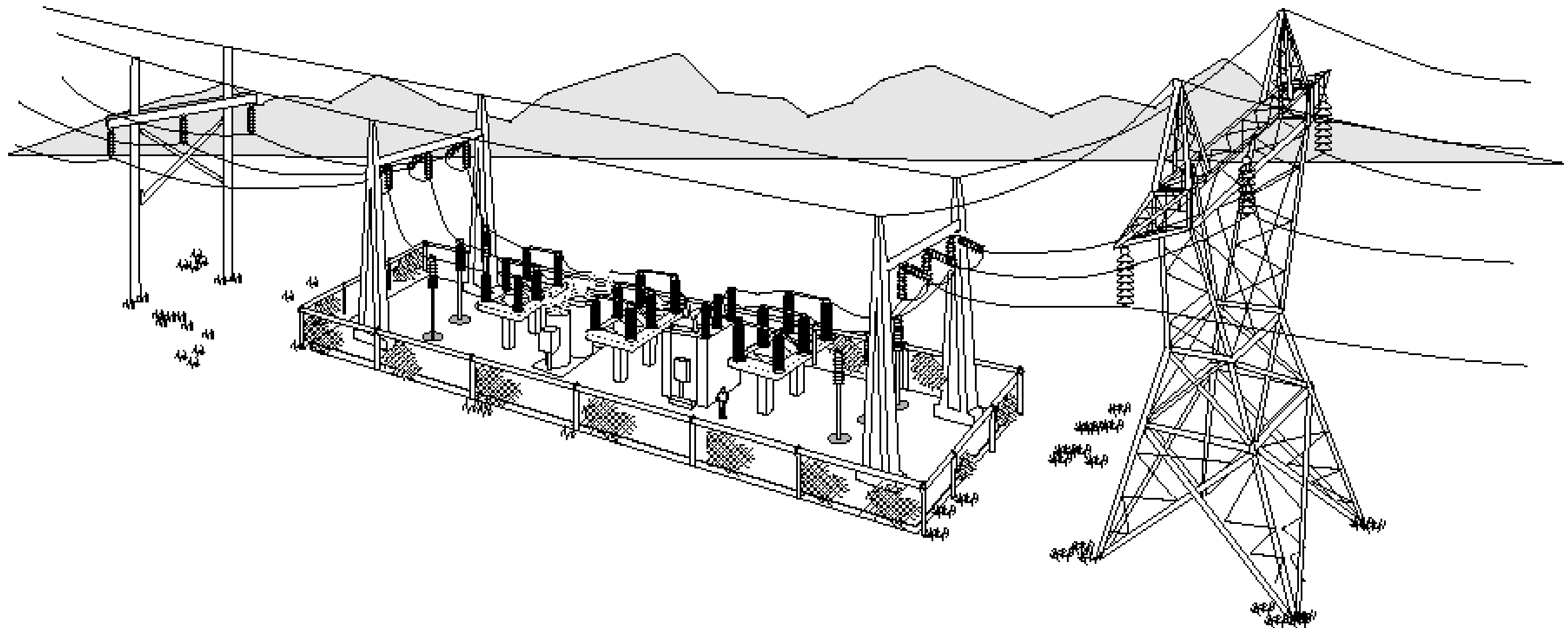


CONSTRUCTION STANDARDS STANDARD DRAWINGS



February 2021

CONSTRUCTION STANDARD DRAWINGS
DIVISION 15

LIST OF DRAWINGS:

- | | |
|--|---|
| 1. 01 2004-1 Rev. D - Concrete Standards General Outline and Reinforcement Notes | 28. 31 1089 Rev. B – Substation Standards Danger Sign |
| 2. 01 2004-2 Rev. D - Concrete Standards General Outline and Reinforcement Notes | 29. 31 1097 Rev. D – Fiber Optic Cable Mounting |
| 3. 01 2005 Rev. B – Standard Designs Sitework Typical Water Crossing | 30. 31 1099 Rev. A – Fiber Optic Cable Armored Cable Installation |
| 4. 01 8000 Rev. B – Design Standards Unified Soil Classification | 31. 31 1100 Rev. H – Substation Standards Equipment and Material Index |
| 5. 31 0001-1 Rev. A - Substation Standards Switching Diagram Operating Numbers Bus Configuration | 32. 31 1500 Rev. B – Substation Standards Grounding Plans Typical Components |
| 6. 31 0001-2 Rev. B - Substation Standards Switching Diagram Operating Numbers Bus Configuration | 33. 31 1501 Rev. D - Substation Standards Fence Grounding Connections Details |
| 7. 31 1000 Rev. D – Substation Standards Identification and Security Signs | 34. 31 1502 – Communication Site Grounding Typical Grounding |
| 8. 31 1004 Rev. B – Substation Standards Insulation Coordination | 35. 31 1503 – Communication Tower Grounding Details |
| 9. 31 1005 Rev. E – Substation Standards Buses and Switches Spacings and Clearances | 36. 31 1504 Rev. A – Building Grounding Substation Details |
| 10. 31 1006 Rev. H – Substation Standards Buried Insulated Cables Typical Details | 37. 31 1505 Rev. A – Building Grounding Remote Site Details |
| 11. 31 1007 Rev. F – Substation Standards Hot-Line Fittings Details | 38. 31 1506 Rev. A – Guy Tower Grounding Anchor Ground Details |
| 12. 31 1020 Rev. F – Substation Standards Insulator and Hardware Assemblies | 39. 31 1700 Rev. A – Substation Standards Conduit Installation Details |
| 13. 31 1058 Rev. C – Substation Standards Typical Grounding Details | 40. 31 2000-1 Rev. A – Substation Standards Chain-Link Fence General Requirements (Sheet 1 of 2) |
| 14. 31 1059 Rev. C – Substation Standards Typical Grounding Details | 41. 31 2000-2 Rev. B – Substation Standards Chain-Link Fence General Requirements (Sheet 2 of 2) |
| 15. 31 1060 Rev. H – Substation Standards Grounding Details | 42. 31 2001 Rev. G – Substation Standards Chain-Link Fence Gate Latches |
| 16. 31 1061 Rev. F – Substation Standards Cable Trench Grounding | 43. 31 2002 Rev. C – Substation Standards – 5/8 & 3/4 DIA Connection Bolts |
| 17. 31 1063 Rev. G – Substation Standards Pipe-Bus Grounding Plan | 44. 31 2003 Rev. D – Substation Standards Typical Eyebolt and Step Details |
| 18. 31 1073 Rev. D – Substation Standards Lighting Fixture Pole and Bracket Mounting | 45. 31 2014 Rev. B – Substation Standards Switch Operating Platforms Steel Design and Details |
| 19. 31 1075 Rev. K – Substation Standards Switch Operating and Equipment Platforms Electrical Design and Details | 46. 31 2038 Rev. B – Substation Standards Chain-Link Fence Swing Gates |
| 20. 31 1077 Rev. D – Substation Standards Ground Cable on Tubular Steel Structures Support Details | 47. 31 2043 – Substation Standards Bollard Details |
| 21. 31 1078 Rev. C – Floodlighting Units | 48. 31 2044 Rev. F – Substation Standards Equipment Cabinet Platforms Steel Design and Details |
| 22. 31 1079 Rev. C – Substation Standards Danger Sign for Shunt Capacitors | 49. 31 2045 Rev. E – Substation Standards Switch Operating Platforms Steel Design and Details |
| 23. 31 1081 Rev. E – Substation Standards Stacking Post Insulators | 50. 31 2046 Rev. A – Substation Standards Switch Operating Platforms Steel Design and Details |
| 24. 31 1085 Rev. I – Substation Standards Terminal and Fuse Boxes | 51. 31 2047 – Substation Standards Grounding Loop |
| 25. 31 1086 Rev. C – Substation Standards Type G, H, and K Terminal Boxes | 52. 31 2049-1 Rev. B – Substation Standards Control Switchboard Equipment & Communication Rack Anchorage Details (Sheet 1 of 2) |
| 26. 31 1087 Rev. A – Substation Standards Stacking Post Insulators Upright M & E Ratings | 53. 31 2049-2 Rev. A – Substation Standards Control Switchboard Equipment & Communication Rack Anchorage Details (Sheet 2 of 2) |
| 27. 31 1088 Rev. A – Substation Standards Stacking Post Insulators Underhung M & E Ratings | 54. 31 2050 Rev. B - Substation Standards Transformer Platforms Steel Design and Details |

CONSTRUCTION STANDARD DRAWINGS
DIVISION 15

- | | |
|---|--|
| 55. 31 2051 Rev. B – Substation Standards Service Building Structural Building Entry Platforms | 82. 41 1023 Rev. E – Transmission Line Standards Tension Insulator Assemblies Double String |
| 56. 31 3300 Rev. A - Facilities Standard – Typical Installation – LP-Gas Container Appurtenances | 83. 41 1024 Rev. B – Transmission Line Standards Horizontal Post Insulator Assemblies |
| 57. 31 3301 - Facilities Standard – Typical Installation – LP-Gas System Arrangement | 84. 41 1025 Rev. C – Transmission Line Standards Suspension Insulator Assemblies Vee String, Single String |
| 58. 31 3302 Rev. A - Facilities Standard – Typical Installation – Generator Set & Transfer Switch | 85. 41 1026 Rev. A – Transmission Line Standard Right-of-Way Clearing Details |
| 59. 31 3303 - Facilities Standard – Typical Installation – Generator Room | 86. 41 1027 Rev. F – Fiber Optic Cable Mounting Lattice Steel Structures |
| 60. 31 3304 Rev. A - Facilities Standard – Typical Installation – Weather Protective Enclosure | 87. 41 1028 Rev. F – Fiber Optic Cable Mounting Steel and Concrete Pole Structures |
| 61. 31 4001 Rev. C – Substation Standards Typical Duplex Switchboard Surge Suppressor Networks Detail Layout | 88. 41 1029 Rev. I – Fiber Optic Cable Mounting Wood Pole Structures |
| 62. 31 4003 Rev. D – Substation Standards Control Switches Escutcheons, Lamps and Developments | 89. 41 1030 Rev. F – Fiber Optic Cable Mounting – Downlead Clamps and Bands |
| 63. 31 4004 Rev. E – Substation Standards Transformer Sudden Pressure Relay Schematic Diagram | 90. 41 1031 Rev. F – Transmission Line Standards Optical Ground Wire Assemblies |
| 64. 31 4005 Rev. D – Substation Standards Duplex Switchboard Panel Wiring Diagram and Cabling Methods | 91. 41 1033 Rev. E – Transmission Line Standards Station Post Jumper Insulator Assemblies |
| 65. 31 4008 Rev. C – Substation Standards Mimic Bus Color Standard | 92. 41 1035 – Fiber Optic Cable Overhead to Underground Transition |
| 66. 31 4018 Rev. B – Control Standards Typical Arrangement Details CT Junction Boxes and Interface Cabinets | 93. 41 2001 Rev. D – Transmission Line Standards Tower Bolts |
| 67. 31 5103 Rev. C – Substation Standards Hand Reset Auxiliary Relay Test and Monitor Circuits | 94. 41 2017 Rev. D – Transmission Line Standards Special Earthwork |
| 68. 31 6000 Rev. E – Substation Standards PCB Control Cabinets Shielded Cable Grounding | 95. 41 2034 Rev. A – Transmission Line Standards Lattice Steel Towers Structure Grounding |
| 69. 31 6005 Rev. A – Substation Standards Control Cable Color Code Identification | 96. 41 2035 Rev. A – Transmission Line Standards Access Roads General Requirements |
| 70. 31 6011 Rev. B – Substation Standards Typical Power Circuit Breaker Wiring Diagram (Sh 1 of 3) | 97. 41 6005 Rev. B – Standard Designs Transmission Lines Type 4SWT 115kV Disconnecting Switch Structure |
| 71. 31 6012 Rev. B – Substation Standards Typical Power Circuit Breaker Wiring Diagram (Sh 2 of 3) | 98. 41 6042 Rev. D – Transmission Line Standards Wood-Pole Dead End Details For Overhead Ground Wire |
| 72. 31 6013 Rev. B – Substation Standards Typical Power Circuit Breaker Wiring Diagram (Sh 3 of 3) | 99. 41 6047 Rev. F – Transmission Line Standards Guy Assembly and Details |
| 73. 41 1011 Rev. C – Transmission Line Standards Transmission Lines Fence Grounding Hardware | 100. 41 6049 Rev. D – Transmission Line Standards Concrete Anchors |
| 74. 41 1012 Rev. C – Transmission Line Standards Wood Pole Structures Grounding Details | 101. 41 6050 Rev. D – Transmission Line Standards Anchor Rod Grouting Details |
| 75. 41 1015 Rev. K – Transmission Line Standards Weathering Steel and Concrete Pole Structures Grounding Details | 102. 41 6053 Rev. E – Transmission Lines Standard Guy Arrangement for For Type 3A and 3AB Structures with Overhead Ground Wires |
| 76. 41 1017 Rev. C – Transmission Line Standards Steel Towers Overhead Ground Wire Assembly | 103. 41 6055 Rev. E – Standard Designs Transmission Lines Standard Guy Arrangement for Type 3TA Structures |
| 77. 41 1018 Rev. C – Transmission Line Standards Steel and Concrete Pole Structures Overhead Ground Wire Assembly | 104. 41 6106 Rev. B – Transmission Line Standards Douglas Fir– Drilling Details |
| 78. 41 1019 Rev. D – Transmission Line Standards Wood Pole Structures Overhead Ground Wire Assembly | 105. 41 6109 Rev. B – Standard Designs Transmission Lines Type 3BT/4BT 69 and 115kV Branch Line Structure |
| 79. 41 1020 Rev. C – Transmission Line Standards Suspension Insulator Assemblies Single String | 106. 41 6113 – Standard Designs Transmission Lines Crossarm Drilling HS-1 and HSB-1 Structures with Adjustable Spacer Fittings |
| 80. 41 1021 Rev. C – Transmission Line Standards Suspension Insulator Assemblies Double String | 107. 41 6114 Rev. A – Standard Designs Transmission Lines Crossarm Drilling Details HA and HSB Structures with Fixed Spacer Fittings |
| 81. 41 1022 Rev. C – Transmission Line Standards Tension Insulator Assemblies Single String | |

CONSTRUCTION STANDARD DRAWINGS
DIVISION 15

108. 41 6116 Rev. B – Standard Designs Transmission Lines Type ST-1 and LST-1 69 and 115kV Tangent and Angle Tension Structures	132. 43 2203 Rev. C – Transmission Line Structure Standards Steel Pole Structures Maintenance Provisions Work Ring
109. 41 6118 Rev. B – Standard Designs Transmission Lines Type 3TA-1 69 and 115kV 3-Pole Tension Structure	133. 43 2206 Rev. H – Transmission Line Structure Standards Steel Pole Structures Maintenance Provisions Outlines
110. 41 6122 Rev. D – Standard Designs Transmission Lines Type HS-1 115kV Suspension Structure	134. 43 2207 Rev. G – Transmission Line Structure Standards Steel Pole Structures Maintenance Provisions Outlines
111. 41 6125 Rev. A – Standard Designs Transmission Lines 3TA-1 Structures Standard Guy Arrangement	135. 43 2208 Rev. H – Transmission Line Structure Standards Steel Pole Structures Maintenance Provisions Outlines
112. 41 6133 Rev. F – Standard Designs Transmission Lines Steel Angle Details for Wood Pole Structures	136. 43 2209 Rev. G – Transmission Line Structure Standards Steel Pole Structures Maintenance Provisions Outlines
113. 41 6138 Rev. B – Standard Designs Transmission Lines Typical Details for Dead End Tees	137. 43 2210 Rev. J – Transmission Line Structure Standards Steel Pole Structures Maintenance Provisions Details
114. 41 6153 Rev. A – Standard Designs Transmission Typical Details for Optical Ground Wire Splice Structures	138. 43 2211 Rev. B – Light Duty Transmission Line Steel Pole Structures Climbing Provisions
115. 41 6157 – Standard Design Transmission Lines Type 3TD 115Kv 3-pole Tension Dead End Structure	139. 43 2212 – Access Road Standards Access Roads General Requirements
116. 41 9002 Rev. N – Transmission Line Standards Barbed Wire Gate For Right-of-Way Fences	140. 43 2213 Rev. A – Transmission Line Structure Standards Steel Pole Structures Anti Perch Provisions
117. 41 9003 Rev. C – Transmission Line Standards Electric Barbed Wire Gate For Right-of-Way Fences	141. 43 2214 Rev. A – Transmission Line Structure Standards Steel Pole Structures Maintenance Provisions – Outlines
118. 41 9004 Rev. E – Transmission Line Standards Wood Pole Structures Aerial Patrol Mile Marker and Number Signs	142. 43 2215 - Transmission Line Structure Standards Steel Pole Structures Maintenance Provisions – Details
119. 41 9005 Rev. D – Transmission Line Standards Lattice Steel Towers Aerial Patrol Number and Warning Signs	143. 43 2216 Rev. A - Transmission Line Structure Standards Steel Pole Structures Maintenance Provisions Permanent Fall Protection – Details
120. 41 9007 Rev. F – Transmission Line Standards Structure Number Signs Details and Location	144. 43 2217-1 - Transmission Line Structure Standards Light Duty Steel Pole Structures Maintenance Provisions – Outlines (Sh 1 of 2)
121. 41 9008 Rev. F – Transmission Line Standards Lattice Towers Danger Signs Details and Locations	145. 43 2217-2 - Transmission Line Structure Standards Light Duty Steel Pole Structures Maintenance Provisions – Details (Sh 2 of 2)
122. 41 9019 Rev. C – Transmission Line Standards Wood Pole Structures Bog Shoe and Bog Anchor	146. 43-20 M W 2201 Rev. A – Standard Microwave Tower 20 FT Monopole Foundation Auger and Pad Type
123. 41 9021 Rev. A – Transmission Line Standards Access Road Rehabilitation Water Bar Construction	147. 43-30 M W 2201 Rev. C – Standard Microwave Tower Monopole Foundations Auger and Pad Type
124. 41 9024 Rev. D – Transmission Line Standards Prefabricated Tubular Steel Gate	148. 43-30 M W 2204 Rev. A – Standard Microwave Tower Monopole Foundation Drilled Auger Type
125. 41 9026 Rev. C – Transmission Line Standards Wood Pole Structures Aerial Patrol Warning Signs Details and Locations	149. 43-40 M W 2201 Rev. A – Standard Microwave Tower Monopole Foundations Auger and Pad Type
126. 41 9027-1 Rev. A – Transmission Line Standards Steel Pole Structures Aerial Patrol Mile Marker and Number Signs (Sh. 1 of 3)	150. 43-40 M W 2203 Rev. A – Standard Microwave Tower 40 Foot Monopole Outline
127. 41 9027-2 Rev. A – Transmission Line Standards Steel Pole Structures Aerial Patrol Mile Marker and Number Signs (Sh. 2 of 3)	151. 43-40 M W 2204 Rev. A – Standard Microwave Tower Monopole Foundation Drilled Auger Type
128. 41 9027-3 – Transmission Line Standards Steel Pole Structures Aerial Patrol Mile Marker and Number Signs (Sh. 3 of 3)	152. 43-50 M W 2200 Rev. A – Standard Microwave Tower 50 Foot Monopole Elevation and Sections
129. 41 9028 Rev. E – Transmission Line Standards Steel Pole Structures Aerial Patrol Warning Signs Details and Locations	153. 43-50 M W 2202 Rev. B – Standard Microwave Tower 50 Foot Monopole Drilled Auger Type Foundation
130. 41 9029 Rev. B – Transmission Line Standards Aerial Patrol Warning Signs and Marker Ball Marking Diagrams	154. 43-70 M W 2202 Rev. A – Standard Microwave 70 Foot Monopole Drilled Auger Type Foundation
131. 41 9030 – Transmission Line Standards Light Duty Steel Pole H-Frames Structure Signs Details and Locations	155. 43 281 D 2200 Rev. A – 281D Pole Structures Outline and Design Loads
	156. 43 281 N 2200 Rev. B – 281N Pole Structures Outline and Design Loads
	157. 53 7050 – Equipment Rack Layout and Details

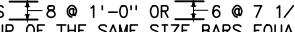
CONSTRUCTION STANDARD DRAWINGS
DIVISION 15

158. 53 7051 – Equipment Rack Anchoring and Grounding Details

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  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.

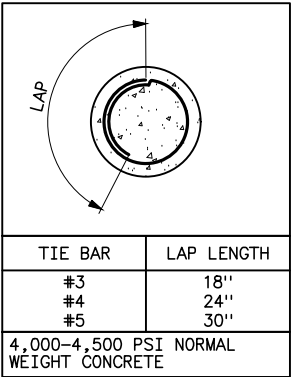
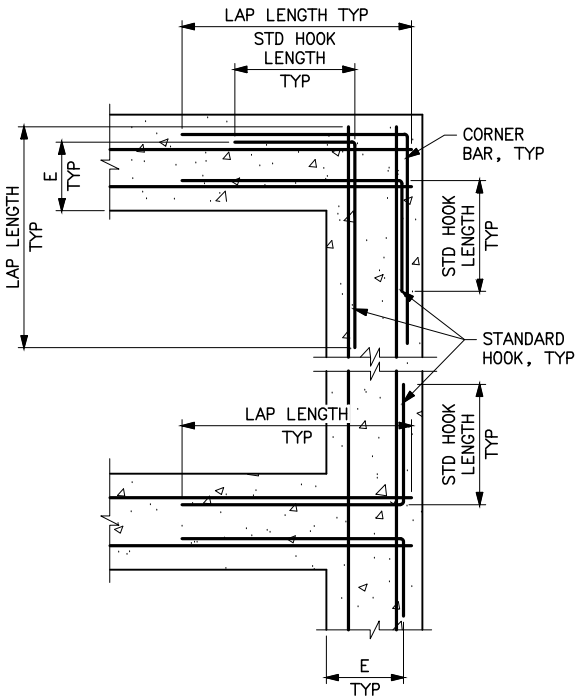
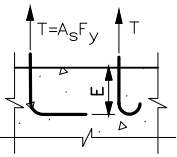
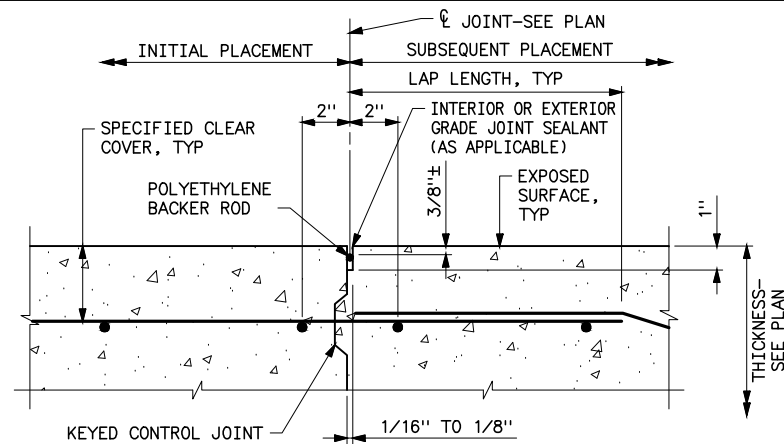


TABLE 5 – CIRCULAR TIE LAPS FOR DRILLED PIERS & COLUMNS

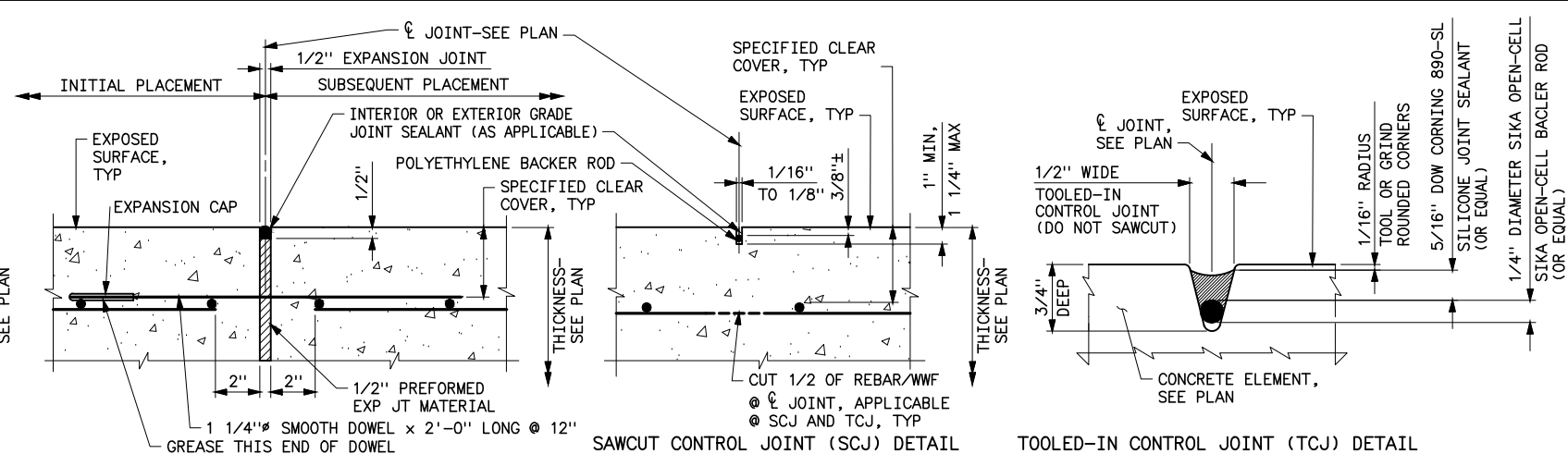


TYPICAL CORNER & INTERSECTION DETAILS

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		
C/A	AUGUST 1, 2006	01 2004–1



CONSTRUCTION JOINT (CJ) DETAIL (SEE NOTE 1)



EXPANSION JOINT (EJ) DETAIL (SEE NOTE 1)

CONTROL JOINT TYPES (SEE NOTE 1)

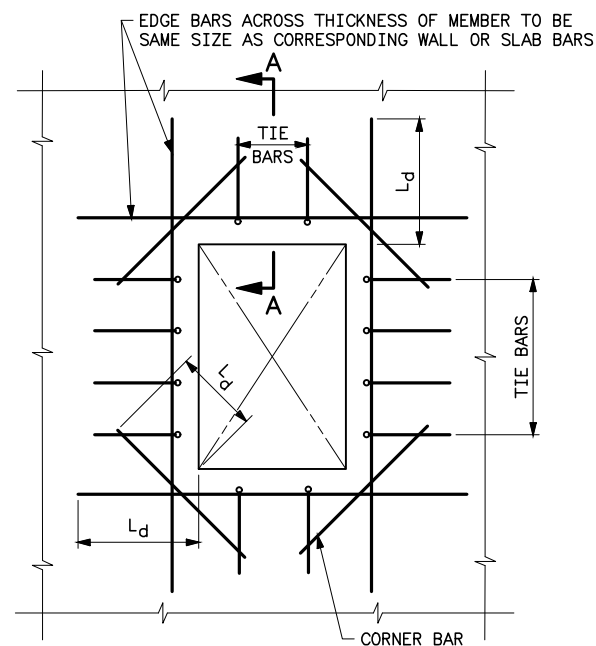
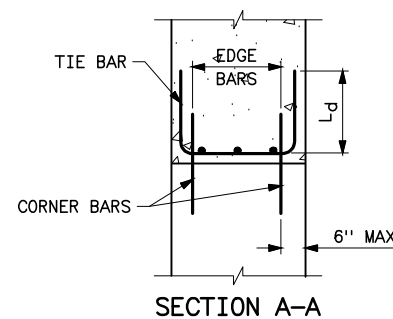


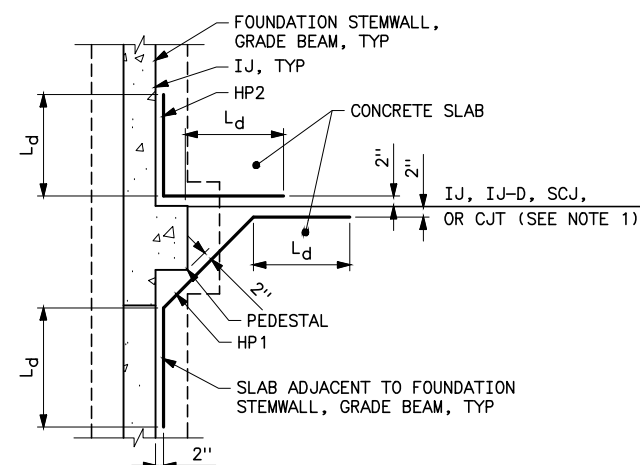
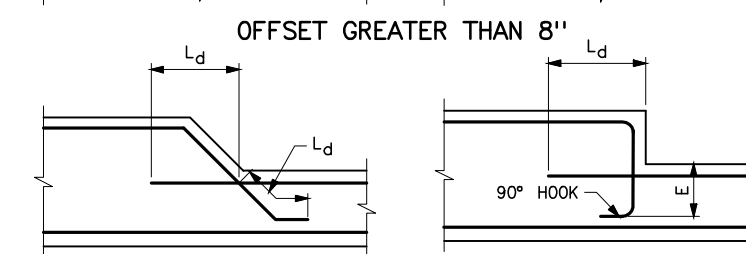
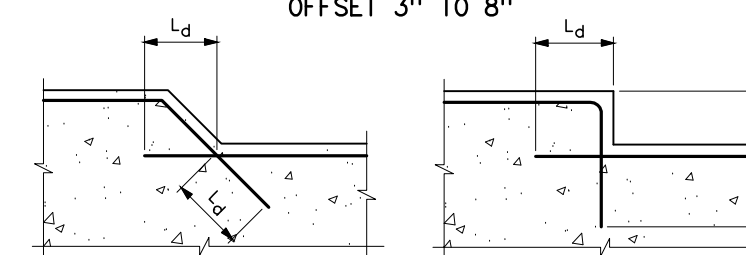
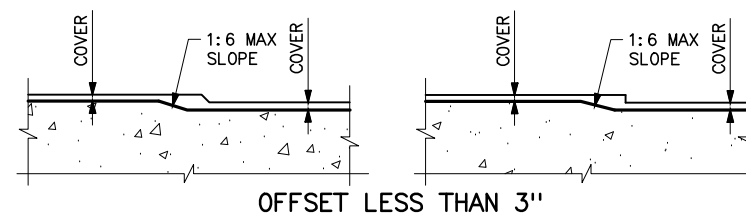
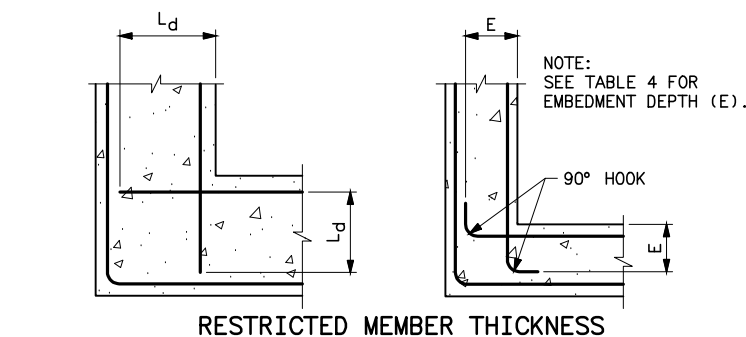
TABLE FOR REINFORCEMENT AROUND OPENINGS			
MEMBER THICKNESS	TIE BARS	EDGE BARS	CORNER BARS
LESS THAN 10"	NONE	1-ML	1-#4, ML
10" THRU 1'-6"	NONE	1-EF	1-#4, EF
1'-7" THRU 3'-0"	#4 @ 1'-0"	3 - EQL SP	1-#6, EF
OVER 3'-0"	#6 @ 1'-0"	SP @ 1'-0"	1-#8, EF

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)OFFSET GREATER THAN 8"
RESTRICTED MEMBER THICKNESS
TYPICAL OFFSET DETAILS

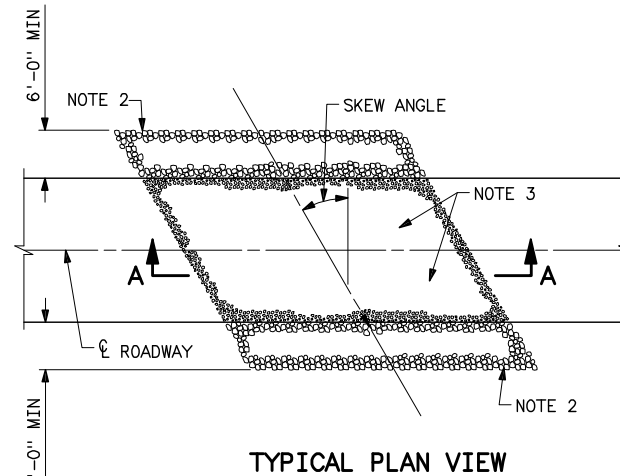
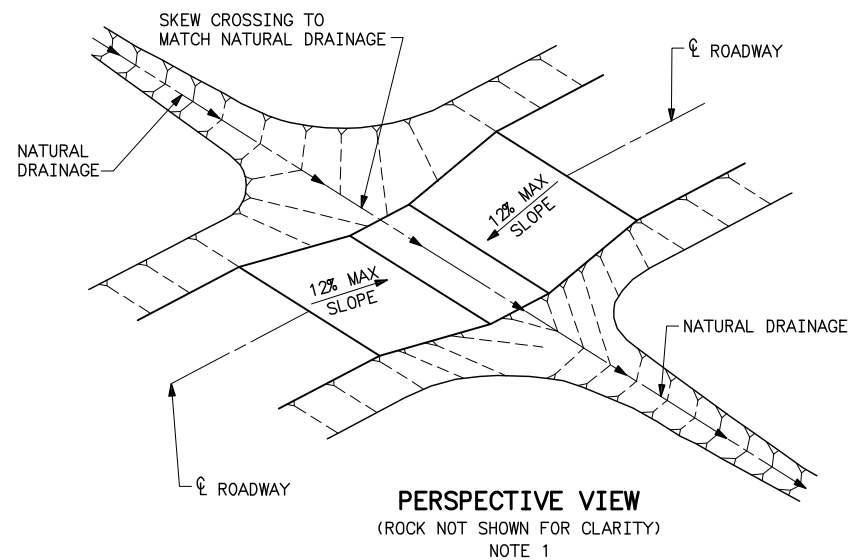
NOTE
1. REFER TO CONCRETE STANDARD DRAWINGS 01 2006-1, -2 AND -3 FOR BUILDING SLABS-ON-GROUND - SPECIFICATIONS, NOTES, PLANS & DETAILS.

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)

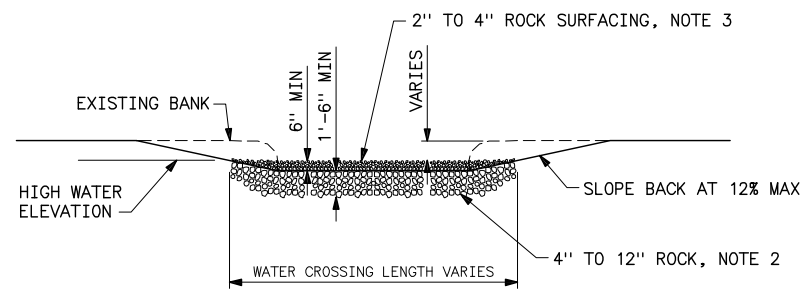
UNITED STATES DEPARTMENT OF ENERGY
WESTERN AREA POWER ADMINISTRATION
HEADQUARTERS - LAKEWOOD, COLORADOCONCRETE STANDARDS
GENERAL OUTLINE AND
REINFORCEMENT NOTESDESIGNED J.A. SCHREIBER APPROVED D. HANSON
ELECTRICAL ENGINEERING MANAGER

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.



B	9-12-12 A7-DH	CORRECTED SPELLING ERROR.
	A	7-15-03 A7-DH
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 -E	FEBRUARY 27, 1995	01 2005

Plotted By: denton Jun 29, 2011- 8:50am
IMAGES: S:\Projects\Misc\StandardDrawings\Drawings\Design\DrawingsReadyForFinal\Scripts\01_8000b.dwg Last Saved By: Debbie Denton on 6/29/2011 8:49 AM

FIELD IDENTIFICATION PROCEDURES (EXCLUDING PARTICLES LARGER THAN 3 INCHES AND BASING FRACTIONS ON ESTIMATED WEIGHTS)					GROUP SYMBOLS L ¹	TYPICAL NAMES	INFORMATION REQUIRED FOR DESCRIBING SOILS	LABORATORY CLASSIFICATION CRITERIA		
COARSE GRAINED SOILS MORE THAN HALF OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE [2 (THE NO. 200 SIEVE SIZE IS ABOUT THE SMALLEST PARTICLE VISIBLE TO THE NAKED EYE)	GRAVELS MORE THAN HALF OF COURSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE (FOR VISUAL CLASSIFICATIONS, THE 1/4" SIZE MAY BE USED AS EQUIVALENT TO THE NO. 4 SIEVE SIZE)	CLEAN GRAVELS (LITTLE OR NO FINES)	WIDE RANGE IN GRAIN SIZE AND SUBSTANTIAL AMOUNTS OF ALL INTERMEDIATE PARTICLE SIZES.		GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES; LITTLE OR NO FINES.	GIVE TYPICAL NAME; INDICATE APPROXIMATE PERCENTAGES OF SAND AND GRAVEL; MAX. SIZE; ANGULARITY, SURFACE CONDITION, AND HARDNESS OF THE COARSE GRAINS; LOCAL OR GEOLOGIC NAME AND OTHER PERTINENT DESCRIPTIVE INFORMATION; AND SYMBOL IN PARENTHESES. FOR UNDISTURBED SOILS ADD INFORMATION ON STRATIFICATION, DEGREE OF COMPACTNESS, CEMENTATION, MOISTURE CONDITIONS AND DRAINAGE CHARACTERISTICS. EXAMPLE: - SILTY SAND, GRAVELLY; ABOUT 20% HARD, ANGULAR GRAVEL PARTICLES 1/2 IN. MAXIMUM SIZE; ROUNDED AND SUBANGULAR SAND GRAINS COARSE TO FINE; ABOUT 15% NON-PLASTIC FINES WITH LOW DRY STRENGTH; WELL COMPACTED AND MOIST IN PLACE; ALLUVIAL SAND; (SM)	USE GRAIN SIZE CURVE IN IDENTIFYING THE FRACTIONS AS GIVEN UNDER FIELD IDENTIFICATION DETERMINE PERCENTAGES OF GRAVEL AND SAND FROM GRAIN SIZE CURVE. DEPENDING ON PERCENTAGE OF FINES (FRACTION SMALLER THAN NO. 200 SIEVE SIZE) COARSE GRAINED SOILS ARE CLASSIFIED AS FOLLOWS: - GW, SW, GP, GM, GC, SC, SP, SM, GP, GC, SM, SC, SP, SM, GP, GC, SC		

L¹ BOUNDARY CLASSIFICATIONS: - SOILS POSSESSING CHARACTERISTICS OF TWO GROUPS ARE DESIGNATED BY COMBINATIONS OF GROUP SYMBOLS. FOR EXAMPLE GW-GC, WELL GRADED GRAVEL-SAND MIXTURE WITH CLAY BINDER.
L² ALL SIEVE SIZES ON THIS CHART ARE U.S. STANDARD

DILATANCY (REACTION TO SHAKING)
AFTER REMOVING PARTICLES LARGER THAN NO. 40 SIEVE SIZE, PREPARE A PAT OF MOIST SOIL WITH A VOLUME OF ABOUT ONE-HALF CUBIC INCH. ADD ENOUGH WATER IF NECESSARY TO MAKE THE SOIL SOFT BUT NOT STICKY.

PLACE THE PAT IN THE OPEN PALM OF ONE HAND AND SHAKE HORIZONTALLY, STRIKING VIGOROUSLY AGAINST THE OTHER HAND SEVERAL TIMES. A POSITIVE REACTION CONSISTS OF THE APPEARANCE OF WATER ON THE SURFACE OF THE PAT WHICH CHANGES TO A LIVELY CONSISTENCY AND BECOMES GLOSSY. WHEN THE SAMPLE IS SQUEEZED BETWEEN THE FINGERS, THE WATER AND GLOSS DISAPPEAR FROM THE SURFACE, THE PAT STIFFENS, AND FINALLY IT CRACKS OR CRUMBLES. THE RAPIDITY OF APPEARANCE OF WATER DURING SHAKING AND OF ITS DISAPPEARANCE DURING SQUEEZING ASSIST IN IDENTIFYING THE CHARACTER OF THE FINES IN A SOIL.

VERY FINE CLEAN SANDS GIVE THE QUICKEST AND MOST DISTINCT REACTION WHEREAS A PLASTIC CLAY HAS NO REACTION. INORGANIC SILTS, SUCH AS A TYPICAL ROCK FLOUR, SHOW A MODERATELY QUICK REACTION.

DRY STRENGTH (CRUSHING CHARACTERISTICS)
AFTER REMOVING PARTICLES LARGER THAN NO. 40 SIEVE SIZE, MOLD A PAT OF SOIL TO THE CONSISTENCY OF PUTTY, ADDING WATER IF NECESSARY. ALLOW THE PAT TO DRY COMPLETELY BY OVEN, SUN, OR AIR DRYING, AND THEN TEST ITS STRENGTH BY BREAKING AND CRUMBLING BETWEEN THE FINGERS. THIS STRENGTH IS A MEASURE OF THE CHARACTER AND QUANTITY OF THE COLLOIDAL FRACTION CONTAINED IN THE SOIL. THE DRY STRENGTH INCREASES WITH INCREASING PLASTICITY.

HIGH DRY STRENGTH IS CHARACTERISTIC FOR CLAYS OF THE CH GROUP. A TYPICAL INORGANIC SILT POSSESSES ONLY VERY SLIGHT DRY STRENGTH. SILTY FINE SANDS AND SILTS HAVE ABOUT THE SAME SLIGHT DRY STRENGTH, BUT CAN BE DISTINGUISHED BY THE FEEL WHEN POWDERING THE DRIED SPECIMEN. FINE SAND FEELS GRITTY WHEREAS A TYPICAL SILT HAS THE SMOOTH FEEL OF FLOUR.

TOUGHNESS (CONSISTENCY NEAR PLASTIC LIMIT)
AFTER REMOVING PARTICLES LARGER THAN THE NO. 40 SIEVE SIZE, A SPECIMEN OF SOIL ABOUT ONE-HALF INCH CUBE IN SIZE IS MOLDED TO THE CONSISTENCY OF PUTTY. IF TOO DRY, WATER MUST BE ADDED AND IF STICKY, THE SPECIMEN SHOULD BE SPREAD OUT IN A THIN LAYER AND ALLOWED TO LOSE SOME MOISTURE BY EVAPORATION. THEN THE SPECIMEN IS ROLLED OUT BY HAND ON A SMOOTH SURFACE OR BETWEEN THE PALMS INTO A THREAD ABOUT ONE-EIGHTH INCH IN DIAMETER. THE THREAD IS THEN FOLDED AND REROLLED REPEATEDLY. DURING THIS MANIPULATION THE MOISTURE CONTENT IS GRADUALLY REDUCED AND THE SPECIMEN STIFFENS, FINALLY LOSING ITS PLASTICITY, AND CRUMBLES WHEN THE PLASTIC LIMIT IS REACHED.

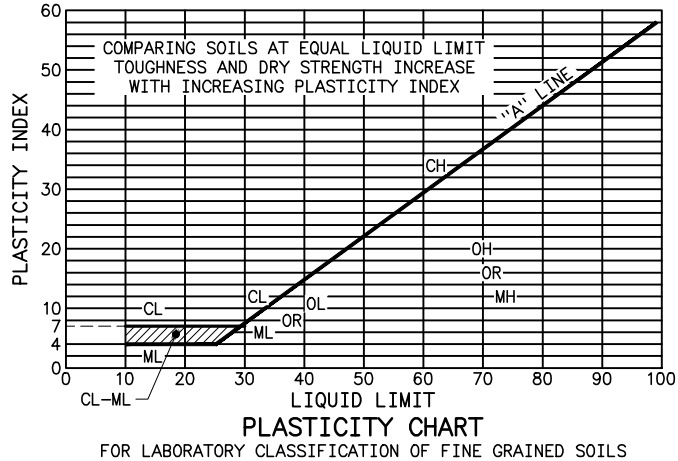
AFTER THE THREAD CRUMBLES, THE PIECES SHOULD BE LUMPED TOGETHER AND A SLIGHT KNEADING ACTION CONTINUED UNTIL THE LUMP CRUMBLES.

THE TOUGHER THE THREAD NEAR THE PLASTIC LIMIT AND THE STIFFER THE LUMP WHEN IT FINALLY CRUMBLES, THE MORE POTENT IS THE COLLOIDAL CLAY FRACTION IN THE SOIL. WEAKNESS OF THE THREAD AT THE PLASTIC LIMIT AND QUICK LOSS OF COHERENCE OF THE LUMP BELOW THE PLASTIC LIMIT INDICATE EITHER INORGANIC CLAY OF LOW PLASTICITY, OR MATERIALS SUCH AS KAOLIN-TYPE CLAYS AND ORGANIC CLAYS WHICH OCCUR BELOW THE A-LINE.

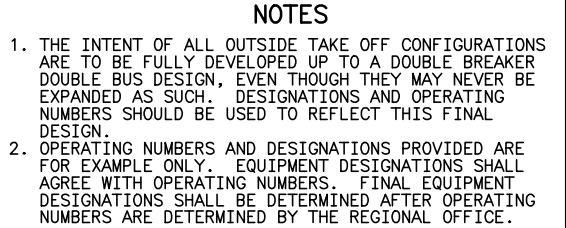
HIGHLY ORGANIC CLAYS HAVE A VERY WEAK AND SPONGY FEEL AT THE PLASTIC LIMIT.

