
2	2C	X
3	3C	X
4	4C	X
5	5C	X
6	6C	X
7	7C	X
8	8C	X
9	9C	X
10	10C	X
11	11C	X
12	12C	X
13	13C	X
14	14C	X
15	15C	X
16	16C	X
17	17C	X
18	18C	X
19	19C	X
20	20C	X

BLACK, OVAL HANDLE
ALL POSITIONS MAINTAINED

DIFFERENTIAL CONTROL
87B1CS*



CONTACTS	POSITIONS		
	1	2	3
1	1C	X	
2	2C	X	
3	3C	X	
4	4C	X	
5	5C	X	
6	6C	X	
7	7C	X	
8	8C	X	
9	9C	X	
10	10C	X	
11	11C	X	
12	12C	X	
13	13C	X	
14	14C	X	
15	15C	X	
16	16C	X	
17	17C	X	
18	18C	X	
19	19C	X	
20	20C	X	
21	21C	X	
22	22C	X	
23	23C	X	
24	24C	X	
25	25C	X	
26	26C	X	
27	27C	X	
28	28C	X	
29	29C	X	
30	30C	X	
31	31C	X	
32	32C	X	

BLACK, OVAL HANDLE
ALL POSITIONS MAINTAINED

SWITCH HANDLES

1. PISTOL GRIP HANDLES ARE USED FOR FUNCTIONS WHICH, WHEN INITIATED, CANNOT BE REVERSED OR STOPPED UNTIL COMPLETED.
2. ROUND OR KNURLD HANDLES ARE USED FOR METERING APPLICATIONS.
3. OVAL HANDLES ARE USED FOR ALL OTHER FUNCTIONS.
4. WHERE RESPONSE TO A CONTROL FUNCTION IS INDICATED ABOVE THE SWITCH, THE DIRECTION OF ROTATION OF THE SWITCH HANDLE SHALL CORRESPOND TO THE DIRECTION OF CHANGE INDICATION.
5. A MINIMUM OF TWO SYNC SWITCH HANDLES SHOULD BE PROVIDED FOR EACH SUBSTATION; HOWEVER, ONLY ONE HANDLE WILL BE ISSUED FOR OPERATION.

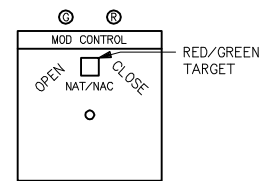
NOTES

1. THE TERMS "CUTOUT SWITCH" SHALL NOT BE USED.
 2. THE USE OF IMINIATURE SWITCHES SUCH AS ELECTROSWITCH MIN SERIES IS ACCEPTABLE.
 3. A "LOCKOUT" OR HAND RESET AUXILIARY IS NOT CONSIDERED A SWITCH AND IS DESCRIBED ON DRAWING 31-5103.
 4. SWITCH DEVELOPMENTS SHOULD BE SHOWN ON SCHEMATIC DIAGRAMS, WHERE POSSIBLE, TO PROVIDE A CONVENIENT, PERMANENT RECORD.
 5. CONTACTS ARRANGEMENT SHOWING HERE ARE TYPICAL GE TYPE SBM SWITCHES.
- * TYPICAL DESIGNATION

LAMPS

- ① AC OR DC POTENTIAL INDICATION
- ② INDICATES EQUIPMENT IN-SERVICE OR ENERGIZED OR TAP CHANGER FULLY LOWERED
- ③ INDICATES EQUIPMENT OUT-OF-SERVICE OR DE-ENERGIZED OR TAP CHANGER FULLY RAISED
- ④ INDICATES COMMUNICATION TRIP SIGNAL
- ⑤ INDICATES RECLOSER OR COMMUNICATION IN-SERVICE

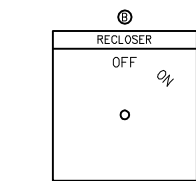
MOD CONTROL
181CS*



CONTACTS	POSITIONS			
	OPEN	OFF	NAT	NAC
1	1C			X
2	2C			X
3	3C			X
4	4C			X
5	5C	X		
6	6C	X		
7	7C	X		
8	8C	X	X	
9	9C	X	X	
10	10C	X	X	

BLACK, PISTOL GRIP HANDLE
SPRING RETURN TO CENTER
GREEN LAMP INDICATES MOD
FULLY OPEN
RED LAMP INDICATES MOD
FULLY CLOSED
RED AND GREEN LAMPS ARE ON
AT INTERMEDIATE POSITIONS

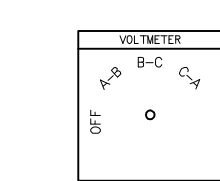
RECLOSER CONTROL
79-182CS*



CONTACTS	POSITIONS	
	OFF	ON
1	1C	X
2	2C	X
3	3C	X
4	4C	X

BLACK, OVAL HANDLE
ALL POSITIONS MAINTAINED

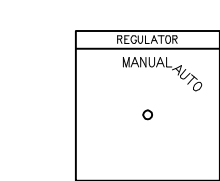
VOLTMETER SELECT
VUIACS*



CONTACTS	POSITIONS			
	OFF	A-B	B-C	C-A
1	1C	X		
2	2C	X		
3	3C	X		
4	4C	X		

BLACK, KNURLD HANDLE
ALL POSITIONS MAINTAINED

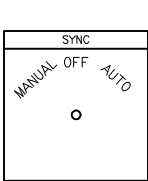
REGULATOR CONTROL
90-KVIACS*



CONTACTS	POSITIONS	
	MAN	AUTO
1	1C	X
2	2C	X
3	3C	X
4	4C	X

BLACK, OVAL HANDLE
ALL POSITIONS MAINTAINED

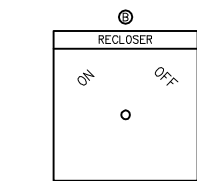
SYNC
25-182CS*



CONTACTS	POSITIONS		
	MAN	OFF	AUTO
1	1C	X	X
2	2C	X	X
3	3C	X	X
4	4C	X	X
5	5C	X	X
6	6C	X	X
7	7C	X	X
8	8C	X	X

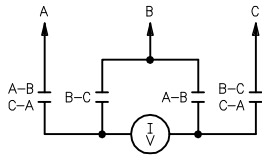
BLACK, OVAL HANDLE
REMOVABLE ONLY IN "OFF"
POSITION
ALL POSITIONS MAINTAINED

RECLOSER CONTROL
79-182CS*



CONTACTS	POSITIONS		
	ON	I	OFF
1	1C		X
2	2C		X
3	3C		X
4	4C		X

BLACK, OVAL HANDLE
SPRING RETURN TO CENTER



SWITCH
DEVELOPMENT FORMAT

NOTE 4 (TYP)

79-182CS (CHAS3F)			
CONTACTS	POSITIONS		
	OFF	ON	DRAWINGS
1	1T	X	5101
2	2T	X	5103
3	3T	X	
4	4T	X	

SBM

DRAWING WHERE
DEVELOPMENT APPEARS

NOTE 4 (TYP)

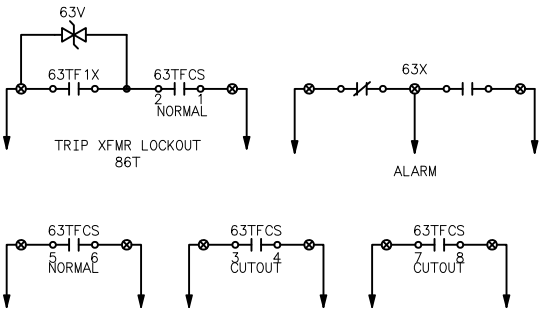
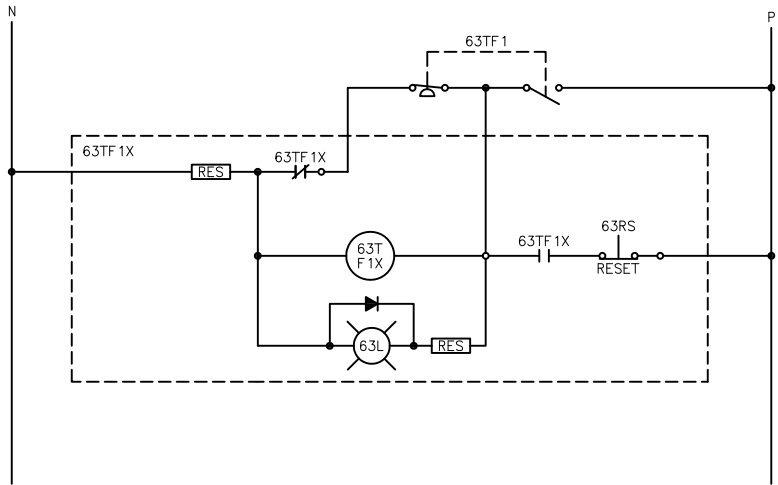
DRAWING	DEVELOPMENT
BREAKER OR MOD DC SCHEMATIC	182CS 181CS 25-182CS 79-182CS
CONTROL TRANSFER DC SCHEMATIC	43-182CS
LINE RELAYING DC SCHEMATIC	BCCS 21-1CS
VOLTAGE TRANSFORMER AC SCHEMATIC	VU1ACS
TRANSFORMER DC CONTROL SCHEMATIC	84-KV1ACS 90-KVIACS
DIFFERENTIAL DC SCHEMATIC	87B1CS 87TB1CS 182BCS

EXPLANATION

- 63TF1_ _ _ _ TRANSFORMER SUDDEN PRESSURE RELAY
63TF1X_ _ _ _ SUDDEN PRESSURE SEAL-IN RELAY
63TFCS_ _ _ _ SUDDEN PRESSURE MAINTENCE CONTROL SWITCH
63L_ _ _ _ _ INDICATING LAMP
63RS_ _ _ _ _ RESET PUSH BUTTON
63X_ _ _ _ _ ALARM AUXILIARY RELAY

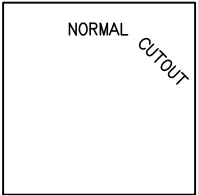
NOTES

1. THE TRANSFORMER MANUFACTURER SHALL FURNISH, MOUNT AND WIRE IN THE TRANSFORMER TERMINAL CABINET, THE SUDDEN PRESSURE AUXILIARY RELAYS AND MAINTENANCE CONTROL SWITCH.
2. A RED NAMEPLATE ENGRAVED IN WHITE "SUDDEN PRESSURE RELAY "63TFCS"" SHALL BE FURNISHED ABOVE THE MAINTENANCE CONTROL SWITCH. IN ADDITION THE CONTROL SWITCH SHALL BE FURNISHED WITH AN ESCUTCHEON PLATE WITH POSITIONS AS SHOWN.
3. THE SUDDEN PRESSURE RELAY SHALL BE QUALITROL 909 OR EQUIVALENT AND SHALL OPERATE AS SHOWN ON THIS DRAWING.