FRACTIONS AS GIVEN UNDER FIELD IDENTIFICATION
DETERMINE PERCENTAGES OF GRAVEL AND SAND FROM GRAIN SIZE CURVE. DEPENDING ON PERCENTAGE OF FINES (FRACTION SMALLER THAN NO. 200 SIEVE SIZE) COARSE GRAINED SOILS ARE CLASSIFIED AS FOLLOWS:-

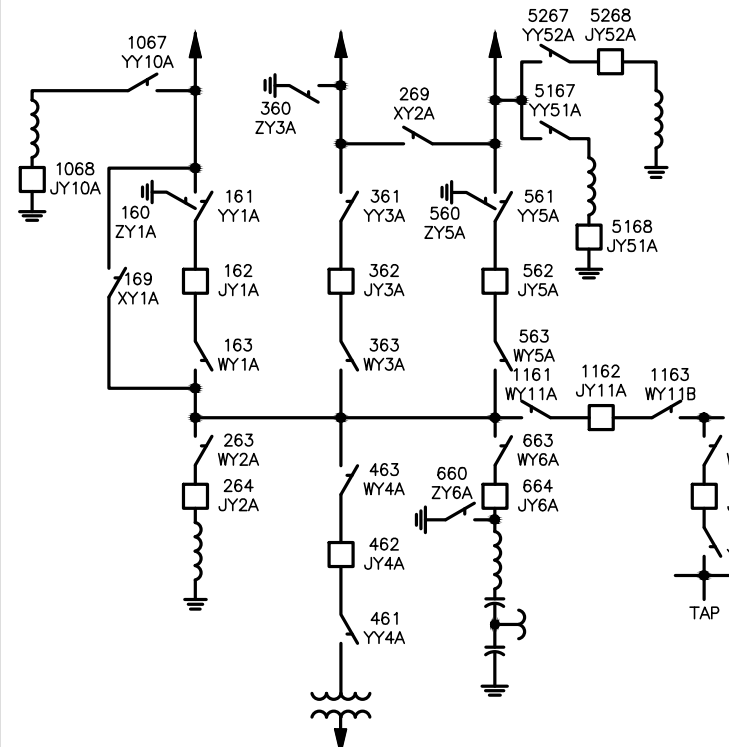
LESS THAN 5%
5% TO 12%
MORE THAN 12%
USE OF DUAL SYMBOLS
BORDERLINE CASES REQUIRING USE OF DUAL SYMBOLS



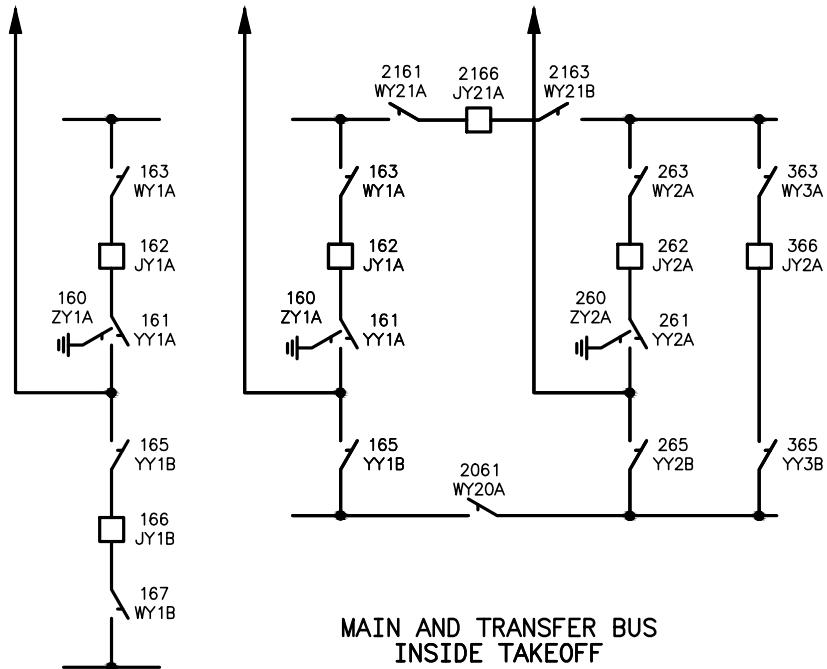
B	6-29-11 A7-DDD	REDRAWN.
SUPERSEDES DWG NO. 103-D-347		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
DESIGN STANDARDS		
UNIFIED SOIL CLASSIFICATION		
DESIGNED BUREC _____ APPROVED BUREC _____		
APRIL 10, 1979	01	8000



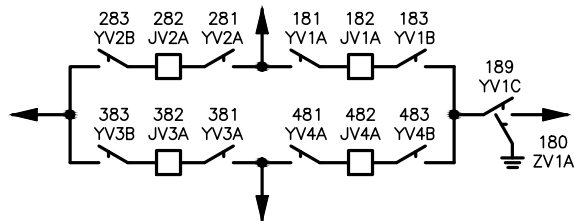
A	4-3-12 A7-RMJ	REVISED BKR & A HALF AND RING BUS LAYOUTS TO CONFORM TO OPERATING NUMBER STANDARDS.
	UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO	
SUBSTATION STANDARDS SWITCHING DIAGRAM OPERATING NUMBERS BUS CONFIGURATIONS		
DESIGNED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



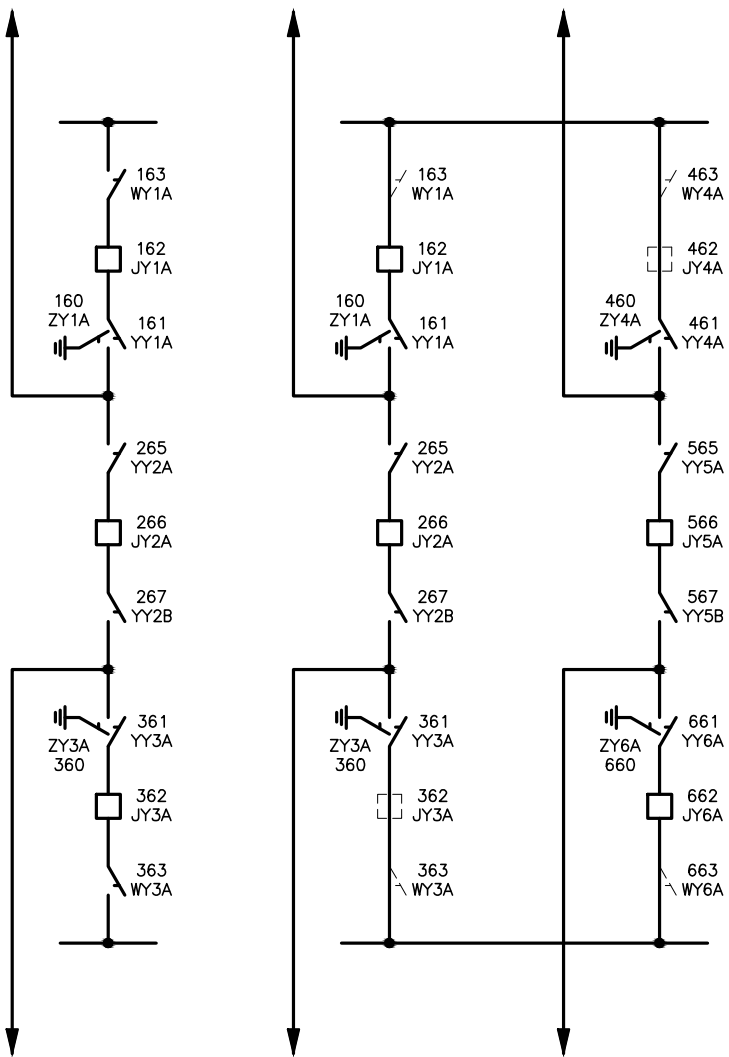
SINGLE BUS CONFIGURATION



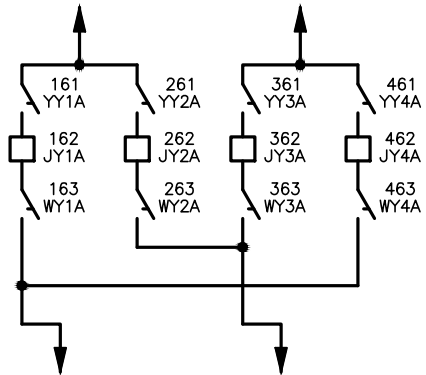
DOUBLE BREAKER DOUBLE BUS INSIDE TAKEOFF



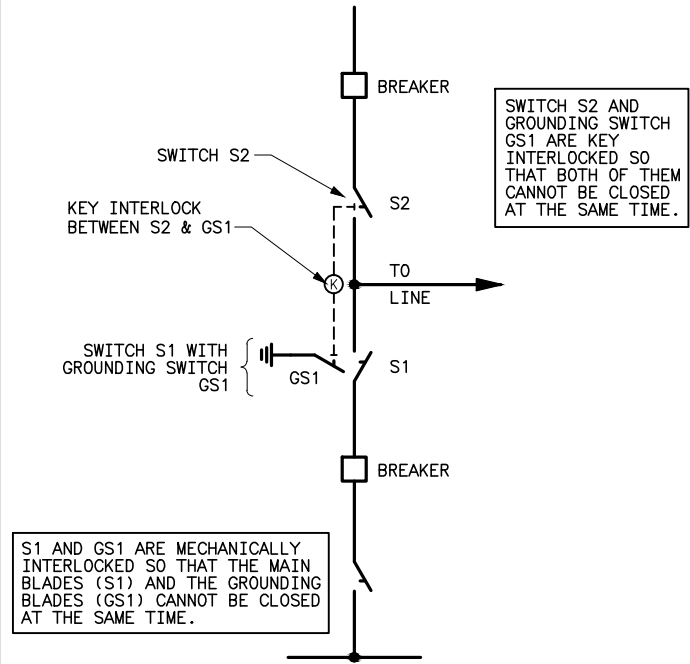
STANDARD RING BUS ARRANGEMENT

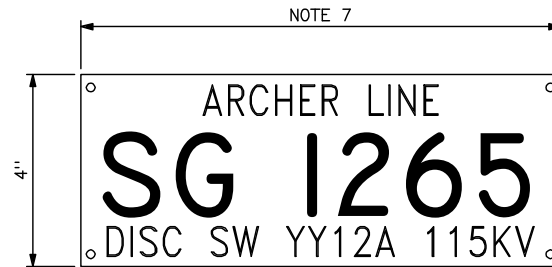
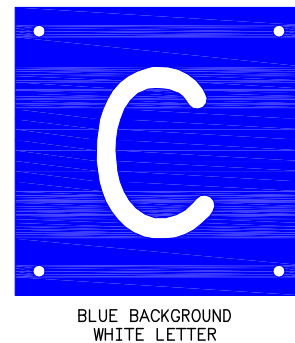
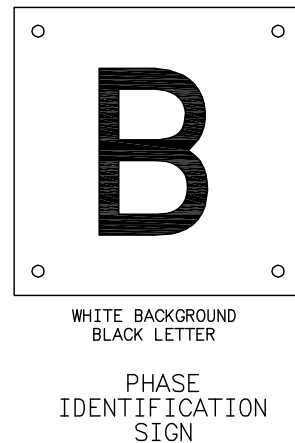
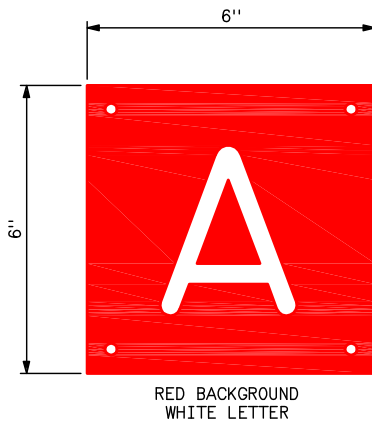
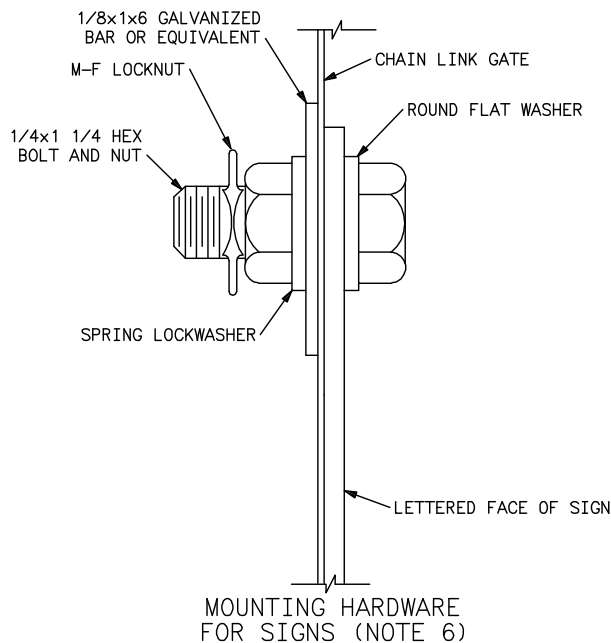
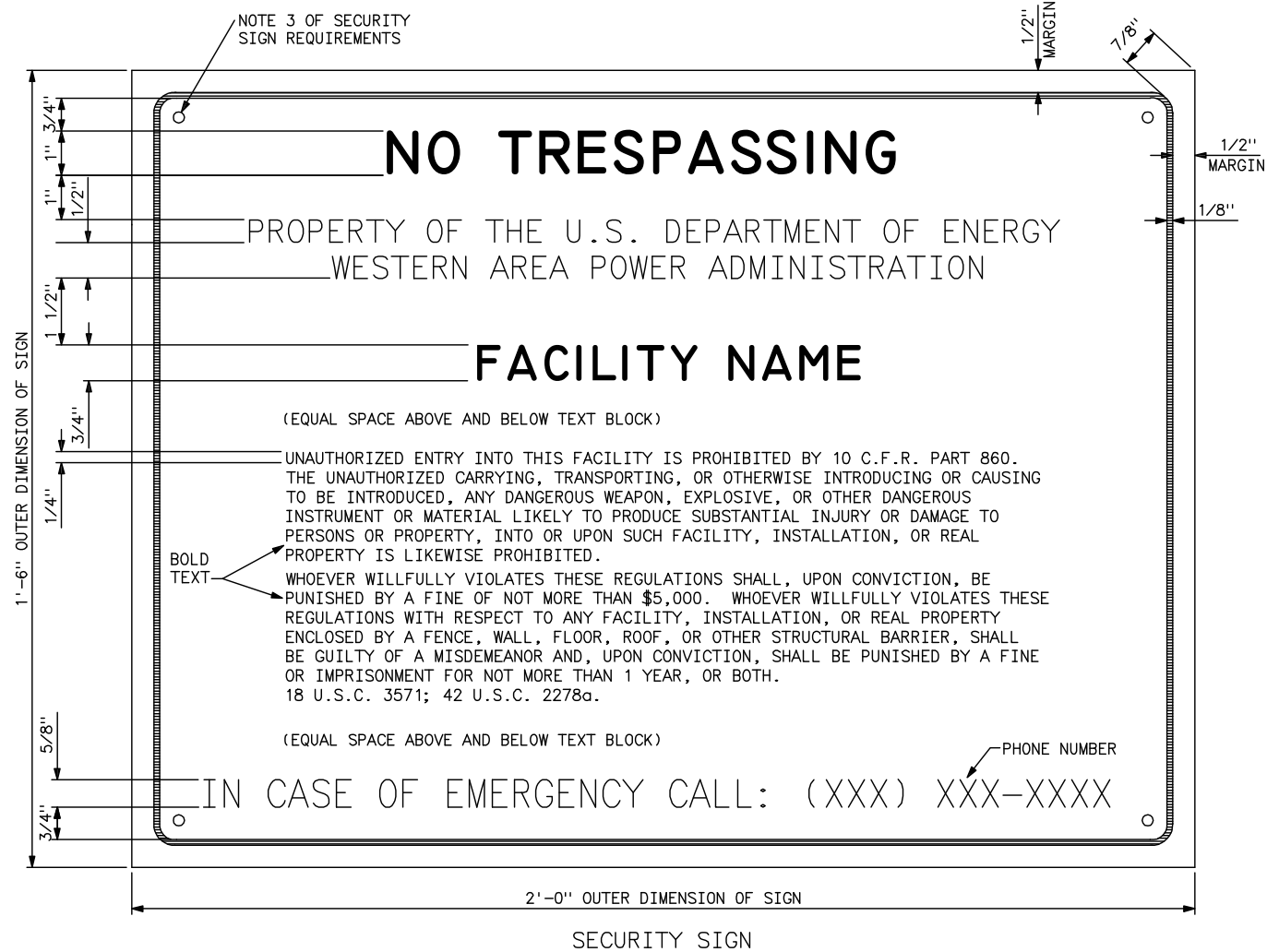


BREAKER AND A HALF RING BUS - FUTURE BREAKER AND A HALF INSIDE TAKEOFF



RING BUS ARRANGEMENT CONVERTIBLE TO BREAKER AND A HALF (ALTERNATE OPERATING NUMBERS SHOWN ON 31 0001-1)





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

INSULATION COORDINATION

RATED SYSTEM VOLTAGE KV	INSULATION LEVEL		GROUNDED NEUTRAL SYSTEM					UNGROUND NEUTRAL SYSTEM				
	BIL KV	KV	5 3/4x10 INSULATOR DISCS NO.	MAXIMUM ELEVATION- FEET				5 3/4x10 INSULATOR DISCS NO.	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
7.2 14.4 14.4	95 95 110	7.5-8.7 7.5-8.7 15	2 2 2	19,800 19,800 19,800	19,800 (c) 19,800	19,800 (c) 19,800	19,800 (c) (b) 13,200	2 2 2	19,800 19,800 19,800	19,800 (c) (b) 13,200	15,100 (c) 13,400	19,800 (c) (b) 13,200
25.0 25.0 25.0	110 150 200	15 23 34.5	2 2 2	19,800 19,800 19,800	(c) (b) 13,200 19,800	(c) 15,400 (e)	(c) 11,000 (f)	2 2 2	19,800 19,800 19,800	(c) 11,000 17,300	(c) 12,000 (e)	(c) 11,000 (f)
34.5 34.5 34.5	150 200 250	23 34.5 46	3 3 3	19,800 19,800 19,800	(c) 11,000 16,000	(c) 13,100 (e)	(c) (a) 6,600 (f)	3 3 3	18,500 18,500 18,500	(c) (a) 6,600 (b) 13,200	(c) 10,500 (e)	(c) (a) 6,600 (f)
46.0 46.0 46.0	200 250 350	34.5 46 69	4 4 4	19,800 19,800 19,800	(c) 11,000 18,200	(c) 11,800 (e)	(c) (a) 6,600 (f)	4 4 4	15,100 15,100 15,100	(c) (a) 6,600 12,700	(c) 10,000 (e)	(c) (a) 6,600 (f)
57.0 57.0 57.0 57.0	200 250 350 550	34.5 46 69 69 H	5 5 5 5	19,800 19,800 19,800 19,800	(c) (c) 12,800 13,700	(c) (c) 18,900 (e)	(c) (c) 6,800 (f)	5 5 5 5	13,400 13,400 13,400 13,400	(c) (c) 6,800 8,800	(c) (c) (b) 13,200 (e)	(c) (c) 6,800 (f)
69.0 69.0 69.0 69.0	250 350 350 550	46 69 69 H 115	5 5 5 6	13,400 13,400 13,400 19,000	(c) 7,800 8,800 19,800	(c) (b) 13,200 (e)	(c) (a) 6,300 (f)	5 5 5 6	10,700 10,700 10,700 12,800	(c) (a) 6,300 (a) 6,600 13,200	(c) 10,000 (e)	(c) (a) 6,300 (f)
115.0 115.0 115.0 115.0	350 550 550 750	69 H 92 115 161	7 7 8 9	11,100 11,100 14,600 18,100	(c) (d) 10,600 17,600	(d) (d) 7,300 (e)	(d) 4,800 (f)	8 8 8 9	10,400 10,400 10,400 (b) 13,200	(c) (d) (a) 6,600 (b) 13,200	(d) (d) (a) 6,600 (e)	(d) (c) (a) 6,600 (f)
138.0 138.0 138.0 138.0	550 750 750 900	115 138 161 196	8 9 10 11	9,100 (b) 12,900 13,900 16,900	5,400 (d) (b) 13,200 16,400	(c) 6,800 (e)	5,400 (f)	9 9 9 10	7,800 7,800 7,800 11,100	(c) (d) 7,300 (b) 13,200	(c) (a) 6,300 (e)	(c) (a) 6,300 (f)
161.0 161.0 161.0 161.0	750 750 900 1050	138 161 196 230	9 10 11 13	7,400 10,800 (b) 13,200 15,900	(d) 7,300 (b) 13,200 15,400	(c) 6,400 (e)	5,800 (f)	11 11 11 12	8,200 8,200 8,200 11,200	(d) (a) 6,100 7,700 (b) 13,200	(c) (a) 6,100 (e)	(c) (a) 6,100 (f)
230.0 230.0 230.0	900 1050 1300	196 230 287	13 14 16	6,900 9,100 12,300	4,800 9,000 12,800	3,300 5,400 (e)	4,800 (f)	15 15 16	6,200 6,200 8,200	(c) 5,400 8,700	(c) 5,400 (e)	(c) 5,400 (f)
287.0 287.0 287.0	1050 1300 1300	230 287 345	15 17 20	3,700 7,400 (b) 12,700	3,300 8,700 (b) 13,200	(c) 5,500 (e)	3,300 (f)	19 19 20	(a) 6,600 (a) 6,600 7,600	(c) 5,100 7,200	(c) 5,100 (e)	(c) 5,100 (f)
345.0 345.0 345.0	1300 1300 1300	287 345 345	19 21 22	4,700 7,800 9,200	3,600 8,400 8,400	(c) 5,200 5,200	3,500 (f)	22 22 23	5,000 5,000 (a) 6,400	(c) 4,800 4,800	(c) 4,800 4,800	(c) 4,800 4,800

EXPLANATION

- (a)___0 TO 6000 FT LIGHTNING ARRESTER.
(b)___6000 TO 12000 FT LIGHTNING ARRESTER.
(c)___DO NOT USE AT ANY ELEVATION.
(d)___NOT AVAILABLE, USE NEXT HIGHER VOLTAGE RATING.
(e)___SEE NOTE 4.
(f)___SEE NOTE 5.

NOTES

1. ENTER ABOVE TABLE IN LEFT-HAND COLUMN WITH RATED SYSTEM VOLTAGE.
2. PROCEED RIGHT ON LINE TO SWITCH AND BUS INSULATOR COLUMN, GROUNDED OR UNGROUNDED, WHICH WILL GIVE MAXIMUM ELEVATIONS AT WHICH DISCONNECTING SWITCHES, FUSES, AND POST-TYPE INSULATORS OF VARIOUS INSULATION LEVELS MAY BE USED. FOR CONVENIENCE THE BIL FOR THE INSULATORS IS NOTED IN SECOND COLUMN FROM LEFT.
3. THE TWO LEFT-HAND COLUMNS, UNDER GROUNDED AND UNGROUNDED, RESPECTIVELY, GIVE THE NUMBER OF INSULATOR DISCS TO USE IN STRAIN AND SUSPENSION INSULATOR ASSEMBLIES FOR VARIOUS ELEVATIONS FOR EACH VOLTAGE CLASS.
4. POWER CIRCUIT BREAKERS MAY BE USED UP TO THE ELEVATION GIVEN IN THE RESPECTIVE COLUMNS, FOR GROUNDED OR UNGROUNDED SERVICE, WITHOUT MENTIONING ELEVATION IN THE PURCHASE SPECIFICATIONS. IF THE MAXIMUM ELEVATIONS GIVEN ABOVE ARE TO BE EXCEEDED, THE SPECIFICATIONS SHOULD SPECIFY A BREAKER VOLTAGE RATING THE SAME AS THE ACTUAL CIRCUIT VOLTAGE AND SPECIFICATIONS SHOULD STATE, "SUITABLE FOR OPERATION AT AN ELEVATION OF _____ FEET."
5. POWER TRANSFORMERS MAY BE USED UP TO THE ELEVATION GIVEN IN THE RESPECTIVE COLUMNS, FOR GROUNDED OR UNGROUNDED SERVICE, WITHOUT MENTIONING ELEVATION IN THE PURCHASE SPECIFICATIONS. NOTE THAT REDUCED INSULATION SHOULD BE USED FOR TRANSFORMERS OF 115KV OR HIGHER VOLTAGE RATING ON SOLIDLY GROUNDED NEUTRAL CIRCUITS. IF THE MAXIMUM ELEVATIONS GIVEN ARE TO BE EXCEEDED, THE SPECIFICATIONS SHOULD SPECIFY AN INSULATION CLASS EQUAL TO OR ONE STEP LESS (AS THE CASE MAY BE) THAN THE ACTUAL CIRCUIT VOLTAGE; HOWEVER, THE BUSHING PARAGRAPH ONLY SHOULD INCLUDE THE FOLLOWING: "THE BUSHINGS SHALL BE SUITABLE FOR OPERATION AT AN ELEVATION OF _____ FEET."
6. LIGHTNING ARRESTERS SHOULD BE APPLIED IN ACCORDANCE WITH THE MANUFACTURER'S STANDARDS, UNLESS OTHERWISE NOTED.
7. COUPLING CAPACITORS AND INSTRUMENT TRANSFORMERS SHOULD BE APPLIED TO SAME ELEVATIONS AS GIVEN FOR SWITCH AND BUS INSULATORS
8. 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 DRY-TYPE SELF-COOLED _____0.3%
FOR DRY-TYPE FORCED-AIR-COOLED _____0.5%

B	5-14-99 A3-OP	REDRAWN AND REVISED.
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		
C A	JANUARY 13, 1984	31 1004

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

LINE NUMBER	RATED MAXIMUM VOLTAGE (KV RMS)	BIL (KV CREST)	PHASE- TO-PHASE METAL- TO-METAL MINIMUM (INCHES)	PHASE-TO-GROUND CLEARANCES		CENTERLINE-TO-CENTERLINE PHASE SPACING			CLEARANCE FROM OVERHEAD CONDUCTOR TO GROUND AND ROAD SURFACES INSIDE SUBSTATIONS	
				RECOMMENDED (INCHES)	RECOMMENDED MINIMUM (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)
1	15.5	110	12	12	7	* 2'-0"	2'-6"	3'-0"	11'-0"	20'-0"
2	25.8	150	15	15	10	* 2'-6"	3'-0"	4'-0"	11'-0"	22'-0"
3	38.0	200	18	23	13	* 3'-0"	4'-0"	5'-0"	11'-0"	22'-0"
4	48.3	250	21	23	17	* 4'-0"	5'-0"	6'-0"	11'-0"	22'-0"
5	72.5	350	31	31	25	5'-0"	6'-0"	7'-0"	11'-0"	23'-0"
6	121	550	53	47	42	7'-0"	9'-0"	10'-0"	12'-0"	24'-0"
7	145	650	63	53	50	8'-0"	11'-0"	12'-0"	13'-0"	25'-0"
8	169	750	72	62	58	9'-0"	13'-0"	14'-0"	14'-0"	26'-0"
9	242	900	89	79	71	12'-0"	16'-0"	16'-0"	15'-0"	27'-0"
10	242	1050	105	91	83	13'-0"	18'-0"	18'-0"	16'-0"	28'-0"
11	362	1300	119	106	104	16'-0"	-	20'-0"	18'-0"	30'-0"
12	550	1800	-	152	144	25'-0"	-	30'-0"	30'-0"	35'-0"

* NOTE 3

TABLE C
(X) SEPARATION OF TRANSFORMERS FROM BUILDINGS

LINE NUMBER	TRANSFORMER RATING (KVA)	OIL (GALLONS)	(X) SEPARATION WITHOUT FIREWALL (FEET)
	(1)	(2)	(3)
1	75 OR LESS	LESS THAN 2,000	10
2	76 - 333	LESS THAN 2,000	20
3	OVER 333	LESS THAN 2,000	30
4	UP TO 11,000	UP TO 5,000	25 (USE 30)
5	OVER 11,000	OVER 5,000	50

1. LINES 1,2, AND 3 ARE IN ACCORDANCE WITH IEEE 979-1994, TABLE 2.
2. LINES 4 AND 5, COLUMNS (2) AND (3) ARE IN ACCORDANCE WITH NFPA 850-2000, TABLE 3-2.4.3 EXCEPT USE 30 FEET FOR LINE 4, COLUMN (3).
3. LINES 4 AND 5, COLUMN 1: THE 11,000 KVA IS AN ESTIMATED VALUE OBTAINED FROM A REPRESENTATIVE OF A TRANSFORMER MANUFACTURER.
4. LARGE OIL-FILLED TRANSFORMERS SHOULD BE SEPARATED BY AT LEAST 30 FEET OF CLEAR SPACE OR A MINIMUM 1H FIRE RATED BARRIER AS REQUIRED BY IEEE 979-1994, PARAGRAPH 4.4.3.

NOTES

1. SPACING AND CLEARANCES:

a. LINES 1 THRU 11, COLUMNS 3 THRU 9; AND LINE 12, COLUMNS 3 THRU 6:
MEET OR EXCEED NEMA SG-6, TABLE 32-1; AND ANSI C37.32 TABLE 3 REQUIREMENTS.

b. LINE 12, COLUMN 8:
ADDED 5 FEET TO LINE 12, COLUMN 6.
- c. LINE 12, COLUMN 9:
BASED ON LIMITING EMF (ELECTRIC AND MAGNETIC FIELDS) ADVERSE EFFECTS.
- d. LINE 1 THRU 12, COLUMN 10:
MEETS OR EXCEEDS ANSI C2, TABLE 232-1 REQUIREMENTS.

2. SPACINGS AND CLEARANCES ARE BASED ON INSULATOR BIL RATINGS WHICH ARE RATED TO ELEVATIONS AS SPECIFIED ON INSULATION COORDINATION DRAWING 31 1004. ABOVE THE SPECIFIED ELEVATIONS, USE NEXT HIGHER BIL LEVEL AND ASSOCIATED SPACINGS AND CLEARANCES.

3. INCREASE AS REQUIRED FOR BUSES THAT COULD BE SUBJECTED TO HIGH SHORT CIRCUIT CURRENTS.

4. IN NO CASE SHOULD CLEARANCES FROM TOP OF FOUNDATION OR EQUIPMENT CABINET PLATFORM TO BOTTOM OF EQUIPMENT BUSHINGS OR INSULATORS BE LESS THAN 8'-6"

5. CONSIDERATION SHOULD BE GIVEN TO RELOCATING FENCES WHERE NECESSARY TO MEET AT LEAST TABLE B, IEEE 1119 MINIMUM ZONE REQUIREMENTS AND PREFERABLY THE RECOMMENDED MINIMUM ZONE REQUIREMENTS WHICH PROVIDES FOR DESIRED ACCESS AND MAINTENANCE SPACE.

TABLE B
STATION FENCE SAFETY CLEARANCES (NOTE 5)

LINE NUMBER	MAXIMUM PHASE-TO- PHASE (KV RMS)	MAXIMUM PHASE-TO- GROUND (KV RMS)	IMPULSE BIL (KV CREST)	DIMENSIONS FOR FIGURE 1			
				IEEE-119-1988 MINIMUM ZONE		RECOMMENDED MINIMUM ZONE	
				DIMENSION-A (FEET-INCHES)	DIMENSION-B (FEET-INCHES)	DIMENSION-A (FEET-INCHES)	DIMENSION-B (FEET-INCHES)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	15.5-38	22	110-150	14'-6"	10	20'-0"	15'-0"
2	48.3-72.5	42	250-350	15'-2"	12	20'-0"	15'-0"
3	121	70	550	16'-2"	13	20'-0"	15'-0"
4	145	84	650	16'-7"	14	20'-0"	15'-0"
5	169	98	750	17'-1"	14	20'-2'	15'-2"
6	242	140	900	18'-6"	16	21'-7"	16'-7"
7	242	140	1050	18'-6"	16	22'-7"	17'-7"
8	362	209	1300	20'-9"	18	23'-10"	18'-10"
9	555	318	1800	24'-5"	21	27'-8"	22'-8"

- COLUMN 4: BASED ON ANSI C2, TABLE 232-1 FOR SPACE SUBJECT TO PEDESTRIAN TRAFFIC AT 3300-FOOT ELEVATION. ABOVE 50KV PHASE-TO-GROUND CLEARANCES ARE INCREASED 3% PER 1000 FEET IN EXCESS OF 3300 FEET ABOVE MEAN SEA LEVEL.
- COLUMN 5: AS LISTED IN IEEE 1119-1988. ANSI C2, SECTION 11 PARAGRAPH 110, A.2. INDICATES THAT THIS MAY BE USED AS A GUIDE.
- COLUMN 6: COLUMN 6 ASSUMES 10 FOOT STICK, ROD, OR OTHER OBJECT RAISED 5 FEET ABOVE GROUND PLUS TABLE A, COLUMN (4) CLEARANCES.
- COLUMN 7: COLUMN 7 ASSUMES 10 FOOT STICK, ROD, OR OTHER OBJECT INSERTED THROUGH FENCE PLUS TABLE A, COLUMN (4) CLEARANCES EXCEPT A MINIMUM OF 15'-0" IS DESIRED FOR ACCESS AND MAINTENANCE. FOR VEHICULAR TRAFFIC BETWEEN LIVE PARTS AND FENCE, HORIZONTAL CLEARANCES OF AT LEAST 30 FEET FOR HV AND 40 FEET FOR EHV ARE NORMALLY DESIRED.

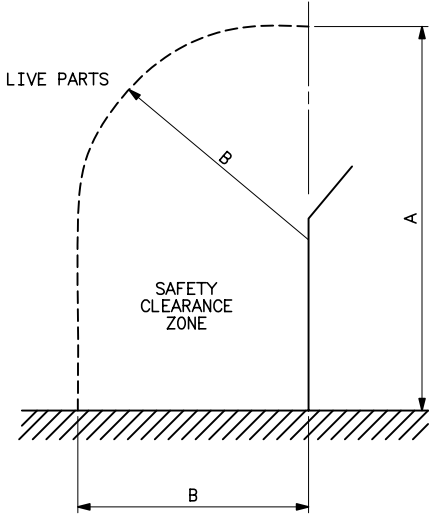
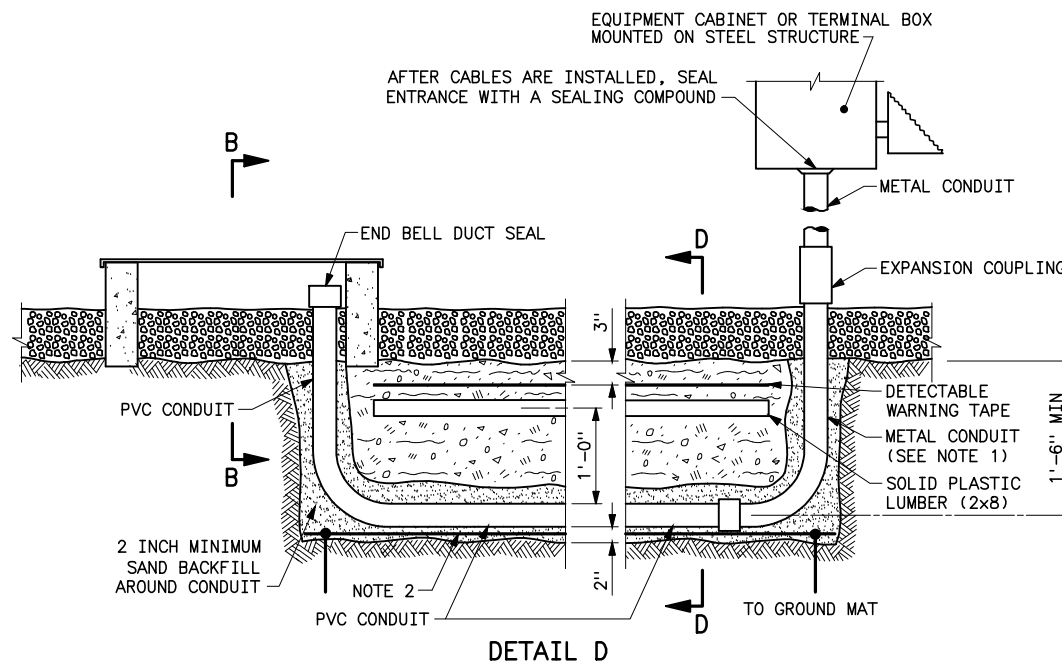
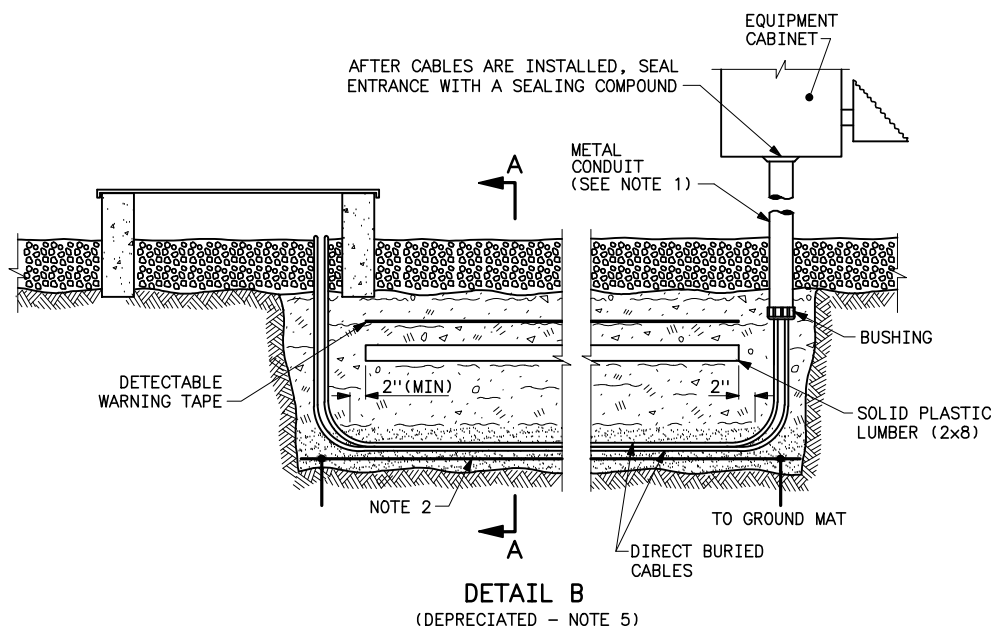
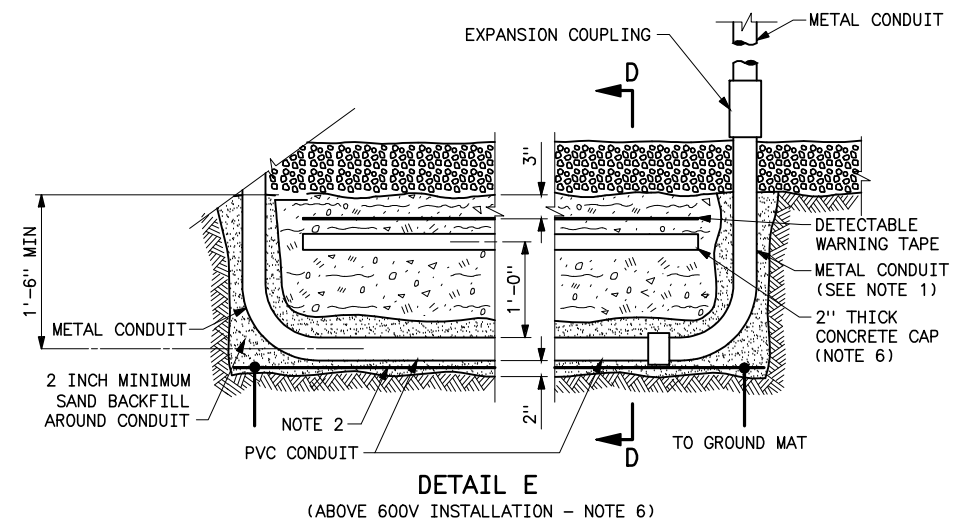
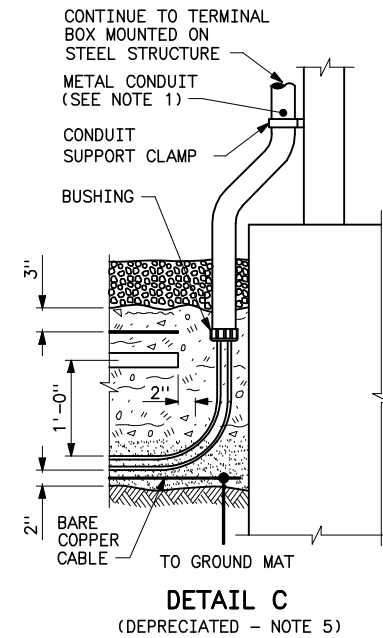
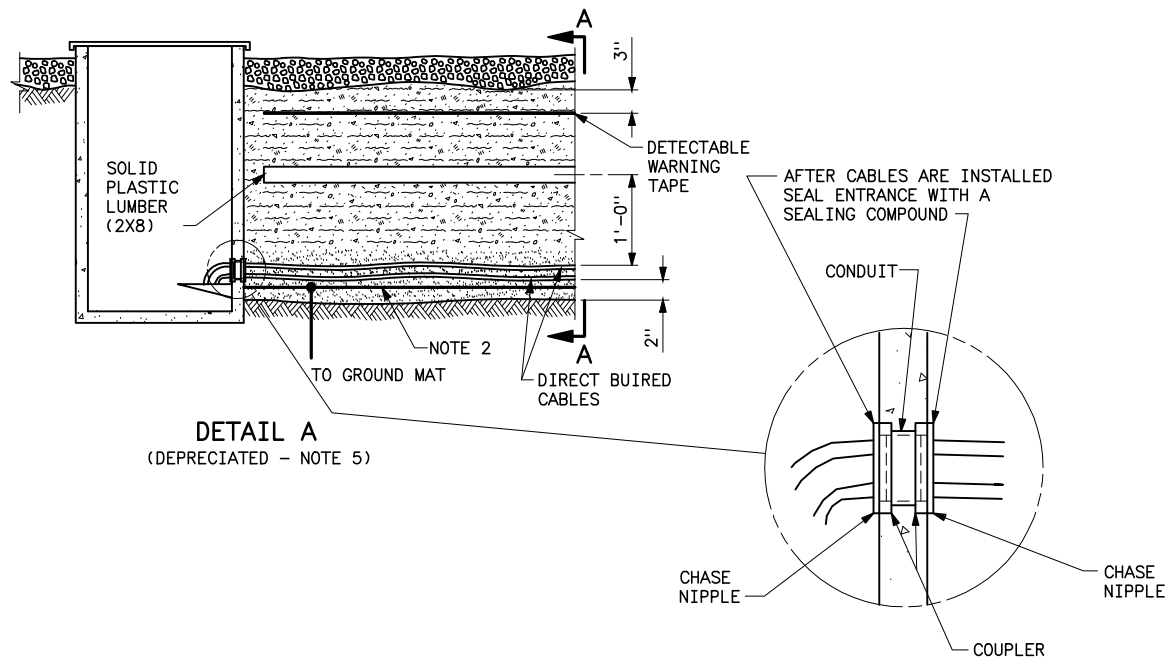


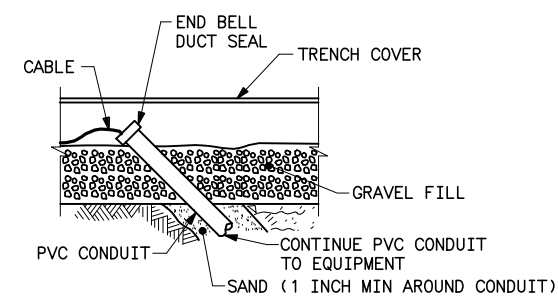
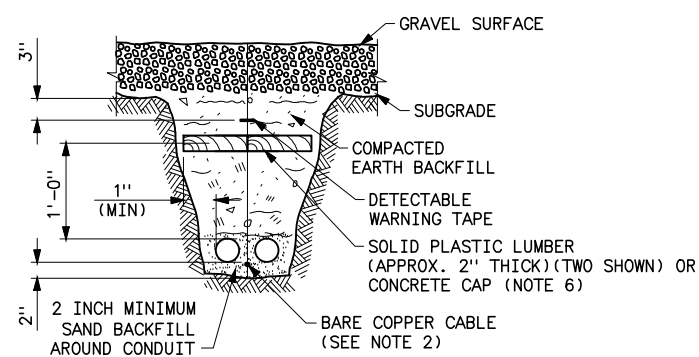
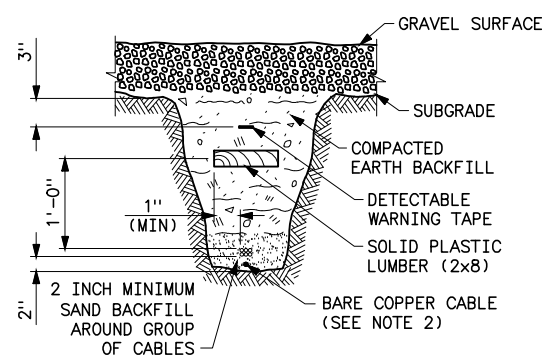
FIG 1
SAFETY-CLEARANCE TO ELECTRIC-SUPPLY STATION FENCES

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



NOTES

1. FOR METAL CONDUIT TERMINATING BELOW FINISHED GRADE, THE PORTION OF METAL CONDUIT 6 INCHES ABOVE AND ALL METAL CONDUIT BELOW FINISHED GRADE TO BE PLASTIC COATED OR TAPE COVERED AS DESCRIBED IN STANDARD 9.2.2.
2. A BARE COPPER CABLE SHALL BE BURIED PARALLEL WITH ALL CABLE RUNS AT SUBSTATIONS WHERE SHIELDED POWER CABLES ARE USED. (REQUIRED FOR ALL 345KV AND ABOVE SUBSTATIONS AND 161KV AND ABOVE SUBSTATIONS WITH CAPACITOR BANKS). THE COPPER CABLE SIZE SHALL BE THE SAME AS THAT OF THE MAIN GROUND MAT.
3. DETECTABLE WARNING TAPE, DETECTABLE WITH A STANDARD METAL DETECTOR, WITH AN OVERALL THICKNESS OF 4 TO 6 MILS AND A MINIMUM WIDTH OF 3 INCHES SHALL BE INSTALLED ABOVE ALL UNDERGROUND CABLES AND CONDUITS. THE TAPE SHALL BE LOCATED DIRECTLY ABOVE THE CABLE 3 INCHES BELOW THE SUBGRADE.
4. A STRUCTURAL GRADE PLASTIC LUMBER (2x8) SHALL BE INSTALLED 12 INCHES ABOVE THE BURIED CABLE OR 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.
5. REFRAIN FROM USING DIRECT BURIED METHODS FOR NEW INSTALLATIONS.
6. 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.

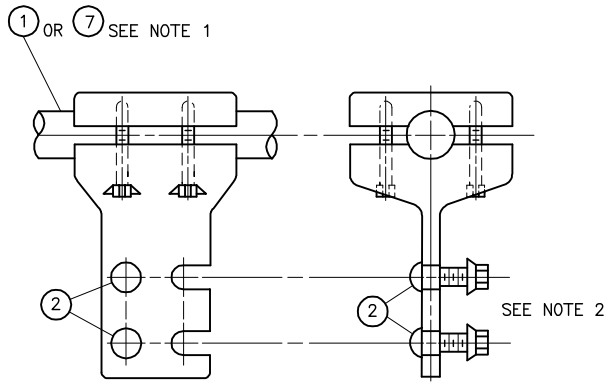


H	9-27-16 A7-RMJ	ADDED DETAIL E FOR ABOVE 600V CONDUIT, SECTION D-D, NOTE 6, & REVISED NOTE 4.
G	1-17-14 A7-RMJ	REVISED DETAIL A AND NOTE 1, NEW NOTE 5, AND OTHER MINOR REVISIONS.
F	3-17-10 G5-GB	ADDED DETECTABLE WARNING TAPE TO DETAILS AND MODIFIED NOTE 3 & ADDED NOTE 4
E	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY
D	5-14-99 A3-OP	REDRAWN. REVISED DETAIL D & NOTES

SUPERSEDES DWG NO. 40-D-5370

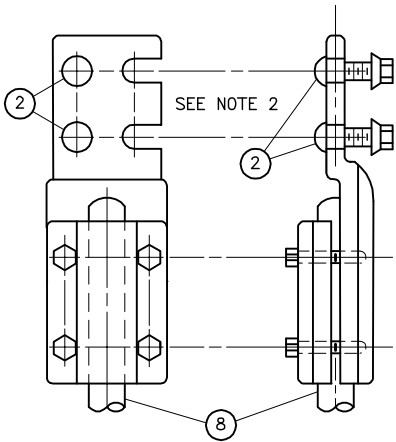
UNITED STATES DEPARTMENT OF ENERGY
WESTERN AREA POWER ADMINISTRATION
CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADOSUBSTATION STANDARDS
BURIED INSULATED CABLES
AND CONDUIT
TYPICAL DETAILSDESIGNED BUREC _____ APPROVED ROSS M. CLARK
ELECTRICAL ENGINEERING MANAGER

MAY 18, 1979 31 1006



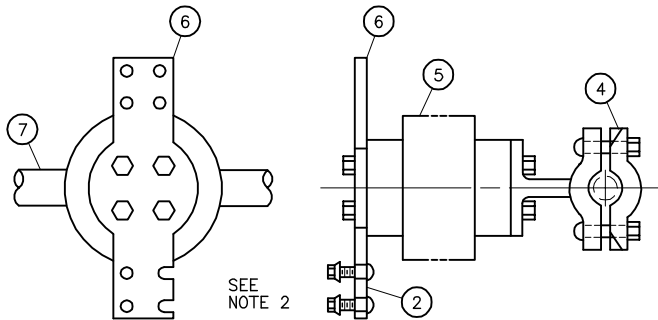
DETAIL A

HOT-LINE T-CONNECTOR (NTS)



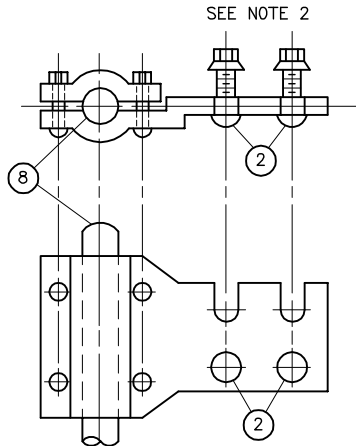
DETAIL C

HOT-LINE STUD TO PAD CONNECTOR (NTS)



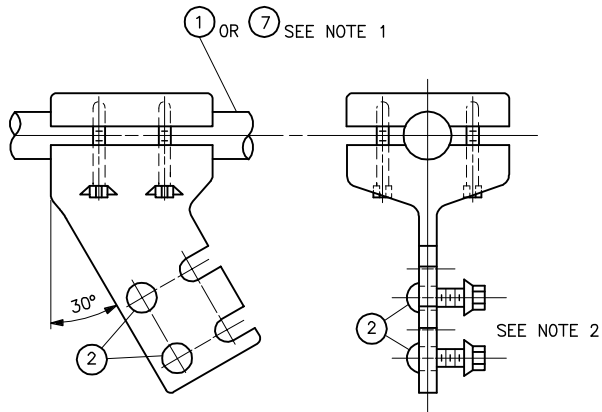
DETAIL E

STAND OFF INSULATOR ASSEMBLY (NTS)



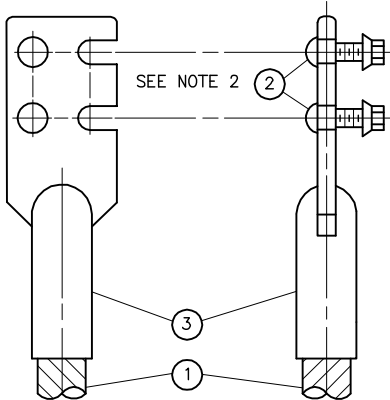
DETAIL G

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



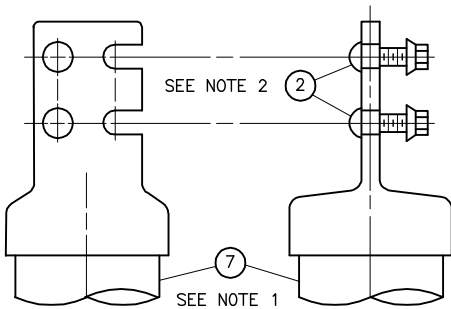
DETAIL B

30° HOT-LINE T-CONNECTOR (NTS)



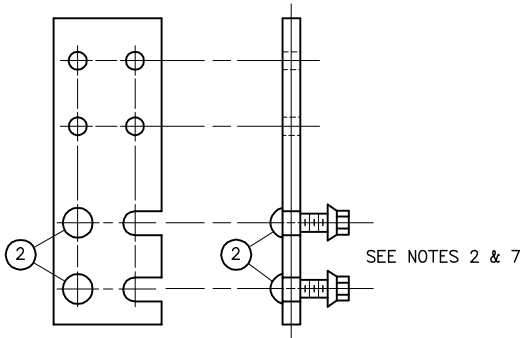
DETAIL D

HOT-LINE JUMPER CONNECTOR (NTS)



DETAIL F

WELDED HOT-LINE END COUPLER (NTS)



DETAIL H

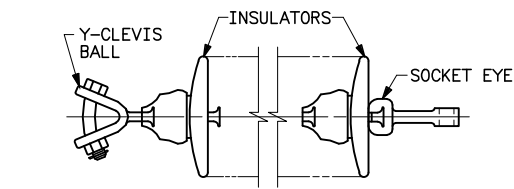
HOT-LINE PAD TO PAD (NTS)

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

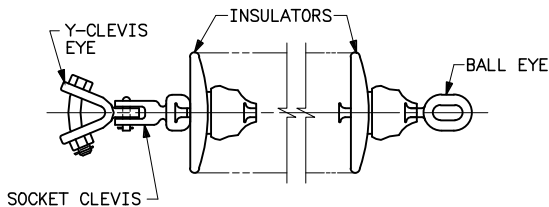
NOTES

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.

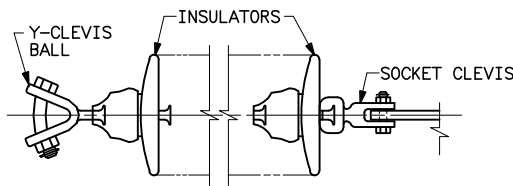
F	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.
E	5-14-99 A3-OP	REDRAWN.
SUPERSEDES DWG NO. 40-D-6928		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS HOT-LINE FITTINGS DETAILS		
DESIGNED BUREC _____ APPROVED ROSS M. CLARK ELECTRICAL ENGINEERING MANAGER		
C A-E	MAY 18, 1979	31 1007



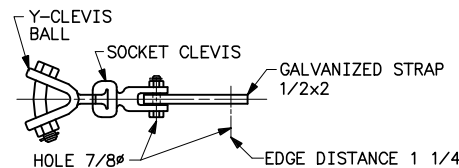
ASSEMBLY A



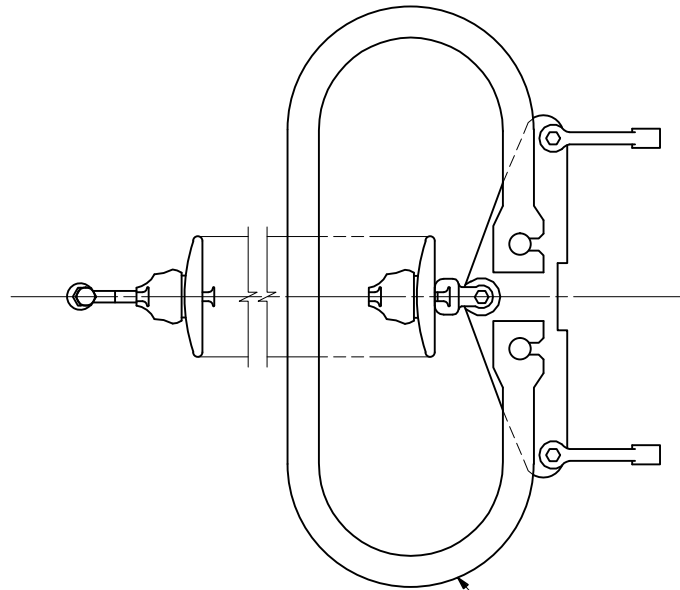
ASSEMBLY C



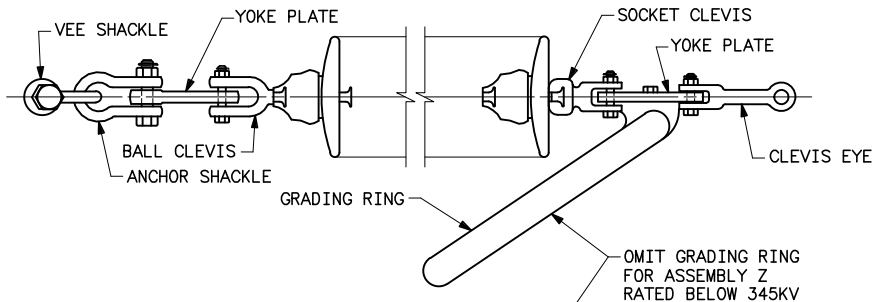
ASSEMBLY D



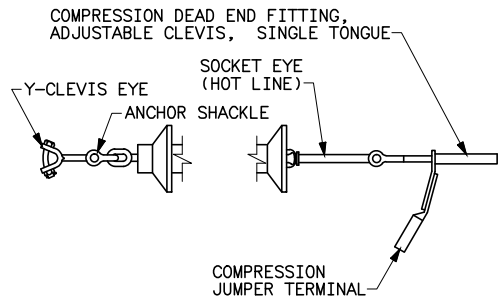
ASSEMBLY E



ASSEMBLY W (AS SHOWN)
ASSEMBLY X (AS NOTED)



ASSEMBLY Y (AS SHOWN)
ASSEMBLY Z (AS NOTED)



ASSEMBLY F
SINGLE POLYMER-FIBERGLASS INSULATOR STRING
ONE SUBCONDUCTOR (NOTE 6)

RATED SYSTEM VOLTAGE KV	GROUNDED NEUTRAL SYSTEM	
	MAXIMUM ALTITUDE (FEET)	THE NUMBER OF 5 3/4x10 DISCS REQD
7.2-25	19,800	2
34.5	19,800	3
46	19,800	4
57	19,800	5
69	13,400	5
69	19,000	6
115	11,100	7
115	14,600	8
115	18,100	9
138	9,100	8
138	12,900	9
138	13,900	10
138	16,900	11
161	7,400	9
161	10,800	10
161	13,200	11
161	15,900	13
230	6,900	13
230	9,100	14
230	12,300	16
287	3,700	15
287	7,400	17
287	12,700	20
345	4,700	19
345	7,800	21
345	9,200	22

TABLE 1

NOTES

1. THE INSULATORS SHALL BE SUSPENSION TYPE 5 3/4x10 PORCELAIN, BALL-SOCKETS OR POLYMER-FIBERGLASS OVAL EYE-BALL.
2. ALL HARDWARE SHALL BE GALVANIZED MALLEABLE IRON OR FORGED STEEL. EXCEPT FOR DOUBLE-STRING ASSEMBLY YOKE PLATES AND TOWER ATTACHMENTS, HARDWARE SHALL HAVE ULTIMATE STRENGTH OF NOT LESS THAN THE RATED STRENGTH OF THE REFERENCED INSULATOR CLASS. YOKE PLATES AND TOWER ATTACHMENT HARDWARE FOR DOUBLE STRING ASSEMBLIES SHALL HAVE ULTIMATE STRENGTH OF NOT LESS THAN TWO TIMES THE RATED STRENGTH OF REFERENCED INSULATOR CLASS.
3. ALL HARDWARE BOLTS SHALL BE FURNISHED WITH NUT AND COTTER KEY.
4. THE INSULATORS SHALL BE RATED 15,000 LB AND 20,000 LB RESPECTIVELY MECHANICAL AND ELECTRICAL STRENGTH (MIN).
5. THE NUMBER OF PORCELAIN INSULATORS SHALL BE DETERMINED BY TABLE 1. IF POLYMER-FIBERGLASS INSULATORS ARE USED, CALCULATE THE PORCELAIN STRING LENGTH AND USE A COMPARABLE LENGTH FOR THE POLYMER-FIBERGLASS INSULATOR(S).
6. REFER TO DRAWING 41 1023 FOR TWO POLYMER-FIBER GLASS INSULATORS STRING WITH TWO SUBCONDUCTORS.

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

MAY 18, 1979	31	1020
--------------	----	------

FIGURE 1

FIGURE 2

FIGURE 3

FIGURE 4

FIGURE 5

C	11-9-11 A7-RMJ	ADDED NOTE 12 AND REVISED DRAWINGS
B	5-14-99 A3-OP	REDRAWN AND MINOR REVISIONS.
FORMERLY DWG NO. 40-D-4334		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - GOLDEN, COLORADO		
SUBSTATION STANDARDS TYPICAL GROUNDING DETAILS (SHEET 1 OF 2)		
DESIGNED BUREC		APPROVED ROSS M. CLARK ELECTRICAL ENGINEERING MANAGER
C A E	MAY 18, 1979	31 1058

TYPICAL GROUND MAT DETAILS (NOTE 2)

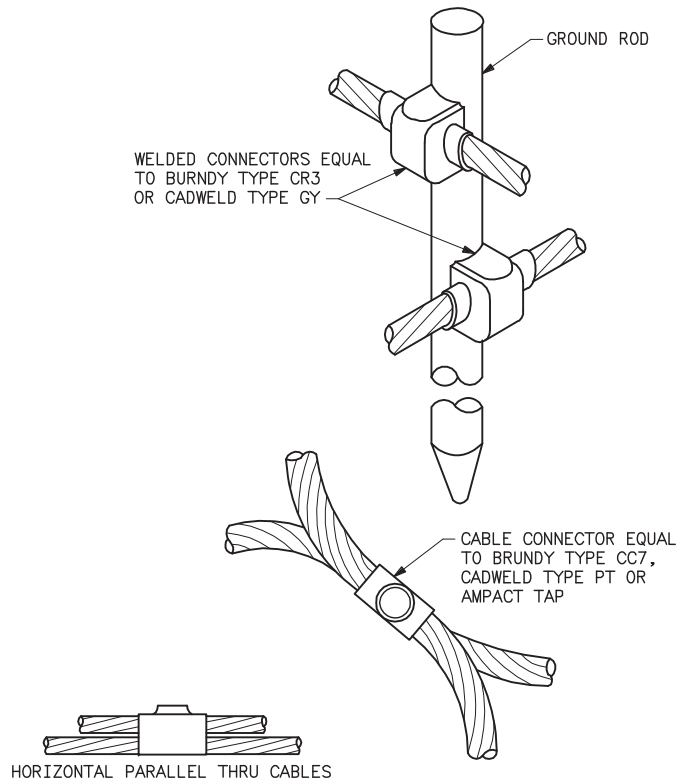


FIGURE 1

TYPICAL GROUNDING DETAILS FOR LIGHTING CABINET OR MISCELLANEOUS POWER

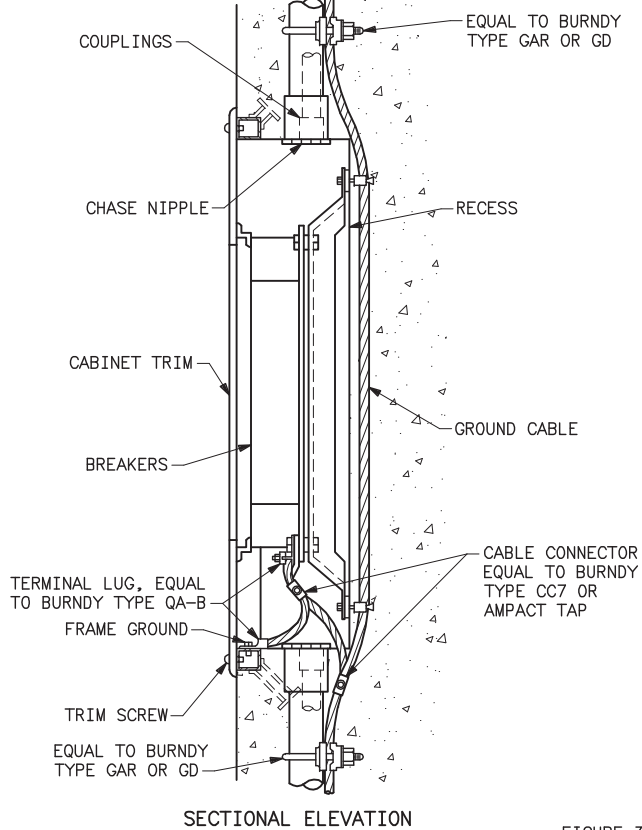


FIGURE 3

TYPICAL GROUNDING DETAILS FOR FLOOR FRAMES

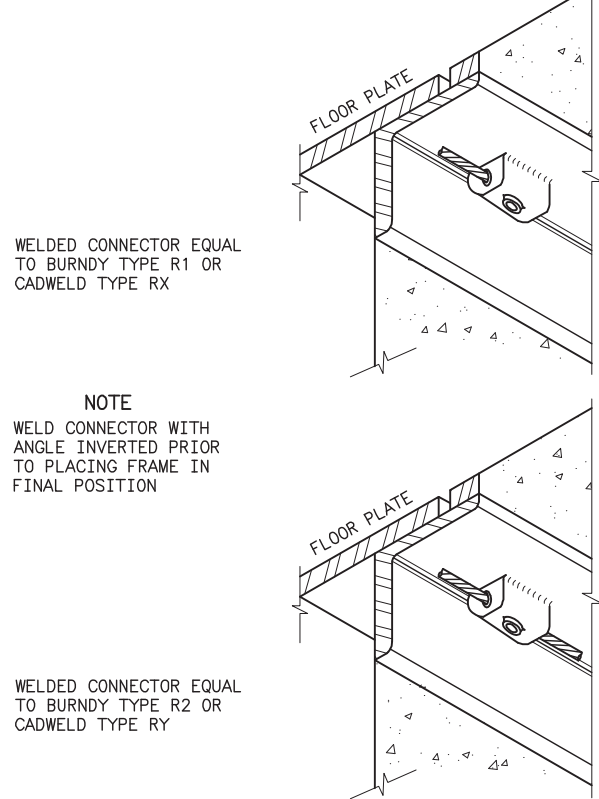


FIGURE 5

TYPICAL GROUNDING DETAILS FOR OIL TANK

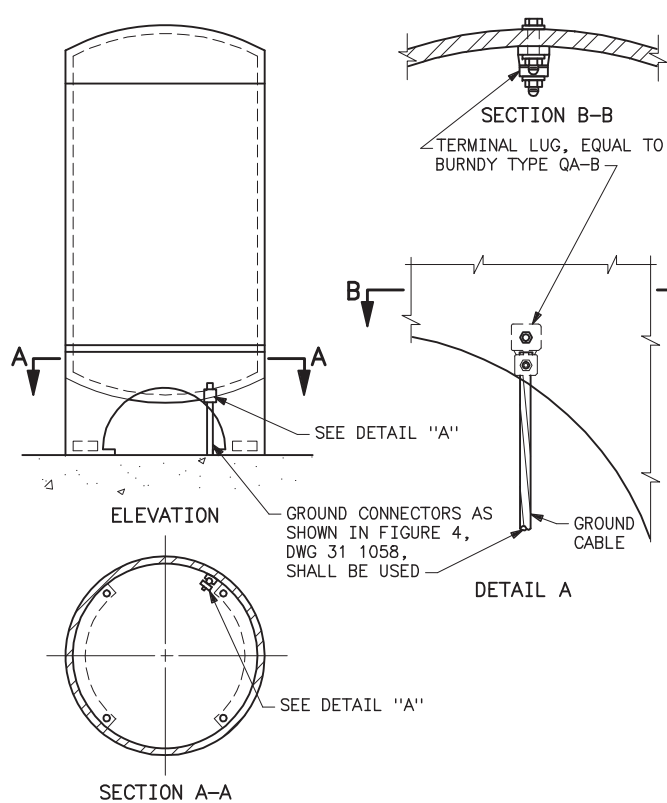


FIGURE 7

TYPICAL GROUNDING DETAILS FOR POWER OUTLET PLUG RECEPTACLE

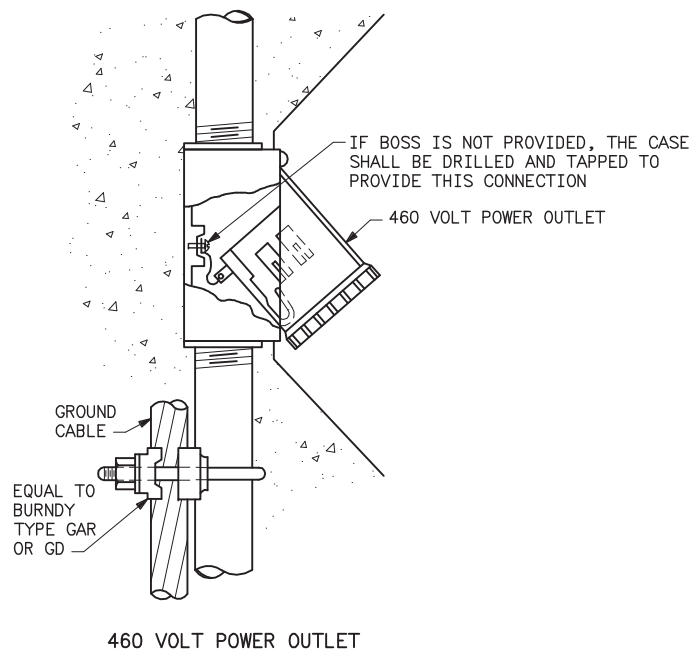


FIGURE 2

TYPICAL GROUNDING DETAILS FOR RAILS

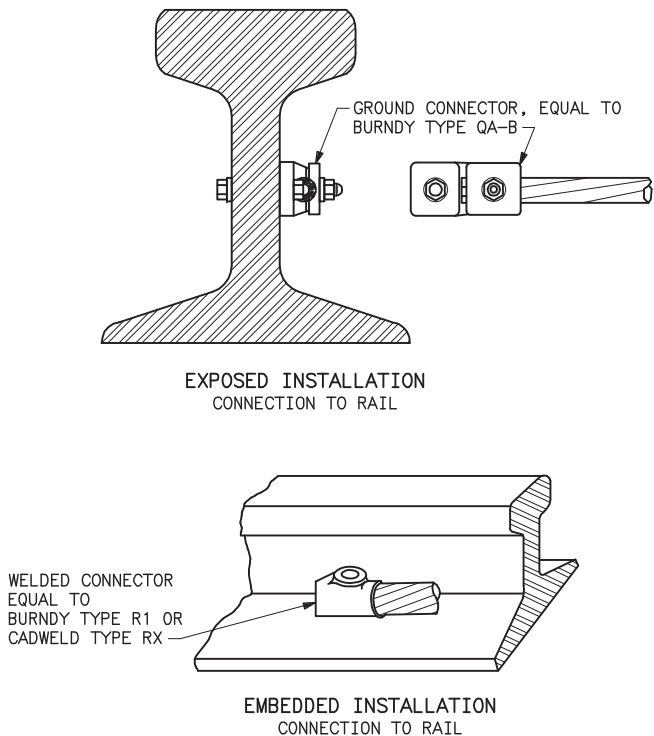


FIGURE 4

TYPICAL GROUNDING DETAILS FOR RAILING POST BASES AND HANDRAIL SUPPORTS

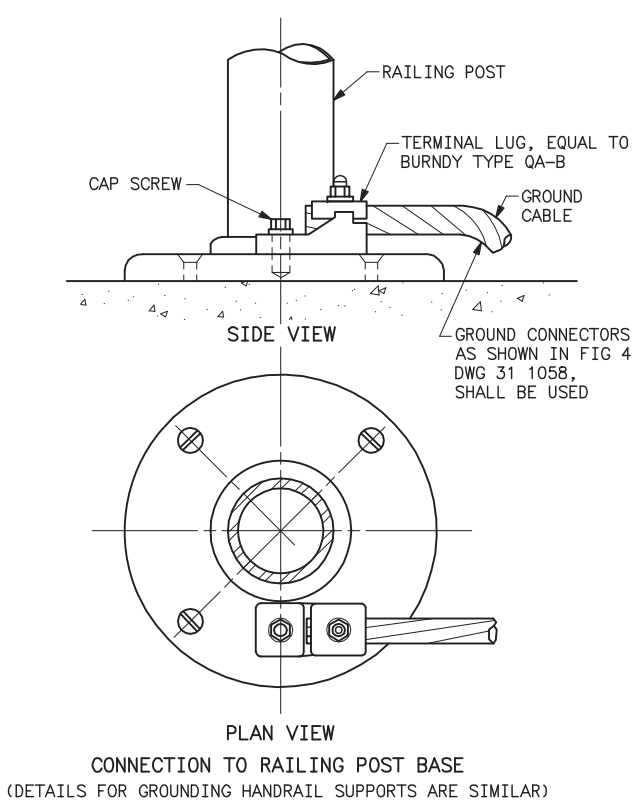


FIGURE 6

NOTES

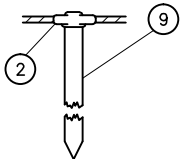
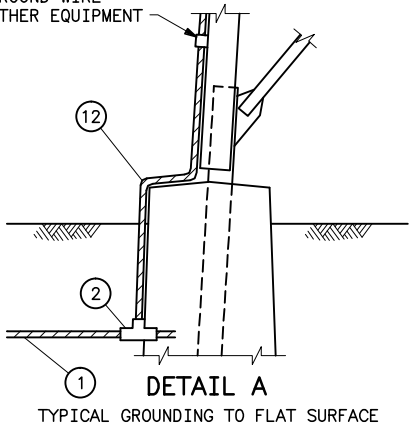
1. FOR NOTES SEE DRAWING NO. 31 1058.
2. SWAGED COMPRESSION CONNECTORS, DMC POWER OR EQUAL, CAN BE USED IN LIEU OF EXOTHERMIC CONNECTORS.

REFERENCE DRAWING

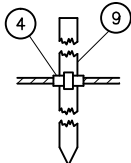
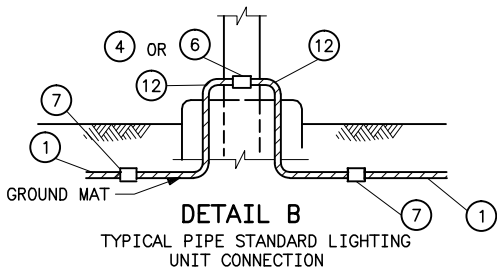
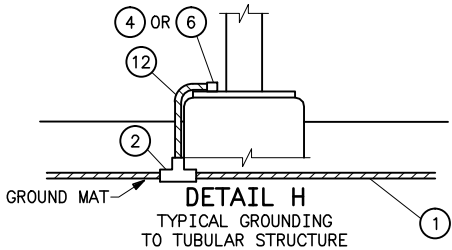
TYPICAL GROUNDING DETAILS-SHEET 1 OF 2 ---31 1058
GROUNDING PLANS-TYPICAL COMPONENTS-----31 1500

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 (SHEET 2 OF 2)		
DESIGNED BUREC	APPROVED ROSS M. CLARK ELECTRICAL ENGINEERING MANAGER	
CAE	MAY 18, 1979	31 1059

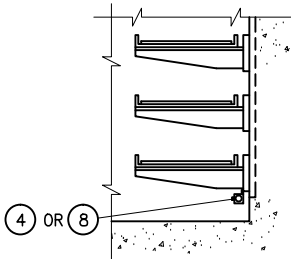
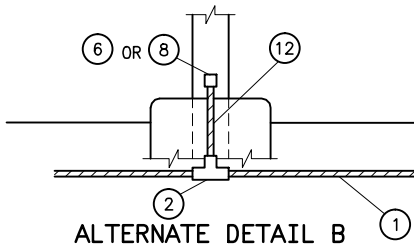
USE 5 6 OR 8 ON APPROX 5-0
CENTERS WHEN GROUND WIRE
CONTINUES TO OTHER EQUIPMENT



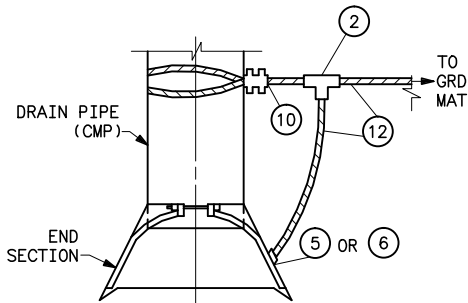
DETAIL E
TYPICAL GROUND-ROD
CONNECTION



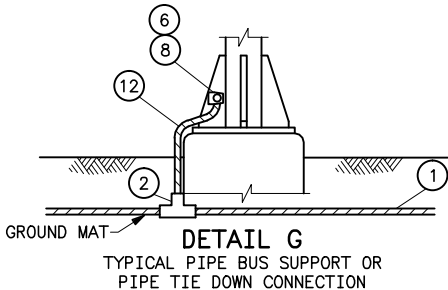
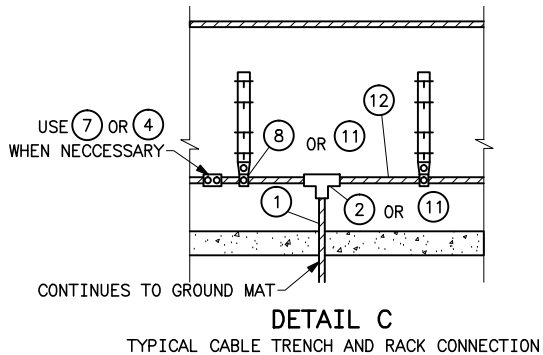
ALTERNATE
DETAIL E



DETAIL F
TYPICAL CABLE TUNNEL
TRAY CONNECTION



DETAIL J (31-1063)
TYPICAL GROUNDING TO CMP PIPE



REFERENCE MATERIALS	
ITEM NO.	DESCRIPTION
1	COPPER CABLE, BARE
2	COMPRESSION TEE FITTING, CABLE TO CABLE OR CABLE TO GROUND ROD
3	
4	THERMOWELD, CADWELD, TECTOWELD, OR OTHER EQUIVALENT PROCESS
5	BOLT, 1/2 IN. GALVANIZED WITH NUT & LOCK WASHER. LENGTH AS REQUIRED
6	COMPRESSION CABLE TO TERMINAL PAD CONNECTOR
7	COMPRESSION CABLE TO CABLE CONNECTOR, DMC POWER GC720, GC721, GC732 OR EQUAL.
8	CABLE TO FLAT BAR CONNECTOR SIMILAR TO BURNDY TYPE GBM
9	GROUND ROD
10	CABLE TO TUBE SIMILAR TO BURNDY TYPE GQ
11	BURNDY KS CONNECTOR
12	7 CONDUCTOR NO. 4 COPPER-CLAD STEEL CABLE, BARE

NOTES

1. ALL GROUND CABLES TO BE STUBBED OUT APPROXIMATELY WHERE INDICATED AND OF SUFFICIENT LENGTH TO BOLT TO EQUIPMENT WHEN INSTALLED.
2. METAL CONDUITS OR CABLE SHIELD SHALL BE GROUNDED, PREFERABLY AT SOURCE END. IF A BREAK OCCURS IN A RUN OF METAL CONDUIT, THE BREAK SHALL BE GROUNDED SEPARATELY. JUNCTION OR PULL BOXES NOT CONTAINING PROTECTIVE EQUIPMENT IN WHICH THE CONDUITS ARE INSTALLED WITH A LOCKNUT AND BONDNUT SHALL NOT BE CONSIDERED A BREAK WHEN THE VOLTAGE IS BELOW 150 VOLTS TO GROUND, BUT SHALL BE SO CONSIDERED FOR HIGHER VOLTAGES. ALL JUNCTION OR PULL BOXES IN RUNS OF NON-METALLIC CONDUIT SHALL BE INDIVIDUALLY GROUNDED. ALL BOXES CONTAINING OVERLOAD PROTECTIVE DEVICES SHALL BE INDIVIDUALLY GROUNDED.
3. ALL PAINT, ENAMEL, AND SCALE SHALL BE REMOVED FROM POINT OF CONTACT ON METAL SURFACES BEFORE APPLYING GROUND CONNECTIONS.
4. ALL BOLTS, MACHINE SCREWS, NUTS AND WASHERS USED IN MAKING GROUNDING CONNECTIONS SHALL BE COPPER ALLOY, SIMILAR TO EVERDUR, UNLESS OTHERWISE NOTED.
5. ALL EXPOSED GROUND CABLE FOR NEW SUBSTATIONS SHALL BE 7 CONDUCTOR NO. 4 COPPER-CLAD STEEL CABLE.

REFERENCE DRAWING

GROUNDING PLANS-TYPICAL COMPONENTS----- 31 1500

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

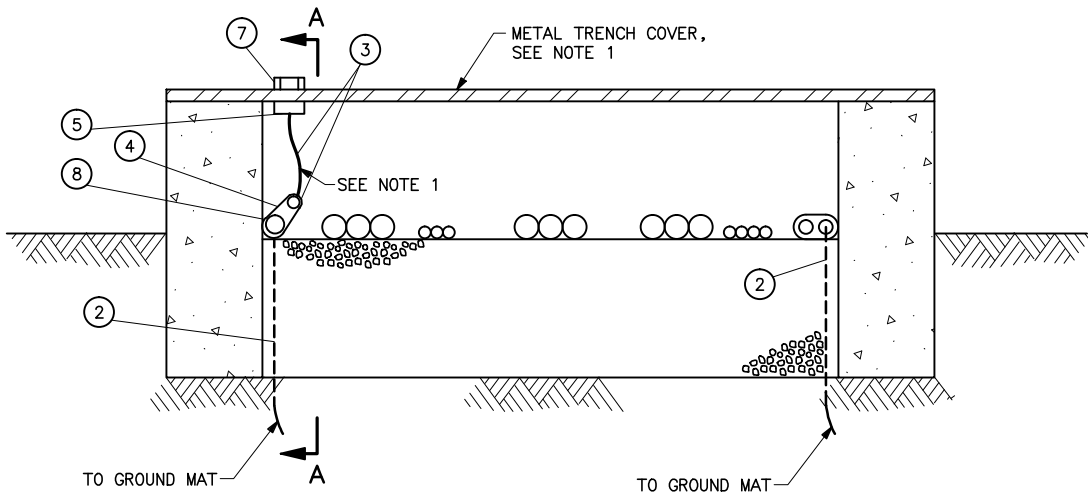
UNITED STATES DEPARTMENT OF ENERGY
WESTERN AREA POWER ADMINISTRATION
CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO

SUBSTATION STANDARDS

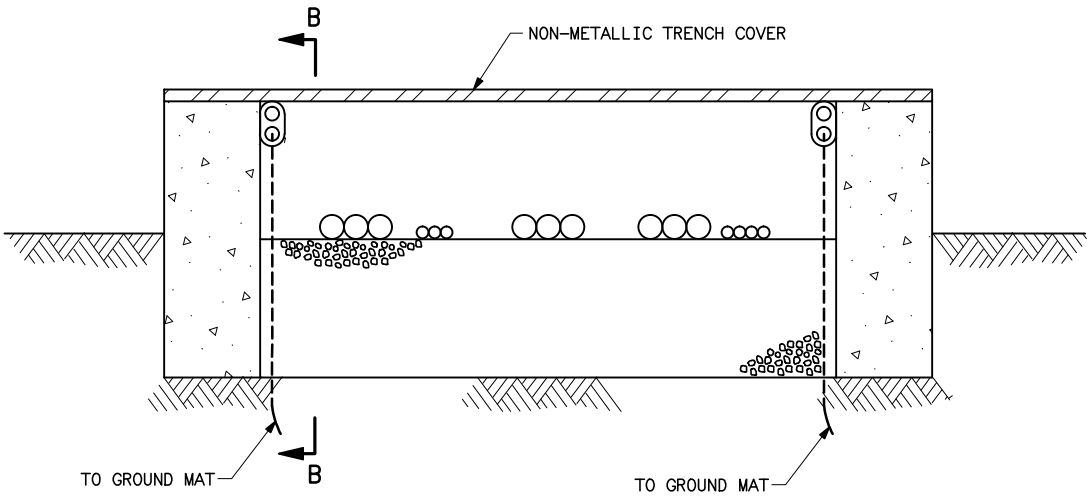
GROUNDING DETAILS

DESIGNED BUREC----- APPROVED ROSS M. CLARK
ELECTRICAL ENGINEERING MANAGER

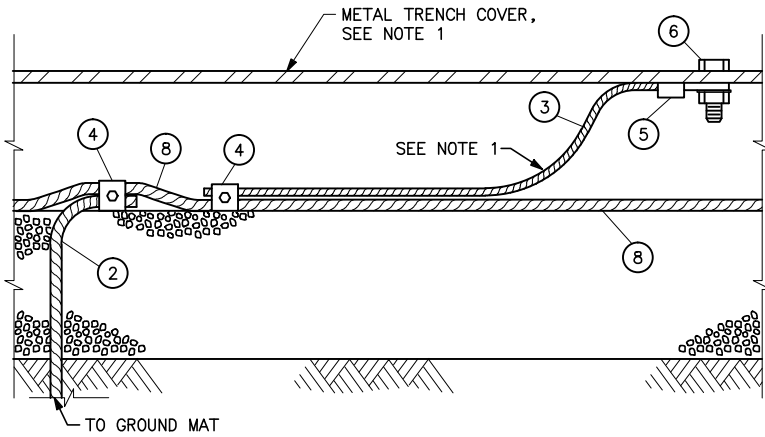
C A E	MAY 18, 1979	31	1060
-------------	--------------	----	------



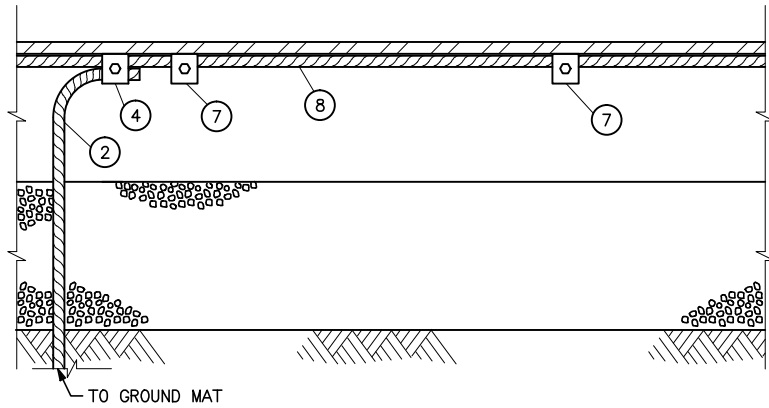
TRENCH WITH METAL COVER



TRENCH WITH NON-METALLIC COVER



SECTION A-A



SECTION B-B

TRENCH COVER TYPE	
TRENCH COVER MATERIAL	REGION
ALUMINUM	DSW, SN
POLYMER CONCRETE	RMR, UGP
GALVANIZED STEEL	

REFERENCE MATERIALS	
ITEM	DESCRIPTION
1	
2	NO. 4/0 AWG COPPER CABLE
3	NO. 6 AWG COPPER CABLE
4	PARALLEL GROOVE CONNECTOR
5	TERMINAL CONNECTOR (TINNED)
6	1/4x1 ALUMINUM BOLT, NUT AND LOCKWASHER
7	CABLE CLIP SUPPORT (NOTE 6)
8	7 CONDUCTOR NO. 4 COPPER-CLAD STEEL CABLE, BARE

NOTES

1. INSTALLATION OF THE NO. 6 COPPER GROUND CABLE IS REQUIRED ONLY WHEN TRENCH COVERS ARE MADE OF METAL.
2. IF NO. 6 AWG INSULATED COPPER CABLE IS INSTALLED, THE INSULATION SHALL BE STRIPPED BACK AT LEAST 12 INCHES FROM EACH END.
3. 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.
4. WHEN TWO OR MORE CABLE TRENCHES ARE LOCATED ADJACENT TO EACH OTHER, EACH TRENCH SHALL BE GROUNDED IN ACCORDANCE WITH THIS DRAWING.
5. ALL MATERIALS SHALL BE EQUIVALENT TO THOSE REFERENCED.
6. CABLE CLIP SUPPORT LOCATED AT APPROXIMATELY 5 FOOT INTERVALS.
7. ALL EXPOSED GROUND CABLE FOR NEW SUBSTATIONS SHALL BE 7 CONDUCTOR NO. 4 COPPER-CLAD STEEL CABLE.
8. 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.

REFERENCE DRAWING

GROUNDING PLANS-TYPICAL COMPONENTS----- 31 1500

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

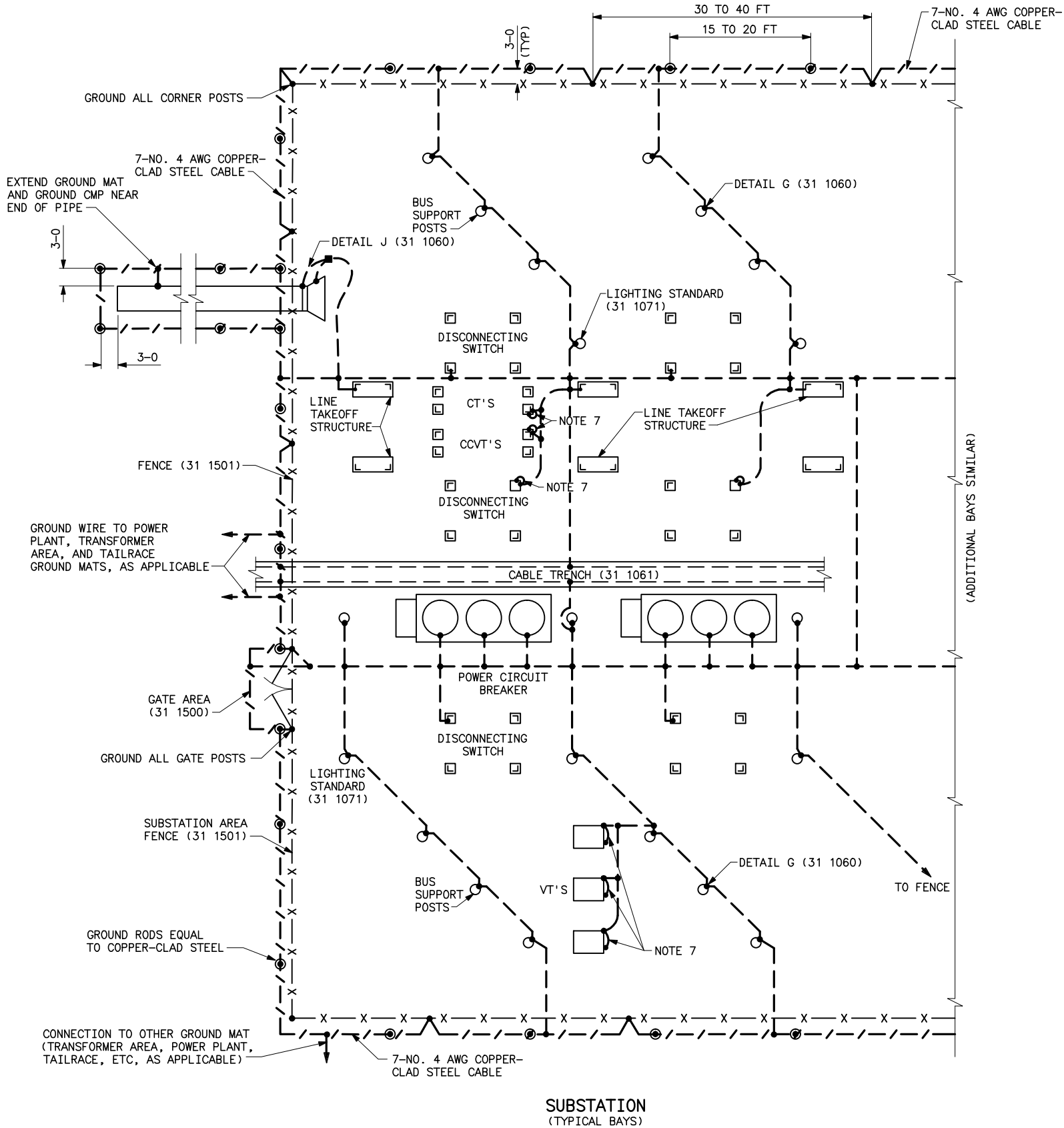
SUBSTATION STANDARDS

CABLE TRENCH GROUNDING

DESIGNED BUREC ----- APPROVED ROSS M. CLARK
ELECTRICAL ENGINEERING MANAGER

C	A	MAY 18, 1979	31	1061
---	---	--------------	----	------

Sep 27, 2016 - 2:00pm Plotted By: See la S: projects\Misc\StandardDrawings\Drawings\Designdrawings\Drawings\Scripts\31_1063g.dwg Last Saved By: See la IMAGES:



GROUND SYMBOLS

- /---/--- BURIED 7-NO. 4 AWG COPPER-CLAD STEEL CABLE
- BURIED COPPER GROUND CABLE
- GROUND CABLE RISER (NOTE 7)
- ELECTRICAL GROUND CONNECTION (NORMAL)
- GROUND ROD

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 AND TANKS 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 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

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.