SUDDEN PRESSURE RELAY
"63TFCS"

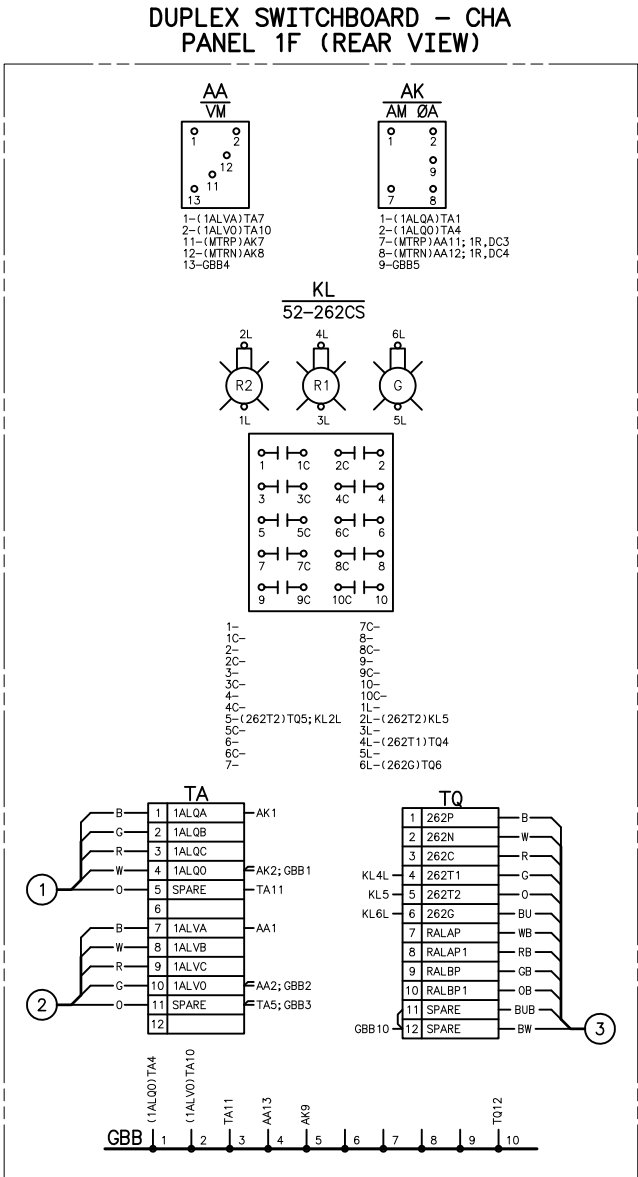
ESCUTCHEON
ENGRAVING



CONTROL SWITCH
DEVELOPMENT

CONTACT	POSITION	
	NORMAL	CUTOUT
1-2	X	
3-4		X
5-6	X	
7-8		X

E	4-21-10 A7-MVL	MINOR REVISIONS.	
	SUPERSEDES DWG NO. E40-D-6119		
	UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
	SUBSTATION STANDARDS TRANSFORMER SUDDEN PRESSURE RELAY SCHEMATIC DIAGRAM		
	DESIGNED <u>ROY G. GEARHART</u> _ _ _ _ _ APPROVED <u>W.A. JACOBY</u> CHIEF, SUBSTATION CONTROL BRANCH		
A	JUNE 8, 1979	31	4004



CONTROL CABLES

① 1JV2A-CHA1F 5/C-10 (6121)
② 1EV2A-CHA1F 5/C-10 (6112)
③ 1CHA1F-JV2A 12/C-10 (6114)

CABLE DESIGNATION CABLE SIZE DRAWING NUMBER

THE THREE PARTS COMPRISING THE CABLE INFORMATION SHOULD ALWAYS APPEAR IN THE ORDER SHOWN

NOTE

1. COPPER BRAID SHIELD AND ALL SPARE CONDUCTORS OF CABLE SHALL BE GROUNDED AT BOTH ENDS.

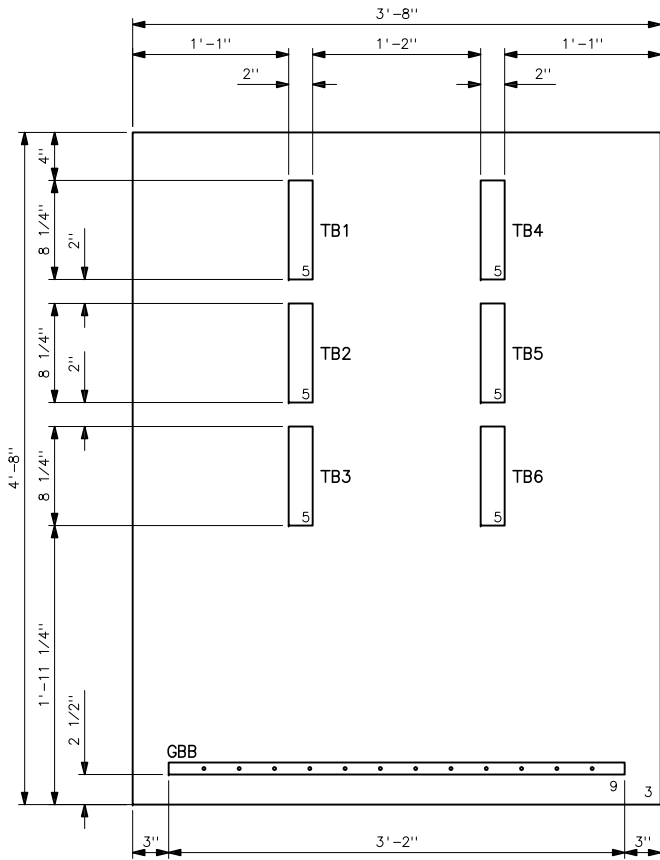
D	3-8-11 A7-JMB	MINOR REVISIONS. REMOVED SURGE SUPPRESSOR INDICATOR AND UPDATED WIRE COLOR CODE.
C	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.
B	9-13-99 A3-WAJ	REDRAWN AND REVISED.
SUPERSEDES DWG NO. 104-D-1032		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE – LAKEWOOD, COLORADO		
SUBSTATION STANDARDS DUPLEX SWITCHBOARD PANEL WIRING DIAGRAM AND CABLING METHODS		
DESIGNED W.A. JACOBY APPROVED W.A. JACOBY SYSTEM CONTROL AND PROTECTION MANAGER		
CAE	MAY 10, 1979	31 4005

COLOR SCHEME FOR MIMIC BUSES		
VOLTAGE	COLOR	APPROXIMATE COLOR NO. FEDERAL STANDARD 595
GROUND BUS	WHITE	17875
480 VOLT	BRIGHT BLUE	15123
2.4 KILOVOLT	DARK BLUE	15045
4.16 KILOVOLT	LIGHT GREEN	14533
6.9 KILOVOLT	BRIGHT GREEN	14187
11.5 KILOVOT	BLUE GREEN	14325
11.95 KILOVOLT	BLUE GREEN	14325
12.47 KILOVOLT	DARK GREEEN	14062
13.8 KILOVOLT	DARK GREEN	14062
25.2 KILOVOLT	YELLOWISH GREEN	24552 *
34.5 KILOVOLT	YELLOWISH GREEN	24552 *
41.8 KILOVOLT	YELLOW	13655
46 KILOVOLT	YELLOW	13655
57 KILOVOLT	LIGHT ORANGE	22356
69 KILOVOLT	LIGHT ORANGE	22356
115 KILOVOLT	BRIGHT ORANGE	12246
138 KILOVOLT	PINK	21668
161 KILOVOLT	LIGHT RED	21158
230 KILOVOLT	BRIGHT RED	21125
287.5 KILOVOLT	DARK RED	11136
295 KILOVOLT	DARK RED	11136
345 KILOVOLT	LAVENDER	27142
500 KILOVOLT AC	PURPLE	37144
500 KILOVOLT DC	DASHED PURPLE AND WHITE	37144 AND 17875
750 KILOVOLT AC	GOLD	11043
750 KILOVOLT DC	DASHED GOLD AND WHITE	17043 AND 17875

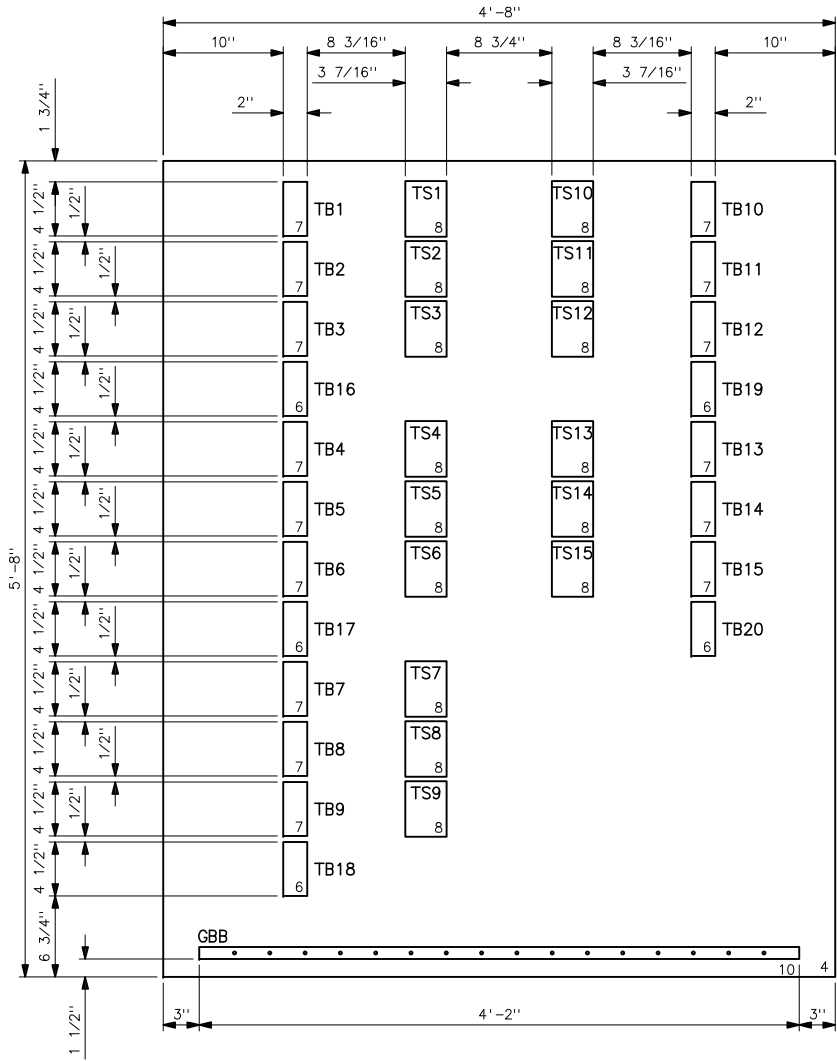
* EXCEPT IN GLOSS FINISH

C	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.	
B	9-13-99 A3-WAJ	REDRAWN.	
SUPERSEDES DWG NO. 40-D-6133			
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO			
SUBSTATION STANDARDS			
MIMIC BUS COLOR STANDARD			
DESIGNED BUREC _____ APPROVED W. A. JACOBY _____ SYSTEM CONTROL AND PROTECTION MANAGER			
C A E	FEBUARY 8, 1980	31	4008

Mar 22, 2006- 2:31pm Plotted By: Seela S:\Engineering\Standard Drawings\3\31_4008c.dwg Last Saved By: palmer IMAGES:



TYPICAL PANEL ARRANGEMENT IN INTERFACE CABINETS
TYPICAL CABINET DESIGNATIONS: (EZ1A), (EZ2A), (EZ3A), ETC.



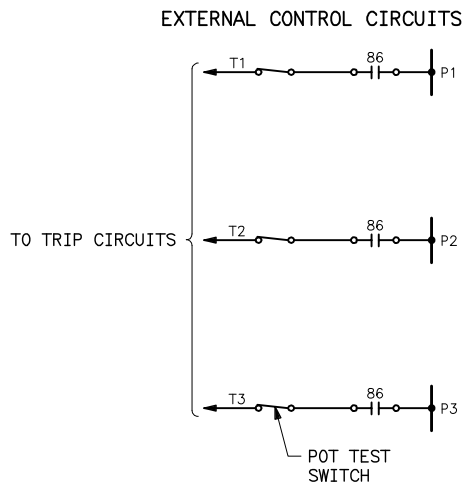
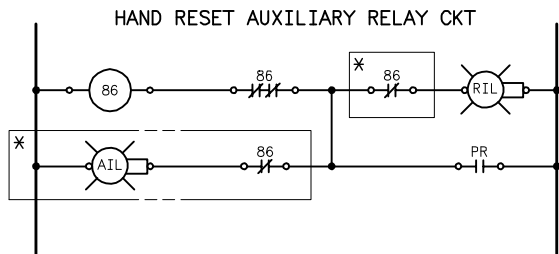
TYPICAL PANEL ARRANGEMENT IN CT JUNCTION BOX
TYPICAL CABINET DESIGNATIONS: (EZ1A), (EZ2A), (EZ3A), ETC.

TYPICAL BILL OF MATERIALS			
ITEM	DESCRIPTION	QTY	COMMENTS
1	ENCLOSURE HOFFMAN A-62H48CLP OR EQUAL	3	WITH DOOR STOP KIT, LATCH KIT AND NAMEPLATE
2	ENCLOSURE HOFFMAN A-74H60DULP OR EQUAL	1	WITH DOOR STOP KIT, LATCH KIT AND NAMEPLATE
3	PANEL HOFFMAN A-60P48 OR EQUAL	3	
4	PANEL HOFFMAN A-72P60 OR EQUAL	1	
5	TERMINAL BLOCK (TB1 THRU TB6) GE EB25A12WC OR EQUAL	18	
6	TERMINAL BLOCK (TB16 THRU TB20) GE EB25A06WC OR EQUAL	5	
7	TERMINAL BLOCK (TB1 THRU TB15) GE EB27A06SC OR EQUAL	15	
8	TEST SWITCH (TS1 THRU TS15) STATES MULTIAMP TYPE "SMH" C3-404S OR EQUAL	15	
9	GROUNDING STRIP (GBB) TINNED COPPER 1"X1/4" WITH 12 DRILLED AND TAPPED HOLES FILLED WITH 10-32 SCREWS	3	
10	GROUNDING STRIP (GBB) TINNED COPPER 1"X1/4" WITH 16 DRILLED AND TAPPED HOLES FILLED WITH 10-32 SCREWS	1	
11	MISC HARDWARE SUCH AS SCREWS, BOLTS, NUTS, TYRAPS, WIRE, ETC.	AS REQD	

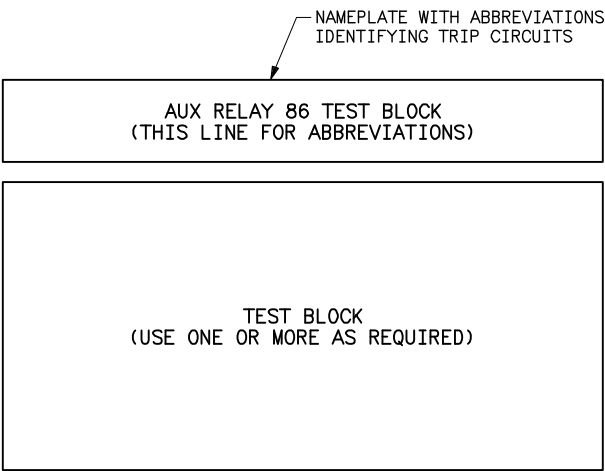
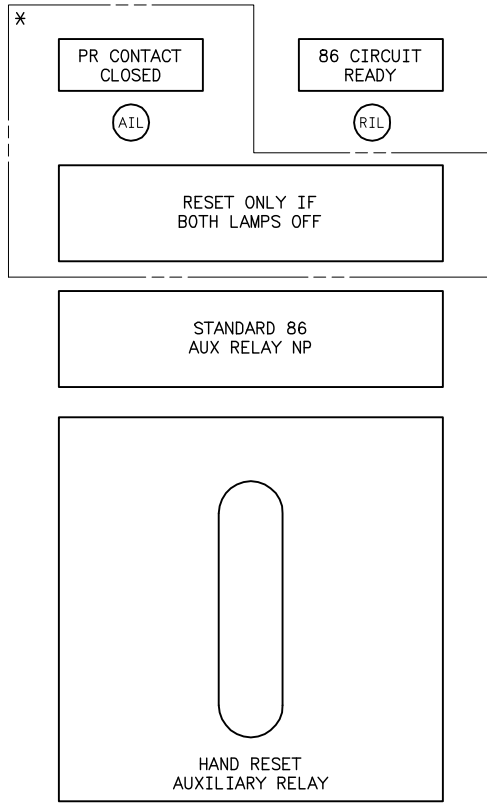
NOTES

1. PROVIDE GASKETED CONDUIT HUBS AT THE BOTTOM OF ENCLOSURE AS REQUIRED FOR CONTROL CABLE ENTRY.
2. THE CONTRACTOR SHALL TERMINATE CONTROL CABLES AT TERMINAL BLOCKS AND PERFORM WIRING BETWEEN TERMINAL BLOCKS AND TEST SWITCHES PER DRAWING(S) TO BE FURNISHED BY GOVERNMENT AT A LATER DATE. STRANDED NO. 14 AWG COPPER THW WIRE SHALL BE LETTERED WITH BL PERMANENT BLACK INK ON A WHITE HEAT SHRINK MARKING SLEEVE FOR EACH WIRE.
3. PROVIDE 3/4"x1/2" NAMEPLATES FOR EACH DEVICE. NAMEPLATE MATERIAL IS LAMINATED PHENOL RESIN SHEET 1/16" THICK - BLACK SURFACE AND WHITE CENTER ENGRAVE DESIGNATIONS TB1, TB2, ETC.

B	6-25-12 A7-DF	MINOR REVISIONS, CONVERTED DIMENSIONS AND UPDATED TITLE BLOCK TO CURRENT STANDARD.	
	4-24-96 A3-RPD	REVISED AND REDRAWN TO UPDATE STANDARD DWG.	
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO			
CONTROL STANDARDS TYPICAL ARRANGEMENT DETAILS CT JUNCTION BOXES AND INTERFACE CABINETS			
DESIGNED <u>J.B. JENNISON</u> _____ APPROVED <u>H. ELGHANDOUR</u> _____ CHIEF, SUBSTATION CONTROL BRANCH			
CA	MARCH 9, 1993	31	4018



DESIRED LOCATION OF LAMPS AND NAMEPLATES

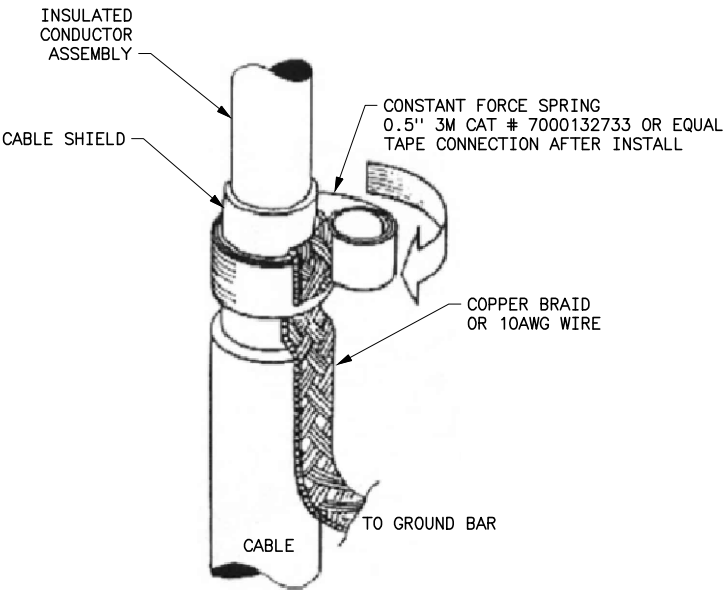
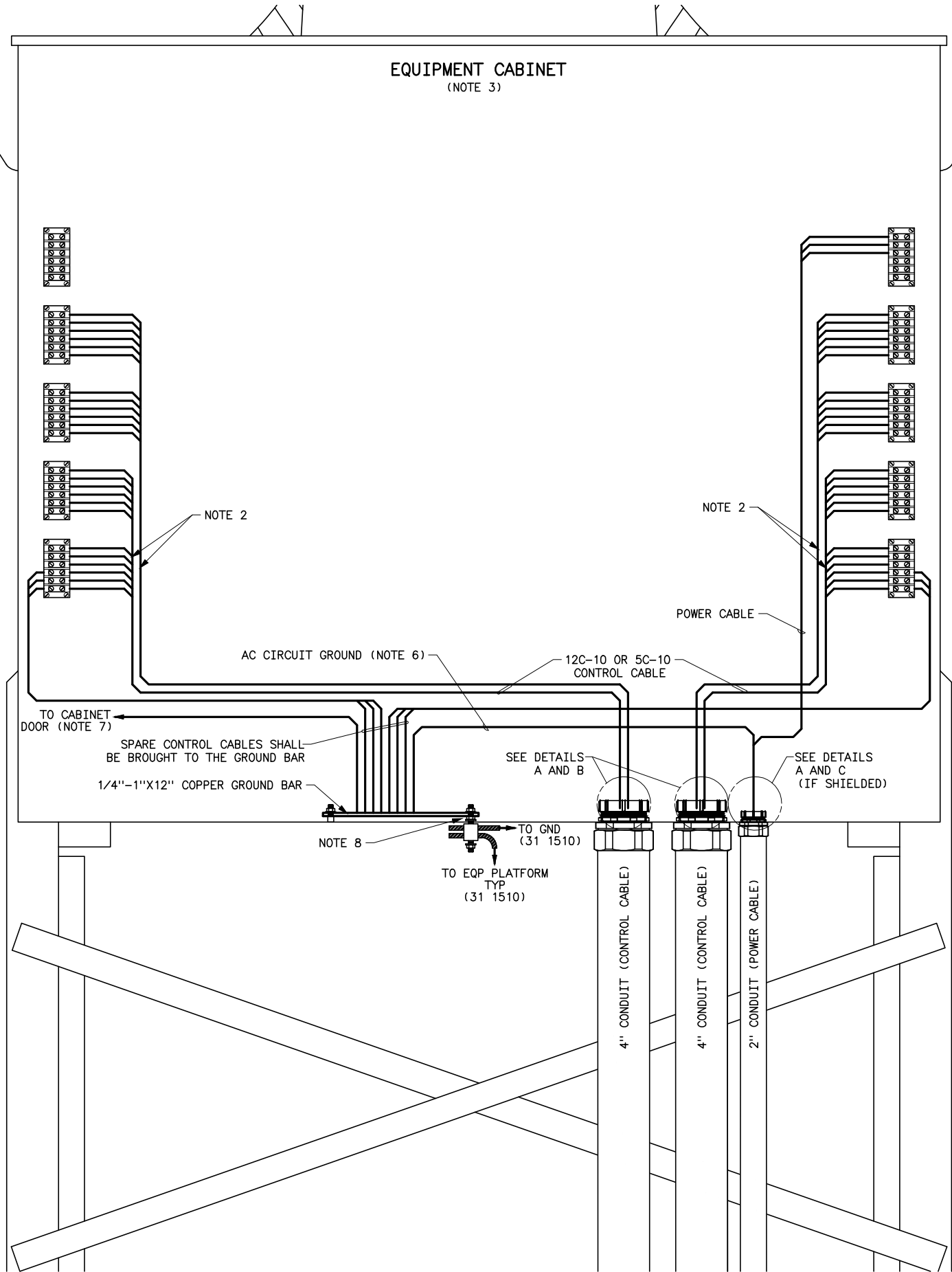


EXPLANATION

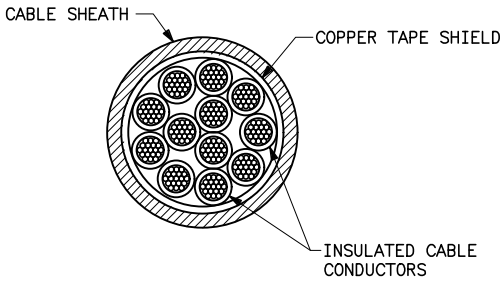
* _ _ _ _ INDICATES AMBER LAMP MONITOR CIRCUIT IS REQUIRED ONLY IF THE PR CONTACT IS A MAINTAINED TYPE SUCH AS ANOTHER HAND RESET AUXILIARY RELAY CONTACT OR A TEMPERATURE RELAY CONTACT, ETC. IF AMBER LAMP MONITOR CIRCUIT IS NOT REQUIRED, THE RED LAMP AND LAMP NAMEPLATE SHALL BE CENTERED ABOVE THE AUX RELAY NAMEPLATE.

PR _ _ _ _ INDICATES PROTECTIVE RELAY

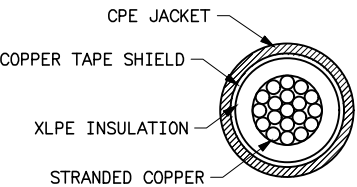
C	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.	
B	7-18-94 A2-JBJ	REDRAWN ON WESTERN CAE SYSTEM.	
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO			
SUBSTATION STANDARDS HAND RESET AUXILIARY RELAY TEST AND MONITOR CIRCUITS			
DESIGNED <u>U.S.B.R.</u> _____		APPROVED <u>JOHN W. WORK</u> CHIEF, SUBSTATION CONTROL BRANCH	
C A_E	AUGUST 20, 1979	31	5103



DETAIL A
LONGITUDINAL CABLE SECTION



DETAIL B
CONTROL CABLE
CROSS SECTION



DETAIL C
SHIELDED POWER CABLE
CROSS SECTION

NOTES

1. THIS DRAWING SHOWS THE PREFERRED METHOD OF GROUNDING THE CABLE SHIELD. OTHER METHODS MAY BE USED PER COR APPROVAL.
2. CABLES SHALL BE ORDERLY AND DRESSED WITH ENOUGH SLACK KEPT TO REACH THE FARTHEST TERMINAL BLOCK AFTER INSTALLATION.
3. DETAILS ARE SHOWN FOR A TYPICAL POWER CIRCUIT BREAKER CABINET, BUT SHALL APPLY TO ALL EQUIPMENT AND TERMINATION CABINETS.
4. CONDUIT IS TERMINATED USING A WATERTIGHT CONDUIT HUB WITH AN INSULATED THROAT. USE APPLETON "UNI-SEAL" TYPE HUB, CROUSE-HINDS TYPE HUB, OR EQUAL.
5. CATALOG REFERENCES SHOWN ARE FOR COMPARISON OF TYPE, DESIGN, CHARACTER OR QUALITY OF ITEM DESIRED AND DO NOT PROHIBIT ITEMS THAT ARE EQUIVALENT.
6. FOR NON-SHIELDED POWER CABLES, REQUIRED AC CIRCUIT GROUND SHALL BE TERMINATED AT THE CABINET GROUND BAR.
7. IF CABINET/TERMINAL BOX DOOR HAS A FACTORY INSTALLED BONDING STUD, A 10AWG JUMPER SHALL BE INSTALLED TO BOND THE DOOR TO THE GROUND BAR.
8. IF CABINET GROUND BAR IS NOT DIRECTLY CONNECTED TO THE ENCLOSURE BONDING LUG, A 10AWG JUMPER SHALL BE PROVIDED TO BOND THE GROUND BAR TO CABINET LUG.