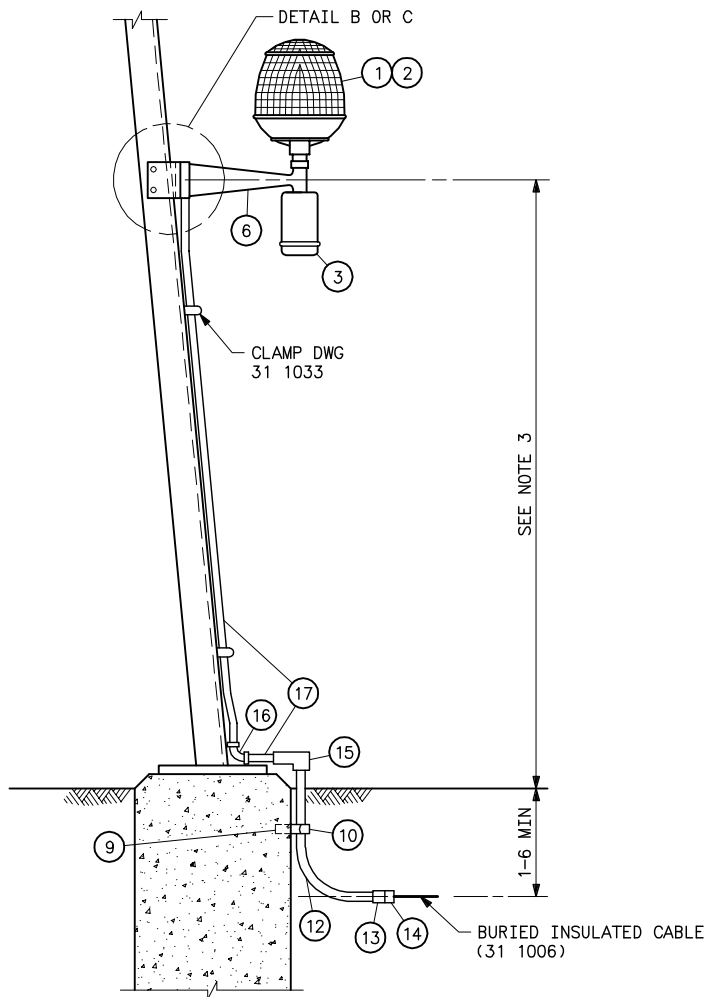
SUPERSEDES DWG NO. 40-D-5141

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

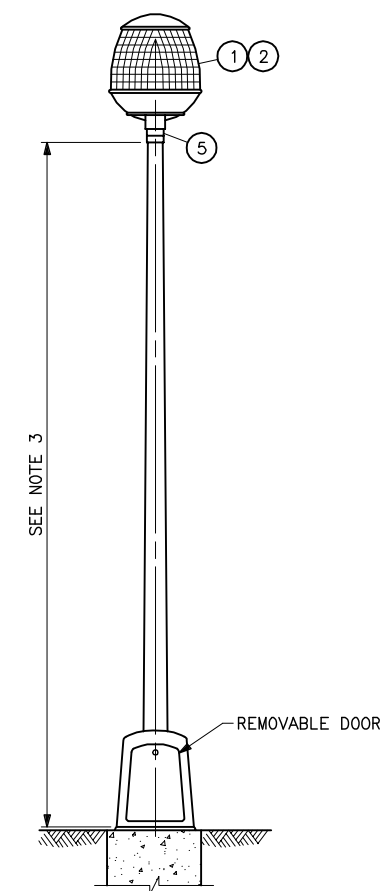
SUBSTATION STANDARDS
PIPE-BUS
GROUNDING PLAN

DESIGNED BUREC _____ APPROVED ROSS M. CLARK
ELECTRICAL ENGINEERING MANAGER

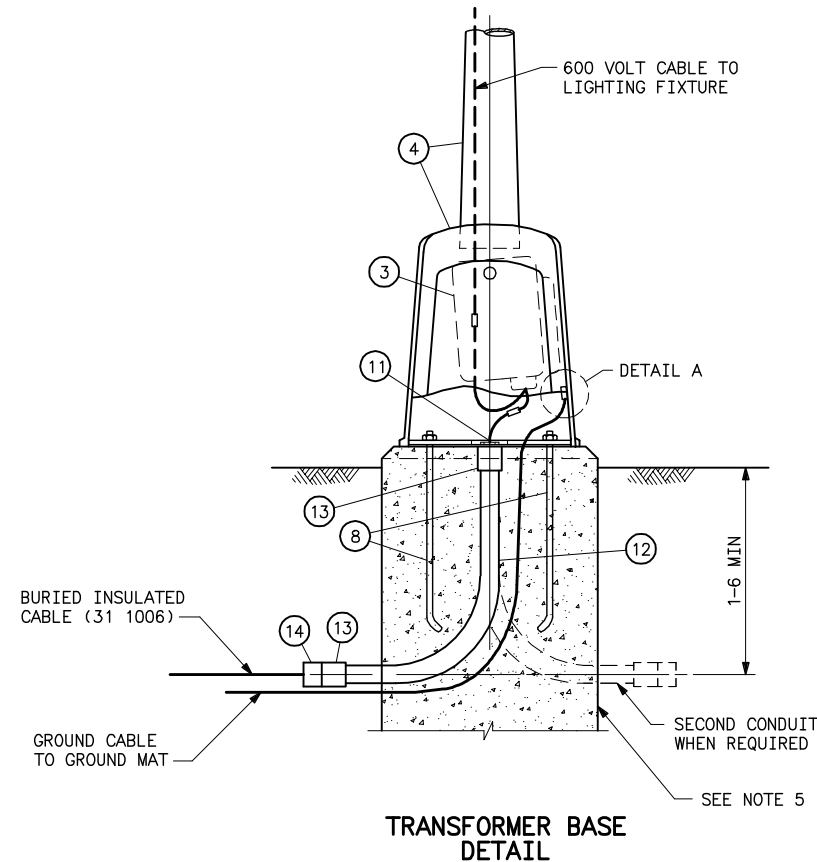
C _A F	MAY 18, 1979	31	1063
------------------	--------------	----	------



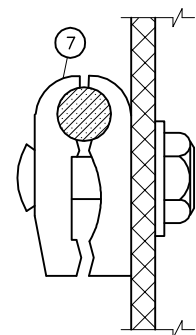
BRACKET TYPE LIGHTING UNIT



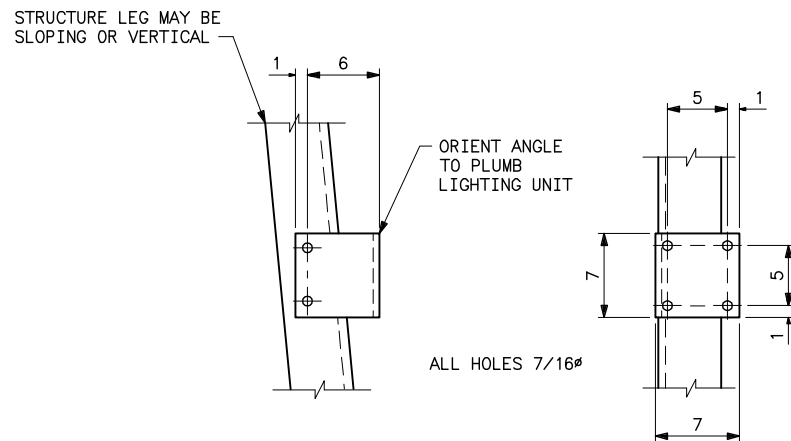
TAPERED POLE TYPE LIGHTING UNIT



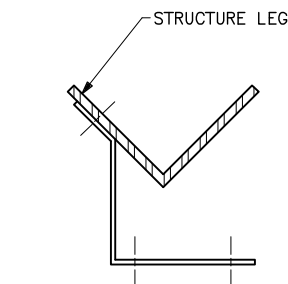
TRANSFORMER BASE DETAIL



DETAIL A



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



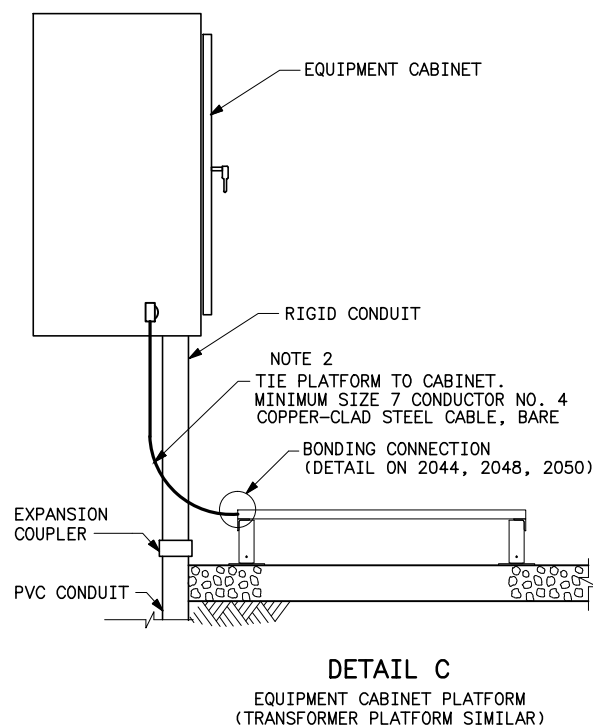
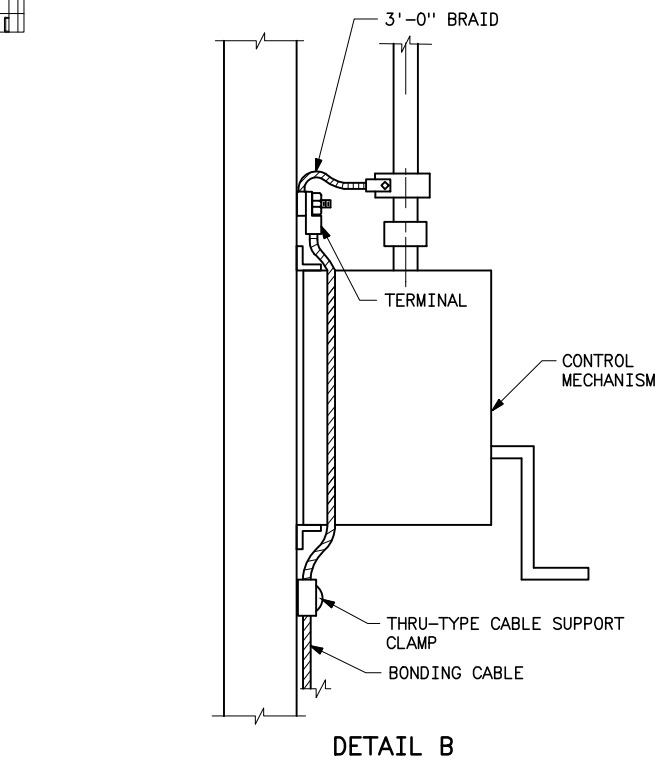
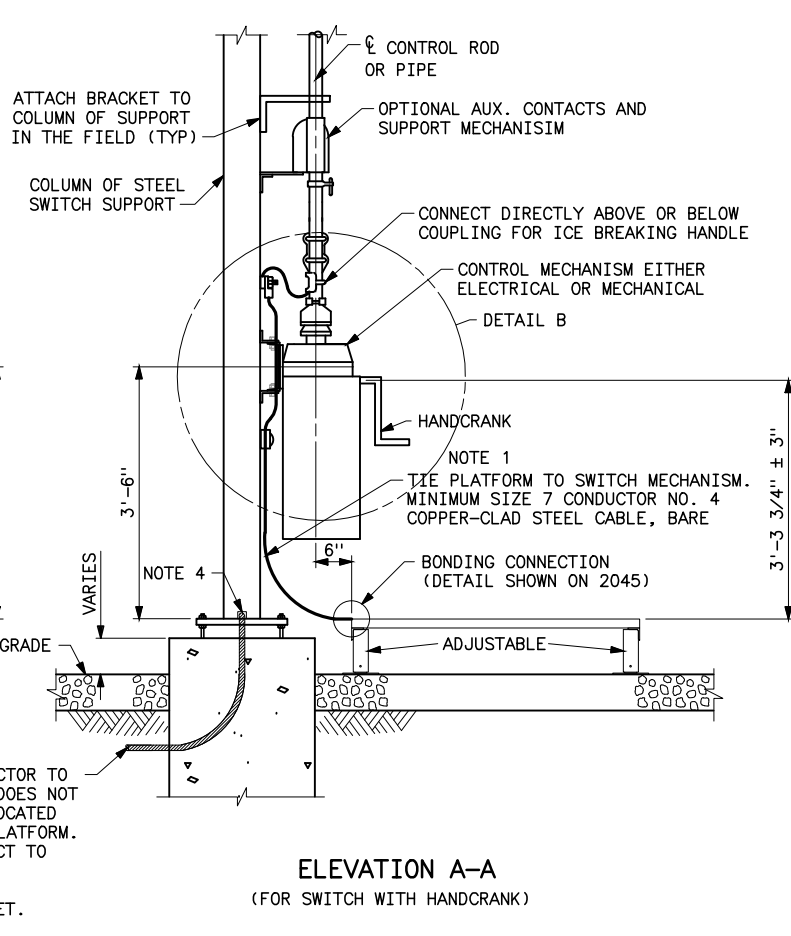
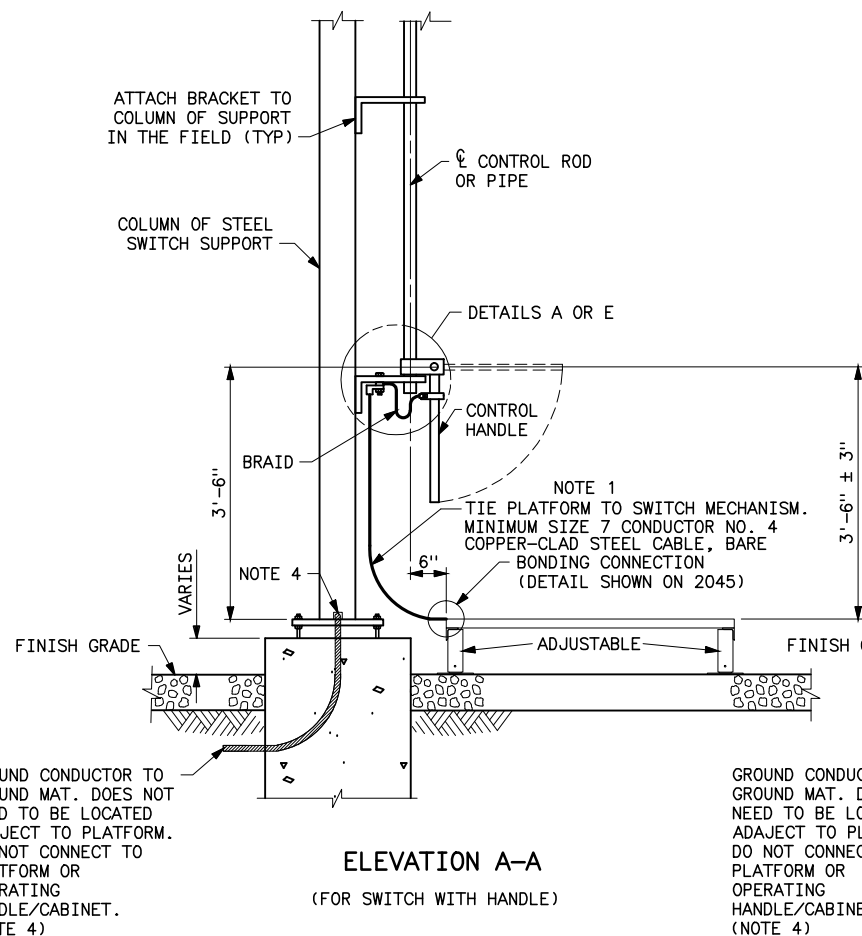
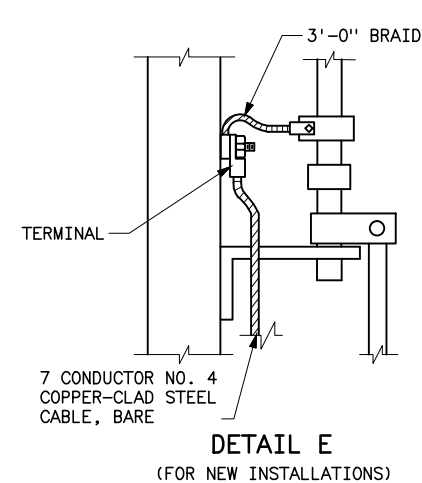
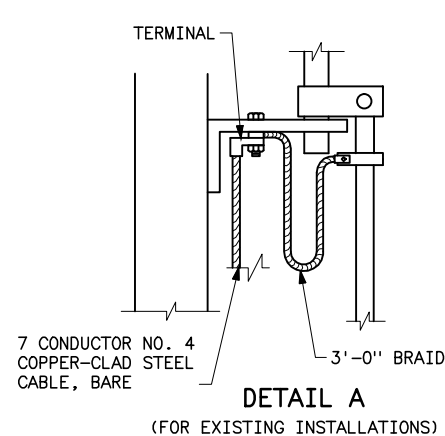
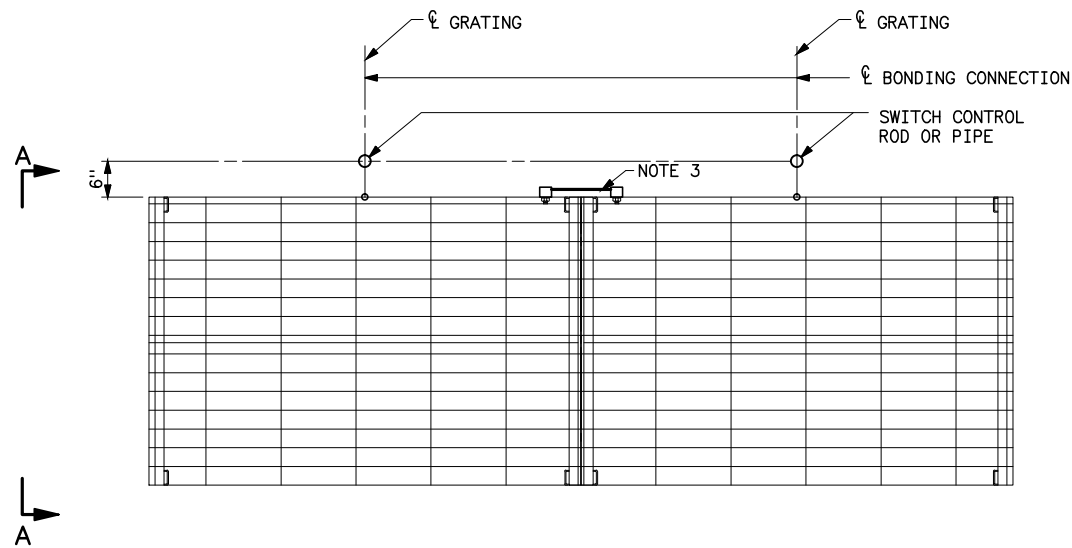
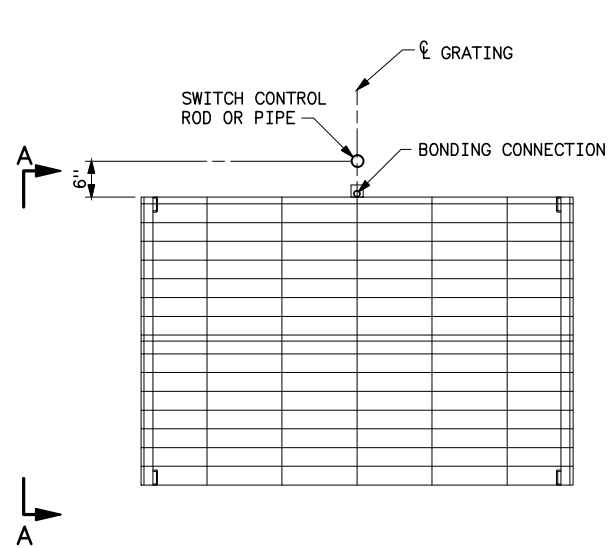
DETAIL C
CORNER MOUNTING ADAPTER
(MATERIAL, DEPTH AND DRILLING
SAME AS DETAIL B)

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.

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 POLE AND BRACKET MOUNTING		
DESIGNED BUREC _____ APPROVED ROSS M. CLARK ELECTRICAL ENGINEERING MANAGER		
C A-E	MAY 18, 1979	31 1073



- NOTES
- DO NOT CONNECT OPERATING PLATFORM DIRECTLY TO GROUND MAT.
 - DO NOT CONNECT EQUIPMENT PLATFORM DIRECTLY TO GROUND MAT.
 - USE 7 CONDUCTOR NO. 4 COPPER-CLAD STEEL CABLE TO BOND THE TWO PLATFORMS TOGETHER.
 - ACTUAL LOCATION OF GROUNDING CONDUCTOR TO PLATFORM OR OPERATING HANDLE/CABINET.

REFERENCE DRAWINGS

GROUNDING PLANS-TYPICAL COMPONENTS	31	1500
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

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
G	11-22-05 A7-RC	ADDED DETAIL E

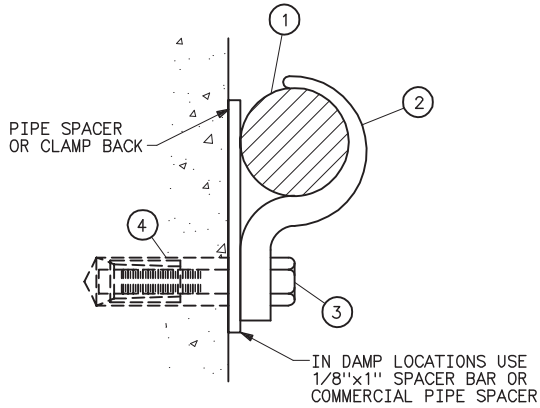
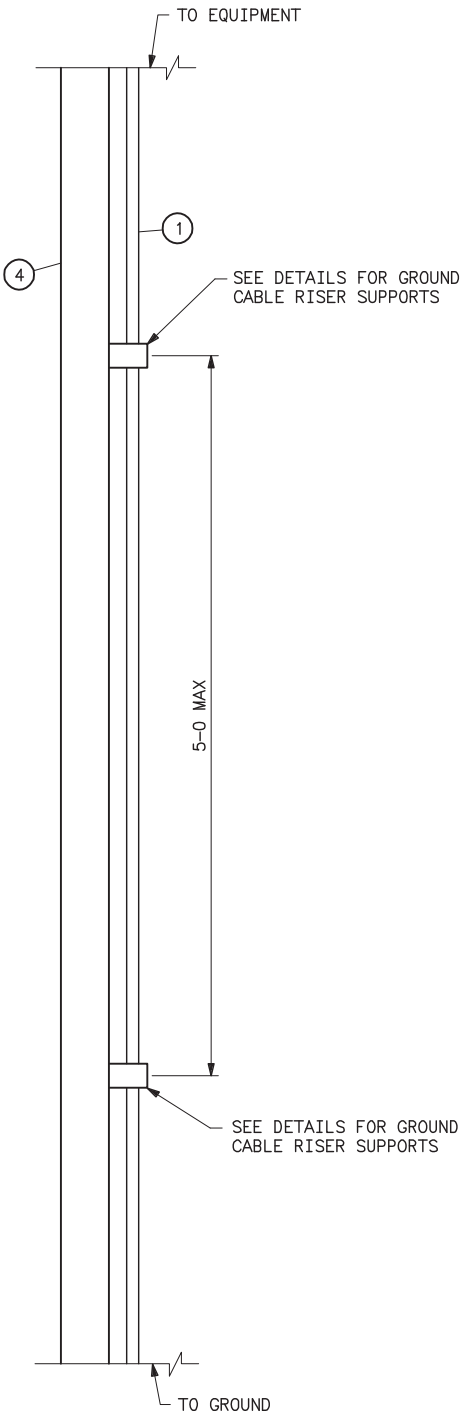
SUPERSEDES DWG NO. 40-D-4874

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

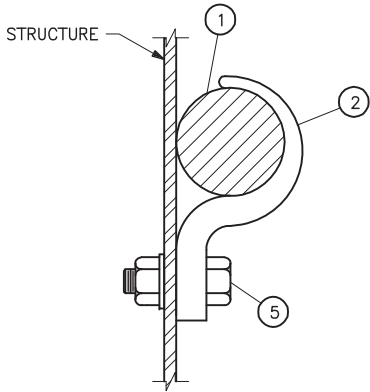
SUBSTATIONS STANDARDS
SWITCH OPERATING AND
EQUIPMENT PLATFORMS
ELECTRICAL DESIGN AND DETAILS

DESIGNED W.L. SOPER APPROVED DON WARNER
FOR DIRECTOR, DIVISION OF
SUBSTATION DESIGN

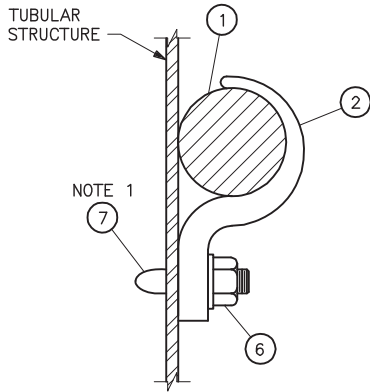
A	MAY 18, 1979	31	1075
---	--------------	----	------



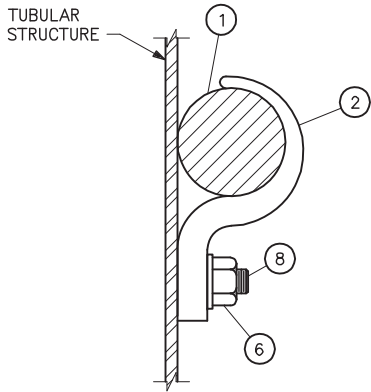
CABLE CLAMPING ON
CONCRETE SURFACE
DETAIL A



CABLE CLAMPING ON
METALLIC STRUCTURE
(BOTH SIDES ACCESSIBLE)
DETAIL B



CABLE CLAMPING ON
TUBULAR STEEL STRUCTURE
DETAIL C



DETAIL D

REFERENCE MATERIALS	
ITEM NO.	DESCRIPTION
1	COPPER GROUNDING CABLE
2	GROUND CONNECTOR (BURNDY TYPE GBM)
3	MACHINE SCREW AND LOCKWASHER
4	EXPANSION ANCHOR
5	MACHINE BOLT, NUT AND LOCKWASHER
6	MACHINE NUT AND LOCKWASHER, GALV STEEL
7	POWDER DRIVEN THREADED STUD (3/8 INCH DIA)
8	STUD BOLT, 1/2 INCH DIAMETER x LENGTH AS REQUIRED, END FLUX WELDED TO STRUCTURE

NOTES

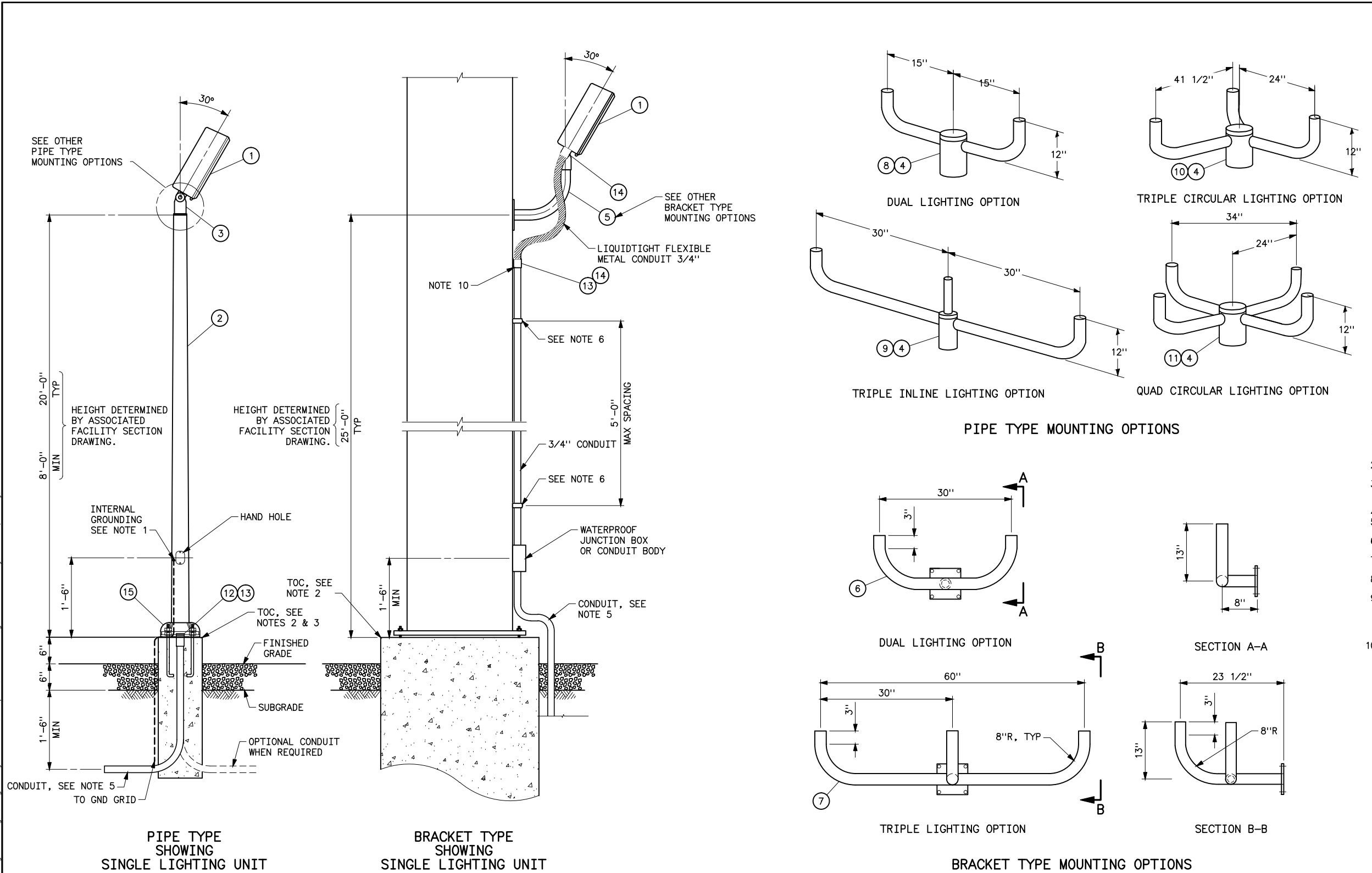
1. THE 3/8 INCH STUD SHALL BE DRIVEN INTO THE TUBULAR STEEL STRUCTURE WITH A POWDER ACTUATED FASTENING TOOL EQUAL TO THAT MANUFACTURED BY RAMSET FASTENING SYSTEM.

REFERENCE DRAWING

GROUNDING PLANS-TYPICAL COMPONENTS----- 31 1500

D	11-9-11 A7-RMJ	ADDED REFERENCE DRAWING.
C	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.
B	5-14-99 A3-OP	REDRAWN.
SUPERSEDES DWG NO. 40-D-6309		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARD GROUND CABLE ON TUBULAR STEEL STRUCTURES SUPPORT DETAILS		
DESIGNED BUREC----- APPROVED ROSS M. CLARK ELECTRICAL ENGINEERING MANAGER		
C A-E	JULY 16, 1979	31 1077

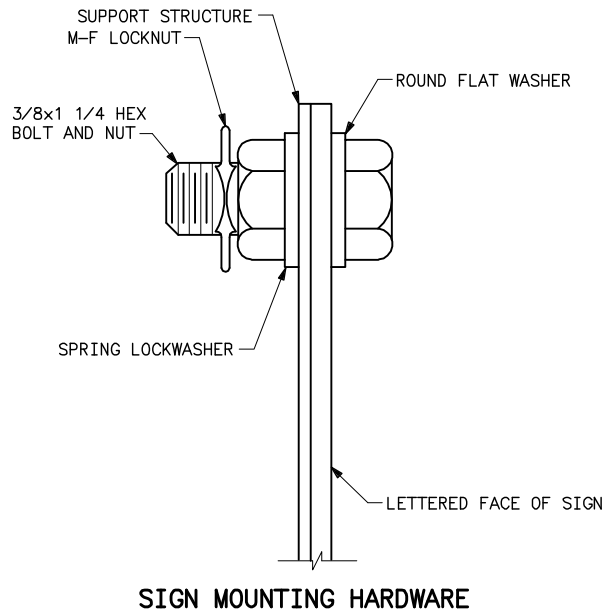
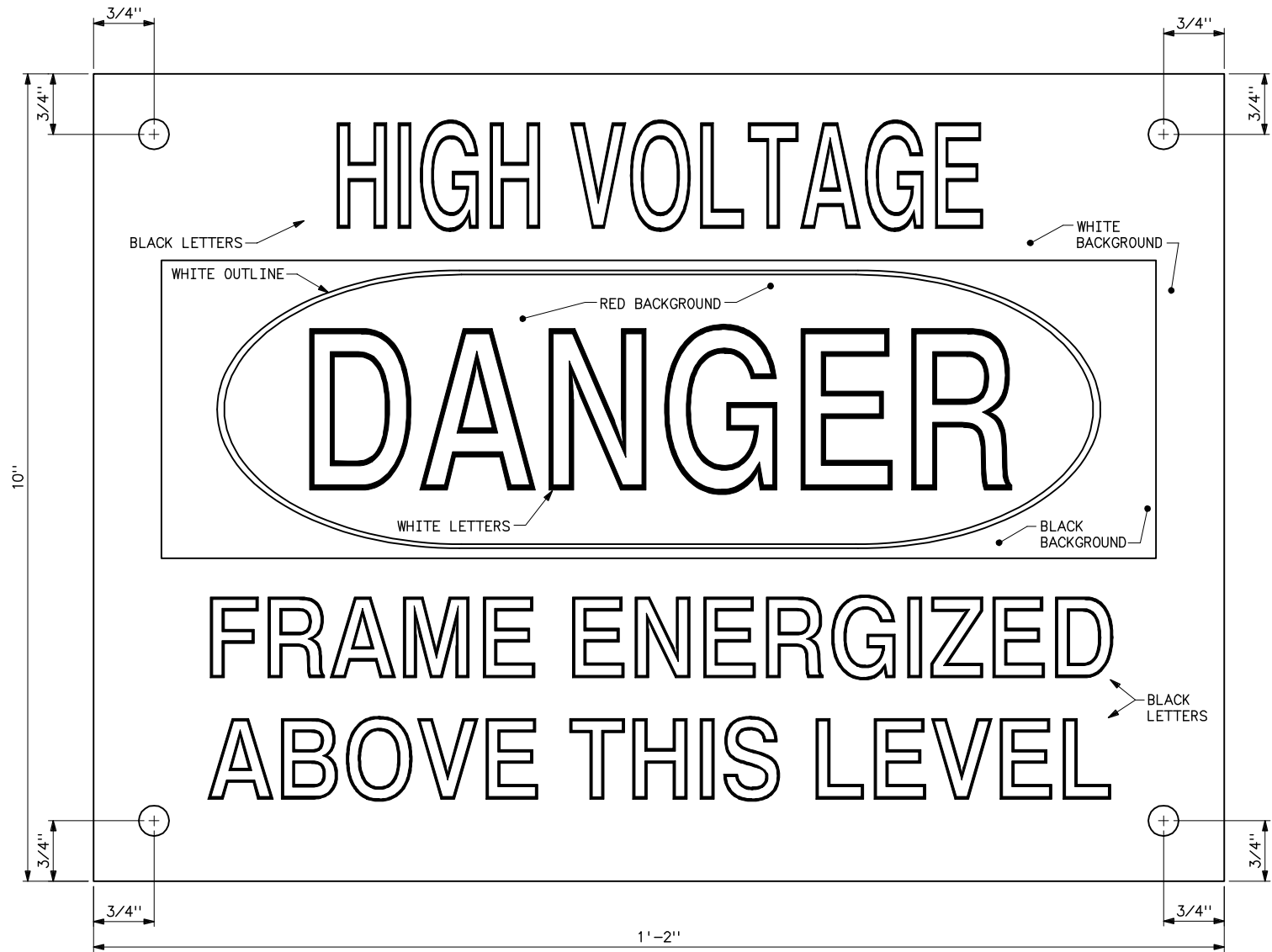
Plotted By: seela Nov 01, 2013- 10:58am
S:\projects\Misc\StandardDrawings\Drawings\DesignDrawings\31-1078c.dwg Last Saved By: Seela, Holly (CONTR) on 11/1/2013 10:58 AM
IMAGES: S:\projects\Misc\StandardDrawings\Drawings\DesignDrawings\31-1078c.dwg



REFERENCE MATERIALS	
ITEM	DESCRIPTION
1	OUTDOOR FLOODLIGHT FIXTURE WITH 400W METAL HALIDE LAMP - LITHONIA TFL 400M RA2 TB SCWA ISDNA LPI OR EQUAL
2	ROUND TAPERED ALUMINUM PIPE - LITHONIA 3RTA HH XX DNA OR EQUAL, SEE NOTES 4 & 9
3	TENON ADAPTER 2 3/8" O.D. - LITHONIA T20 OR EQUAL, SEE NOTE 4
4	TENON ADAPTER 2 7/8" O.D. - LITHONIA T25 OR EQUAL, SEE NOTE 4
5	STEEL WALL MOUNT BRACKET - LITHONIA FRWB_GALV OR EQUAL
6	DUAL LIGHT, STEEL WALL BRACKET - LITHONIA FRWBBH28GALV OR EQUAL
7	TRIPLE LIGHT, STEEL WALL BRACKET - LITHONIA FRWBBH38GALV
8	DUAL LIGHT BRACKET - LITHONIA RBA28_DNA
9	TRIPLE INLINE LIGHT BRACKET - LITHONIA RBA38_DNA
10	TRIPLE CIRCULAR LIGHT BRACKET - LITHONIA RB32_DNA
11	QUAD CIRCULAR LIGHT BRACKET - LITHONIA RBA49_DNA
12	CHASE NIPPLE
13	COUPLER
14	CONNECTOR
15	ALUMINUM COVER

- NOTES**
- PROVISIONS FOR GROUNDING INSIDE PIPE PROVIDED BY PIPE MANUFACTURER. CONTRACTOR SHALL PROVIDE GROUNDING HARDWARE.
 - FOUNDATION DESIGN LOCATED ON ASSOCIATED FACILITY FOUNDATION DRAWING.
 - CONTRACTOR SHALL USE MANUFACTURER'S SUPPLIED ANCHOR BOLT TEMPLATES AND RECOMMENDED ANCHOR BOLTS.
 - TENON ADAPTER MUST BE ORDERED WITH PIPE.
 - CONDUIT SIZED ON ASSOCIATED FACILITY CONDUIT DRAWING.
 - CONDUIT SUPPORT SHALL BE IN ACCORDANCE WITH DRAWING 31 1700.
 - CONTRACTOR SHALL PROVIDE ALL NECESSARY HARDWARE AND INSULATED CABLE TO COMPLETE THE INSTALLATION.
 - DIMENSIONS SHOWN FOR MOUNTING OPTIONS ARE APPROXIMATE.
 - CONTRACTOR SHALL DETERMINE AND REPLACE HH WITH REQUIRED MOUNTING HEIGHT AND WALL THICKNESS CODES, AND REPLACE XX WITH APPROPRIATE MOUNTING OPTIONS. SUBSTITUTE THE FOUR BOLT RTA FOR 3RTA FOR HEIGHTS GREATER THAN 20'-0".
 - JUNCTION BOX IS REQUIRED FOR MULTIPLE LIGHTS.

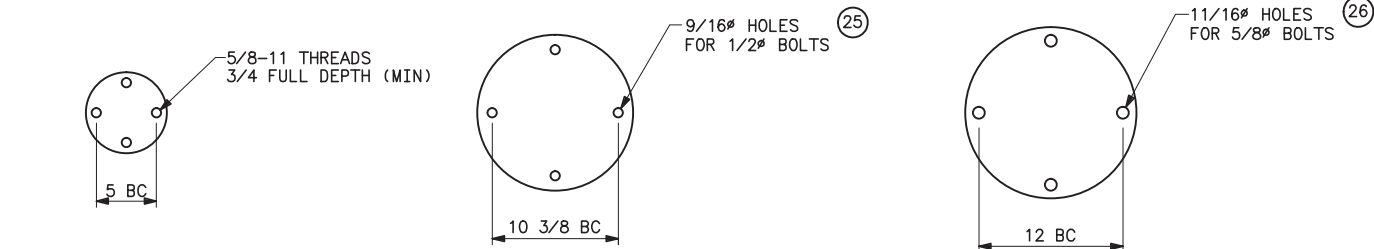
C	11-1-13 A7-RMJ	REVISED AND REDRAWN. REFER TO DWG 31 1078 REV B FOR HID FLOODLIGHTS.
B	5/14/99 A7-OP	REDRAWN.
FORMERLY DWG NO. 40-D-6289		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS FLOODLIGHTING UNITS		
DESIGNED BUREC _____ APPROVED BUREC _____ ELECTRICAL ENGINEERING MANAGER		
C_A_F	OCTOBER 1, 1981	31 1078



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			
C A-E	DECEMBER 1, 1981	31	1079



END CAP FOR ALL INSULATOR STACKS

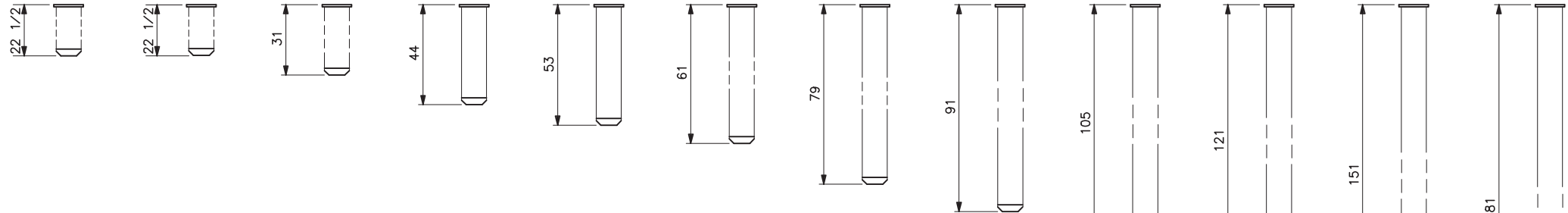
FLANGED BASE CAP FOR 200-1050KV BIL ASSEMBLIES

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

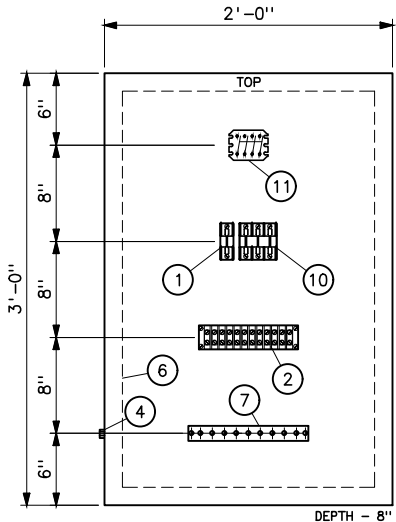
NOTES

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.

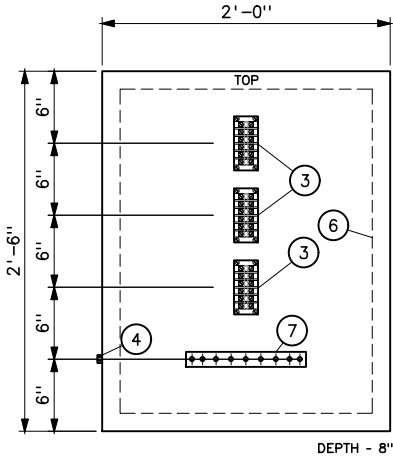
REFERENCE DRAWINGS

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

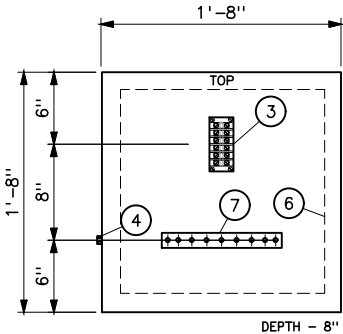
E	9-06-12 A7-DP	REVISED LAPP PART NUMBERS ON ITEMS 5,7,17, AND 19 IN THE DESCRIPTION TABLE.
D	3-26-09 B5-MK	REVISED NEWELL NUMBERS
C	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.
B	5-14-99 A3-OP	REVISED NOTE 3 AND NOTATIONS UNDER DRAWINGS OF INSULATOR STACKS
A	4-26-91 A2-	REDRAWN AND REVISED
UNITED STATES 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		
CAE	NOVEMBER 3, 1986	31 1081



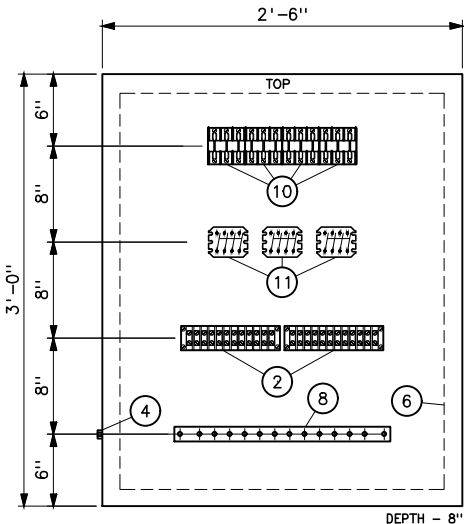
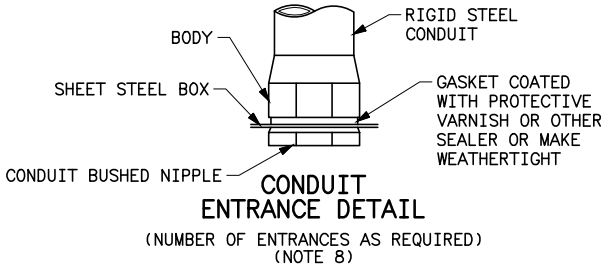
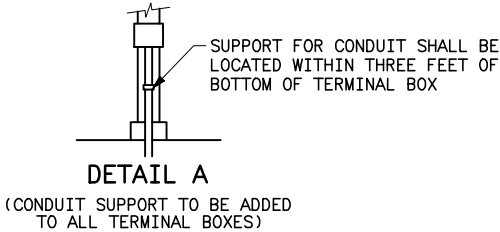
TYPE A
(FOR SINGLE-PHASE VOLTAGE TRANSFORMERS OR
COUPLING CAPACITOR VOLTAGE TRANSFORMERS)
(TYPICAL)



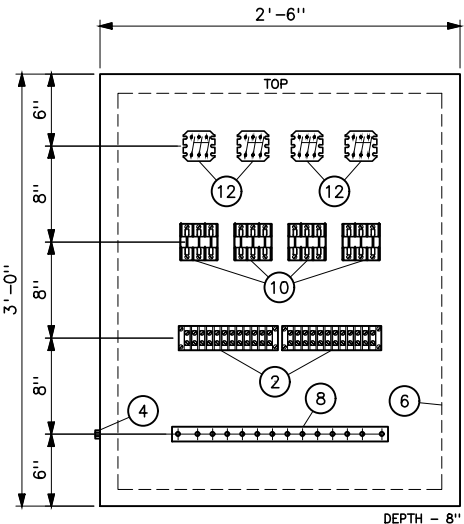
TYPE C
(FOR 3-PHASE CURRENT TRANSFORMERS)
(TYPICAL)



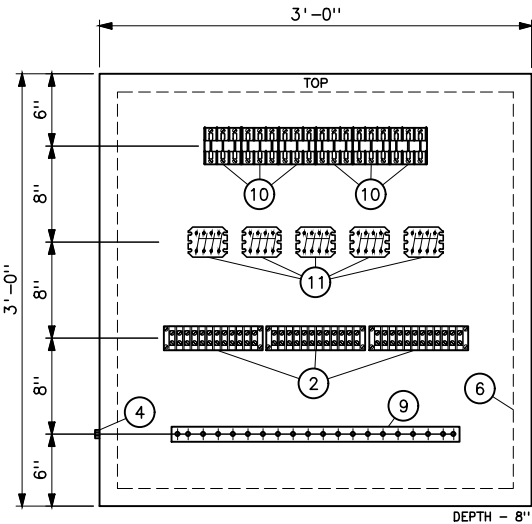
TYPE D
(FOR SINGLE-PHASE CURRENT TRANSFORMERS)
(TYPICAL)



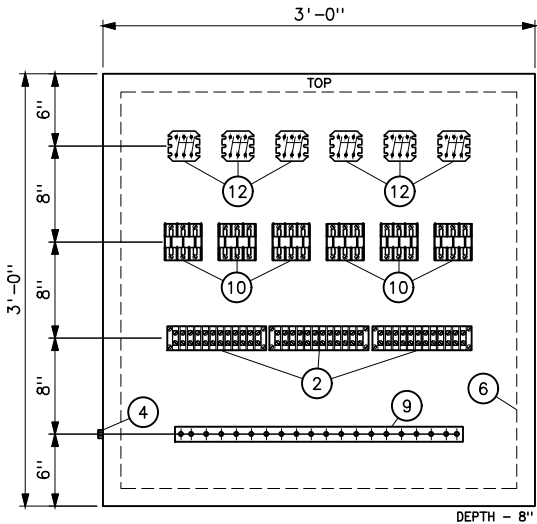
TYPE F (OPTION 1)
(FOR 3-PHASE VOLTAGE TRANSFORMERS OR
COUPLING CAPACITOR VOLTAGE TRANSFORMERS)
(DSW ONLY)



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)

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. H2M5030-3SR	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.