REFERENCE DRAWING

GROUNDING PLANS TYPICAL DETAILS----- 31 1510

F	3/13/26 A7-KV	CHANGED SHIELD GROUND PREFERENCE TO CONSTANT FORCE SPRING. ADDED SHIELDED POWER CABLE DETAILS, UPDATED NOTES.
E	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.
D	2-11-94 A2-RPD	MINOR REVISIONS
C	4-7-93 A2-RPD	REVISED TO SHOW SLACK CABLES
B	9-10-92 A2-RPD	REDRAWN
SUPERSEDES DWG NO. 104-D-944		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS		
EQUIPMENT CABINET SHIELDED CABLE GROUNDING		
DESIGNED BUREC _____ APPROVED W. A. JACOBY ELECTRICAL ENGINEERING MANAGER		
C _A E	MARCH 14, 1979	31 6000

Mar 22, 2006- 2:34pm Plotted By: Seela S:\Engineering\Standard Drawings\31\31_6005a.dwg Last Saved By: palmer IMAGES:

NEMA IDENTIFICATION COLOR CODE FOR CONTROL CABLES

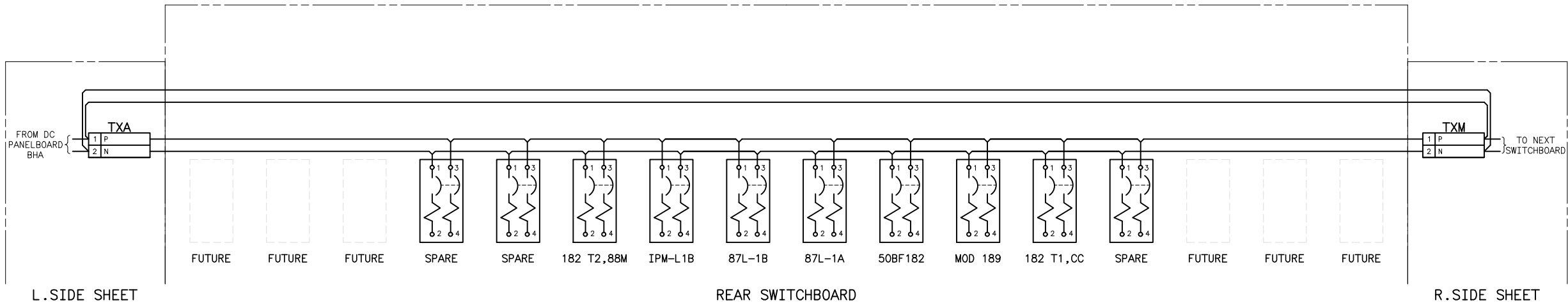
CABLE	NUMBER	ABBRE- VIATION	BASE	TRACER	TRACER
2/C	1	B	BLACK		
	2	W	WHITE		
3/C	3	R	RED		
5/C	4	G	GREEN		
	5	O	ORANGE		
7/C	6	BU	BLUE		
	7	WB	WHITE	BLACK	
9/C	8	RB	RED	BLACK	
	9	GB	GREEN	BLACK	
12/C	10	OB	ORANGE	BLACK	
	11	BUB	BLUE	BLACK	
	12	BW	BLACK	WHITE	
16/C	13	RW	RED	WHITE	
	14	GW	GREEN	WHITE	
	15	BUW	BLUE	WHITE	
	16	BR	BLACK	RED	
37/C	17	WR	WHITE	RED	
	18	OR	ORANGE	RED	
	19	BUR	BLUE	RED	
	20	RG	RED	GREEN	
	21	OG	ORANGE	GREEN	
	22	BWR	BLACK	WHITE	RED
	23	WBR	WHITE	BLACK	RED
	24	RBW	RED	BLACK	WHITE
	25	GBW	GREEN	BLACK	WHITE
	26	OBW	ORANGE	BLACK	WHITE
	27	BUBW	BLUE	BLACK	WHITE
	28	BRG	BLACK	RED	GREEN
	29	WRG	WHITE	RED	GREEN
	30	RBG	RED	BLACK	GREEN
	31	GBO	GREEN	BLACK	ORANGE
	32	OBG	ORANGE	BLACK	GREEN
	33	BUWO	BLUE	WHITE	ORANGE
	34	BWO	BLACK	WHITE	ORANGE
	35	WRO	WHITE	RED	ORANGE
	36	OWBU	ORANGE	WHITE	BLUE
	37	WRBU	WHITE	RED	BLUE

NOTES

1. WHERE POSSIBLE FIELD WILL CONNECT INDIVIDUAL WIRES OF MULTICONDUCTOR CABLES TO TERMINAL BLOCKS IN THE ORDER SHOWN ABOVE, FROM TOP TO BOTTOM FOR VERTICAL BLOCKS AND LEFT TO RIGHT FOR HORIZONTAL.
2. ACTUAL BASE AND TRACER COLORS SHALL BE USED. PRINTED CONDUCTOR NUMBERS AND COLOR DESIGNATIONS WILL NOT BE ACCEPTABLE.

A	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.	
	SUPERSEDES DWG NO. 31-1076		
	UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
	SUBSTATION STANDARDS CONTROL CABLE COLOR CODE IDENTIFICATION		
	DESIGNED _____ APPROVED <u>W. A. JACOBY</u> DIRECTOR, DIVISION OF SUBSTATION DESIGN		
C A E	NOVEMBER 13, 1989	31	6005

LEGACY SWITCHBOARD DC BUS CONNECTIONS (SINGLE DC SOURCE;BHA)

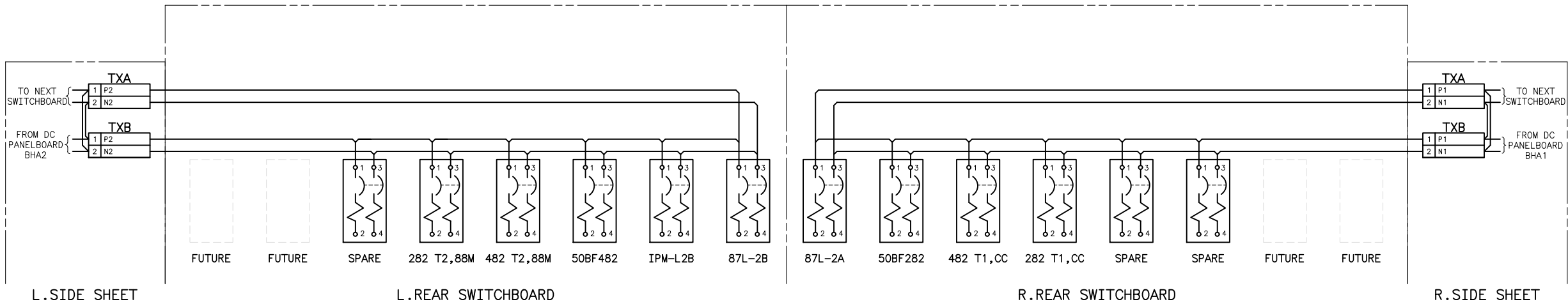


EXPLANATION

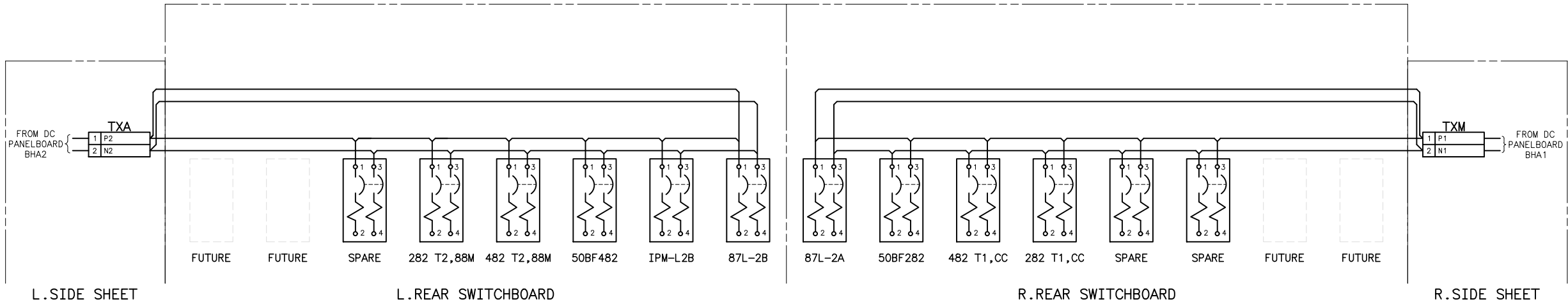
NOTES

1. THE OPTIONS SHOWN PROVIDE A METHOD TO REPLACE A CIRCUIT BREAKER WITHOUT DISCONNECTING THE POWER TO THE SWITCHBOARD.
2. THE TERM "LEGACY" APPLIES PRIMARILY TO DUPLEX SWITCHBOARD DESIGNS PRIOR TO 2010 WHEN THE DIGITAL CONTROL STANDARD (DCS) WAS ESTABLISHED.
3. DCS DESIGNS AFTER 2010 USE TWO DC DISTRIBUTION PANELBOARDS (BHA1 & BHA2) TO PROVIDE REDUNDANT SUPPLIES OF DC POWER.
4. BHA1 PROVIDES POWER NAMED DC1 AND SHOWN AS "P1" TO A-SET RELAYS,PCB CLOSE COIL AND TRIP COIL 1.
5. BHA2 PROVIDES POWER NAMED DC2 AND SHOWN AS "P2" TO B-SET RELAYS,PCB TRIP COIL 2 AND THE MOTOR.
6. USE TWO 2-POLE DC POWER BLOCKS PER SWITCHBOARD SIDE (4 TOTAL) WHEN THE DC DISTRIBUTION PANELBOARD BRANCH CIRCUIT BREAKER SUPPLIES MULTIPLE SWITCHBOARDS WITH THE SAME CIRCUIT BREAKER.
7. OPTIONAL;USE ONE 2-POLE DC POWER BLOCK PER SWITCHBOARD SIDE (2 TOTAL) WHEN THE DC DISTRIBUTION PANELBOARD BRANCH CIRCUIT BREAKER SUPPLIES ONLY ONE SWITCHBOARD.

TYPICAL DIGITAL CONTROL STANDARD (DCS) SWITCHBOARD DC BUS CONNECTIONS (DUAL DC SOURCE;BHA1 & BHA2)



OPTIONAL DIGITAL CONTROL STANDARD (DCS) SWITCHBOARD DC BUS CONNECTIONS (DUAL DC SOURCE;BHA1 & BHA2)

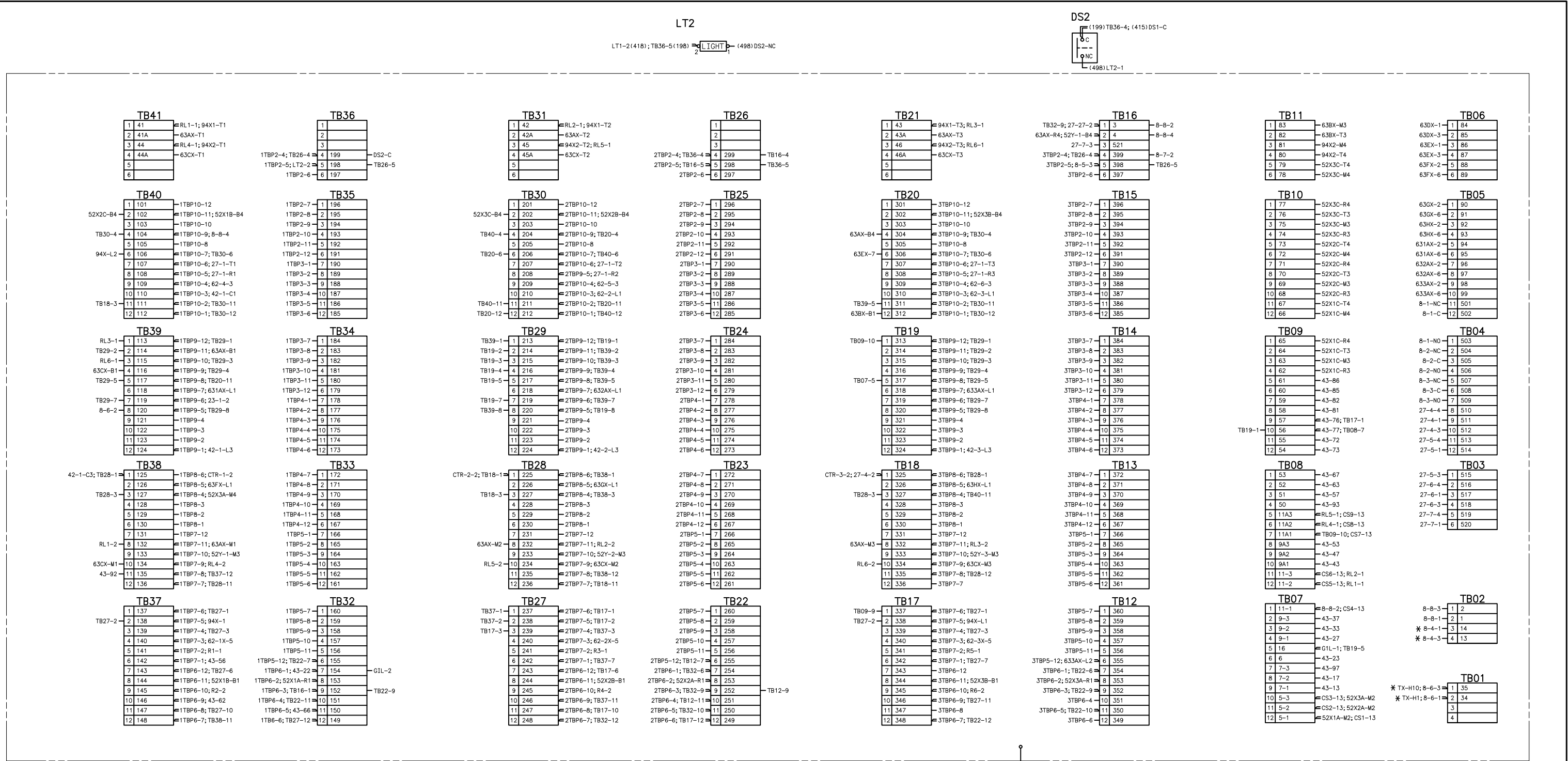


A	4-17-26 A7-DWS	UPDATED TO SHOW DCS DC CIRCUIT BREAKER CONNECTIONS.	
	UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - GOLDEN, COLORADO		
STANDARD DRAWING			
SWITCHBOARD DC CIRCUIT BUS			
WIRING DIAGRAM			
DESIGNED <u>VAN LE</u> -----		RECOMMENDED <u>RANDY DIEDE</u> -----	
DRAWN <u>C. KNEZEL</u> -----		APPROVED <u>W.A. JACOBY</u> -----	
CHECKED <u>RANDY DIEDE</u> -----		CHIEF, SUBSTATION CONTROL BRANCH	
A7	FEBRUARY 11, 1994	31	6010

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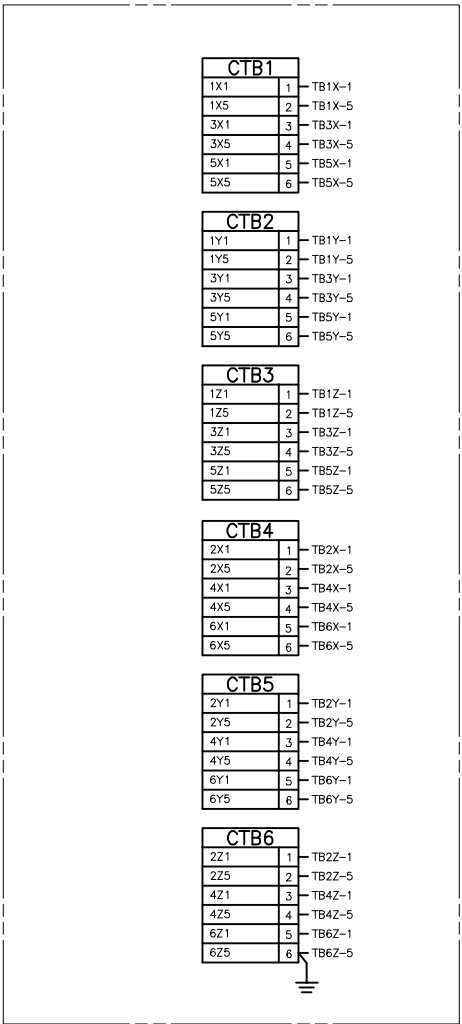
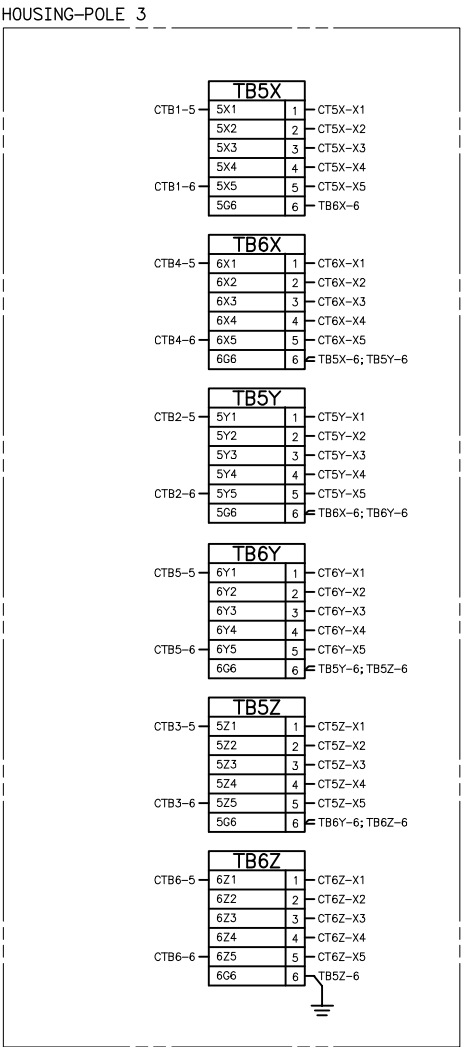
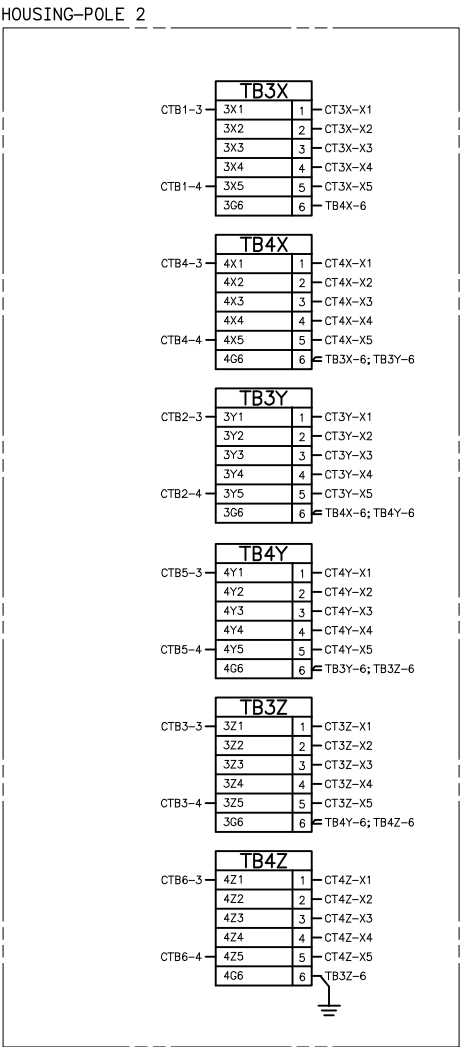
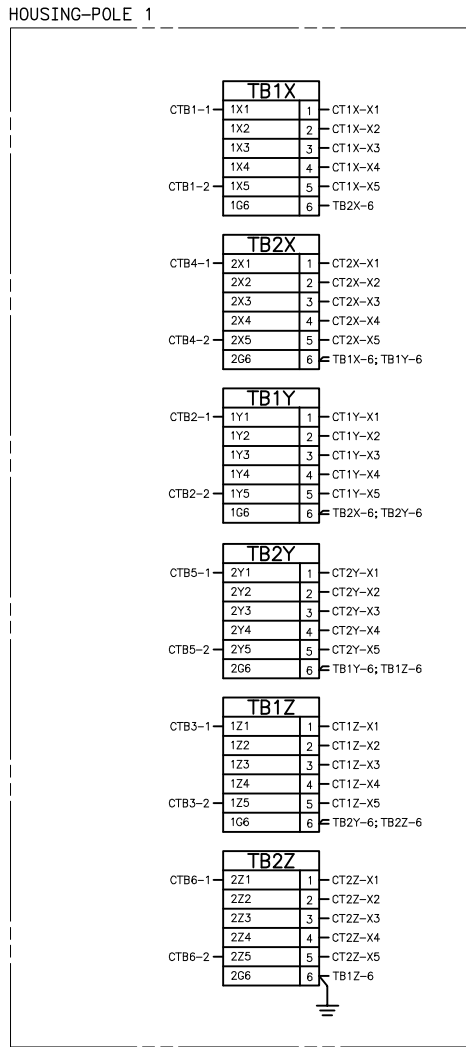
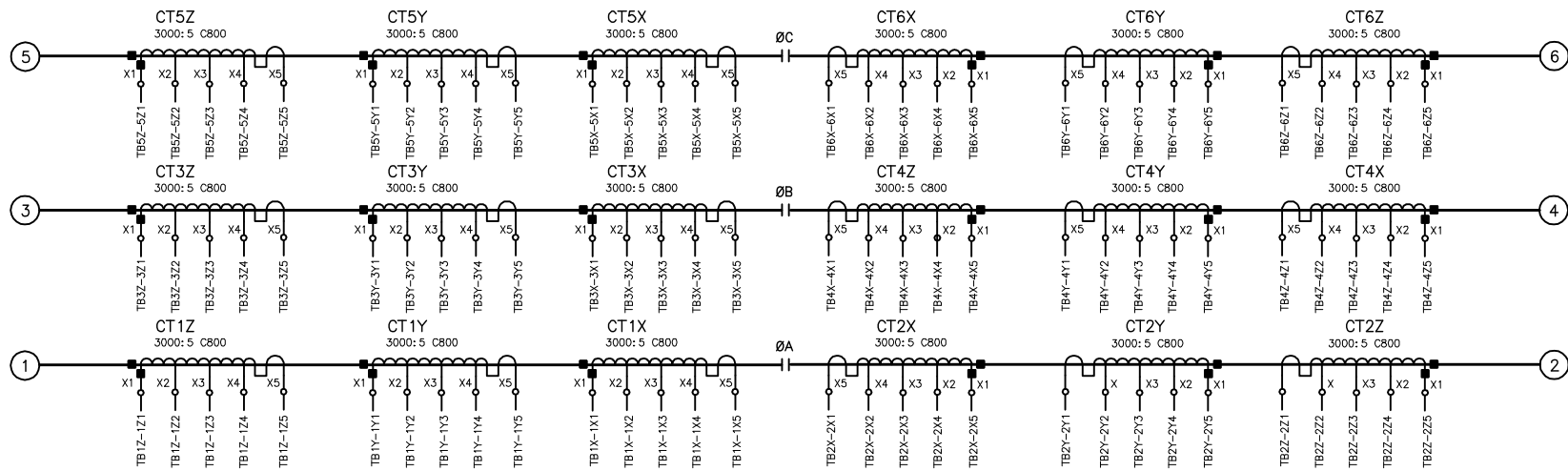
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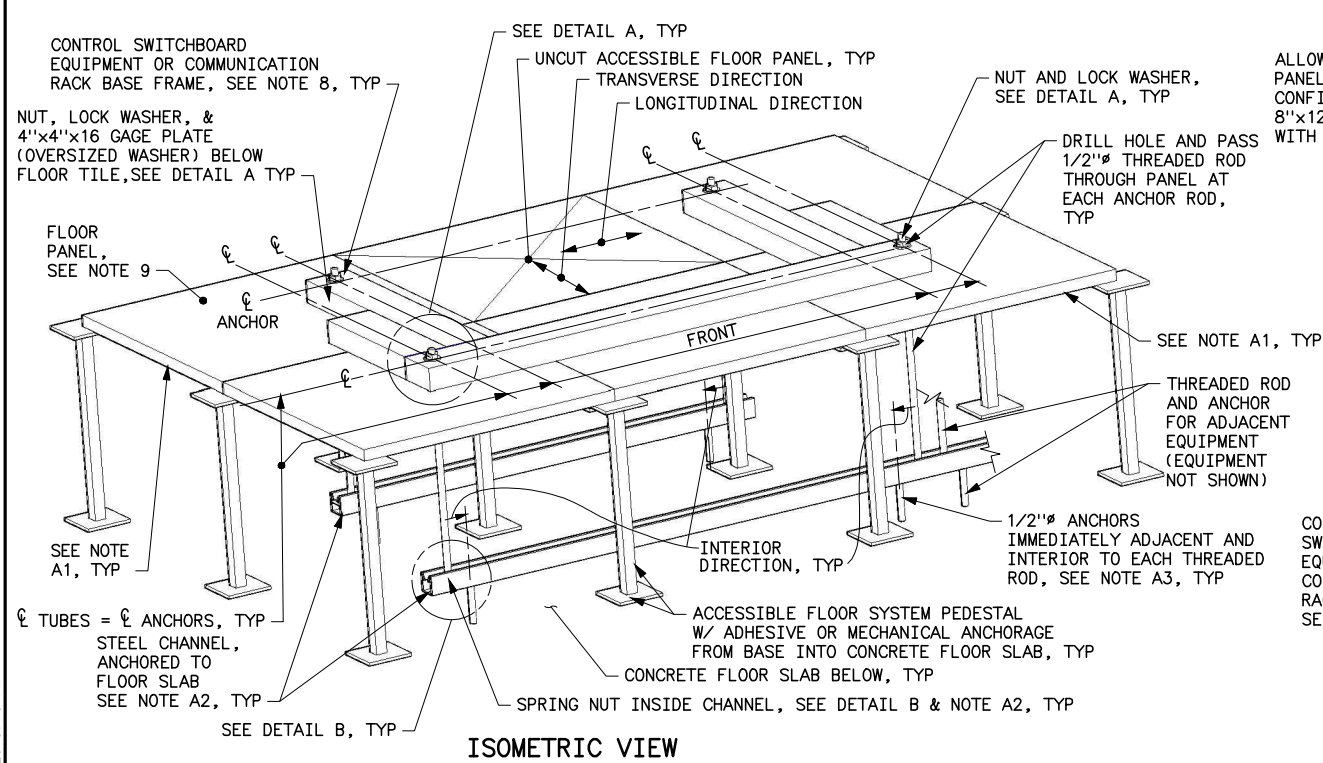