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 CUTOFF 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.

I	4-8-19 A7-KV	REVISED TYPE F AND TYPE J OPTIONS AND CATALOG NUMBERS.
H	9-27-16 A7-RMJ	REVISED COPPER-CLAD STEEL SIZE.
G	1-31-14 A7-RMJ	REVISED SWITCHES AND SHORTING BLOCKS. TABLE 1, REFERENCE MATERIALS, AND NOTES REDRAWN.
F	7-29-09 A7-RMC	ADDED A KNIFE SWITCH BEFORE FUSE BLOCK ON TERMINAL BOXES TYPE A, F, AND J.
E	7-12-05 A7-RMC	REVISED DIMENSIONS AND NOTES.
D	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.
C	8-13-96 A3-RMC	REVISED TYPE F TERMINAL BOX AND CHANGED FUSE HOLDER FOR CCVTS AND VTS
B	6-23-93 A3-TAS	REVISED TYPE C AND D TERMINAL BOXES, ADDED NOTES 9 AND 10, DELETED TYPE E TERMINAL BOX
A	6-27-91 A2-RHR	REVISED TYPE A, F, AND J TERMINAL BOXES, ADDED BILL OF MATERIAL ITEM 10

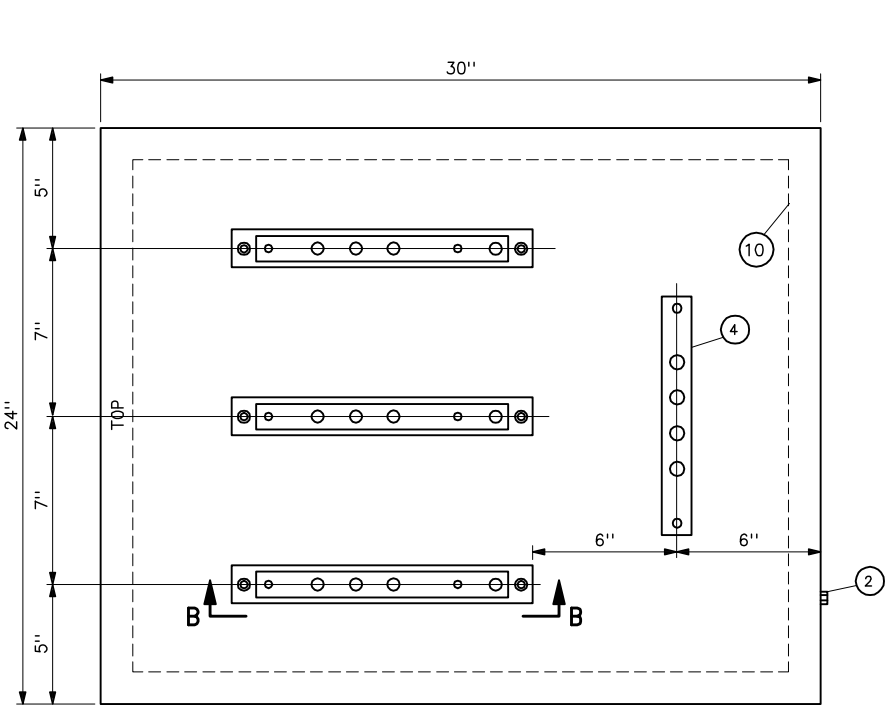
SUPERSEDES DWG NO. 31-1064

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

SUBSTATION STANDARDS

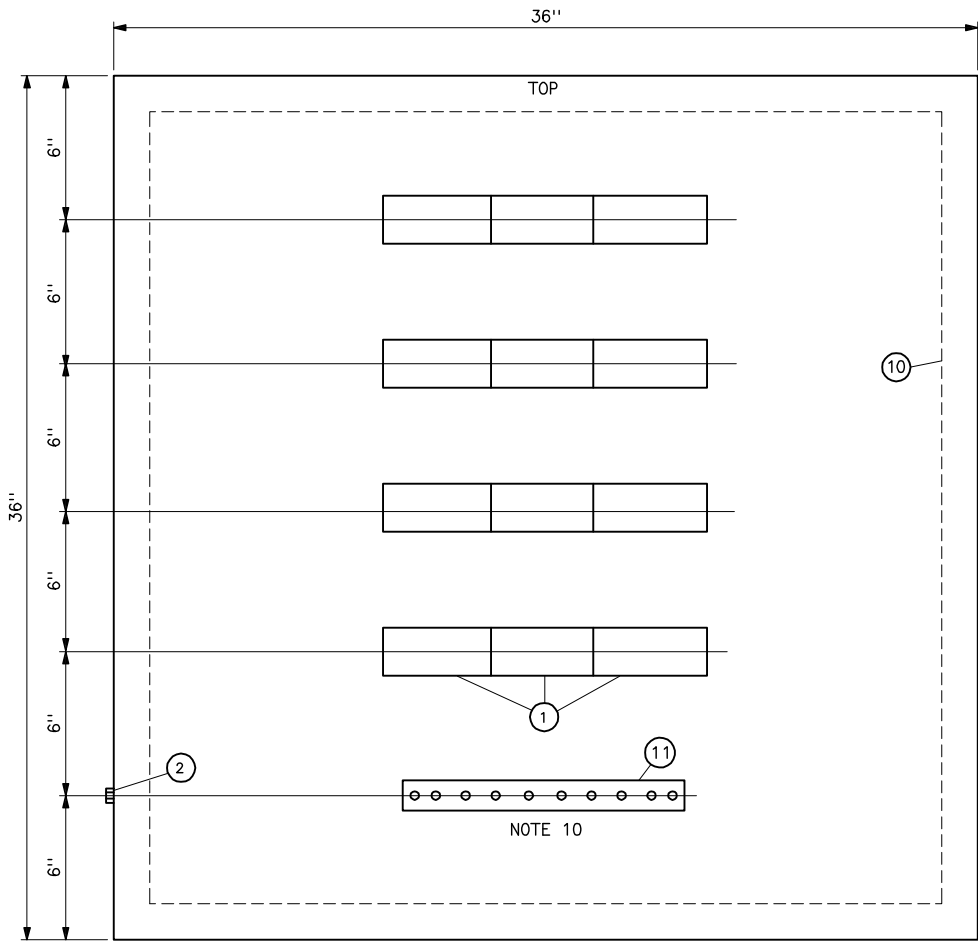
TERMINAL AND FUSE BOXES

DESIGNED BRUCE A. HARRINGTON APPROVED GERALD D. BIRNEY
DIRECTOR, DIVISION OF
SUBSTATION DESIGN



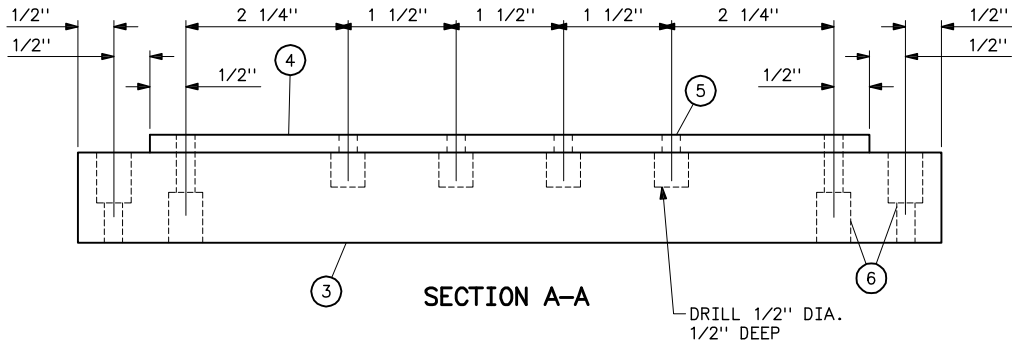
TYPE H

DEPTH - 8"



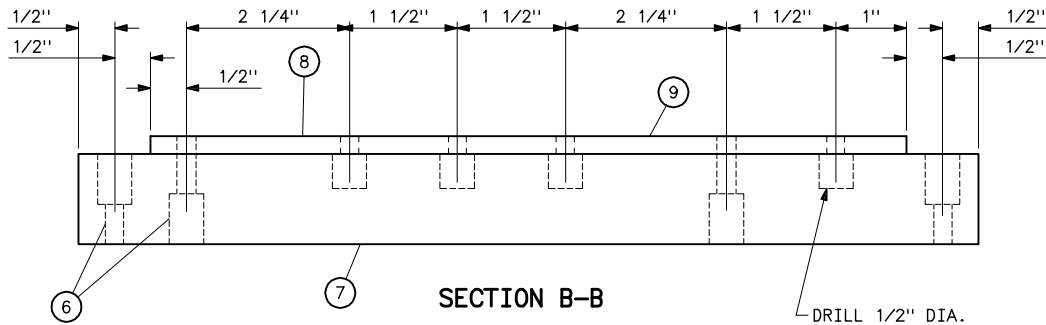
TYPE K

(FOR MULTIPLE WINDING CURRENT TRANSFORMERS)



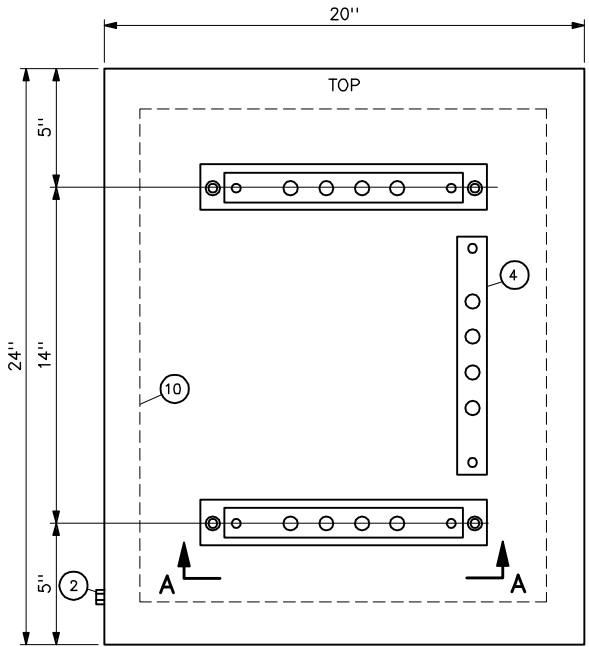
SECTION A-A

DRILL 1/2" DIA.
1/2" DEEP



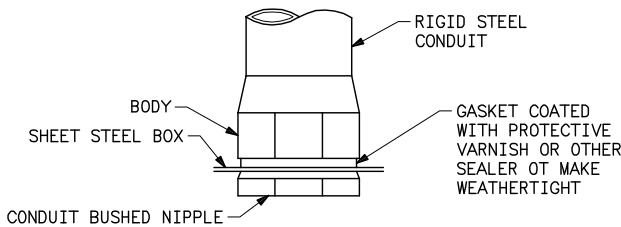
SECTION B-B

DRILL 1/2" DIA.
1/2" DEEP



TYPE G

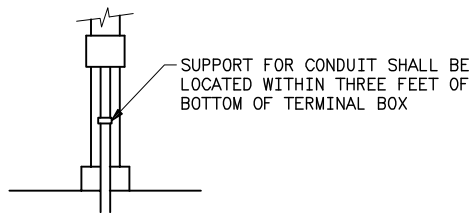
DEPTH - 8"



CONDUIT
ENTRANCE DETAIL

(NUMBER OF ENTRANCES AS REQUIRED)

(NOTE 8)



DETAIL A

(CONDUIT SUPPORT TO BE ADDED
TO ALL TERMINAL BOXES)

ITEM NO.	BILL OF MATERIAL
1	6-POINT TERMINAL BLOCK, SHORT CIRCUITING TYPE, G.E. CAT. NO. EB27B06SC
2	GROUND CONNECTOR, BURNDY TYPE K2C20B1 WITH 2-EVERDUR NUTS AND LOCKWASHER
3	BAKELITE, MICARTA, OR EQUIVALENT INSULATING MATERIAL 1 1/4" X 1 1/2" X 1'-0". DRILL 4 HOLES AND COUNTER BORE TO SUIT
4	COPPER BAR 1/4" X 1" X 10". DRILL AND TAP 4 HOLES FOR ITEM 5. DRILL 2 HOLES FOR ITEM 6.
5	BRONZE MACHINE SCREWS 3/8" X 1/2" LONG WITH BRONZE WASHERS
6	BRONZE MACHINE SCREWS NO. 10 X 32 WITH BRONZE WASHERS AND NUTS
7	BAKELITE, MICARTA, OR EQUIVALENT INSULATING MATERIAL 1 1/4" X 1 1/2" X 1'-0 1/2". DRILL 4 HOLES AND COUNTER BORE TO SUIT
8	COPPER BAR 3/8" X 1" X 10 1/2". DRILL AND TAP 4 HOLES FOR ITEM 9. DRILL 2 HOLES FOR ITEM 6.
9	BRONZE MACHINE SCREWS 3/8" X 3/4" LONG WITH BRONZE WASHERS
10	PANEL BOARD MOUNTED TO REAR OF TERMINAL BOX
11	COPPER BAR 1/4" X 1 1/4" X 18". DRILL AND TAP 12 HOLES FOR ITEM 6. DRILL 2 HOLES FOR ITEM 6.

NOTES

- 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.
- 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 61 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 CUTOFF BASES SHALL BE HOT DIPPED GALVANIZED OR NON-FERROUS, NON-CORROSIVE METAL.
- 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.
- GROUND ALL BOXES TO THE MAIN GROUND GRID WITH NO. 4 AWG BARE COPPER 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 A QUICK RELEASE LATCH WITH HASP. THE USE OF SCREWS TO SECURE THE COVER IS NOT PERMITTED.
- GROUND BAR IN TERMINAL BOX TYPE K FOR CABLE SHIELD ONLY.

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

SUBSTATION STANDARDS
TYPE G, H, AND K TERMINAL BOXES

DESIGNED BRUCE A. HARRINGTON APPROVED GERALD D. BIRNEY
DIRECTOR, DIVISION OF
SUBSTATION DESIGN

	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						
CATALOG NUMBER		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						

	ANSI TR 308 EQUIV NOTE 1	ITEM NUMBER 7						ANSI TR 316 EQUIV NOTE 1	ITEM NUMBER 8						ANSI TR 369 EQUIV NOTE 1	ITEM NUMBER 9 (TAPERED)						ANSI TR 373 EQUIV NOTE 1	ITEM NUMBER 10 (TAPERED)						ANSI 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				PE20532	J310877 -70	47855- 3071	N/A					
		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												
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

A	5-14-99 A3-0P	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 <u>D.R. TORGERSON</u> _____		RECOMMENDED <u>R.H. RICHARDSON</u> _____
DRAWN <u>A. J. ARMSTRONG</u> _____		APPROVED <u>G.C. WEGNER</u> _____
CHECKED <u>R.A. JOHNSON</u> _____ ACT. DIRECTOR, DIVISION OF SUBSTATION DESIGN		
C.A.F.	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		

NOTES

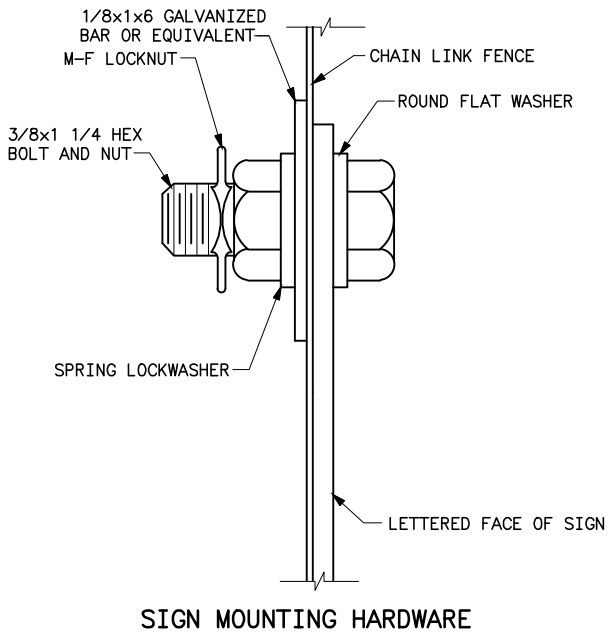
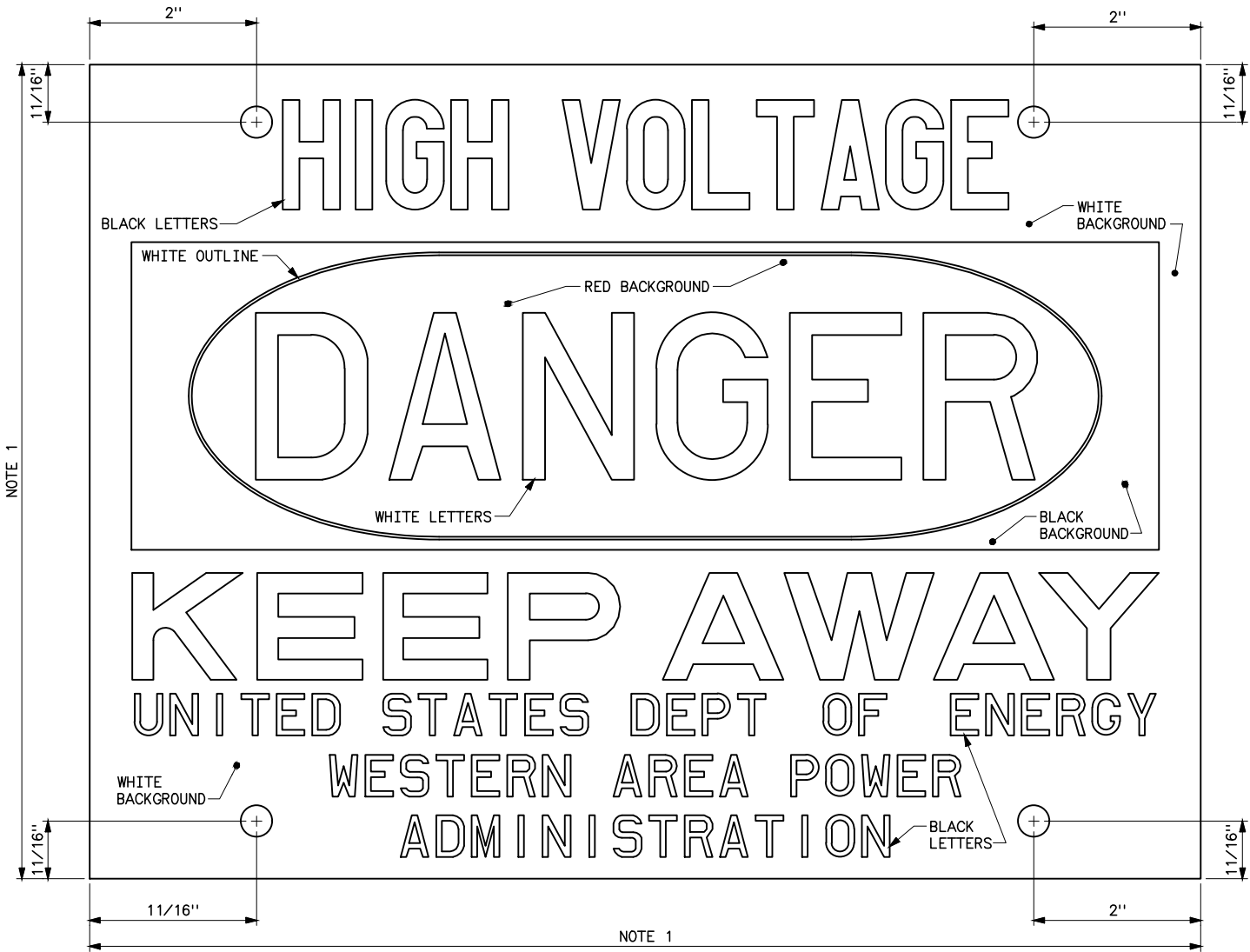
UNDERHUNG STACKING POST INSULATORS (NOTE 1)

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

A	5-14-99 A3-0P	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. TORGERSON	RECOMMENDED R.H. RICHARDSON
DRAWN	A. J. ARMSTRONG	APPROVED G.C. WEGNER
CHECKED	R.A. JOHNSON	DIRECTOR, DIVISION OF SUBSTATION DESIGN
C.A.F.	JANUARY 24, 1990	31 1088



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.

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

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		ACA (AFL)	1
8	LFMC COMPATIBLE SPLICE ENCLOSURE CONNECTOR		ACA (AFL)	1
9	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

NOTES

- 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.
 7. WATERPROOF ADAPTOR AND REDUCER CONNECTOR ARE REQUIRED TO SEAL THE 2 INCH RIGID METALLIC CONDUIT AROUND THE 1 INCH LFMC.

REFERENCE DRAWING

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

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.

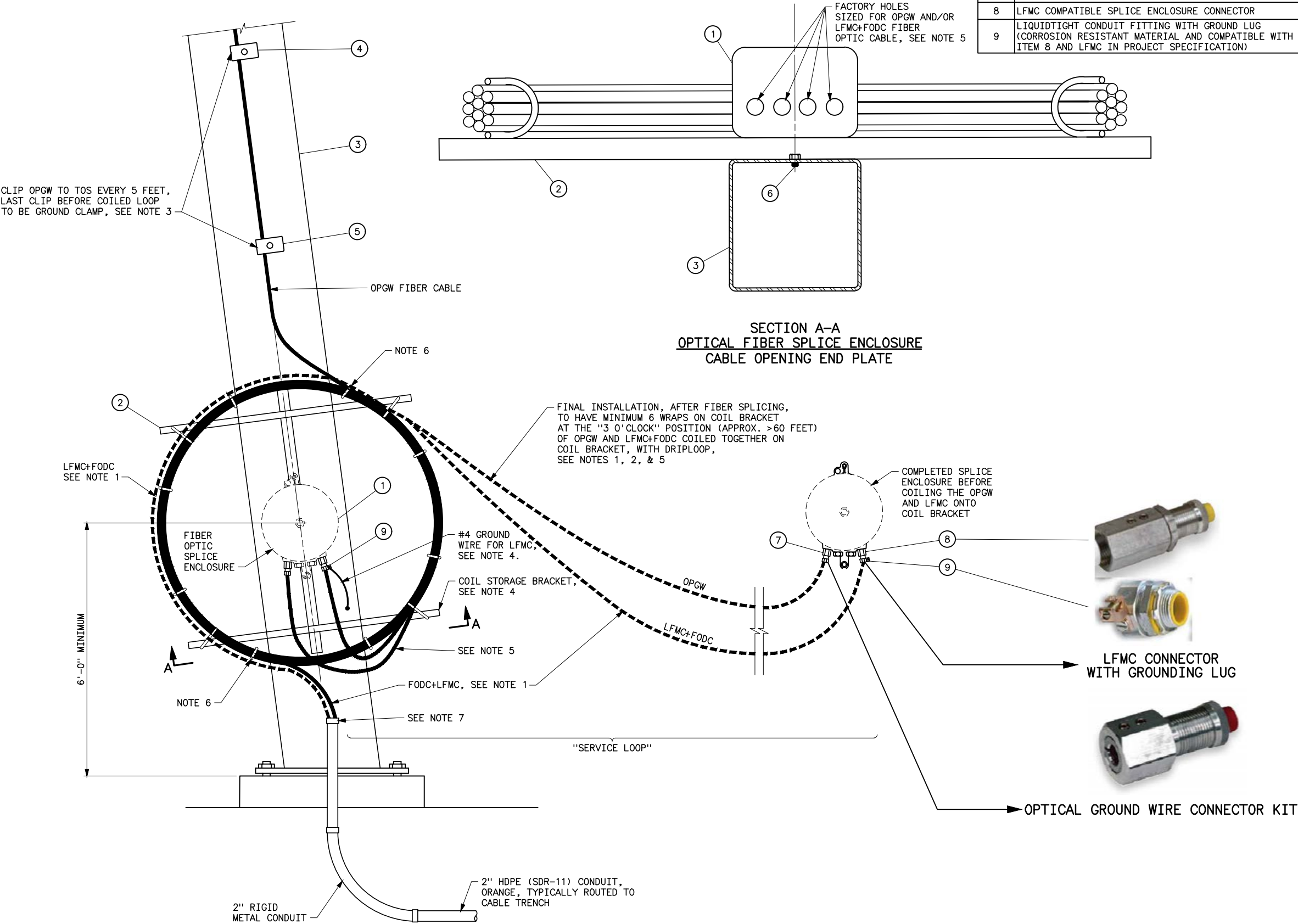
UNITED STATES DEPARTMENT OF ENERGY
WESTERN AREA POWER ADMINISTRATION
CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO

SUBSTATION STANDARDS

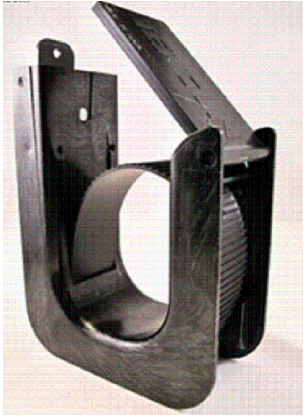
FIBER OPTIC CABLE MOUNTING

DESIGNED JOHN FLEURY _____ APPROVED ROSS CLARK
ELECTRICAL ENGINEERING MANAGER

CAE	NOVEMBER 1, 2010	31	1097
-----	------------------	----	------



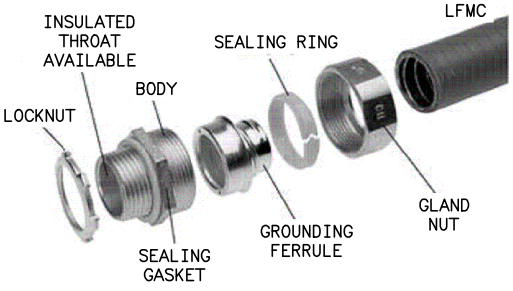
ITEM NO.	ITEM DESCRIPTION	PART NUMBER (OR EQUAL)	MANUFACTURER (OR EQUAL)	QUANTITY
1	FIBER OPTIC SPLICE ENCLOSURE	SB01	ACA (AFL)	1
2	3-PIECE EXTERNAL COIL BRACKET	CB-44-3AL	ACA (AFL)	1
3	TOS			
4	STRUCTURE DOWNLEAD CLAMP	SEE NOTE 5	ACA (AFL)	AS REQD
5	GROUND BONDING CLAMP		ACA (AFL)	1
6	5/8" MACHINE BOLT & LOCK WASHER			4
7	OPGW SPLICE ENCLOSURE CONNECTOR		ACA (AFL)	1
8	LFMC COMPATIBLE SPLICE ENCLOSURE CONNECTOR		ACA (AFL)	1
9	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



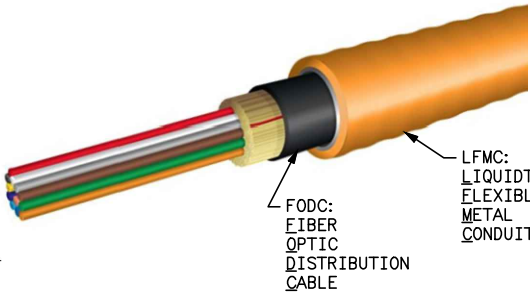
CABLE HANGERS (4 EACH)



LFMC CONNECTOR
GROUND LUG
SEE NOTES 2 & 3



REMOVE LFMC (ARMOR) FROM FODC
SEE NOTE 1



EXPLANATION

☒ FIBER OPTIC SPLICE BOX

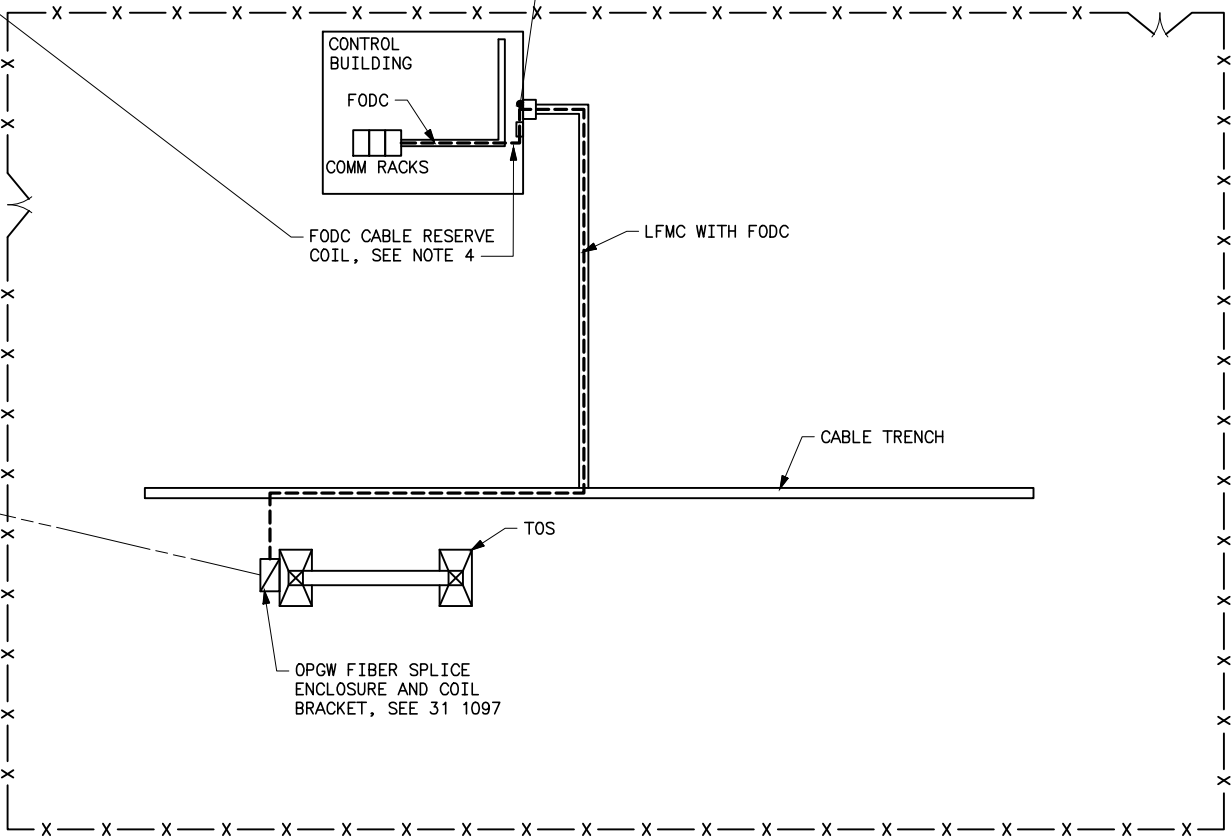
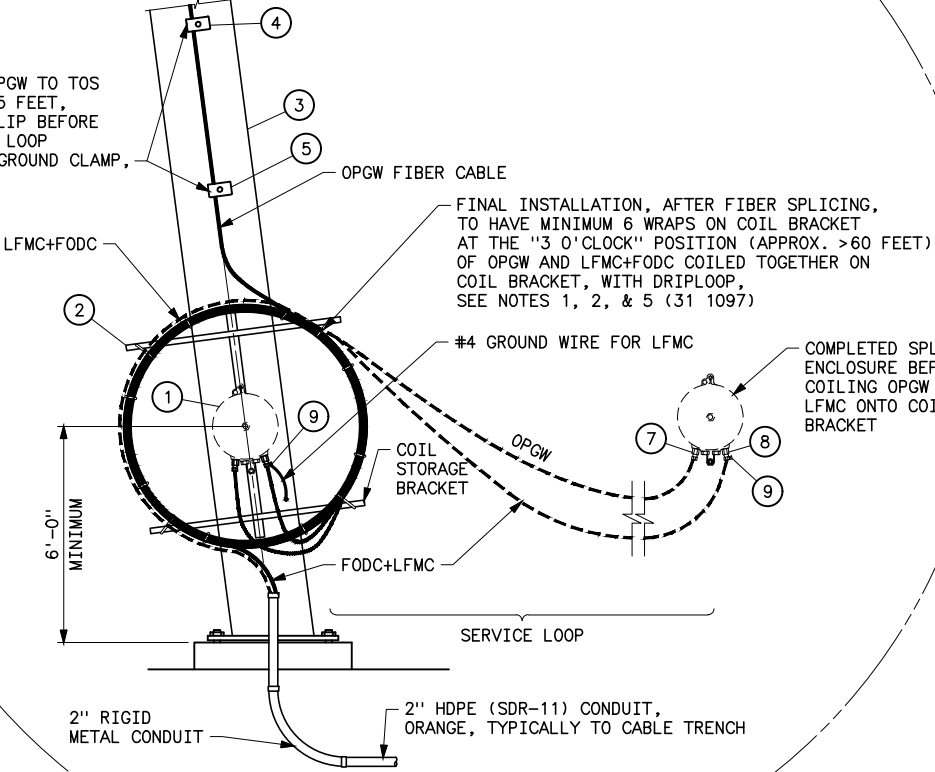
NOTES

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 BOTH ENDS OF LFMC (INSIDE BUILDING AND AT TOS) 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.
5. 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.

REFERENCE DRAWING

SUBSTATION STANDARDS
FIBER OPTIC CABLE MOUNTING----- 31 1097

CLIP OPGW TO TOS
EVERY 5 FEET,
LAST CLIP BEFORE
COILED LOOP
TO BE GROUND CLAMP.

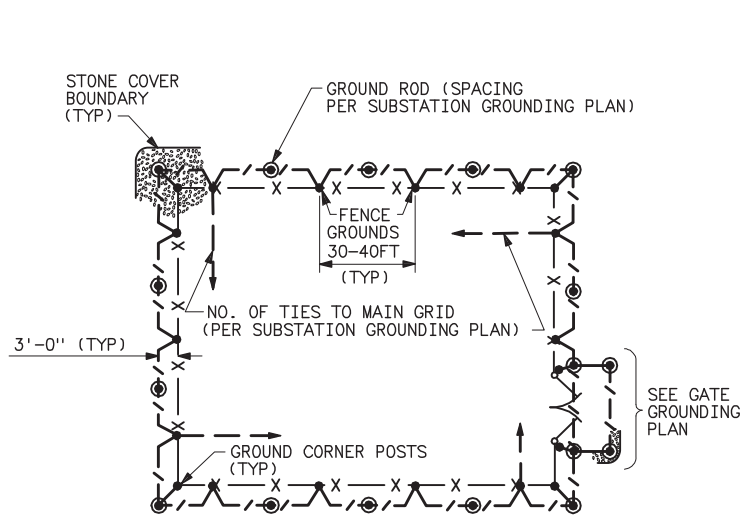


EXAMPLE SUBSTATION WITH TOS & CABLE TRENCH

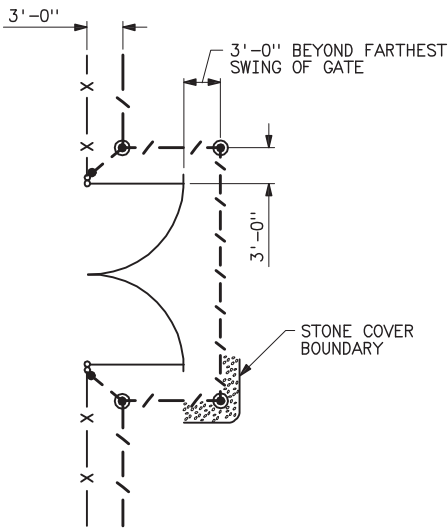
A	11-20-19 A7-TE	REVISED COIL BRACKET DETAILS.
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS FIBER OPTIC CABLE ARMORED CABLE INSTALLATION		
DESIGNED T. ERIKSON ----- APPROVED STEVE ROCK ELECTRICAL ENGINEERING MANAGER		
C _A E	SEPTEMBER 26, 2019	31 1099

S:\projects\Misc\StandardDrawings\Drawings\DesignDrawings\

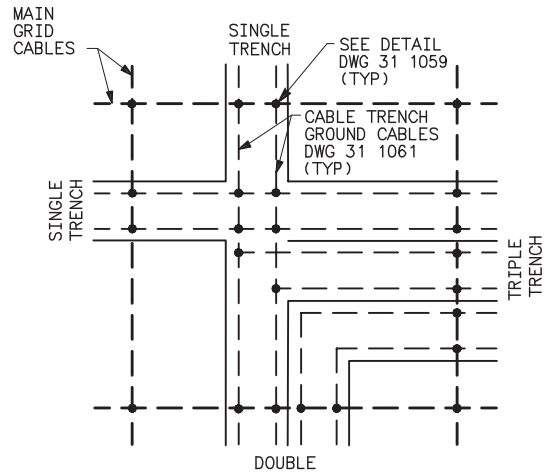
XREF(S):XREF(S):XREF(S):XREF(S):



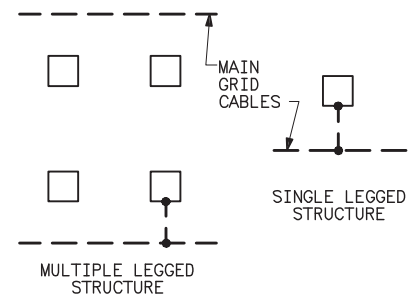
FENCE GROUNDING PLAN



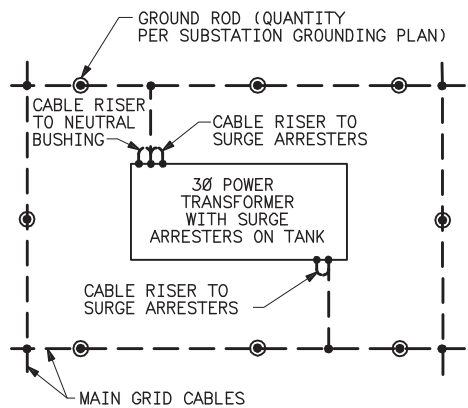
FENCE GATE GROUNDING PLAN



CABLE TRENCH GROUNDING PLAN



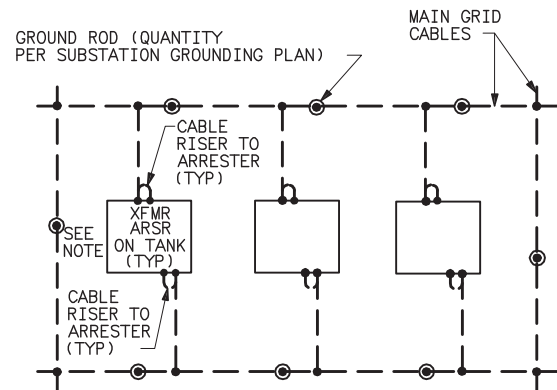
STRUCTURE GROUNDING PLAN



3-PHASE POWER TRANSFORMER GROUNDING PLAN

NOTE

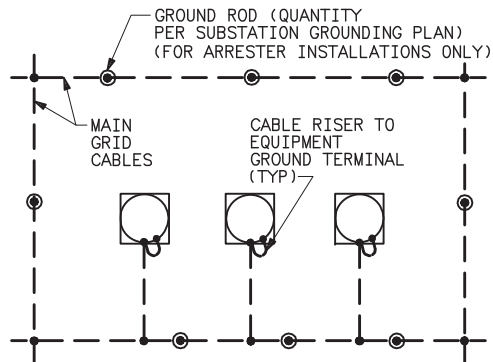
1. SIMILAR FOR 3 PH SHUNT REACTOR



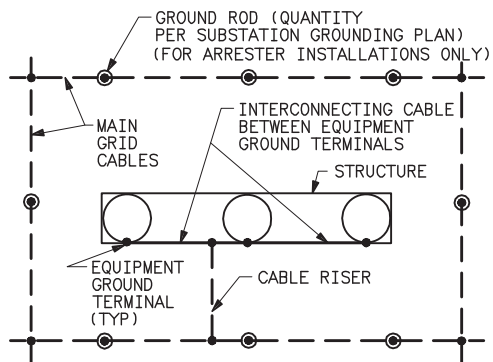
3 SINGLE-PHASE POWER TRANSFORMERS GROUNDING PLAN

NOTES

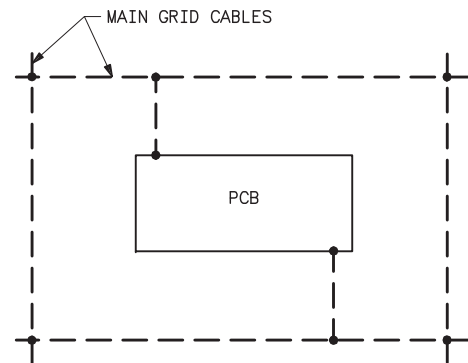
1. SEE PROJECT DRAWINGS FOR NEUTRAL BUSHING GROUNDING.
2. SIMILAR FOR 1 PH SHUNT REACTORS



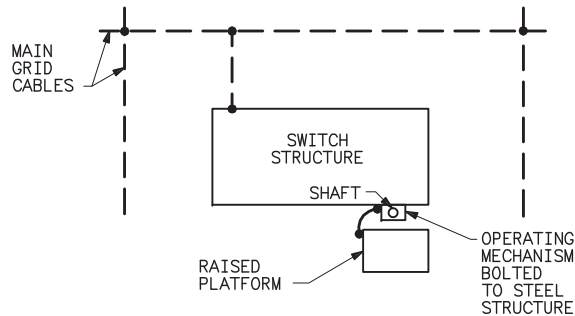
SEPARATELY MOUNTED INSTRUMENT TRANSFORMERS AND SURGE ARRESTERS GROUNDING PLAN



STRUCTURE MOUNTED INSTRUMENT TRANSFORMERS AND SURGE ARRESTERS GROUNDING PLAN



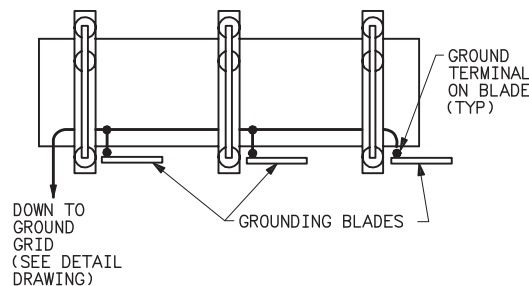
POWER CIRCUIT BREAKER GROUNDING PLAN



AIR SWITCH OPERATING PLATFORM GROUNDING PLAN

NOTE:

DO NOT GROUND PLATFORM DIRECTLY TO GROUND GRID. (SEE DRAWING 31 1075)



AIR SWITCH GROUNDING BLADE GROUNDING PLAN

EXPLANATION

- COPPER GROUND CABLE (BURIED)
- /-/- COPPER-CLAD STEEL GROUND CABLE (BURIED)
- COPPER GROUND CABLE (EXPOSED)
- COPPER GROUND CABLE (IN TRENCH)
- X- FENCE
- GROUND ROD
- ELECTRICAL GROUNDING CONNECTION
- GROUND CABLE RISER

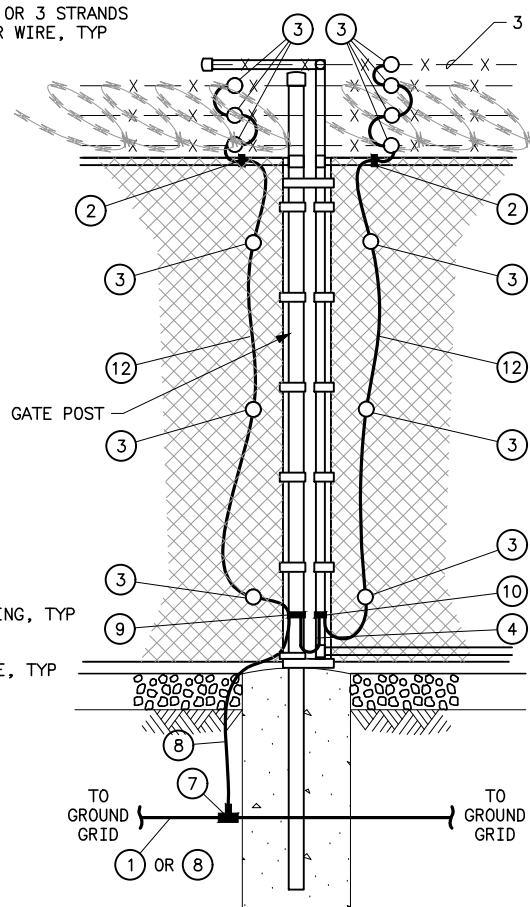
NOTES

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. WHEN TWO OR MORE CABLE TRENCHES ARE LOCATED ADJACENT TO EACH OTHER, EACH TRENCH SHALL BE GROUNDED IN ACCORDANCE WITH THE INSTRUCTIONS AND THE DETAILS SHOWN FOR A SINGLE TRENCH. THE NO. 6 AWG COPPER CABLES FOR TRENCH COVER GROUNDING SHALL BE INSTALLED WITH ENOUGH SLACK TO ALLOW THE COVERS TO BE REMOVED AND PLACED FLAT WITHOUT INTERFERING WITH OTHER STRUCTURES.
3. NO. 4/0 AWG MINIMUM SIZE COPPER GROUND CABLES SHALL BE RUN DIRECTLY FROM THE GROUND GRID TO THE GROUND BLADES OF AIR SWITCHES.
4. PLACE GROUND RODS AT 20-0 INTERVALS (MAXIMUM).