EXPLANATION
* _ _ _ _ _ DENOTES NO. 10 AWG SIS WIRE

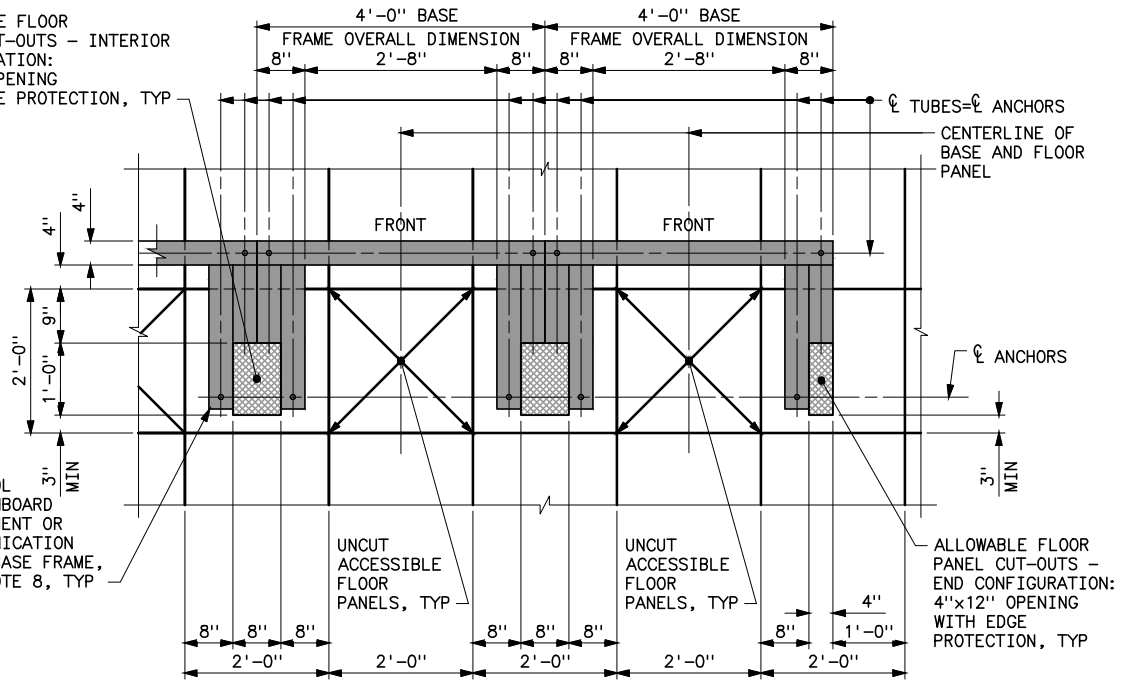
B	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.			
	A	7-27-99 A3-CLC	REMOVED REFERENCE DRAWINGS		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO					
SUBSTATION STANDARDS TYPICAL POWER CIRCUIT BREAKER WIRING DIAGRAM (SH 1 OF 3)					
DESIGNED MFR _____ APPROVED H. ELGHANDOUR CHIEF, SUBSTATION CONTROL BRANCH					
C	A	JULY 13, 1994	31	6011	



B	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.		
A	7-27-99 A3-CLC	REMOVED REFERENCE DRAWINGS		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO				
SUBSTATION STANDARDS TYPICAL POWER CIRCUIT BREAKER WIRING DIAGRAM (SH 2 OF 3)				
DESIGNED <u>MFR</u> _____ APPROVED <u>H. ELGHANDOUR</u> _____ CHIEF, SUBSTATION CONTROL BRANCH				
A	JULY 13, 1994	31	6012	



ALLOWABLE FLOOR
PANEL CUT-OUTS - INTERIOR
CONFIGURATION:
8"x12" OPENING
WITH EDGE PROTECTION, TYP



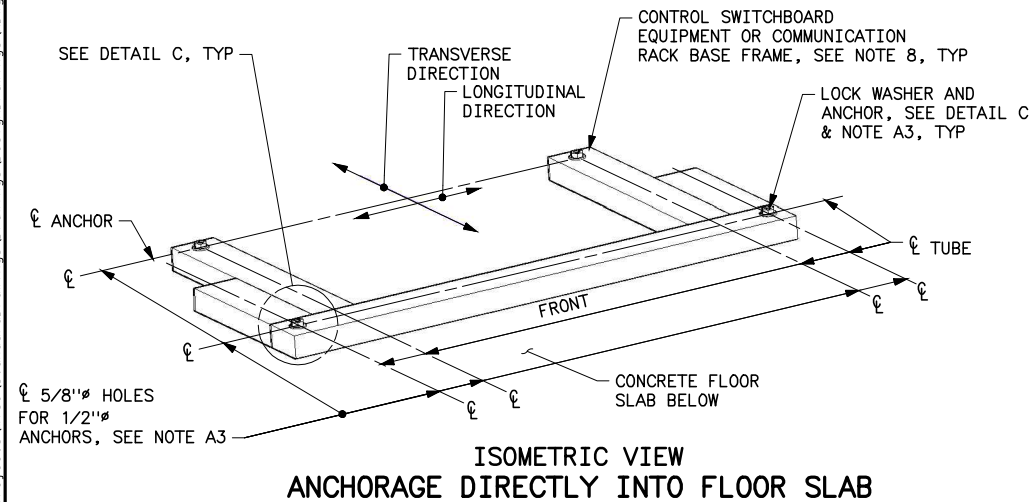
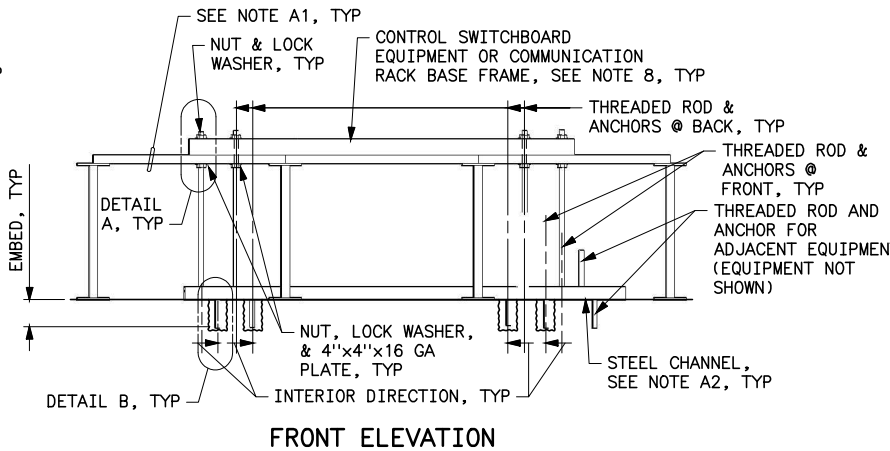
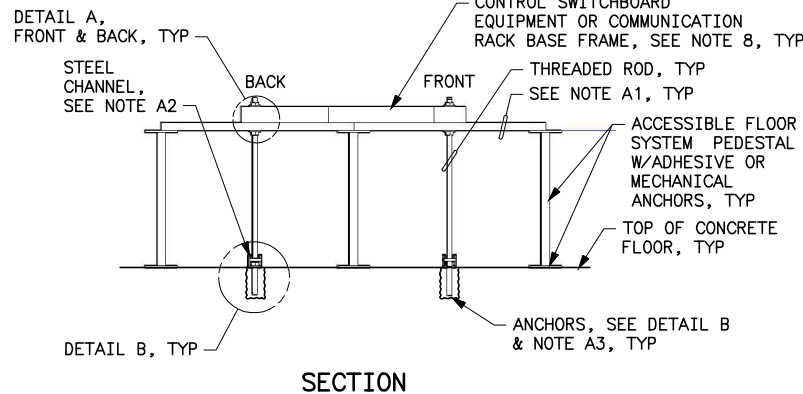
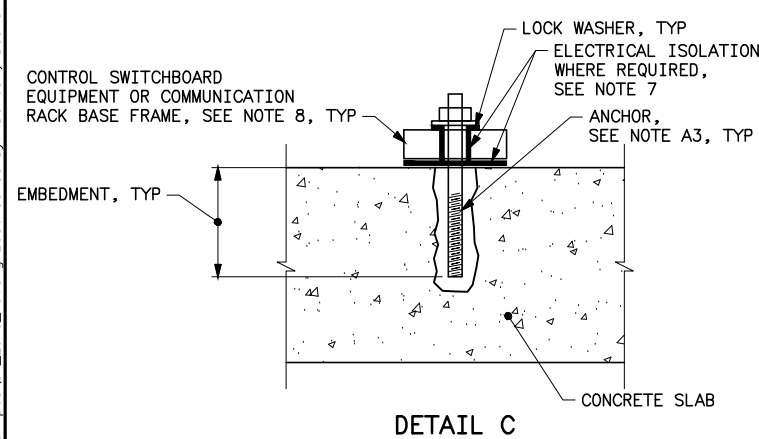
PLAN - BASE FRAME RELATIONSHIP TO FLOOR PANELS &
ALLOWABLE FLOOR PANEL CUT-OUTS, SEE NOTES 4 & 9

GENERAL NOTES

1. BASE ANCHORAGE DETAILS SHOWN ON THIS SHEET ARE MINIMUM REQUIREMENTS APPLICABLE FOR ALL IBC SEISMIC DESIGN CATEGORIES (SDC), ALL IEEE 693 SEISMIC QUALIFICATION LEVELS (SQL), AND ALL NON-SPECIFIED LOCATIONS.
2. FOR CONTROL SWITCHBOARD EQUIPMENT OR COMMUNICATION RACK LOCATIONS, SEE ARCHITECTURAL FLOOR PLAN AND BUILDING ARRANGEMENT, CONDUIT & GROUNDING DRAWING.
3. REFER TO SPECIFICATIONS FOR IEEE 693 SEISMIC QUALIFICATION LEVEL (SQL) AND/OR BUILDING GENERAL STRUCTURAL NOTES (GSN) FOR IBC SEISMIC DESIGN CATEGORY (SDC).
4. REGARDING CABLE CUTOUPS FOR INSTALLATION OF CONTROL SWITCHBOARD EQUIPMENT OR COMMUNICATION RACKS: DO NOT CUT STRUCTURAL STRINGERS SPANNING BETWEEN TOPS OF FLOOR PEDESTALS; DO NOT CUT STIFFENED PERIMETER SECTIONS OF FLOOR PANELS; AND DO NOT CUT WITHIN 3" OF FLOOR PANEL EDGES IN ANY DIRECTION.
5. CONTROL SWITCHBOARD EQUIPMENT OR COMMUNICATION RACK BASE FRAME IS SHOWN IN CONCEPT ONLY; REFER TO MANUFACTURER FOR ACTUAL CONFIGURATION AND DETAILS (TO BE COMPATIBLE WITH ANCHORAGE REQUIREMENTS SHOWN).
6. FOR APPROVAL PRIOR TO INSTALLATION, SUBMIT SEISMIC OUTLINE DRAWING (PER IEEE 693) AND SHOP DETAIL DRAWINGS OF BASE SHOWING COMPONENTS AND ANCHOR LOCATIONS.
7. REFER TO 53 7051, ELECTRICAL STANDARDS & SPECIFICATIONS FOR EQUIPMENT REQUIRING ELECTRICAL ISOLATION BETWEEN ANCHOR & BASE; AND BETWEEN ANCHOR, THROUGH RAISED FLOOR INTO CONCRETE SLAB.
8. CONTROL SWITCHBOARD EQUIPMENT OR COMMUNICATIONS RACK SIDE WALL FRAMES NOT SHOWN FOR CLARITY.
9. COORDINATE W/ ARCHITECTURAL FLOOR PLAN REGARDING FLOOR PANEL LAYOUT.

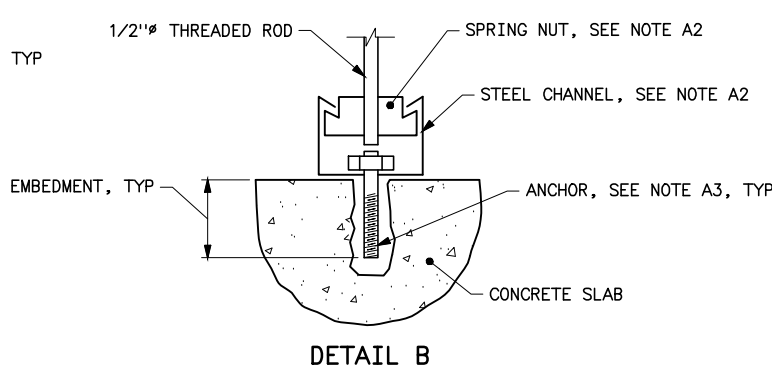
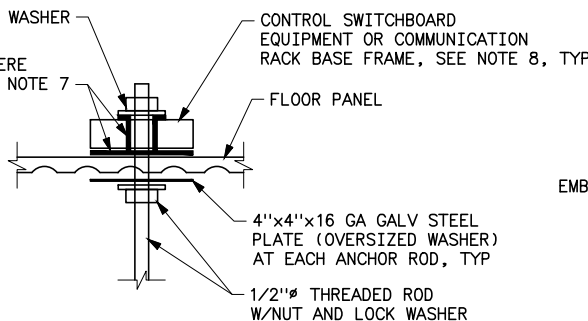
OPTION A NOTES

- A1. STRINGERS BETWEEN TOPS OF FLOOR PEDESTALS NOT SHOWN FOR CLARITY.
- A2. UNISTRUT SYSTEM (OR EQUAL): P1000T, 12 GAUGE, 1 5/8" GALVANIZED STEEL CHANNEL; P1010 CHANNEL NUT WITH SPRING THREADED FOR 1/2" ROD.
- A3. ANCHOR OPTIONS:
 - A. HILTI (OR EQUAL) HIT-RE 500-SD EPOXY ANCHORING SYSTEM: 1/2" HILTI HAS THREADED RODS WITH 4 1/2" MIN EMBEDMENT INTO CONCRETE SLAB.
 - B. HILTI (OR EQUAL) KWIK BOLT TZ-SS 304 EXPANSION ANCHORS: 1/2" WITH 3 1/4" MIN EMBEDMENT INTO CONCRETE SLAB.



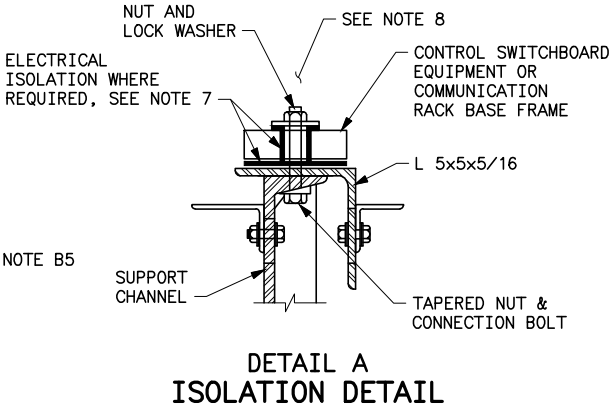
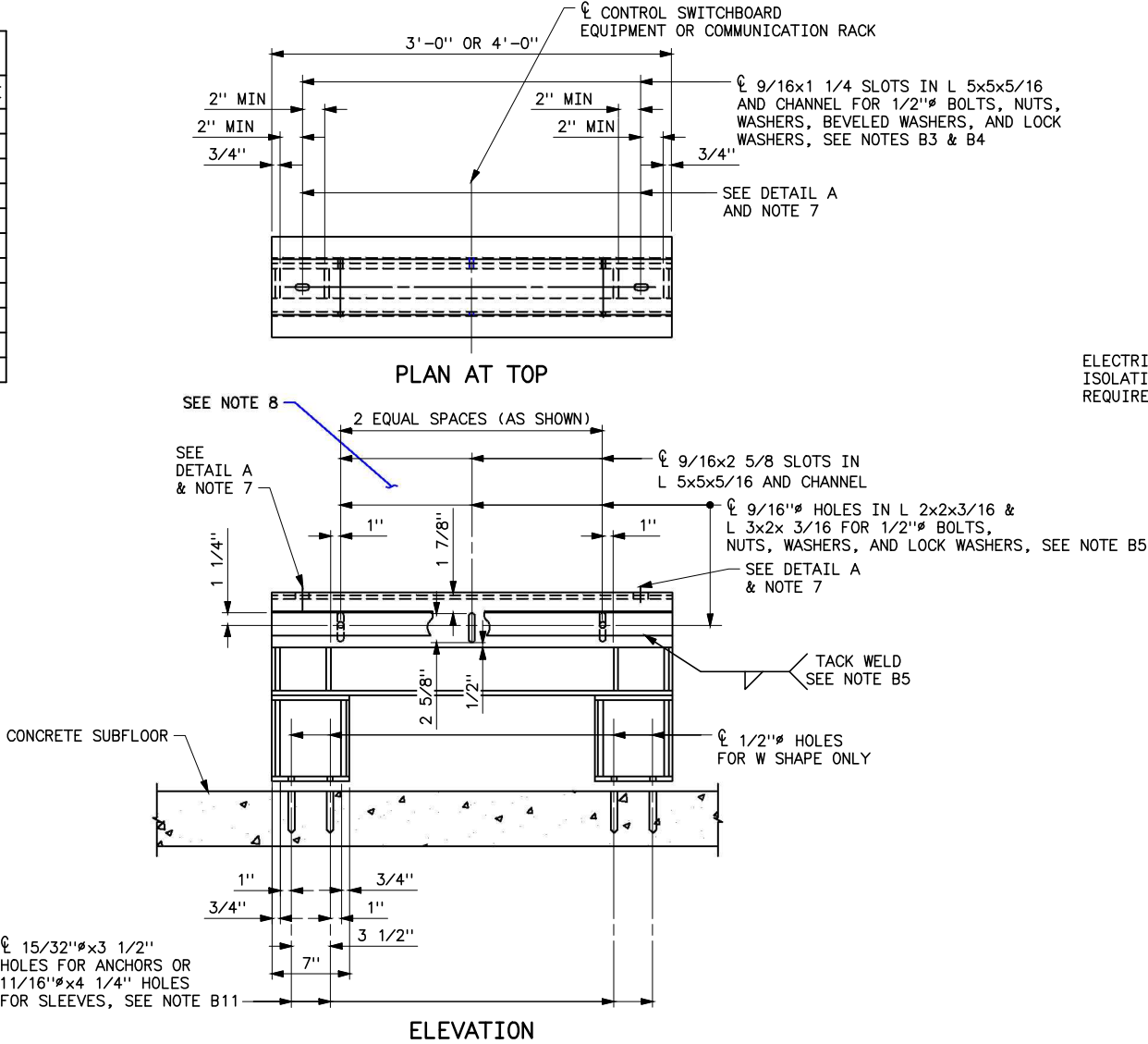
DETAIL A

ANCHORAGE THROUGH RAISED FLOOR INTO FLOOR SLAB BELOW
OPTION A: THREADED ROD & CHANNEL SYSTEM



B	10-5-20 A7-JAS	REMOVED A3.C.
A	3-23-18 A7-JAS	UPDATED FOR NEW BASE ASSEMBLY CONFIGURATION: ADDED PLAN - BASE FRAME RELATIONSHIP TO FLOOR PANELS & ALLOWABLE FLOOR PANEL CUT-OUTS.
SUPERSEDES DWG NO. 31_2049A (IN PART)		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS CONTROL SWITCHBOARD EQUIPMENT & COMMUNICATION RACK BASE ANCHORAGE DETAILS (SHEET 1 OF 2)		
DESIGNED J. SCHREIBER ----- APPROVED D. HANSON CIVIL ENGINEERING MANAGER		
A	OCTOBER 13, 2016	31 2049-1

OPTION B: W SHAPE & CHANNEL COMBINATIONS						
ACCESS FLOOR HEIGHT (IN)	W SHAPE	CHANNEL	TOTAL BASE HEIGHT (IN)		ESTIMATED WEIGHT (LBS)	
			MIN	MAX	4-FT BASE	3-FT BASE
12	W 4x13	MC 7x19.1	12.0	12.6	175	140
15	W 5x19	C 9x20	15.0	15.6	180	145
16	W 6x20	C 9x20	16.0	16.6	185	150
17	W 6x20	C 10x20	17.0	17.6	185	150
18	W 8x24	C 9x20	17.7	18.3	190	155
19	W 8x24	C 10x20	18.7	19.3	190	155
20	W 10x22	C 9x20	19.7	20.3	195	160
21	W 10x22	C 10x20	20.7	21.3	195	160
22	W 12x26	C 9x20	21.7	22.3	200	165
23	W 12x26	C 10x20	22.7	23.3	200	165
24	W 14x30	C 9x20	23.7	24.3	205	170



- GENERAL NOTES**
1. BASE ANCHORAGE DETAILS SHOWN ON THIS SHEET ARE MINIMUM REQUIREMENTS APPLICABLE FOR ALL IBC SEISMIC DESIGN CATEGORIES (SDC), ALL IEEE 693 SEISMIC QUALIFICATION LEVELS (SQL), AND ALL NON-SPECIFIED LOCATIONS.
 2. FOR CONTROL SWITCHBOARD EQUIPMENT OR COMMUNICATION RACK LOCATIONS, SEE ARCHITECTURAL FLOOR PLAN AND BUILDING ARRANGEMENT, CONDUIT & GROUNDING DRAWING.
 3. REFER TO SPECIFICATIONS FOR IEEE 693 SEISMIC QUALIFICATION LEVEL (SQL) AND/OR BUILDING GENERAL STRUCTURAL NOTES (GSN) FOR IBC SEISMIC DESIGN CATEGORY (SDC).
 4. REGARDING CABLE CUTOUTS FOR INSTALLATION OF CONTROL SWITCHBOARD EQUIPMENT OR COMMUNICATION RACKS: DO NOT CUT STRUCTURAL STRINGERS SPANNING BETWEEN TOPS OF FLOOR PEDESTALS; DO NOT CUT STIFFENED PERIMETER SECTIONS OF FLOOR PANELS; AND DO NOT CUT WITHIN 3' OF FLOOR PANEL EDGES IN ANY DIRECTION.
 5. CONTROL SWITCHBOARD EQUIPMENT OR COMMUNICATION RACK BASE FRAME IS SHOWN IN CONCEPT ONLY; REFER TO MANUFACTURER FOR ACTUAL CONFIGURATION AND DETAILS (TO BE COMPATIBLE WITH ANCHORAGE REQUIREMENTS SHOWN).
 6. FOR APPROVAL PRIOR TO INSTALLATION, SUBMIT SEISMIC OUTLINE DRAWING (PER IEEE 693) AND SHOP DETAIL DRAWINGS OF BASE SHOWING COMPONENTS AND ANCHOR LOCATIONS.
 7. REFER TO 53 7051, ELECTRICAL STANDARDS & SPECIFICATIONS FOR EQUIPMENT REQUIRING ELECTRICAL ISOLATION BETWEEN ANCHOR & BASE.
 8. CONTROL SWITCHBOARD EQUIPMENT OR COMMUNICATIONS RACK SIDEWALL FRAMES NOT SHOWN FOR CLARITY.
 9. COORDINATE W/ARCHITECTURAL FLOOR PLAN REGARDING FLOOR PANEL LAYOUT.