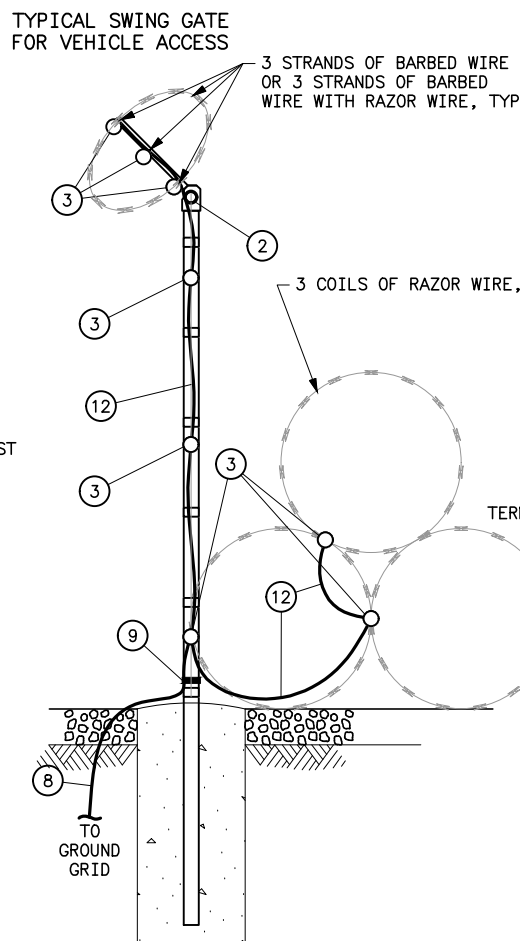
REFERENCE DRAWINGS

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

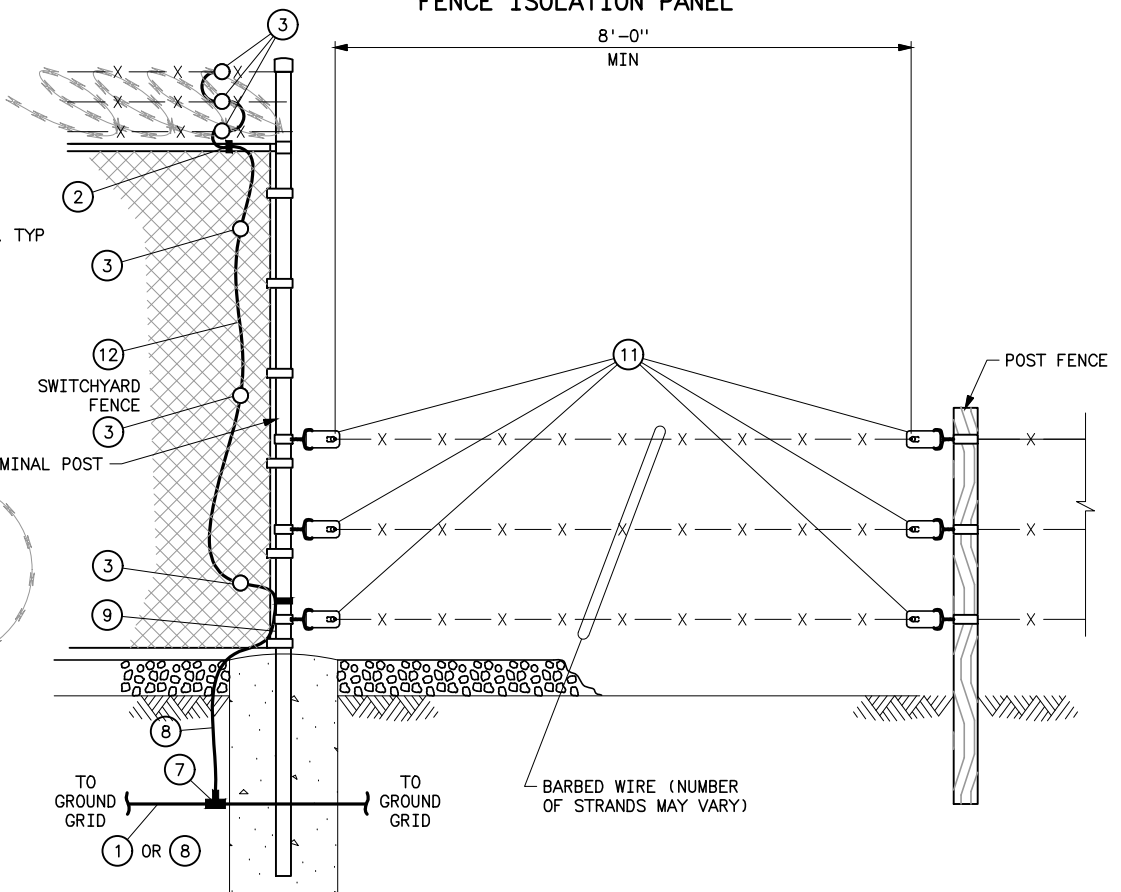
B	11-10-11 A7-RMJ	REVISED GATE DETAILS AND REFERENCE DRAWINGS.
A	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS GROUNDING PLANS TYPICAL COMPONENTS		
DESIGNED O. PERKINS APPROVED ROSS M. CLARK ELECTRICAL ENGINEERING MANAGER		
C _A E	MAY 14, 1999	31 1500



DETAIL A
FENCE GROUNDING



DETAIL E
RAZOR WIRE GROUNDING



DETAIL D
BARBED WIRE TERMINATION ON SUBSTATION

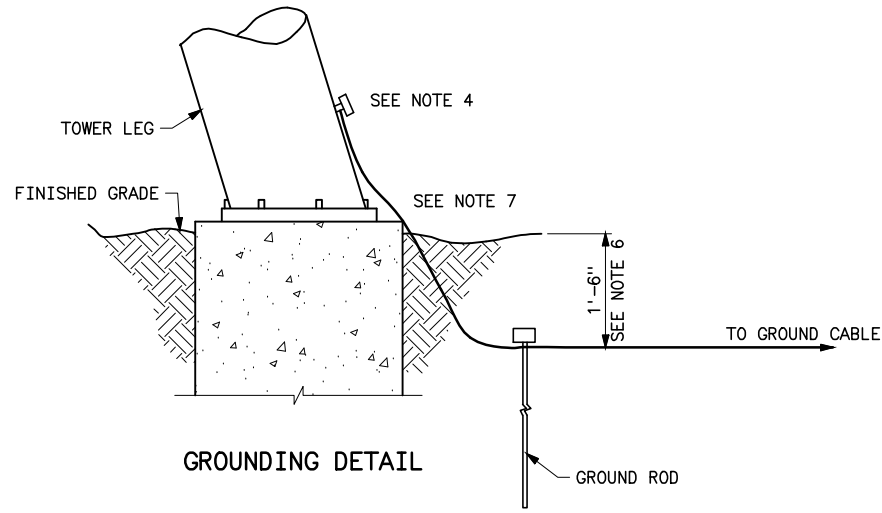
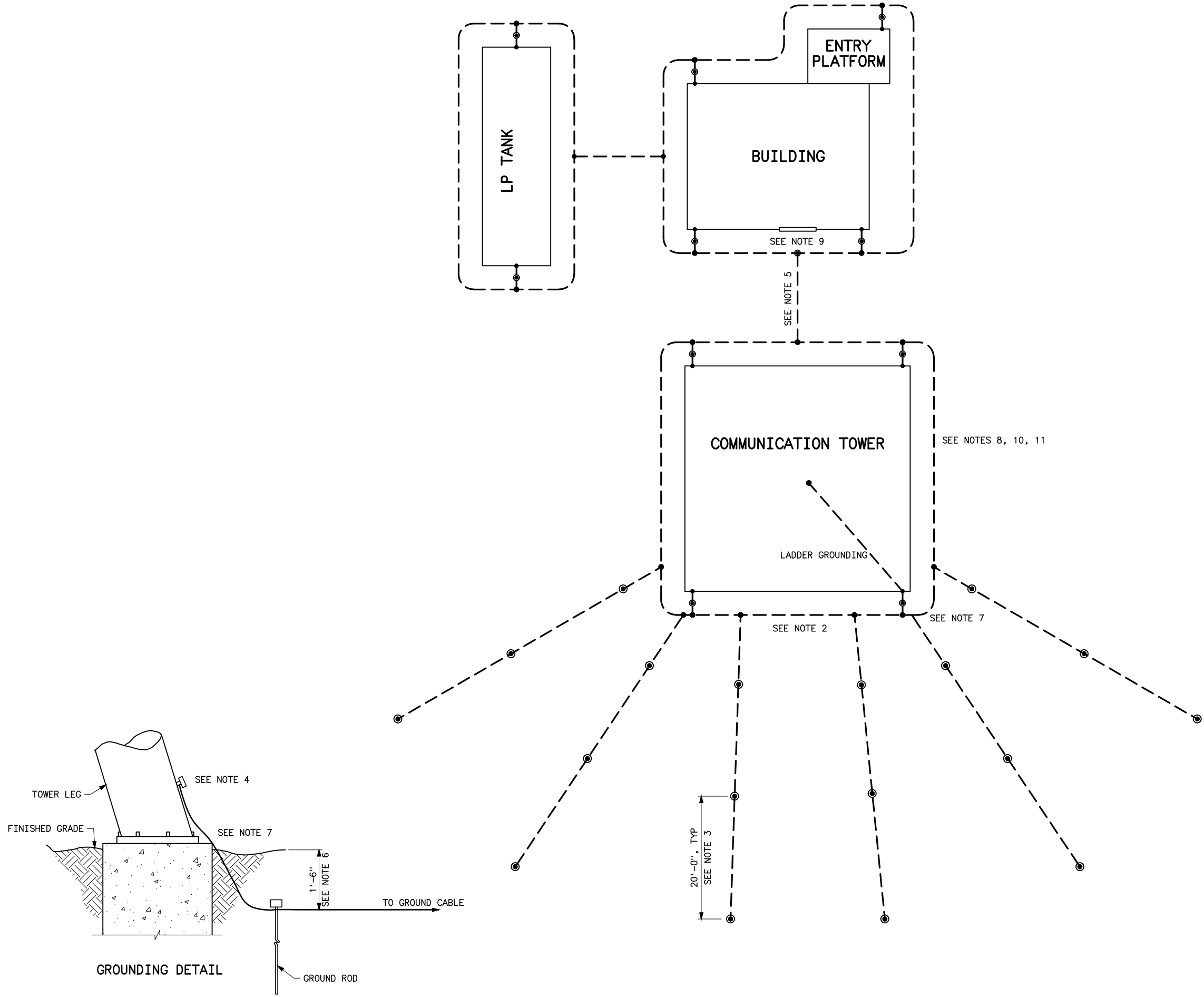
NOTES

1. PROVIDE LOCAL GROUND CONNECTION TO FENCE POST AND BOTTOM OF FENCE FABRIC.
2. DMC POWER'S FENCE POST CONNECTOR GC764 OR GC763 AND A PARALLEL SWAGED CONNECTOR SUCH AS GC732 OR EQUAL MAY BE USED IN COMBINATION FOR REFERENCE MATERIAL ITEM 9.
3. CEDAR POSTS SHALL BE THOROUGHLY PRETREATED WITH MILDEW RESISTANT CEDAR STAIN. ANY HOLES MADE SHALL BE FILLED WITH CLEAR CAULK.
4. PIPE STRAPS TO SUPPORT THE WOOD POST SHALL BE INSTALLED APPROXIMATELY EVERY 1'-3" APART ON BOTH SIDES WITH REQUIRED OFFSET. PRE-DRILL HOLES IN WOOD AND INSTALL GALVANIZED LAGGED BOLTS WITH A MINIMUM 2-INCH PENETRATION. THERE SHALL BE NO ELECTRICAL CONTINUITY BETWEEN ISOLATION PANEL AND ADJOINING FENCE. ISOLATION PANEL SHALL BE INSTALLED ON THE OUTSIDE OF SWITCHYARD FENCE, REPLACING A SECTION OF THE EXTERNAL SECURITY FENCE. INTERSECTING MIDSPAN WITH SWITCHYARD FENCE REQUIRES AN ADDITIONAL SWITCHYARD FENCE POST.
5. COPPER CLAD STEEL CABLE SHALL BE SIZED TO MEET OR EXCEED THE FUSING RATING OF THE GROUND GRID CONDUCTOR PER IEEE STD 80, TABLE 3. FOR EXAMPLE, 4/0 AWG SOFT DRAWN COPPER IS RATED AT 40KA FOR 30 CYCLES.
6. COPPER CLAD STEEL FENCE GROUNDING CABLE SHALL BE SIZED TO MEET OR EXCEED THE FUSING RATING OF NO. 6 AWG SOFT DRAWN BARE COPPER (5KA FOR 30 CYCLES PER UNDERDONK 1083 DEG C).

GROUNDING PLANS-TYPICAL COMPONENTS_____31 1500

UNITED STATES DEPARTMENT OF ENERGY			
WESTERN AREA POWER ADMINISTRATION			
CORPORATE SERVICES OFFICE — LAKEWOOD, COLORADO			
SUBSTATION STANDARDS			
FENCE GROUNDING			
CONNECTIONS			
DETAILS			
DESIGNED <u>JEFFREY T. HEIN</u> — — — —		APPROVED <u>ROSS M. CLARK</u> — — — — ELECTRICAL ENGINEERING MANAGER	
C _A _E	MARCH 10, 2004	31	1501

Plotted By: denton Oct 25, 2016- 11:01am
S:\projects\Wisc\StandardsDrawings\Drawings\DesignDrawings\DrawingsReadyForFinal\Scripts\31_1502.dwg Last Saved By: Denton, Debra on 10/25/2016 11:01 AM
IMAGES:



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 MADE USING BURNDY THERMOWELD, CADWELD, OR EQUIVALENT PROCESS AS SHOWN ON DRAWING 31 1060.
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

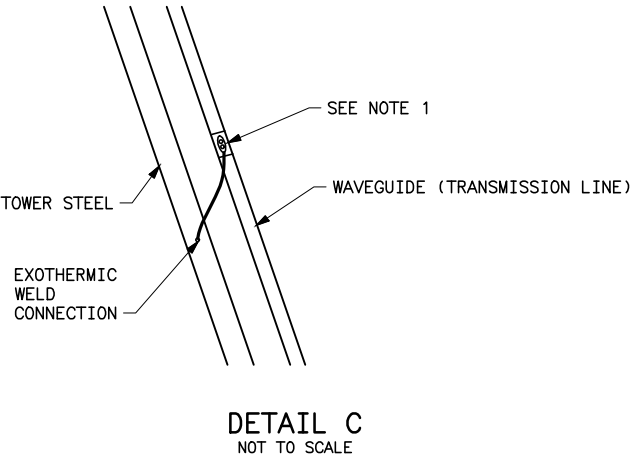
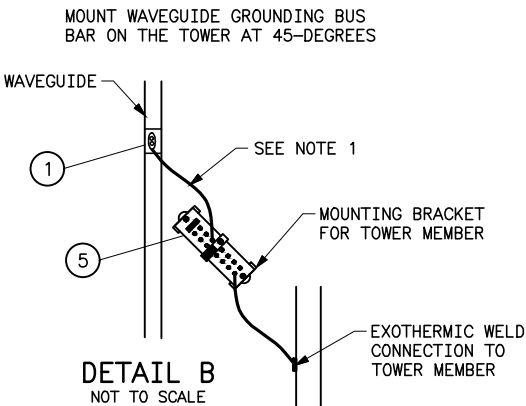
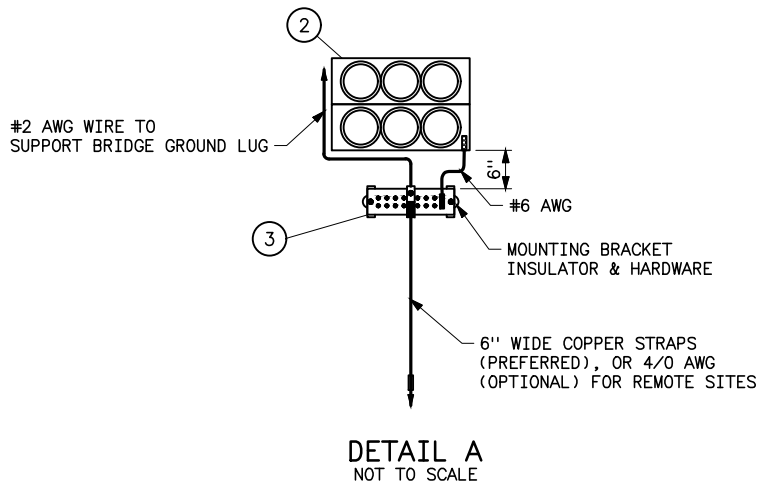
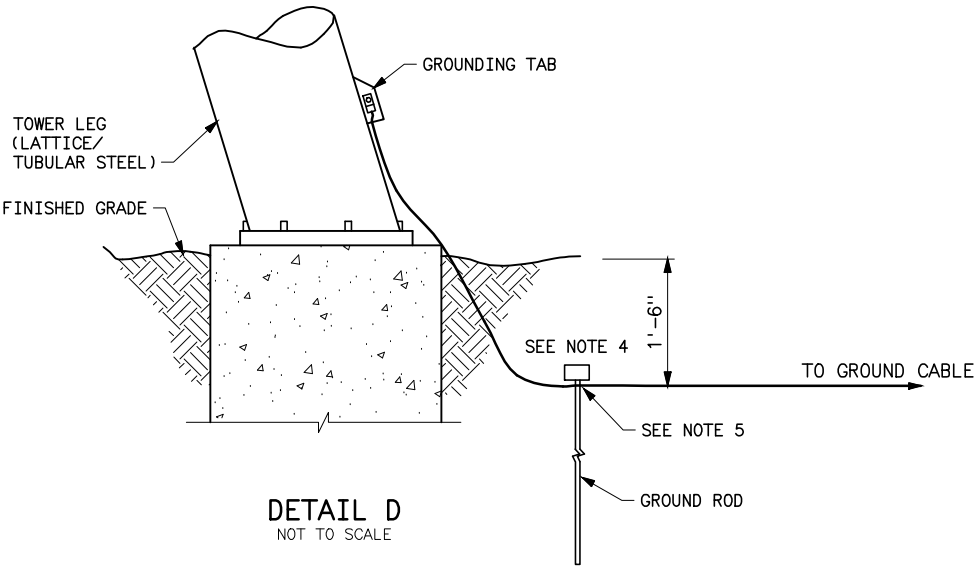
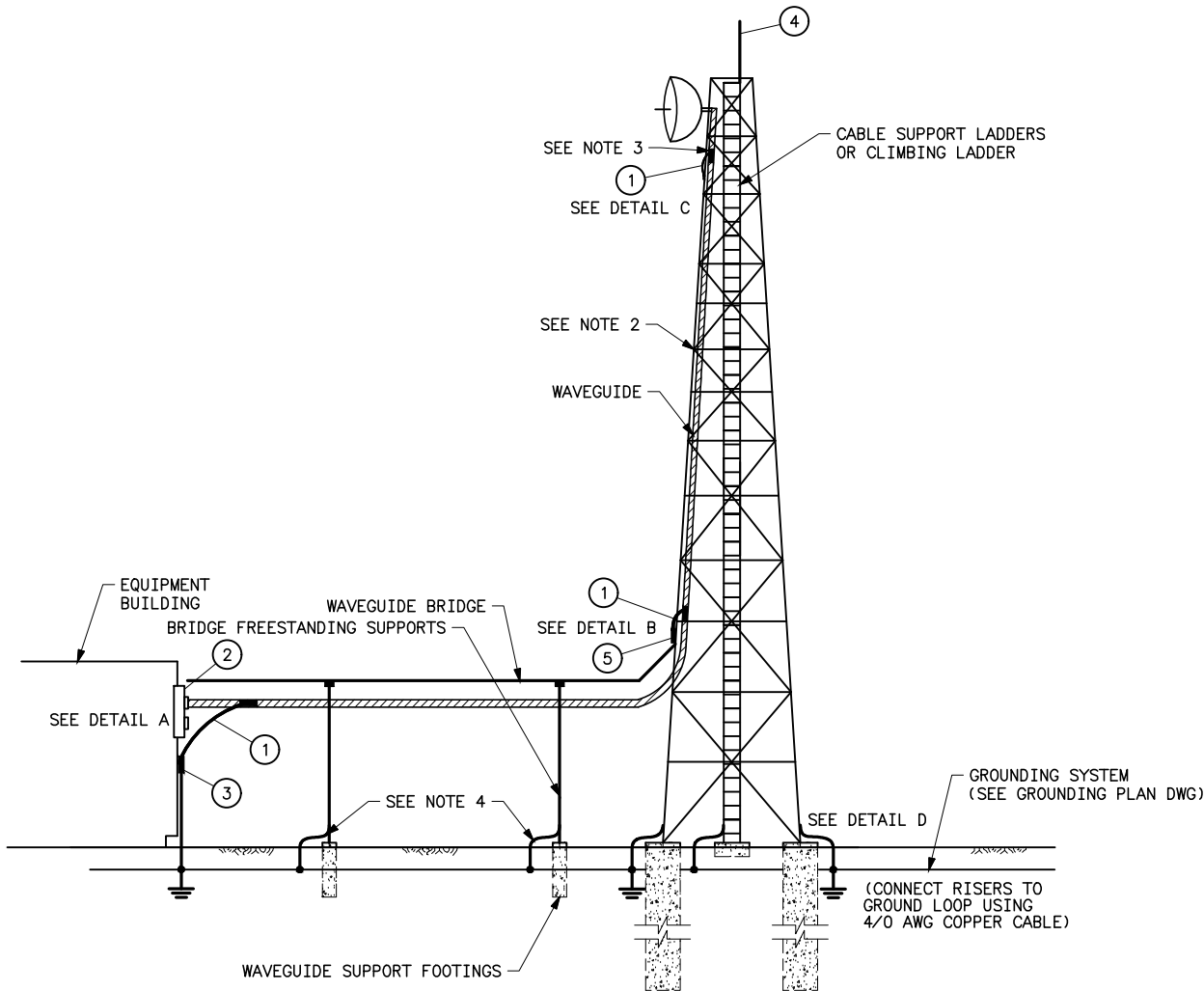
- ⊙ --- 5/8"x10'-0" GROUND ROD
- NO. 4/0 AWG STRANDED BARE COPPER GROUND CABLE
- --- ELECTRICAL CONNECTION TO THE GROUND WIRE

REFERENCE DRAWINGS

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

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	
C_A_E	OCTOBER 25, 2016	31 1502

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

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

REFERENCE DRAWINGS

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

SUPERSEDES DWG NO. 41 7001B		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
COMMUNICATIONS STANDARD COMMUNICATION TOWER GROUNDING DETAILS		
DESIGNED SCOTT JOHNSON	APPROVED DAN HAMAI SYSTEM CONTROL MANAGER	
CAR OCTOBER 25, 2016	31	1503

Plotted By: denton Oct 25, 2016 11:02am
S:\projects\Wisc\StandardDrawings\Drawings\DesignReadyForFinal\Scripts\31_1503.dwg Last Saved By: Denton, Debra on 10/25/2016 11:02 AM
IMAGES:

XREF(S):

LEGEND

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

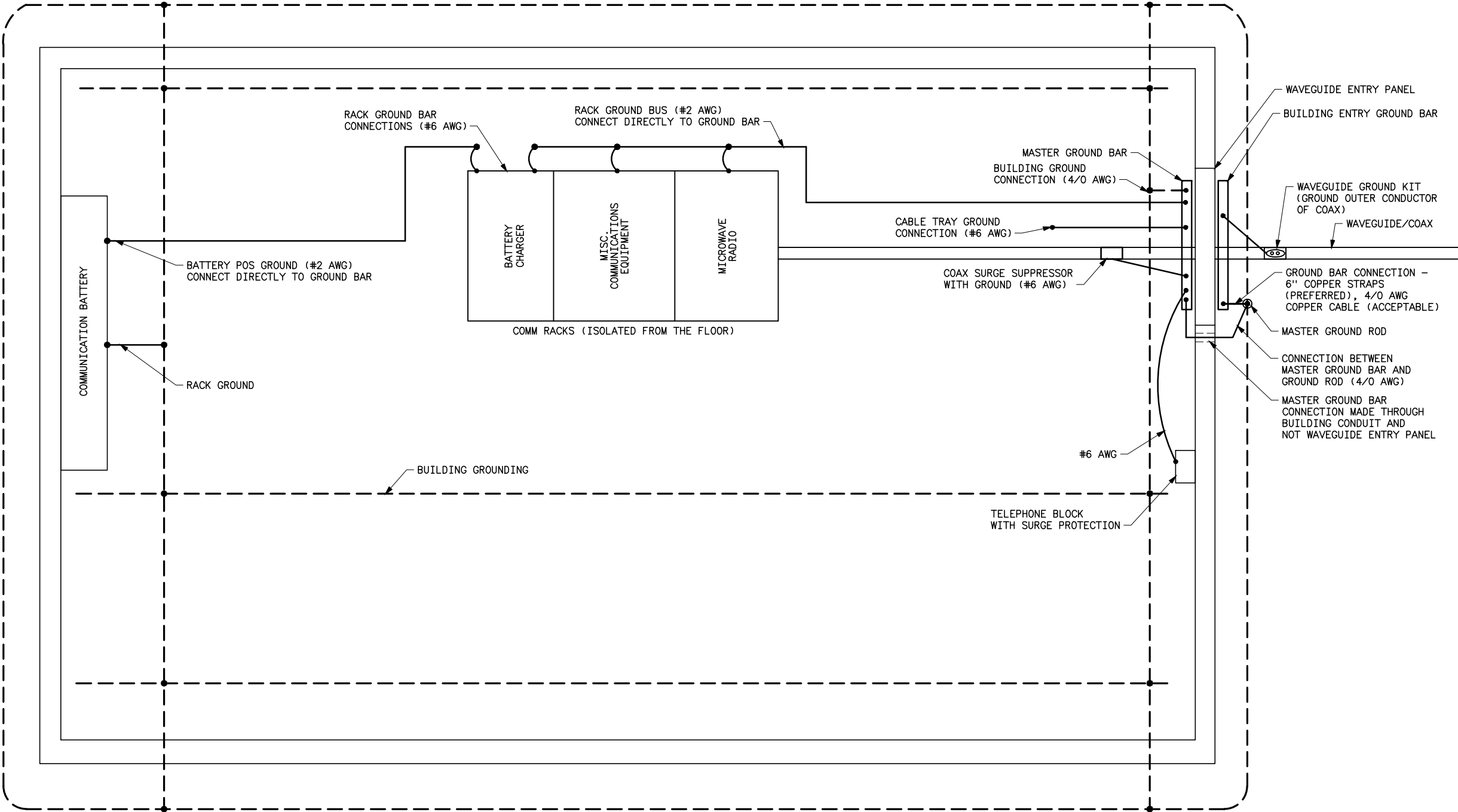
NOTES

- 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 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

A	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 <u>SCOTT JOHNSON</u> _ _ _ _ _		APPROVED <u>DAN HAMAI</u> SYSTEM CONTROL MANAGER _ _ _ _ _	
C E	OCTOBER 25, 2016	31	1504



Plotted By: denton Dec 04, 2018- 12:42pm
S:\projects\Wisc\StandardDrawings\Drawings\DesignDrawings\DrawingsReadyForFinal\Scripts\31_1504a.dwg Last Saved By: Denton, Debra on 12/4/2018 12:42 PM

XREF (S):

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.

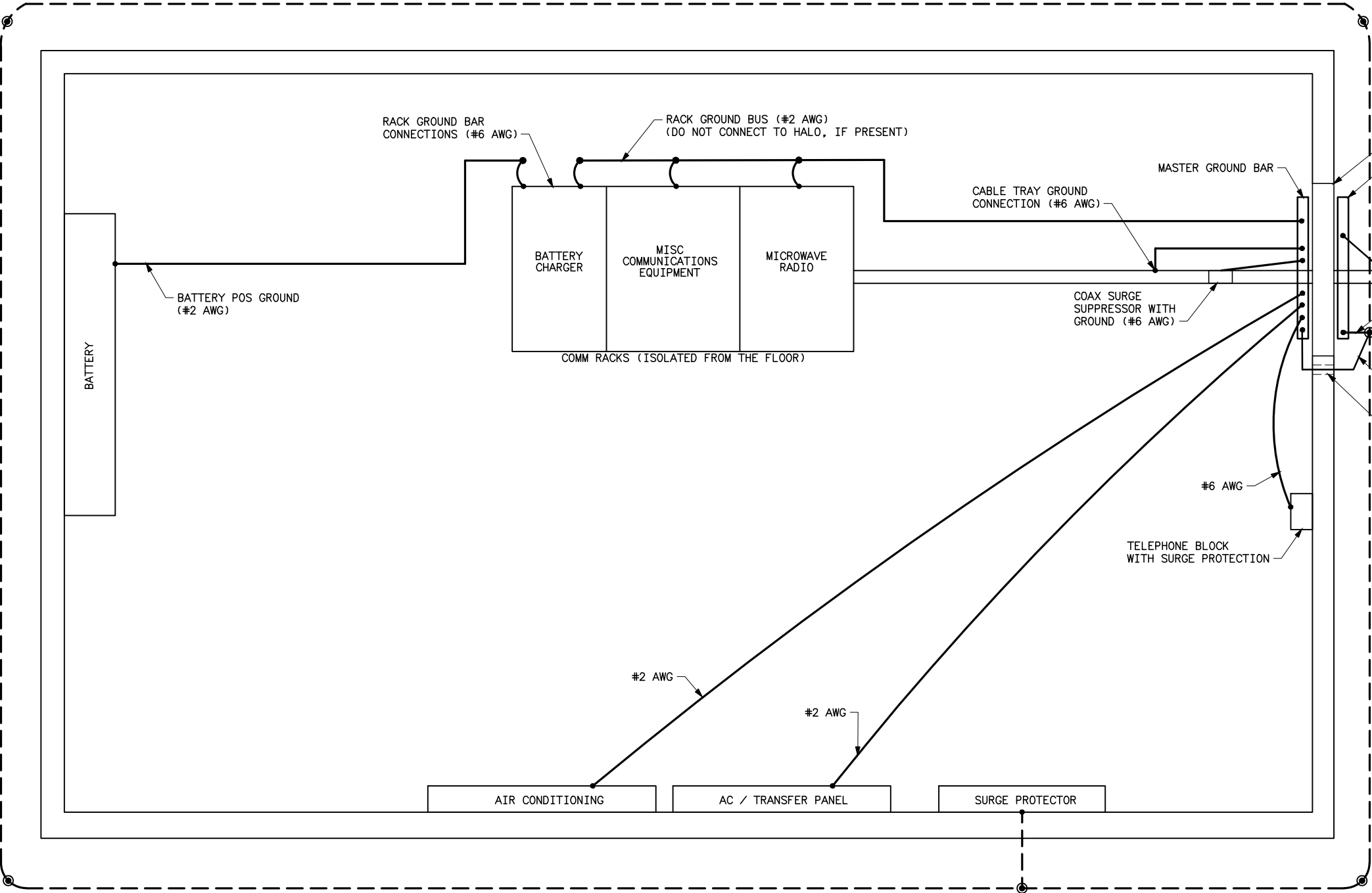
REFERENCE DRAWINGS

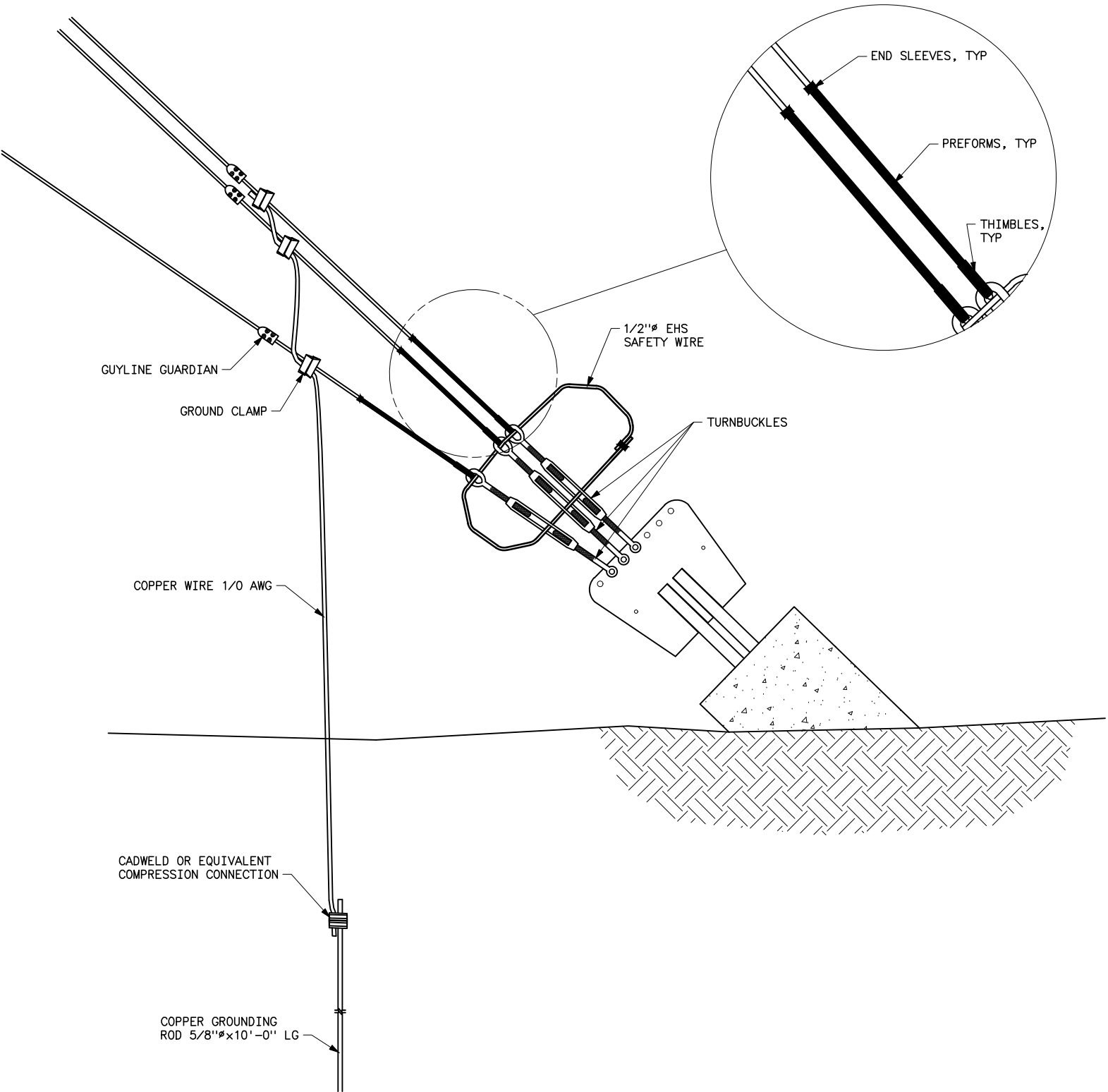
SUBSTATION STANDARDS-GROUNDING DETAILS	31	1060
GROUNDING PLAN	31	1502
MICROWAVE TOWER GROUNDING	31	1503
COMMUNICATIONS RACK-LAYOUT & DETAILS	53	7050

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

Plotted By: denton Dec 04, 2018- 12:42pm S:\projects\Wisc\StandardDrawings\Drawings\DesignDrawings\DrawingsReadyForFinal\Scripts\31_1505a.dwg Last Saved By: Denton, Debra on 12/4/2018 12:42 PM

XREF (S) :





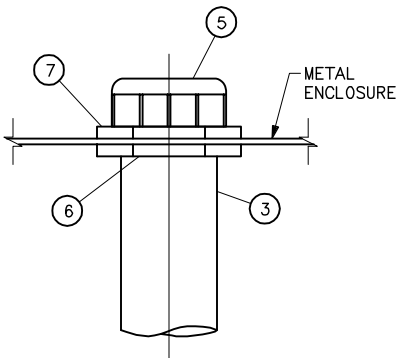
NOTES

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.

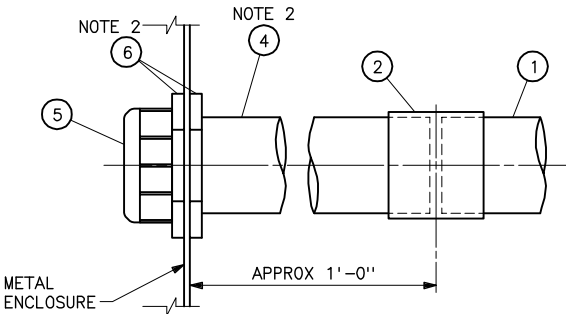
A	12-4-18 A7-SJ	CONNECTION REVISIONS.	
	SUPERSEDES DWG NO. 41 7006		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO			
COMMUNICATIONS STANDARD GUY TOWER GROUNDING ANCHOR GROUND DETAILS			
DESIGNED S. JOHNSON		APPROVED DAN HAMAI SYSTEM CONTROL MANAGER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

Plotted By: denton Dec 04, 2018- 12:42pm
S:\projects\Misc\StandardDrawings\Drawings\DrawingsReadyForFinal\Scripts\31_1506a.dwg Last Saved By: Denton, Debra on 12/4/2018 12:42 PM
IMAGES:

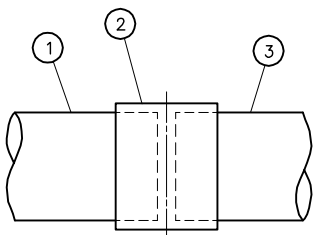
XREF (S):



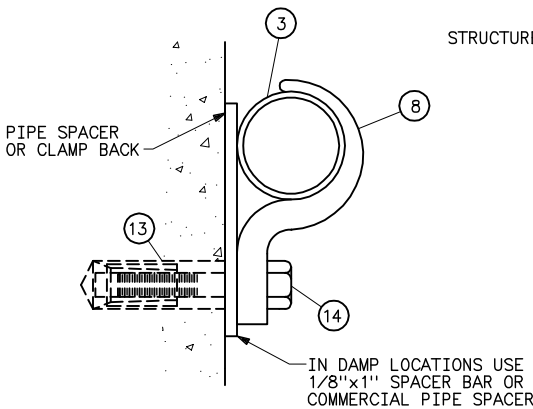
METALLIC CONDUIT TERMINATION
IN METAL ENCLOSURE
DETAIL A



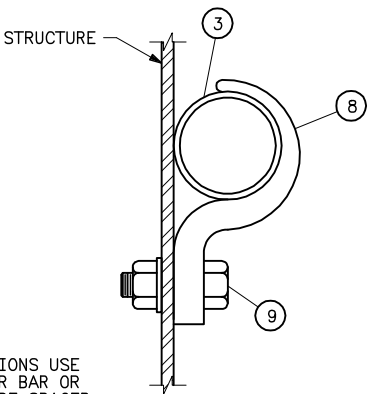
NON-METALLIC CONDUIT TERMINATION
IN METAL ENCLOSURE
DETAIL B



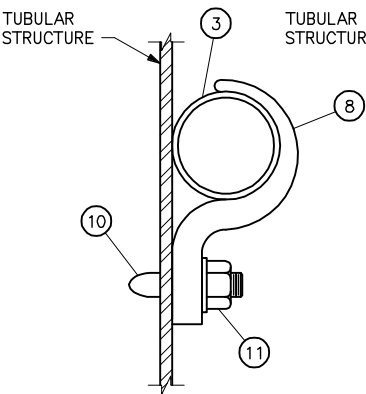
CONNECTING RIGID STEEL
AND PVC CONDUIT
DETAIL C



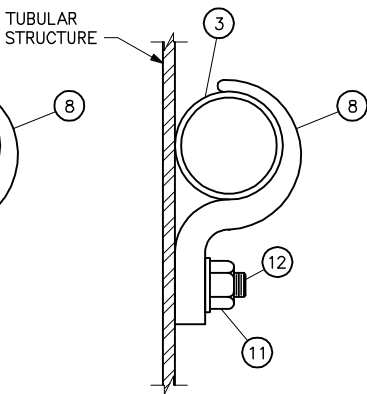
CONDUIT CLAMPING ON
CONCRETE SURFACE
DETAIL D



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

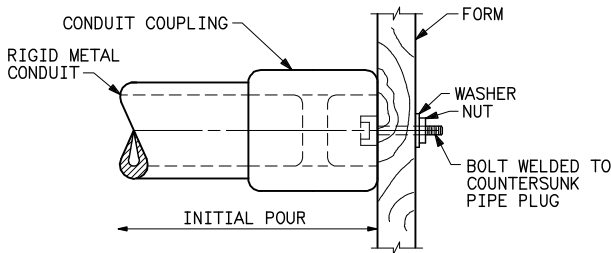


DETAIL F

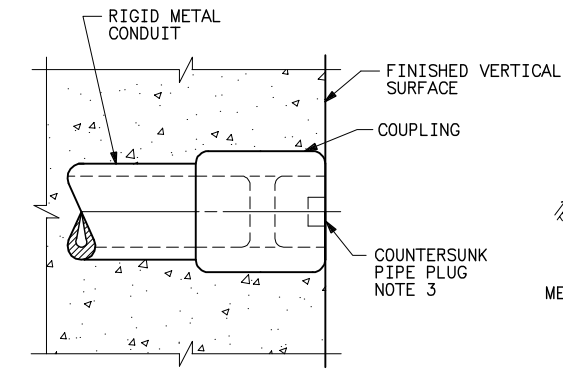


DETAIL G

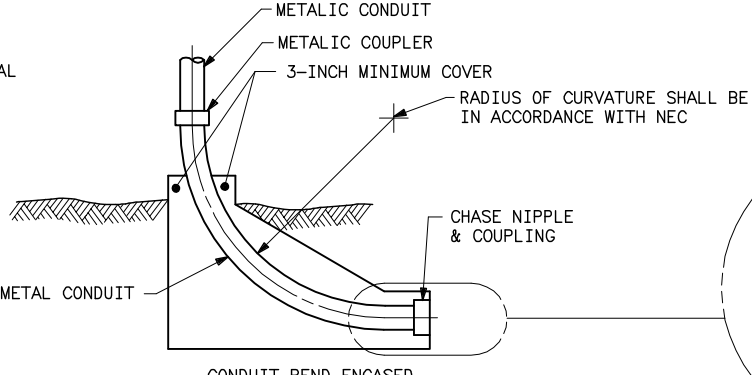
CONDUIT CLAMPING ON
TUBULAR STEEL STRUCTURE



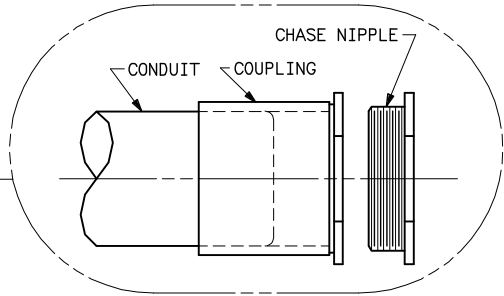
IN FORM WORK
DETAIL H



PLUGGED AFTER FORM HAS BEEN REMOVED
DETAIL I



CONDUIT BEND ENCASED
IN CONCRETE
DETAIL J



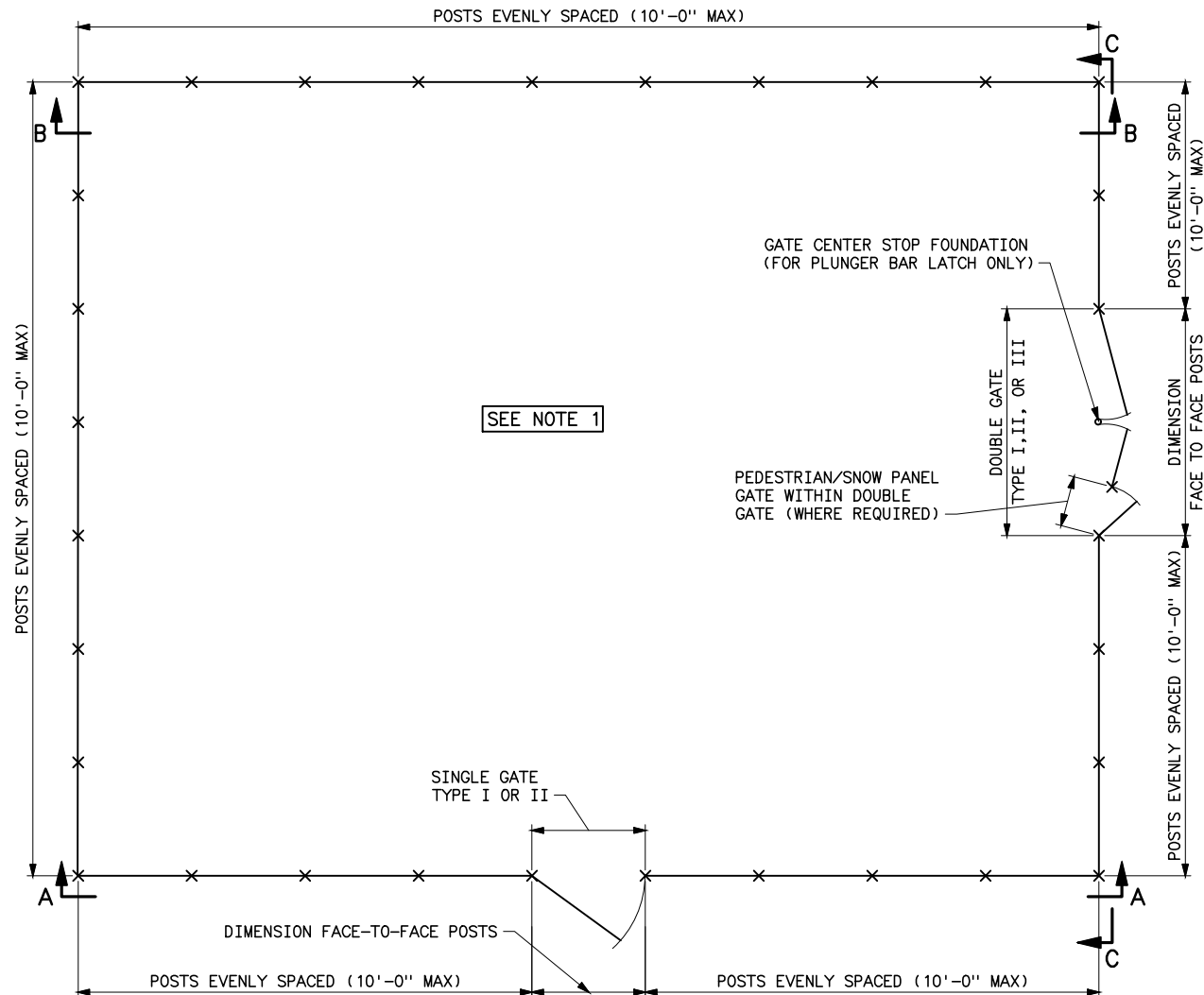
REFERENCE MATERIALS

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, MALLEABLE IRON, ONE HOLE EQUAL
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

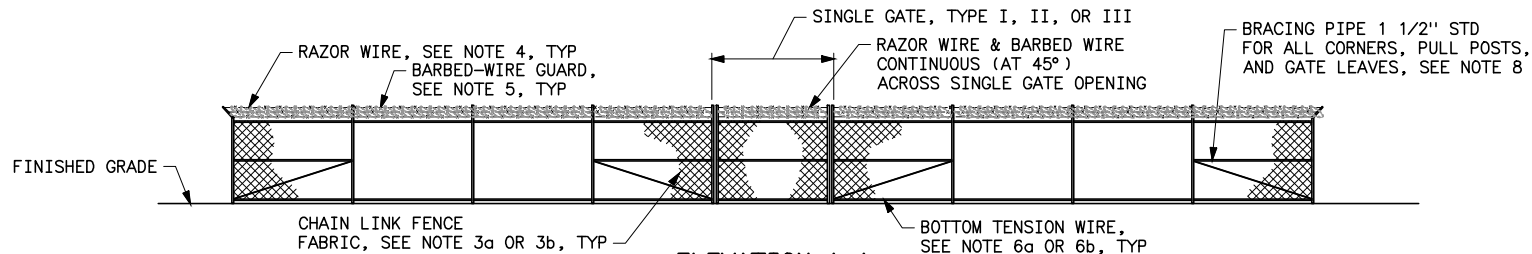
NOTES

1. UNLESS OTHERWISE SPECIFIED ON DRAWINGS, CONDUIT BENDS SHALL BE IN ACCORDANCE WITH NATIONAL ELECTRICAL CODE (NEC).
2. USE ALUMINUM OR BRASS NIPPLE AND LOCKNUTS AND SLOT STEEL BOX BETWEEN KNOCKOUTS WHERE SINGLE PHASE CABLES ONLY ARE RUN IN ONE CONDUIT.
3. REPLACE PLUG WITH CHASE NIPPLE BEFORE INSTALLING CABLE OR WIRE.