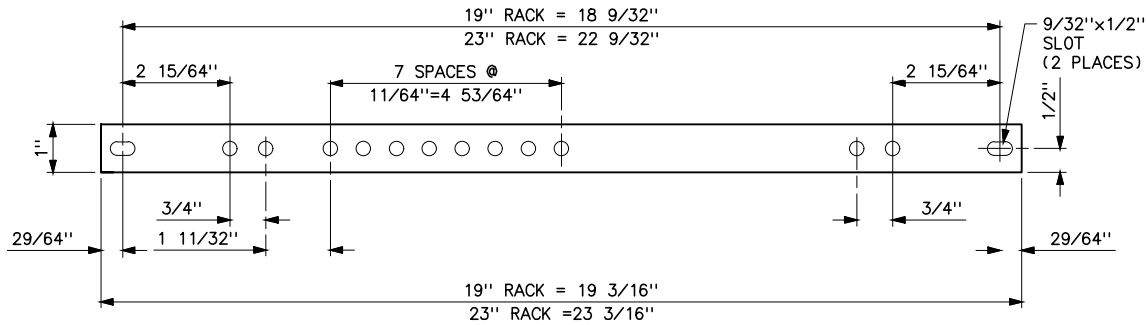
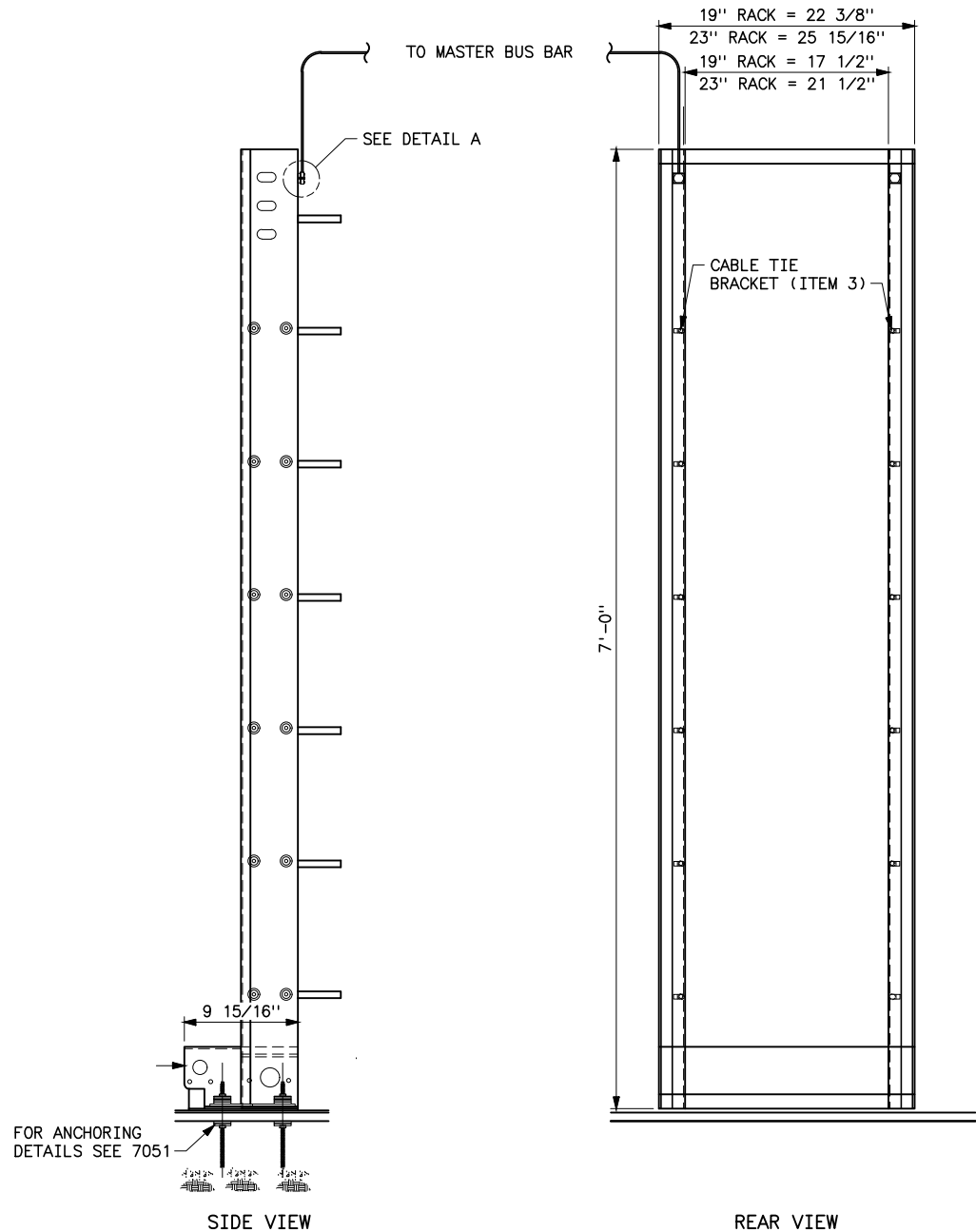
- OPTION B NOTES**
- B1. VERIFY ACCESS FLOOR HEIGHT WITH COR PRIOR TO FABRICATION.
 - B2. INSTALL STEEL BASES UNDER FRONT AND REAR BASE FRAMES OF EACH NEW AND RELOCATED CONTROL SWITCHBOARD EQUIPMENT OR COMMUNICATION RACK.
 - B3. CONTRACTOR IS REQUIRED TO FIELD DRILL SLOTS THROUGH L 5x5 AND CHANNEL TO MATCH MOUNTING HOLES IN FRONT AND REAR BASE FRAMES OF CONTROL SWITCHBOARD EQUIPMENT OR COMMUNICATION RACK.
 - B4. CONTRACTOR IS REQUIRED TO SUPPLY HARDWARE INCLUDING NUTS, BOLTS, LOCK WASHERS, & WASHERS IN ORDER TO MOUNT FRONT AND REAR BASE FRAMES OF CONTROL SWITCHBOARD EQUIPMENT OR COMMUNICATION RACK ONTO STEEL BASES WITH A MINIMUM OF TWO 1/2-INCH DIAMETER BOLTS. REAM MOUNTING HOLES IN BASE FRAMES OF CONTROL SWITCHBOARD EQUIPMENT AND COMMUNICATION RACK TO 9/16-INCH DIAMETER IF NECESSARY.
 - B5. LEVEL ACCESS FLOOR WITH ADJUSTABLE L 2x2x3/16 & L 3x2x3/16 (LLH). TACK WELD AFTER LEVELING. STRUCTURAL STEEL: ASTM A36 OR EQUAL.
 - B6. BOLTS: ASTM A325 OR EQUAL.
 - B7. NUTS: ASTM A536, GRADE D OR EQUAL.
 - B8. WASHERS: ASTM F436 OR EQUAL.
 - B9. WELDING SHALL BE PERFORMED IN ACCORDANCE WITH THE LATEST EDITION OF ANSI/AWS D1.1, "STRUCTURAL WELDING CODE".
 - B10. ADHESIVE ANCHOR SYSTEM SHALL BE EQUAL TO HILTI HVA ADHESIVE ANCHOR SYSTEM, WITH 3/8" HAS THREADED RODS WITH 3 1/2" MINIMUM DIRECT EMBEDMENT INTO 5 1/2" MINIMUM THICKNESS CONCRETE SLAB. OPTIONAL HIS INTERNALLY THREADED INSERT SLEEVES MAY BE USED PROVIDE SLAB THICKNESS IS 6 1/2" MINIMUM, SLEEVE EMBEDMENT IS 4 1/4", AND HAS ROD LENGTH IS ADJUSTED TO MATCH REQUIRED PROJECTION. ADJUST LEVELING NUTS TO LEVEL BASES AND TO PROVIDE CLEARANCE BETWEEN ACCESS FLOOR AND DOORS IN END PANELS OF CONTROL SWITCHBOARD EQUIPMENT OR COMMUNICATION RACKS.
 - B11. ORIGINAL DESIGN PREPARED BY B. HAGLER, JUNE 1993. (SHOWN THIS SHEET).

A	3-23-18 A7-JAS	CLARIFICATIONS AND NOTE REVISIONS.	
	SUPERSEDES DWG NO. 31_2049A (IN PART)		
	UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
	SUBSTATION STANDARDS CONTROL SWITCHBOARD EQUIPMENT & COMMUNICATION RACK BASE ANCHORAGE DETAILS (SHEET 2 OF 2)		
	DESIGNED <u>B. HAGLER/J. SCHREIBER</u> — APPROVED <u>D. HANSON</u> — CIVIL ENGINEERING MANAGER		
31	OCTOBER 13, 2016	31	2049-2

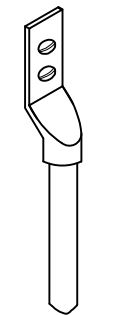
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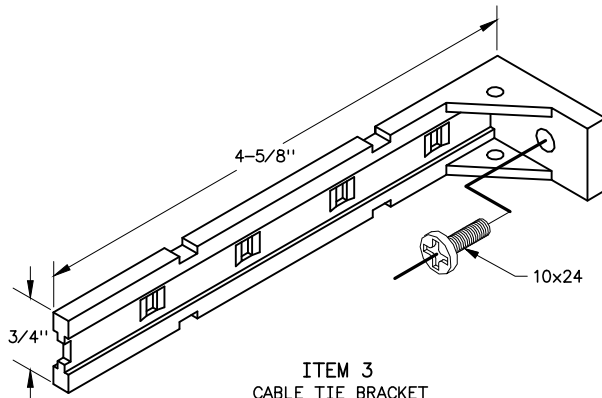
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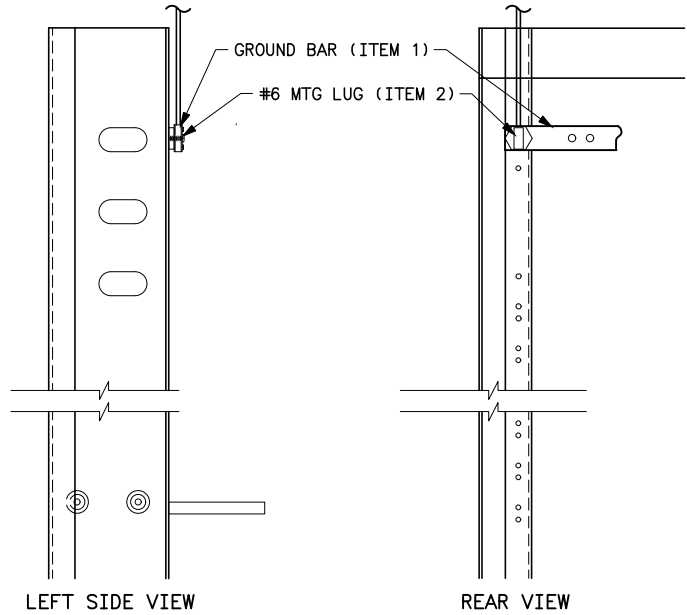
ITEM 1
1/4x1 COPPER GROUND BAR



ITEM 2
#6 MTG LUG



ITEM 3
CABLE TIE BRACKET
4-5/8" NYLON



DETAIL A

REFERENCE DRAWING
EQUIPMENT RACK ANCHORING & GROUNDING DETAILS _____ 53 7051

NOTES

1. UNLESS OTHERWISE NOTED, ALL RACKS ARE 7'-0" HIGH AND 19" WIDE.
2. RACK FLANGES ARE DRILLED FRONT AND REAR WITH EIA STANDARD 1.75" RACK UNIT (RU) HOLE PATTERNS.
3. ALL RACKS HAVE FRONT MOUNTED COVERED BASE GUARD RAIL.
4. SEE BUILDING DRAWINGS FOR FLOOR LAYOUT AND RACK LOCATION AND DESIGNATION.
5. EQUIPMENT RACKS FROM OTHER MANUFACTURERS CAN BE USED WITH ACCEPTANCE FROM COR.

A	7-31-26 A7-SJ	MINOR REVISIONS.	
	SUPERSEDES DWG NO. 41 7004		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO			
COMMUNICATIONS STANDARD EQUIPMENT RACK LAYOUT & DETAILS			
DESIGNED SCOTT JOHNSON		APPROVED DAN HAMAI SYSTEM CONTROL MANAGER	
CAE	OCTOBER 13, 2016	53	7050