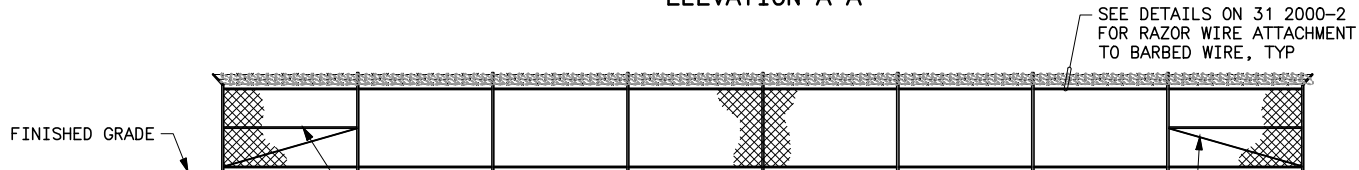
A	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.
SUPERSEDES DWG NO. 31-1027, 31-1028, 31-1033, 31-1034 AND (IN PART) 31-1077		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS CONDUIT INSTALLATION DETAILS		
DESIGNED BUREC	APPROVED ROSS M. CLARK ELECTRICAL ENGINEERING MANAGER	
C _A E	MAY 14, 1999	31 1700



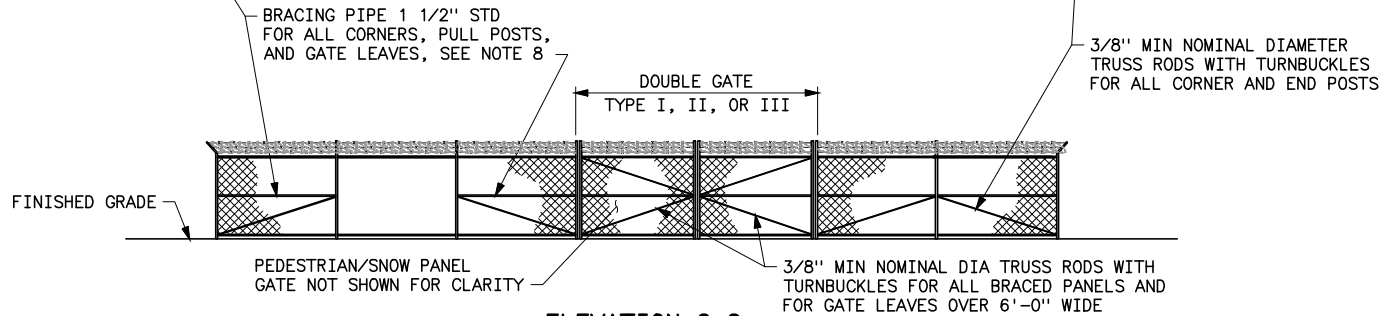
TYPICAL PLAN



ELEVATION A-A



ELEVATION B-B



ELEVATION C-C

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 LEAF KEEPER" TYPE OR THE PLUNGER BAR 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

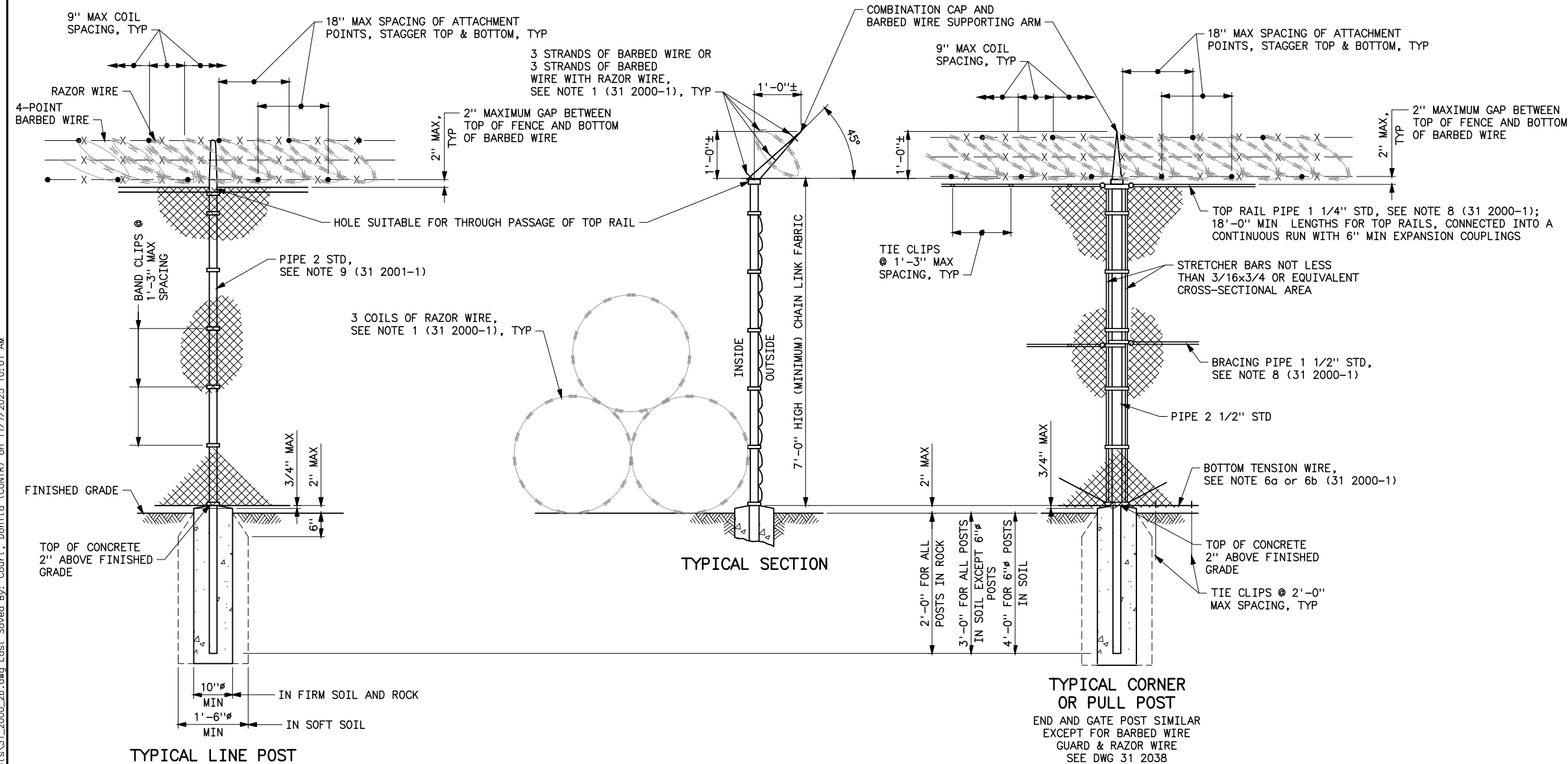
FENCE GROUNDING CONNECTIONS DETAILS	31 1501
SUBSTATION STANDARDS CHAIN-LINK FENCE GENERAL REQUIREMENTS	31 2000-2
CHAIN-LINK FENCE GATE LATCHES	31 2001
CHAIN-LINK FENCE SWING GATES	31 2038

A	5-14-18 A7-FF	MODIFIED NOTE 1B.
	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 <u>JERRY SCHREIBER</u> _____ APPROVED <u>DOUG HANSON</u> _____ CIVIL ENGINEERING MANAGER		
C/A	SEPTEMBER 27, 2016	31 2000-1

Plotted By: Court Nov 07, 2025- 10:01am
S:\Projects\Wisc\Standards\Drawings\Drawings\DrawingsReadyForFinal\Scripts\31_2000_2b.dwg Last Saved By: Court, Donita (CONTR) on 11/7/2025 10:01 AM

IMAGES:

XREF(S):



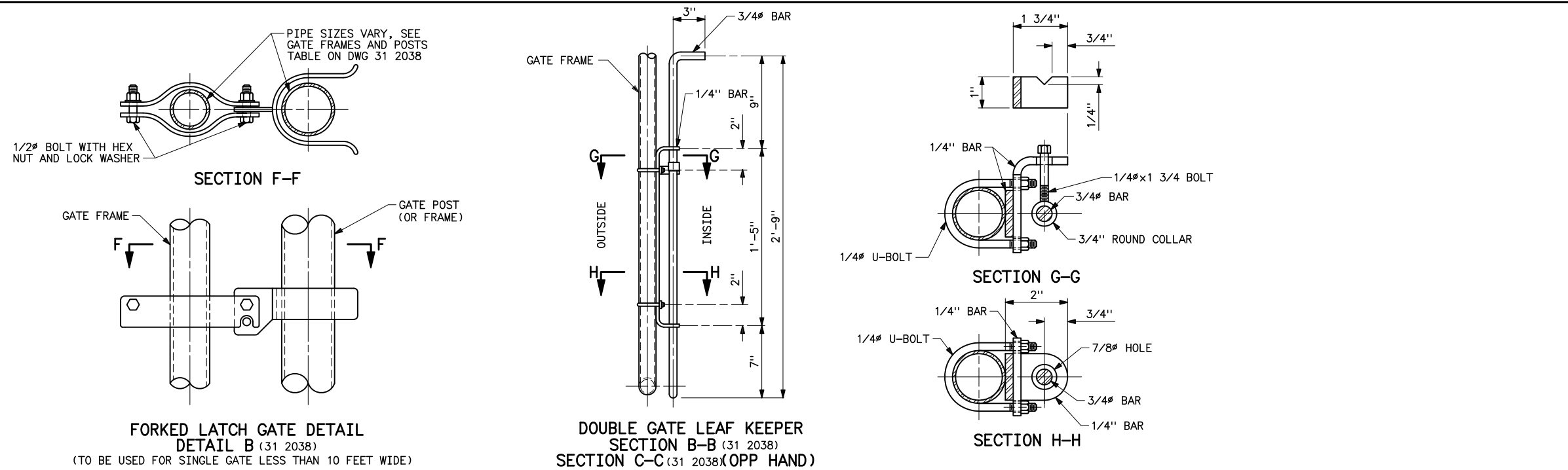
NOTE

1. REFERENCE NOTES ON 31 2000-1.

REFERENCE DRAWINGS

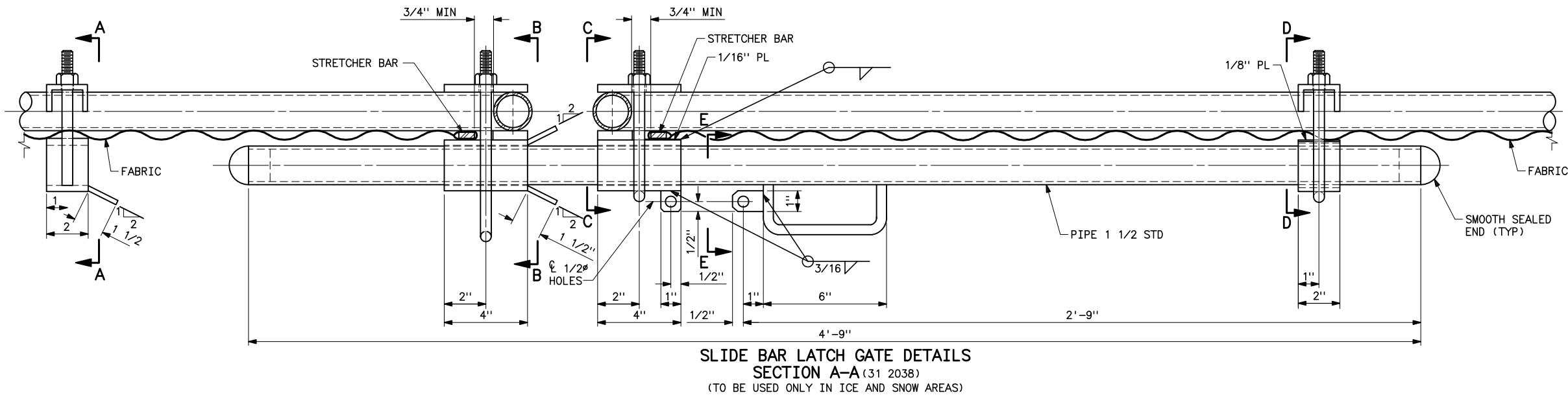
FENCE GROUNDING CONNECTIONS DETAILS	31 1501
SUBSTATION STANDARDS CHAIN-LINK FENCE	
GENERAL REQUIREMENTS	31 2000-1
CHAIN-LINK FENCE GATE LATCHES	31 2001
CHAIN-LINK FENCE SWING GATES	31 2038

B	11-7-25 A7-FF	UPDATED TOP OF CONCRETE TO BE AT 2" ABOVE FINISHED GRADE
A	5-14-18 A7-FF	MODIFIED THE TOP OF THE 'TYPICAL SECTION' DETAIL TO SHOW CONNECTION TO BOTTOM ROW OF BARBED WIRE.
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 2 OF 2)		
DESIGNED JERRY SCHREIBER APPROVED DOUG HANSON CIVIL ENGINEERING MANAGER		
A	SEPTEMBER 27, 2016	31 2000-2



NOTE

1. REFERENCE NOTES ARE ON 31 2000-1.



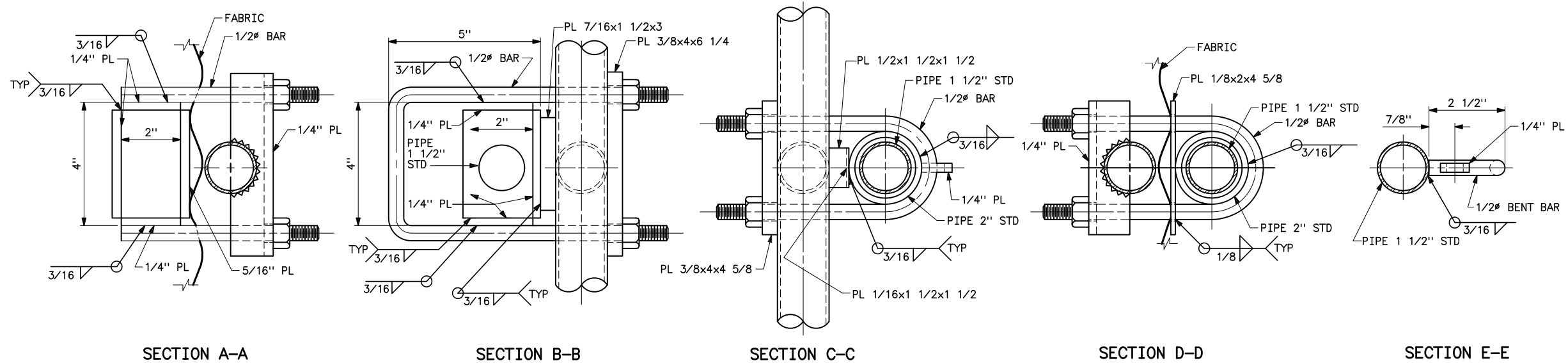
REFERENCE DRAWINGS

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 SWING GATES _____ 31 2038

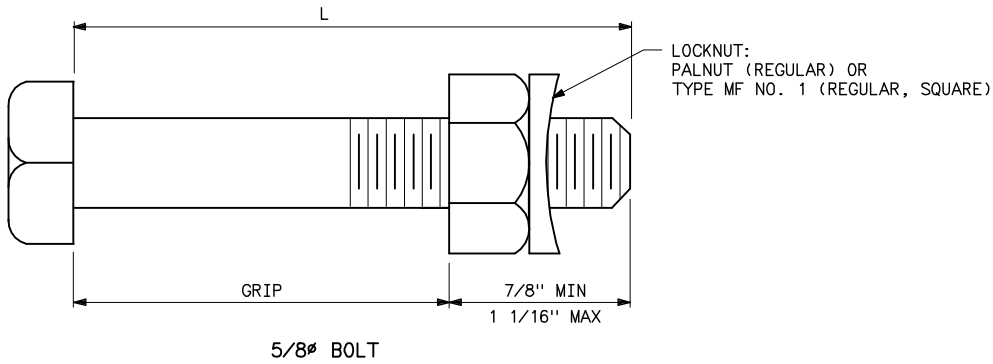


G	9/27/16 A7-JAS	GENERAL REVISIONS TO INCORPORATE OSEM WAPA ORDER 470.1H, 2016.
F	7-15-03 A7-DH	REVISED TITLE BLOCK ONLY.
E	2-28-91 A2-GB	DELETED TYP GATE EL ADDED DETAIL B & REF DWG
D	8-25-89 A2-GB	REDRAWN AND REVISED ON CAE
SUPERSEDES DWG NO. E40-D-6188		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS CHAIN-LINK FENCE GATE LATCHES		
DESIGNED J.G. HANSON _____ APPROVED D.A. COVINGTON _____ DIRECTOR, DIVISION OF CIVIL DESIGN		
A	APRIL 10, 1979	31 2001

Plotted By: Seela Sep 27, 2016 - 2:18pm
S:\projects\StandardDrawings\Drawings\DrawingsReadyForFinal\Scripts\31_2001g.dwg Last Saved By: Seela, Holly (CONTR) on 9/27/2016 2:03 PM

XREF(S):

Mar 22, 2006- 2:28pm Plotted By: Seela S:\Engineering\Standard Drawings\31\31_2002c.dwg Last Saved By: palmer IMAGES:

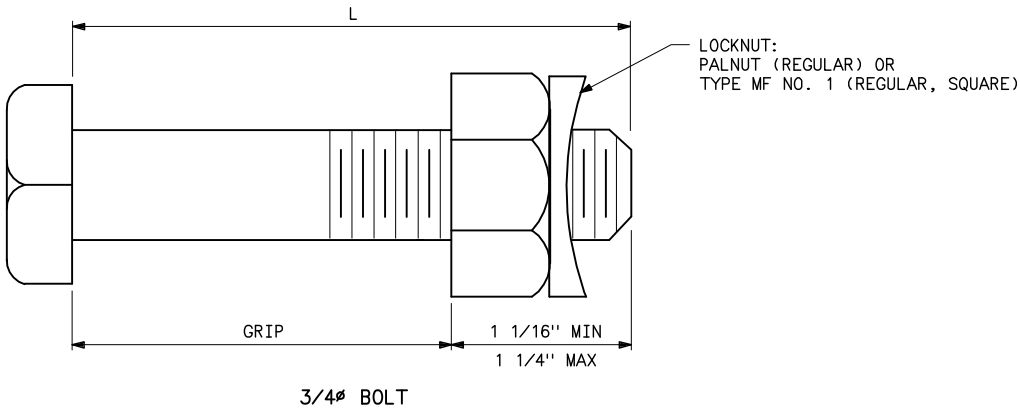


BOLT LENGTHS REQUIRED FOR VARIOUS GRIPS

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

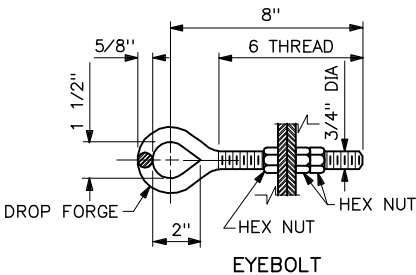
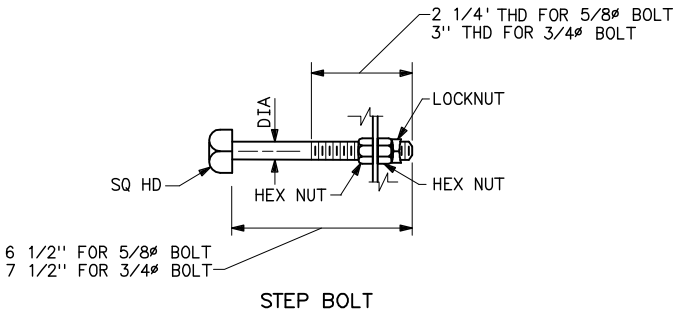
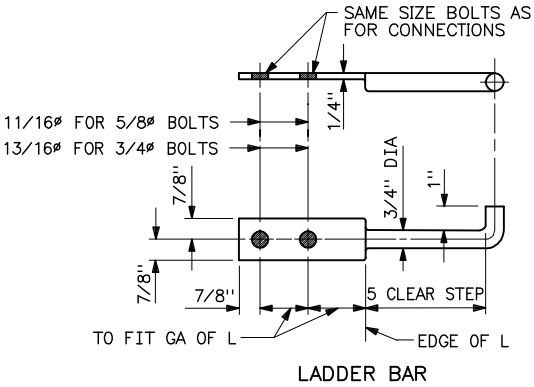
1. GRIP INCLUDES FILLS AND BEVEL WASHERS WHERE USED.



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"

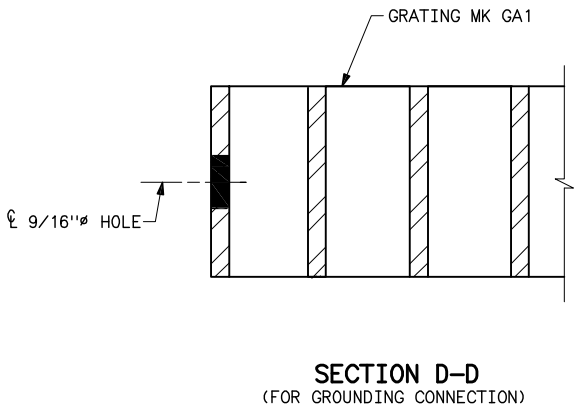
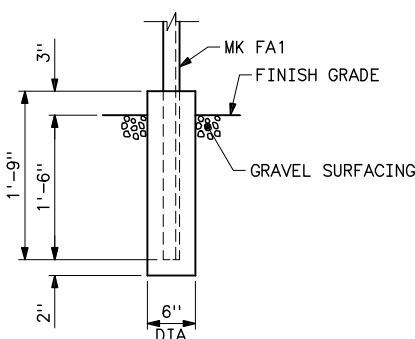
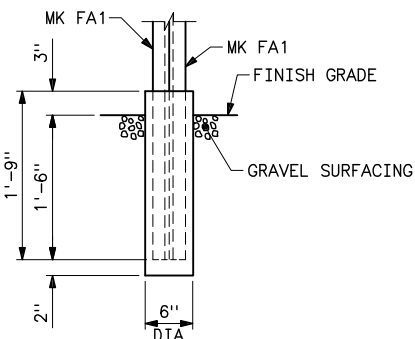
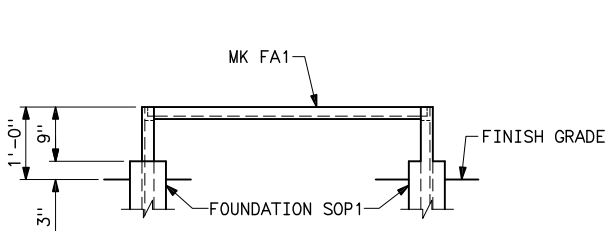
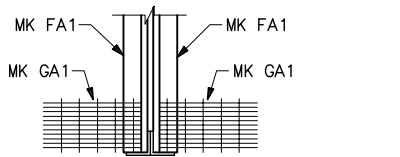
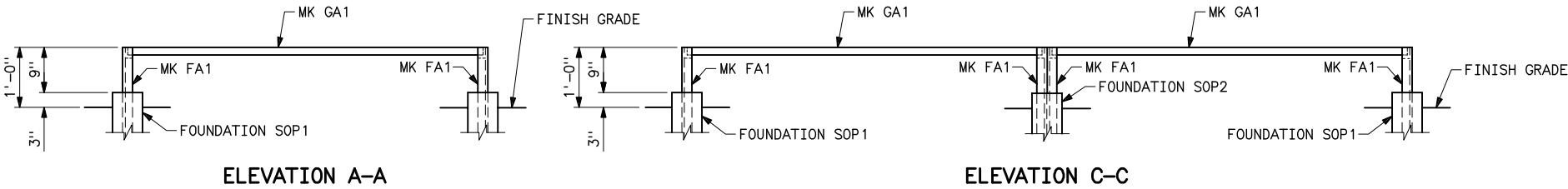
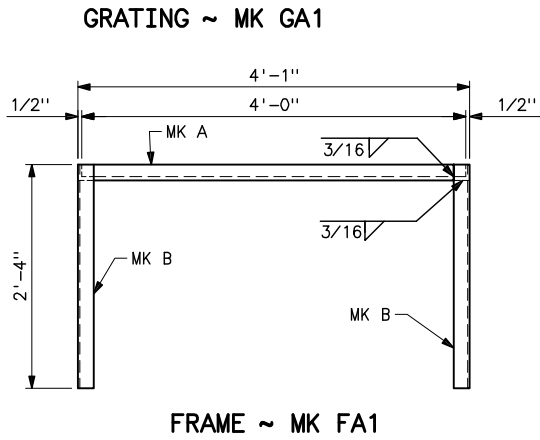
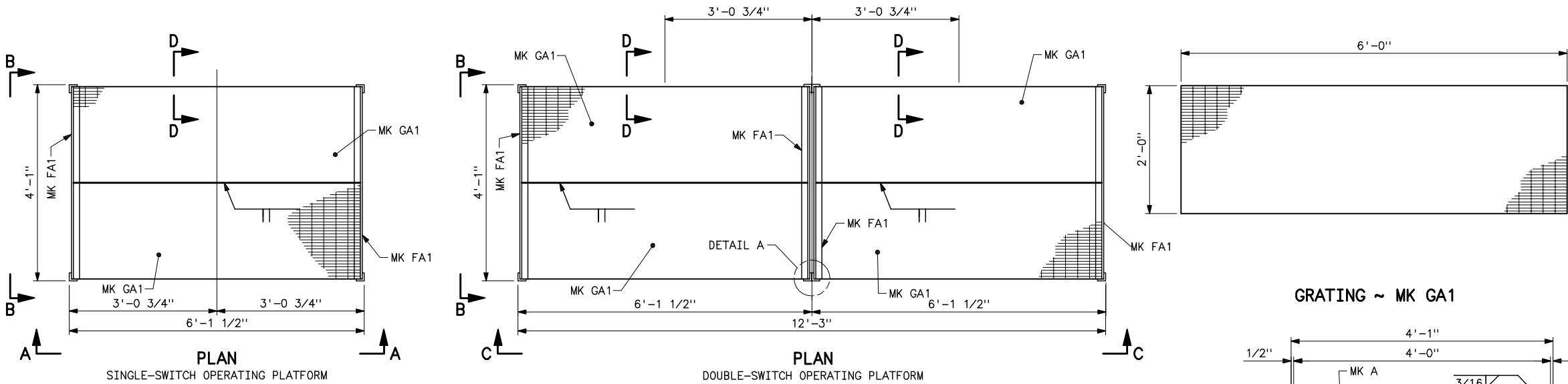
C	7-15-03 A7-DH	REVISED TITLE BLOCK ONLY.	
	8-28-89 A2-GB	REDRAWN AND REVISED ON CAE.	
SUPERSEDES DWG NO. E40-D-5665			
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO			
SUBSTATION STANDARDS 5/8 & 3/4 DIA CONNECTION BOLTS			
DESIGNED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



NOTE

1. ALL MATERIAL TO BE GALVANIZED.

D	9-12-12 A7-DH	MINOR REVISION.
C	7-15-03 A7-DH	REVISED TITLE BLOCK ONLY.
B	8-15-89 A2-	REDRAWN AND REVISED ON CAE
SUPERSEDES DWG NO. E40-D-5155		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS TYPICAL EYEBOLT AND STEP DETAILS		
DESIGNED _____ APPROVED _____ DIRECTOR, DIVISION OF SUBSTATION DESIGN		
A _F	APRIL 10, 1979	31 2003



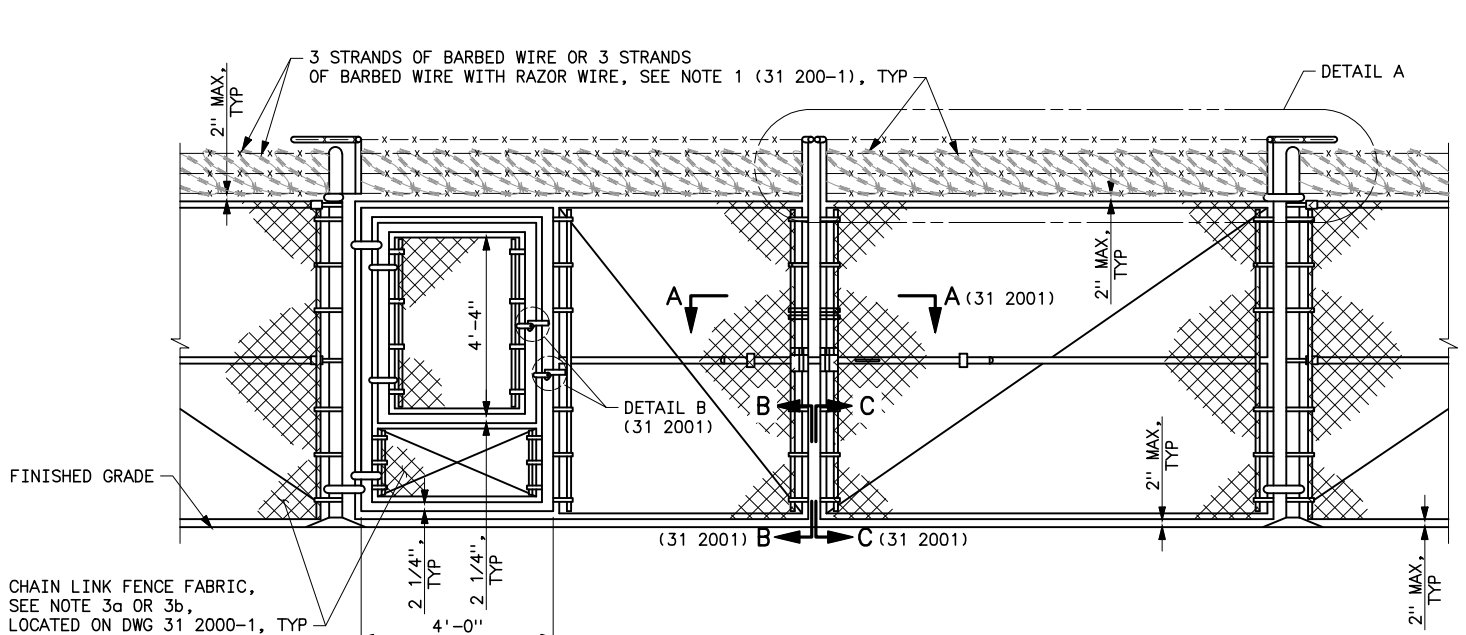
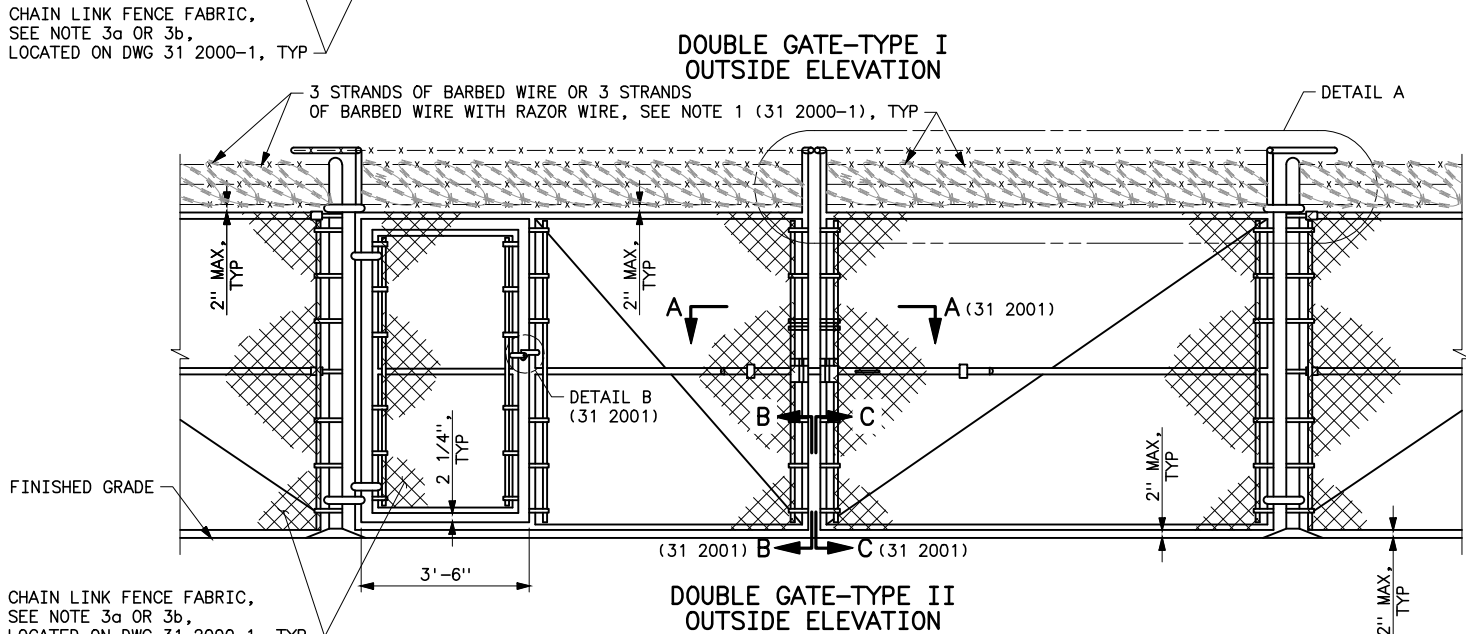
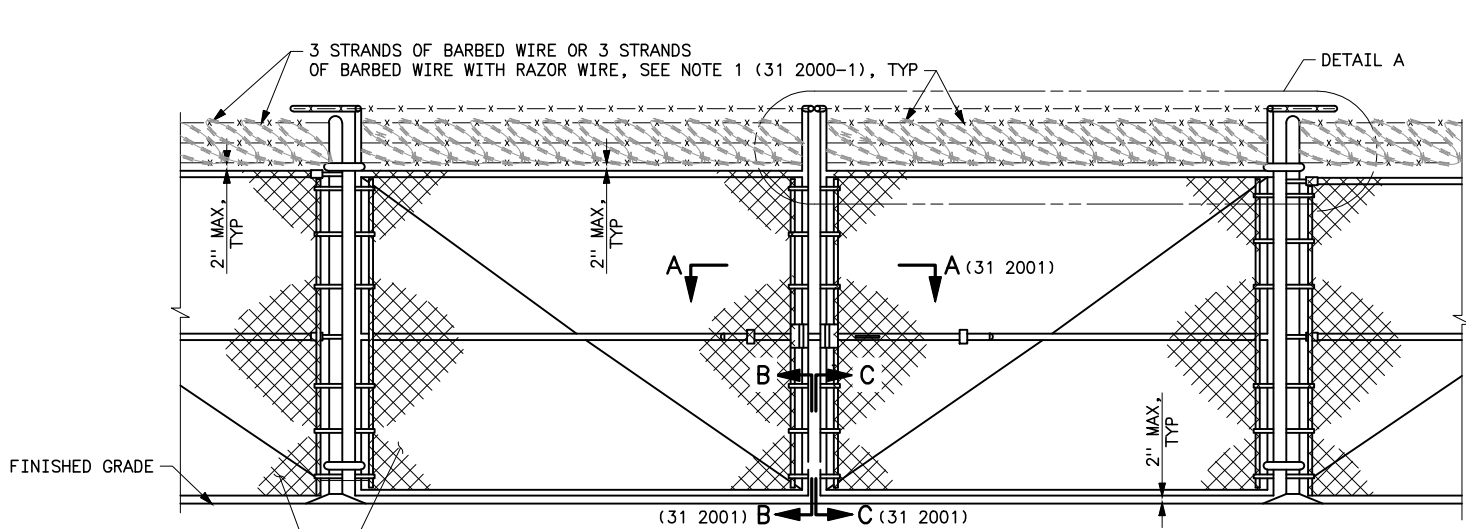
BILL OF MATERIAL				
MARK NO.	DESCRIPTION	LENGTH (FT-IN)	NO. REQUIRED	BLACK WT (LBS)
SINGLE-SWITCH OPERATING PLATFORM				
FA1	FRAME		2	---
A	L 1 3/4x1 3/4x1/4	4'-0"	2	22.2
B	L 1 3/4x1 3/4x1/4	2'-4"	4	25.8
GA1	SERRATED GRATING, 1 1/2x3/16 BARS, 1 3/16" C TO C, 2'-0" WIDE	6'-0"	2	259.2
TOTAL WEIGHT ONE 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.

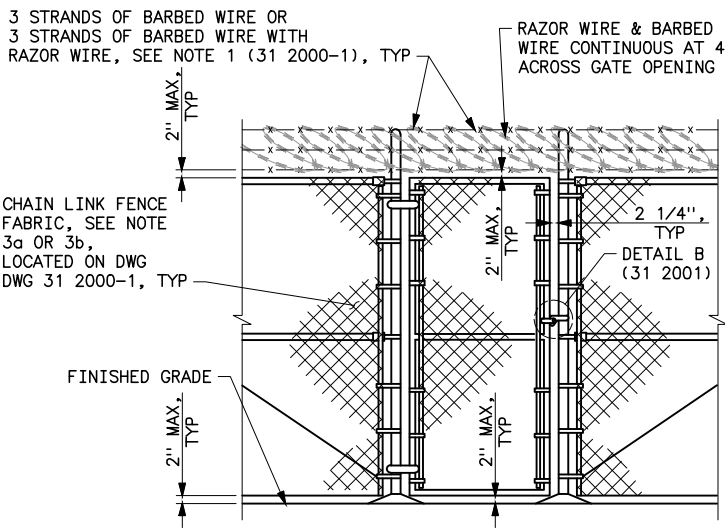
REFERENCE DRAWING

SWITCH OPERATING PLATFORMS-
ELECTRICAL DESIGN AND DETAILS _____ 31 1075

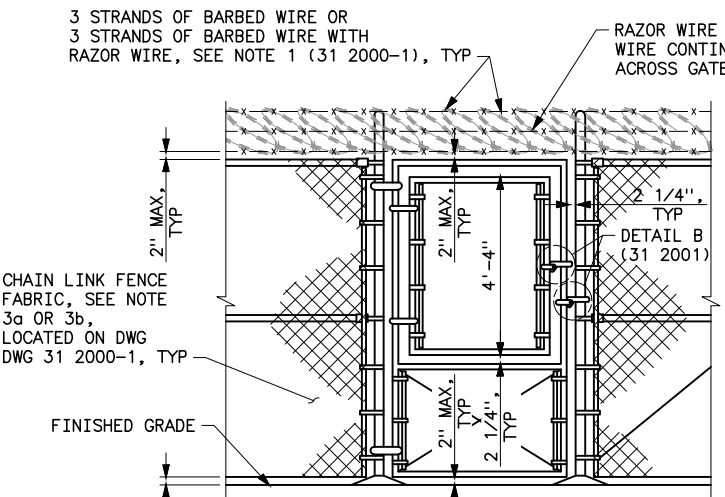
B	7-5-11 A7-DDD	MADE DRAWING A MODEL SPACE/PAPER SPACE DRAWING.
A	7-15-03 A7-DH	REVISED TITLE BLOCK ONLY.
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS SWITCH OPERATING PLATFORMS STEEL DESIGN AND DETAILS		
DESIGNED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



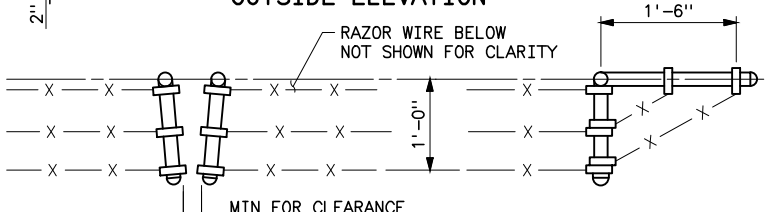
DOUBLE GATE-TYPE III OUTSIDE ELEVATION



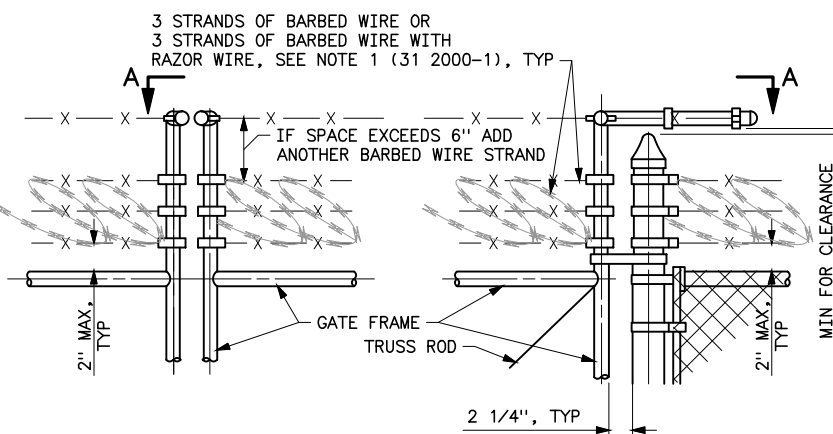
SINGLE GATE-TYPE I OUTSIDE ELEVATION



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.

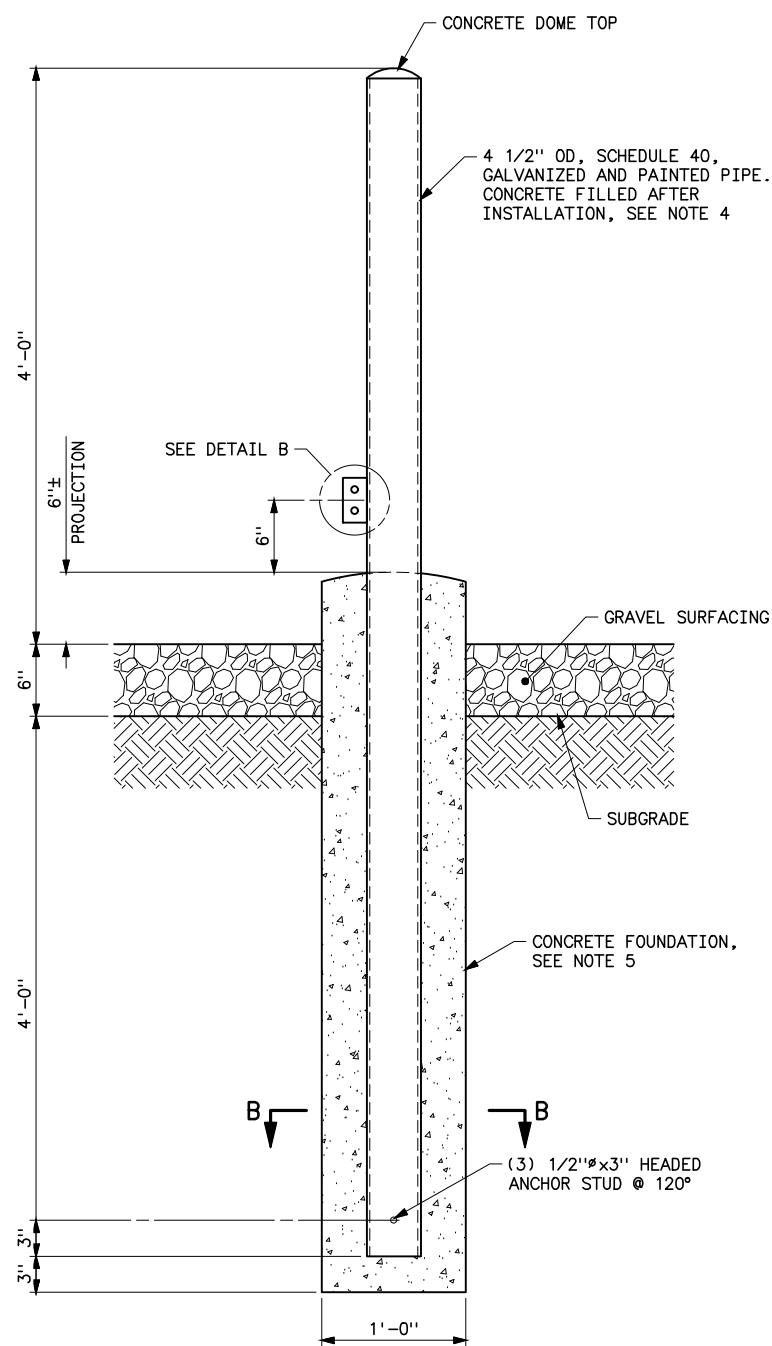
REFERENCE DRAWINGS

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

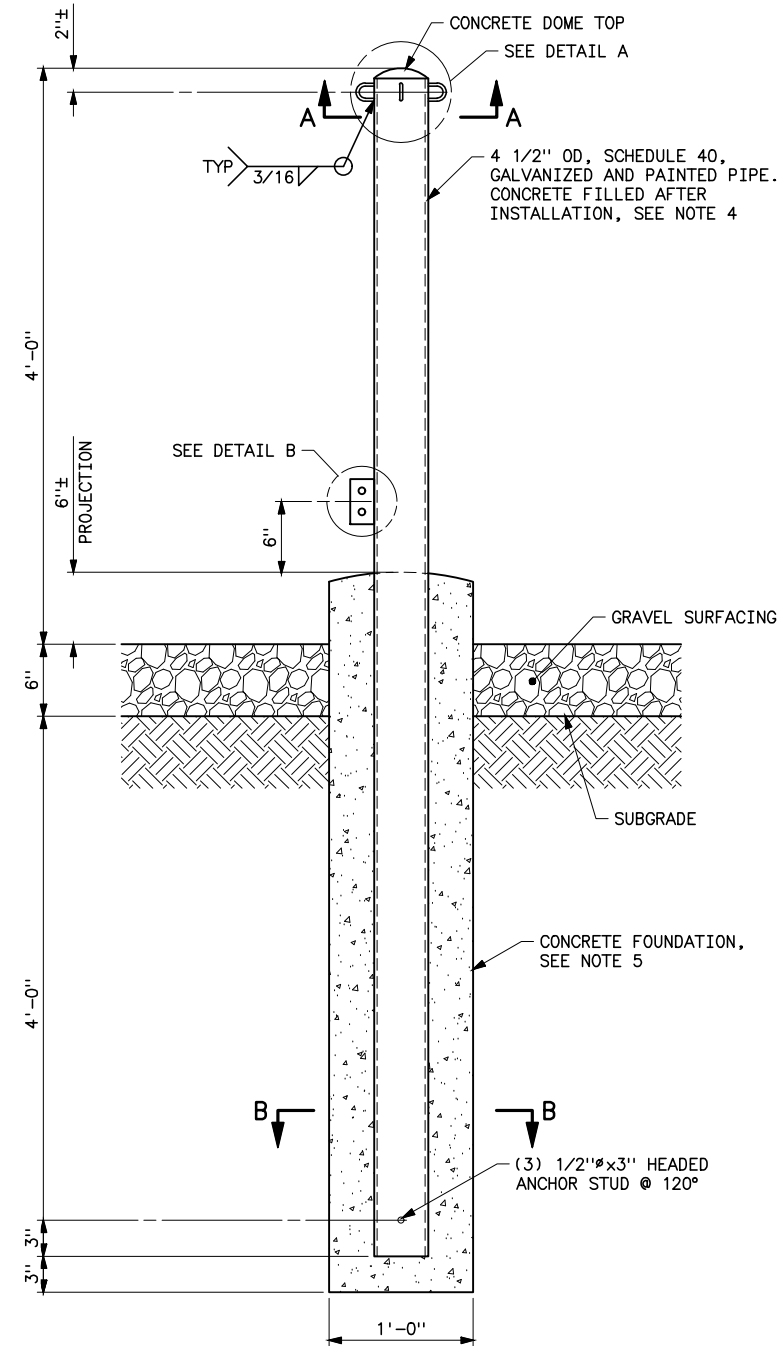
B	9-27-16 A7-JAS	GENERAL REVISIONS TO INCORPORATE OSEM WAPA ORDER 470.1H, 2016.
	7-15-03 A7-DH	REVISED TITLE BLOCK ONLY.
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS CHAIN-LINK FENCE SWING GATES		
DESIGNED ALONZO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

Plotted By: Seela Sep 27, 2016- 2:07pm
S:\projects\WAPA\StandardDrawings\Drawings\DesignReadyForFinal\Scripts\31_2038b.dwg Last Saved By: Seela, Holly (CONTR) on 9/27/2016 2:07 PM
IMAGES:

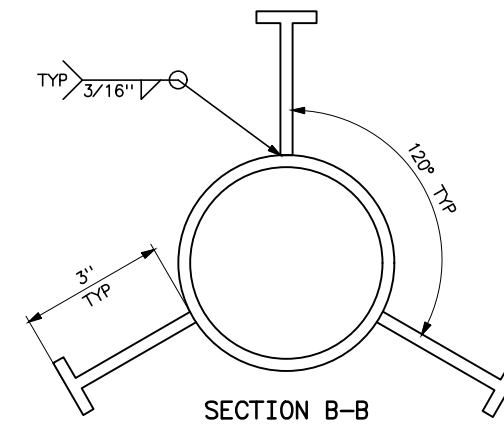
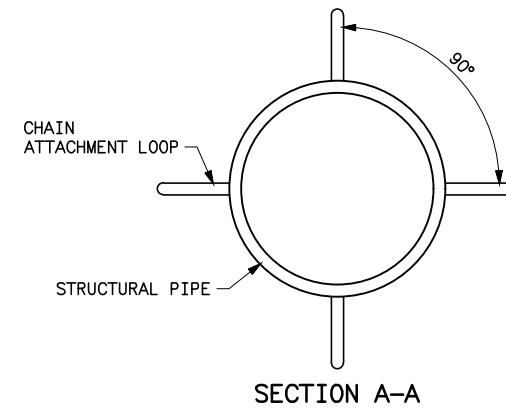
XREF (S):



DETAIL
WITHOUT CHAIN CONNECTIONS
TYPE I

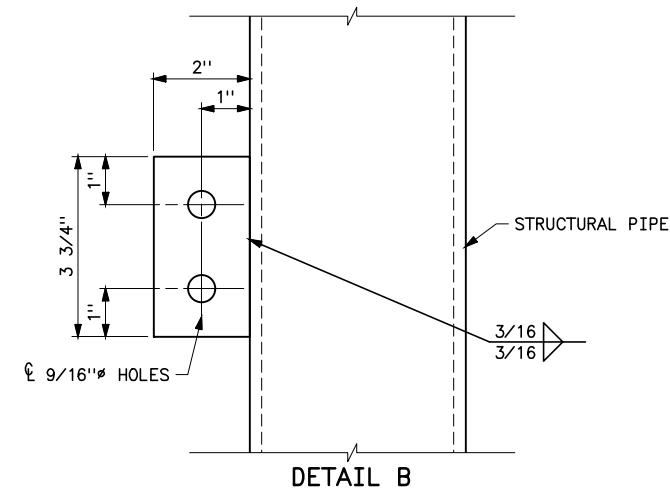
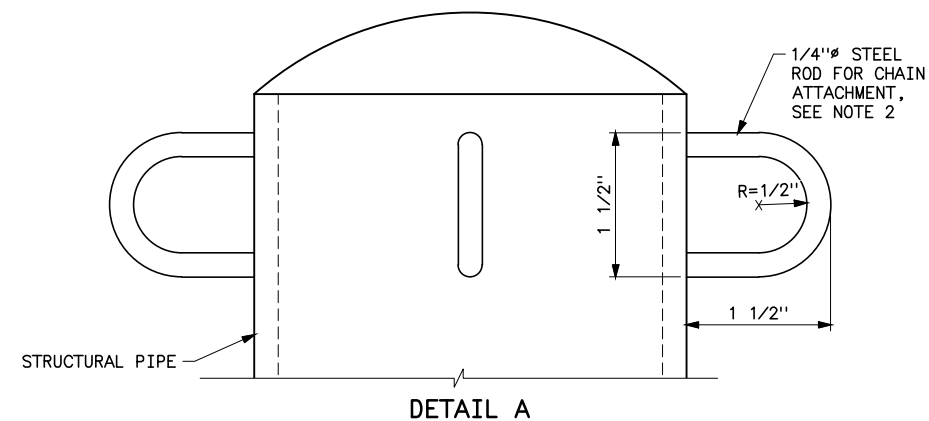


DETAIL
WITH CHAIN CONNECTIONS
TYPE II
(SEE NOTE 1)



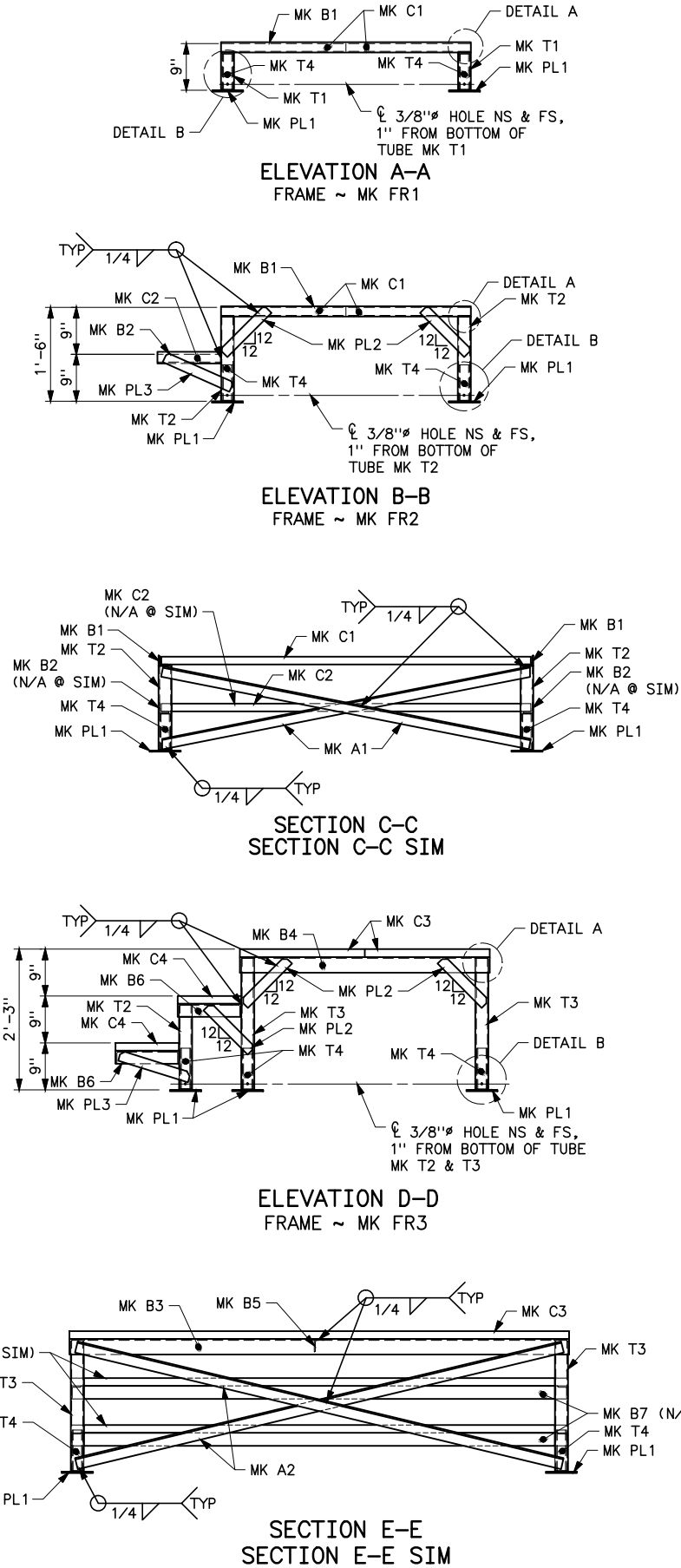
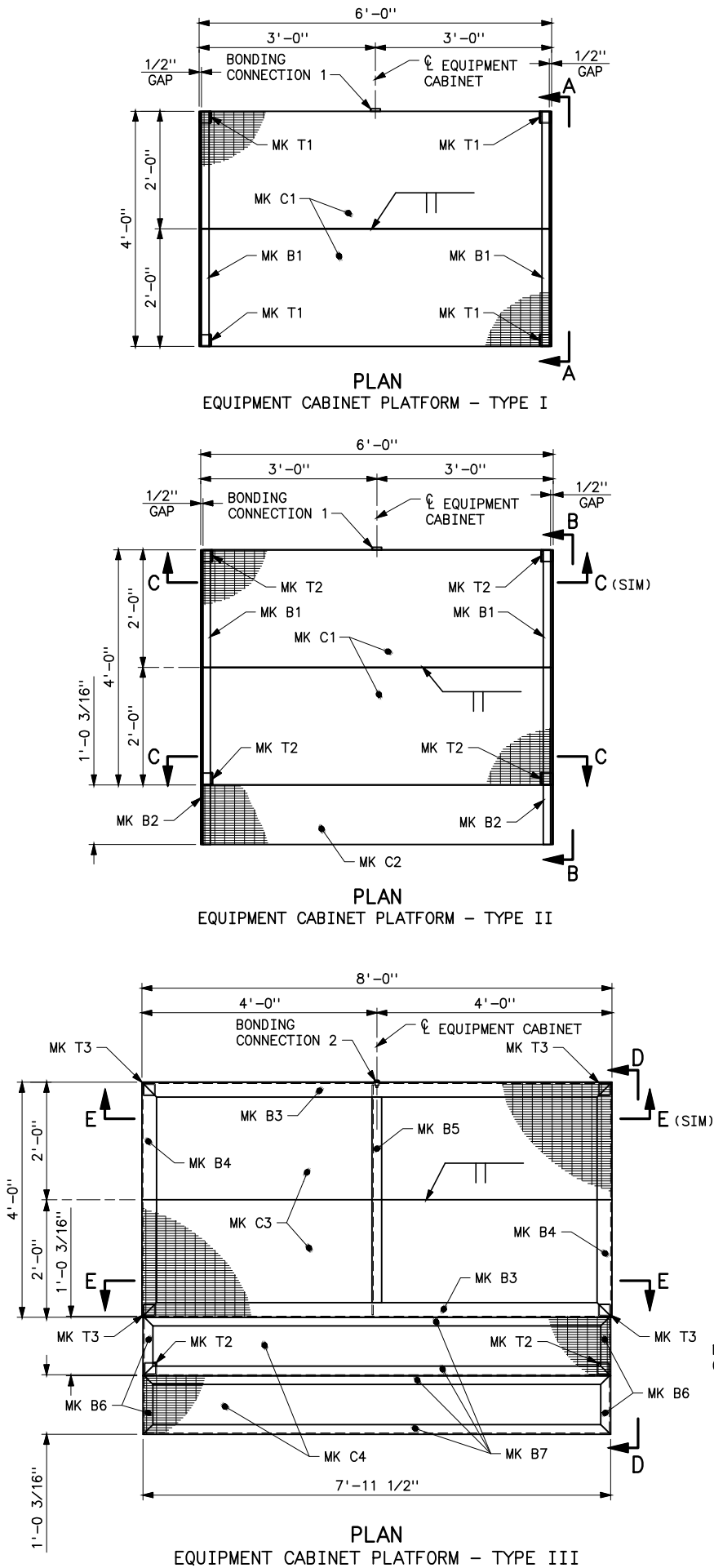
NOTES

1. CHAIN SHALL BE ASTM A413, GRADE 30, PROOF COIL 3/8"Ø LINK CHAIN COATED WITH A SAFETY YELLOW POLYURETHANE ELASTOMER COATING WITH REMOVABLE CLASPS AT EACH END SECTION.
2. STRUCTURAL STEEL SHALL BE ASTM A36, UNLESS OTHERWISE NOTED.
3. STRUCTURAL PIPE SHALL BE ASTM A500, GRADE B, UNLESS OTHERWISE NOTED.
4. PAINT SHALL BE COLOR OSHA SAFETY YELLOW.
5. CONCRETE SHALL HAVE A MINIMUM STRENGTH OF 3,000 PSI AT 28 DAYS.

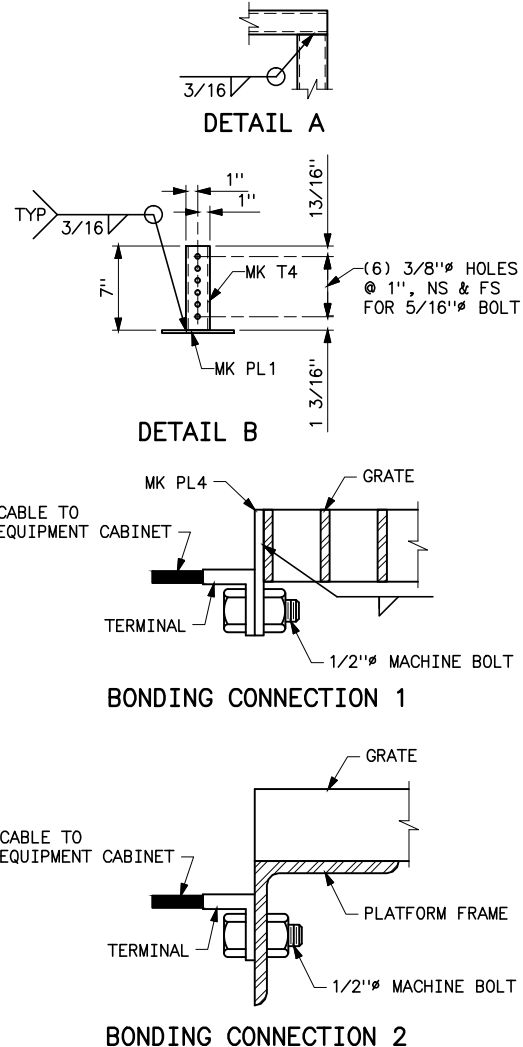


UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS BOLLARD DETAILS		
DESIGNED B. PERRY	APPROVED DOUG HANSON CIVIL ENGINEERING MANAGER	
DECEMBER 19, 2016	31	2043

Plotted By: See la, Sep 27, 2016- 2:08pm
S:\projects\Wisc\Standards\Drawings\DrawingsReadyForFinal\Scripts\31_2044f.dwg Last Saved By: See la, Holly (CONTR) on 9/27/2016 2:08 PM
IMAGES:



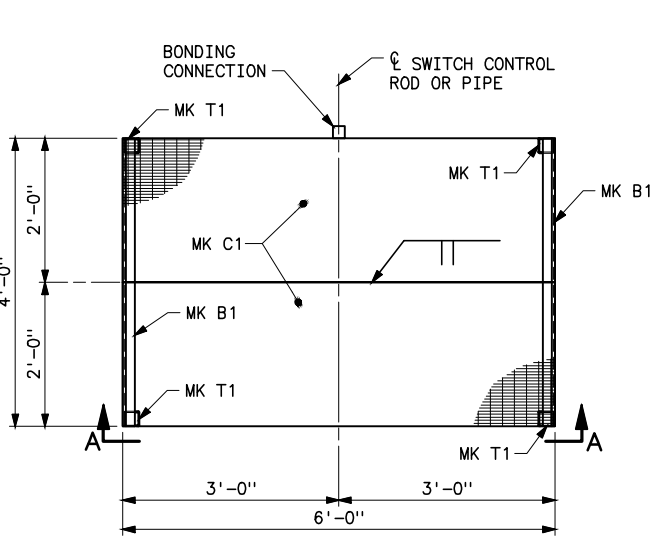
BILL OF MATERIAL			
EQUIPMENT CABINET PLATFORM - TYPE I			
MARK NO.	DESCRIPTION	LENGTH	NO. REQUIRED
FR1	FRAME		
T1	HSS 2 1/2x2 1/2x3/16	0'-7 1/8"	4
T4	HSS 2x2x1/4	0'-7"	4
B1	L 2x2x1/4	4'-0"	2
PL1	PL 6x6x1/4	-	4
PL4	PL 2x2 5/8x3/16	-	1
C1	SERRATED GRATING 1 1/2"x3/16" BARS, 1 3/16" C TO C, 2'-0" WIDE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



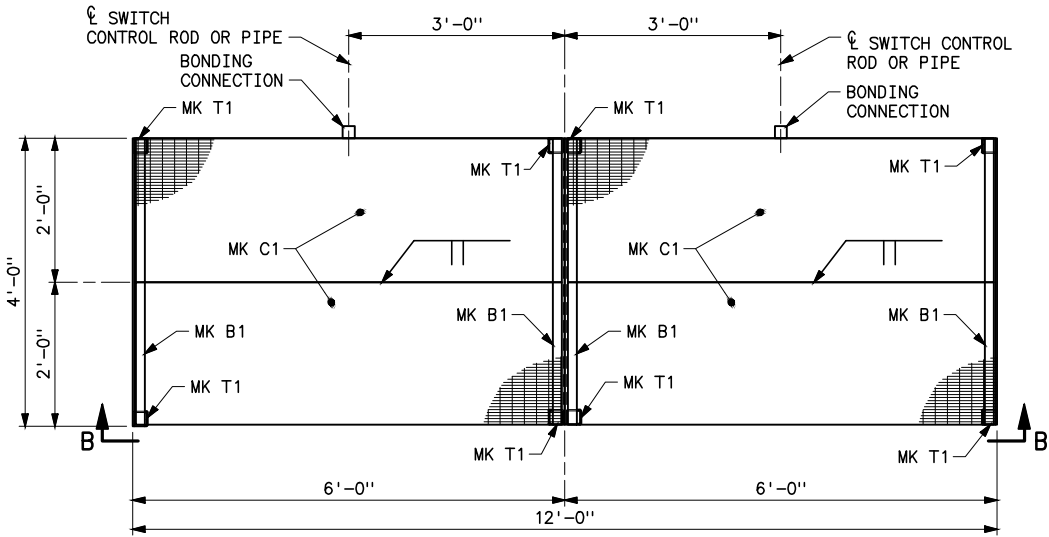
- NOTES
1. GALVANIZE MATERIAL AFTER FABRICATION.
 2. STRUCTURAL STEEL: ASTM A36.
 3. FABRICATED MATERIAL SHALL BE STRAIGHT, TRUE, AND FREE FROM TWISTS AND WARPS.
 4. WELD ARE TYPICAL FOR SIMILAR CONDITIONS.
 5. ATTACH GRATING TO FRAMES WITH STANDARD CLIPS.
 6. GRATING FOR STEPS SHALL BE WELDED TO FRAMES.
 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			

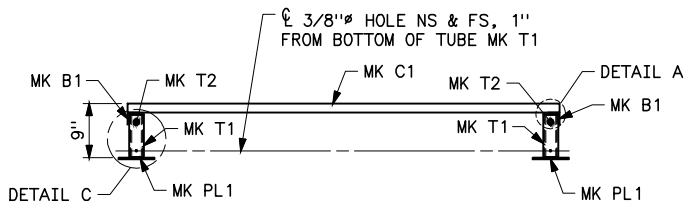
F	9-27-16 A7-JAS	CHANGED THE WORDING GROUNDING CONNECTION TO BONDING CONNECTION.
E	7-31-13 A7-JAS	MINOR CORRECTIONS & CLARIFICATIONS.
D	4-11-13 A7-JM	REVISED EQUIPMENT PLATFORM TYPE III.
C	9-12-12 A7-JM	REVISED AND REDRAWN.
B	2-16-11 A3-CTG	REVISED MARK F1. GROUNDING DETAIL AND WEIGHT IN TABLE.
SUPERSEDES DWG NO. 61 2950		
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		
A	APRIL 28, 2003	31 2044



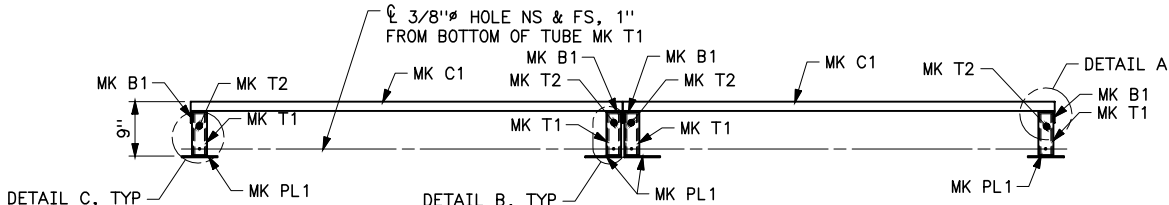
PLAN
SINGLE PLATFORM – TYPE I



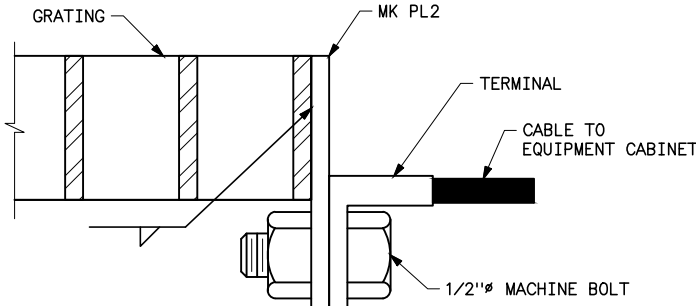
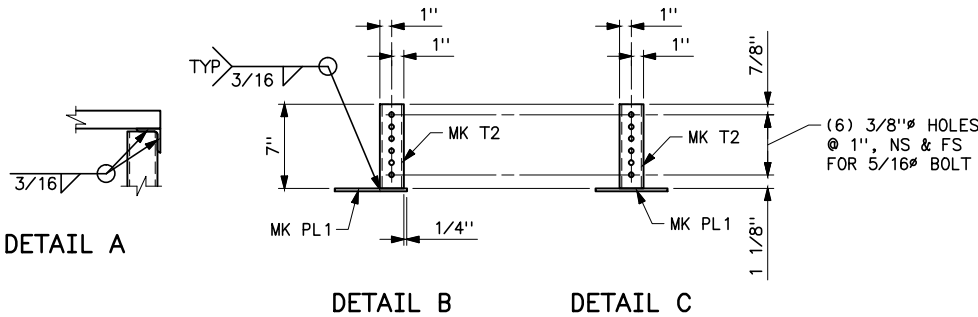
PLAN
DOUBLE PLATFORM – TYPE II



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

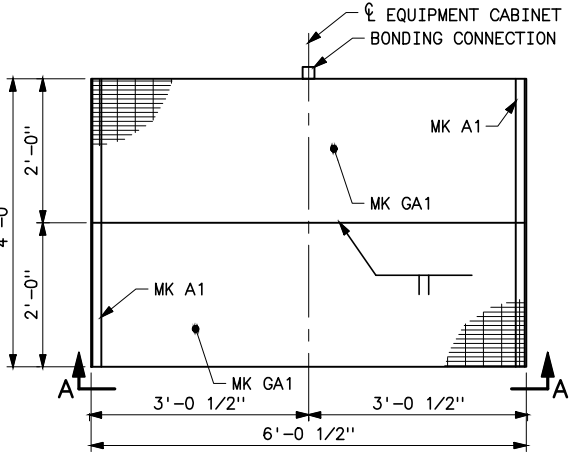
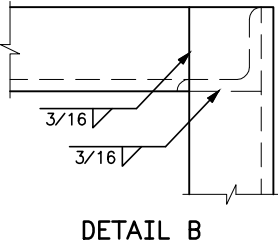
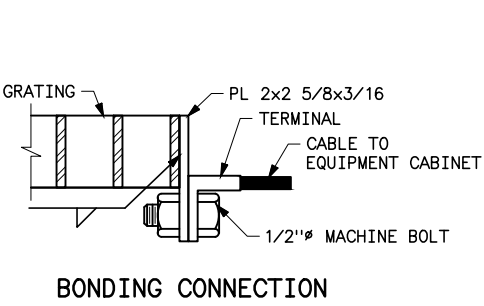
BILL OF MATERIAL

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

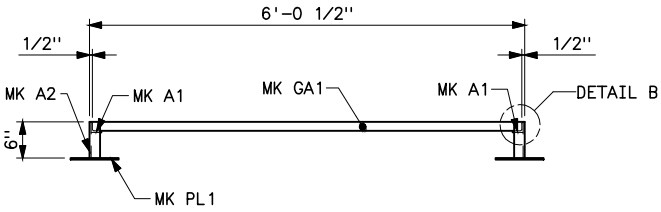
NOTES

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



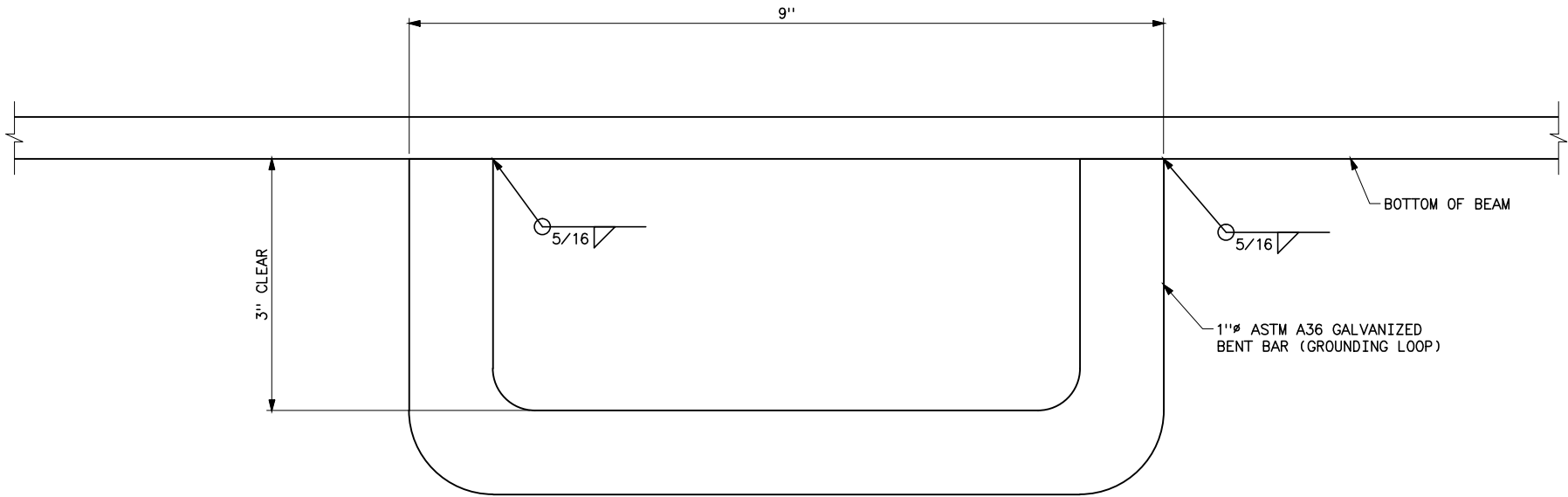
PLAN
SINGLE SWITCH OPERATING PLATFORM - TYPE IV



ELEVATION A-A
FRAME ~ MK FA2

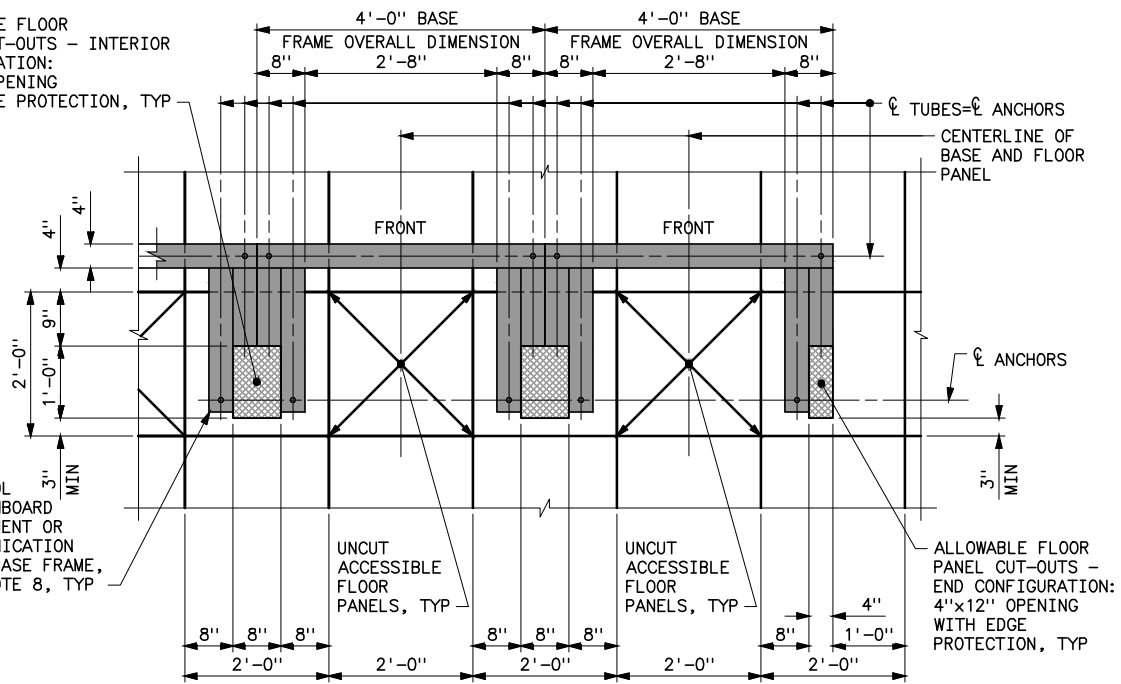
NOTES

- 1. INSTALL GROUNDING LOOPS FOR EACH PHASE ON THE BOTTOM OF THE BEAM.
- 2. FOR EXISTING STRUCTURES, REMOVE GALVANIZING AND PAINT ON THE BEAM AND GROUNDING LOOP BEFORE WELDING. REPAIR THE GALVANIZING AND DAMAGED AREAS WITH A 3 MIL MINIMUM THICKNESS IN ACCORDANCE WITH ASTM A780.



ELEVATION

UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS GROUNDING LOOP		
DESIGNED TERRY BURLEY _____ APPROVED DOUG HANSON CIVIL ENGINEERING MANAGER _____		
CAE	FEBRUARY 13, 2006	31 2047



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



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

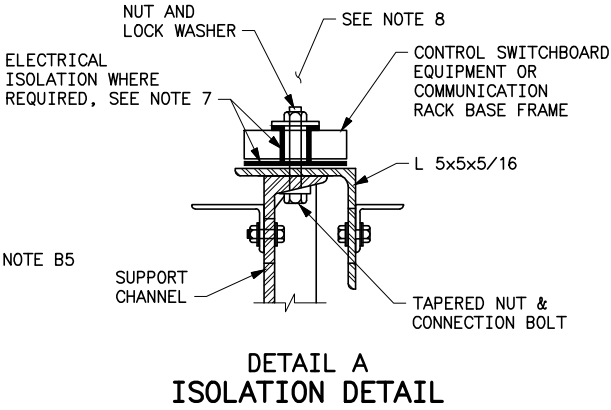
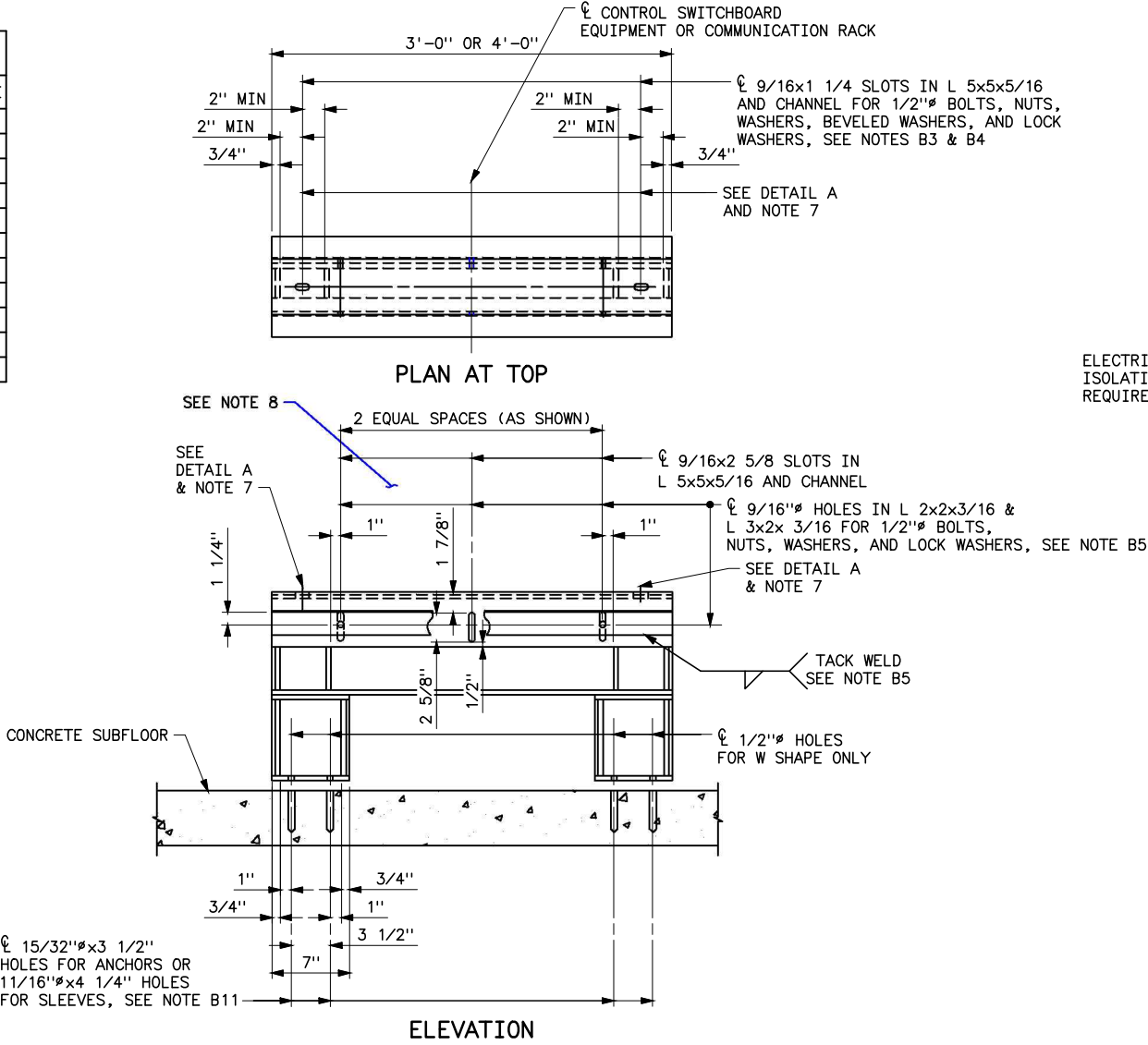


1. BASE ANCHORAGE DETAILS SHOWN ON THIS SHEET ARE MINIMUM REQUIREMENTS APPLICABLE FOR ALL IBC SEISMIC DESIGN CATEGORIES (SDC), ALL IEEE 693 SEISMIC QUALIFICATION LEVELS (SQL), AND ALL NON-SPECIFIED LOCATIONS.
2. FOR CONTROL SWITCHBOARD EQUIPMENT OR COMMUNICATION RACK LOCATIONS, SEE ARCHITECTURAL FLOOR 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; 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.

- 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"Ø ROD.
- A3. ANCHOR OPTIONS:
 - A. HILTI (OR EQUAL) HIT-RE 500-SD EPOXY ANCHORING SYSTEM: 1/2"Ø 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"Ø WITH 3 1/4" MIN EMBEDMENT INTO CONCRETE SLAB.

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 <u>J. SCHREIBER</u> _____ APPROVED <u>D. HANSON</u> _____ CIVIL ENGINEERING MANAGER		
C.A.F.	OCTOBER 13, 2016	31 2049-

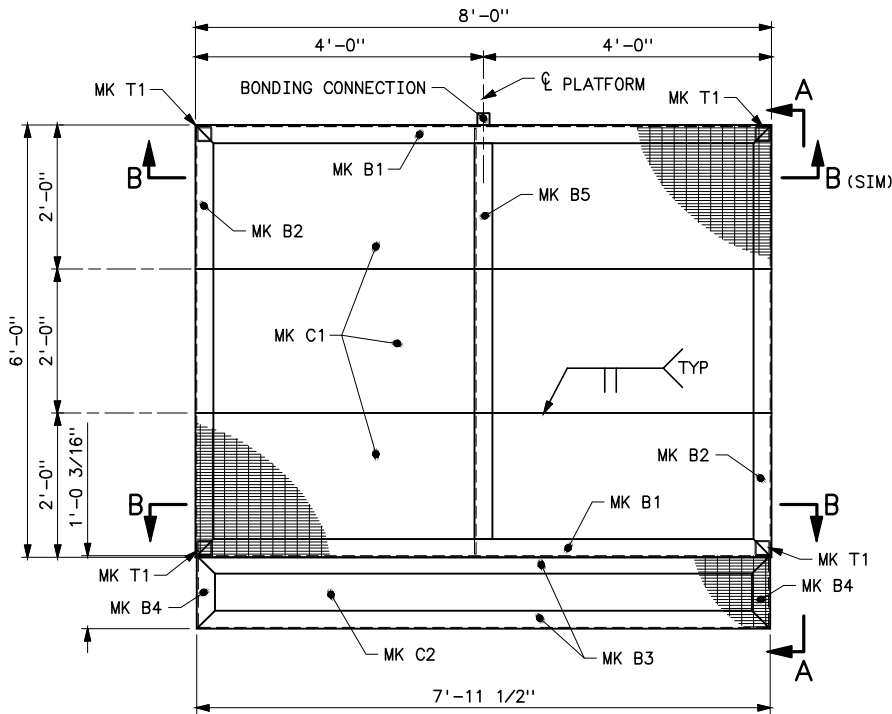
OPTION B: W SHAPE & CHANNEL COMBINATIONS						
ACCESS FLOOR HEIGHT (IN)	W SHAPE	CHANNEL	TOTAL BASE HEIGHT (IN)		ESTIMATED WEIGHT (LBS)	
			MIN	MAX	4-FT BASE	3-FT BASE
12	W 4x13	MC 7x19.1	12.0	12.6	175	140
15	W 5x19	C 9x20	15.0	15.6	180	145
16	W 6x20	C 9x20	16.0	16.6	185	150
17	W 6x20	C 10x20	17.0	17.6	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



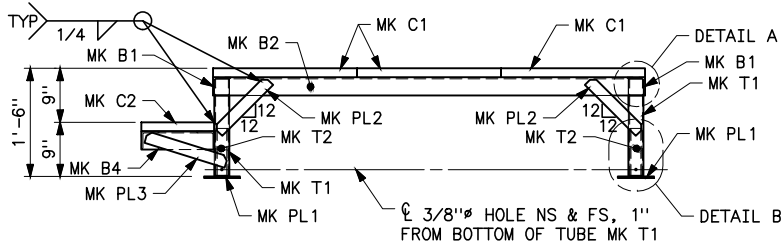
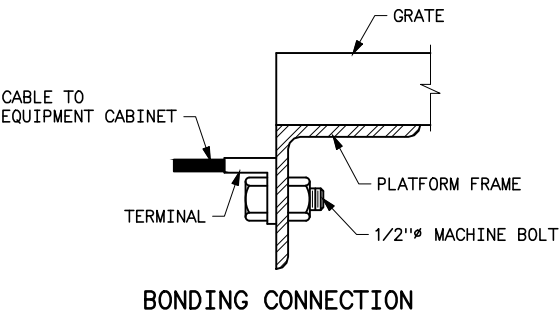
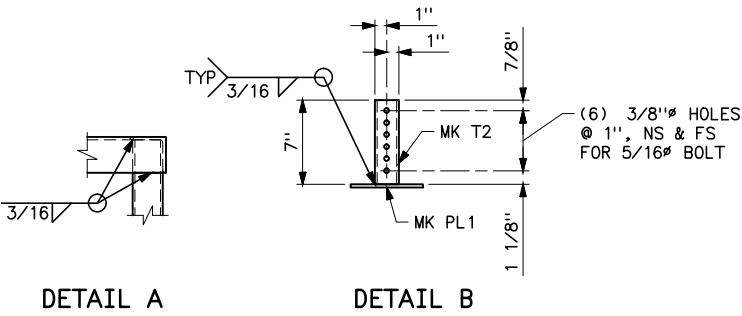
- GENERAL NOTES**
- BASE ANCHORAGE DETAILS SHOWN ON THIS SHEET ARE MINIMUM REQUIREMENTS APPLICABLE FOR ALL IBC SEISMIC DESIGN CATEGORIES (SDC), ALL IEEE 693 SEISMIC QUALIFICATION LEVELS (SQL), AND ALL NON-SPECIFIED LOCATIONS.
 - FOR CONTROL SWITCHBOARD EQUIPMENT OR COMMUNICATION RACK LOCATIONS, SEE ARCHITECTURAL FLOOR PLAN AND BUILDING ARRANGEMENT, CONDUIT & GROUNDING DRAWING.
 - REFER TO SPECIFICATIONS FOR IEEE 693 SEISMIC QUALIFICATION LEVEL (SQL) AND/OR BUILDING GENERAL STRUCTURAL NOTES (GSN) FOR IBC SEISMIC DESIGN CATEGORY (SDC).
 - 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.
 - 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).
 - FOR APPROVAL PRIOR TO INSTALLATION, SUBMIT SEISMIC OUTLINE DRAWING (PER IEEE 693) AND SHOP DETAIL DRAWINGS OF BASE SHOWING COMPONENTS AND ANCHOR LOCATIONS.
 - REFER TO 53 7051, ELECTRICAL STANDARDS & SPECIFICATIONS FOR EQUIPMENT REQUIRING ELECTRICAL ISOLATION BETWEEN ANCHOR & BASE.
 - CONTROL SWITCHBOARD EQUIPMENT OR COMMUNICATIONS RACK SIDEWALL FRAMES NOT SHOWN FOR CLARITY.
 - COORDINATE W/ARCHITECTURAL FLOOR PLAN REGARDING FLOOR PANEL LAYOUT.

- OPTION B NOTES**
- VERIFY ACCESS FLOOR HEIGHT WITH COR PRIOR TO FABRICATION.
 - INSTALL STEEL BASES UNDER FRONT AND REAR BASE FRAMES OF EACH NEW AND RELOCATED CONTROL SWITCHBOARD EQUIPMENT OR COMMUNICATION RACK.
 - 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.
 - 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.
 - LEVEL ACCESS FLOOR WITH ADJUSTABLE L 2x2x3/16 & L 3x2x3/16 (LLH). TACK WELD AFTER LEVELING. STRUCTURAL STEEL: ASTM A36 OR EQUAL.
 - BOLTS: ASTM A325 OR EQUAL.
 - NUTS: ASTM A536, GRADE D OR EQUAL.
 - WASHERS: ASTM F436 OR EQUAL.
 - WELDING SHALL BE PERFORMED IN ACCORDANCE WITH THE LATEST EDITION OF ANSI/AWS D1.1, "STRUCTURAL WELDING CODE".
 - 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.
 - ORIGINAL DESIGN PREPARED BY B. HAGLER, JUNE 1993. (SHOWN THIS SHEET).

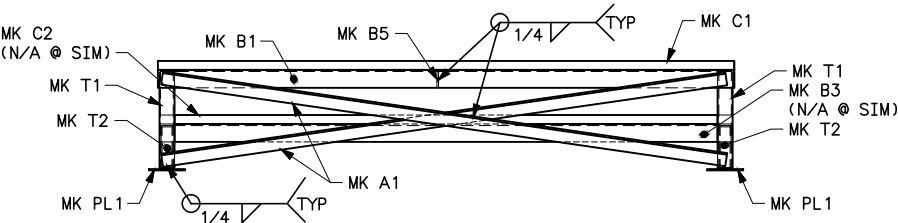
A	3-23-18 A7-JAS	CLARIFICATIONS AND NOTE REVISIONS.	
	SUPERSEDES DWG NO. 31_2049A (IN PART)		
	UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
	SUBSTATION STANDARDS CONTROL SWITCHBOARD EQUIPMENT & COMMUNICATION RACK BASE ANCHORAGE DETAILS (SHEET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



PLAN
TRANSFORMER PLATFORM - TYPE I



ELEVATION A-A
FRAME ~ MK FR1



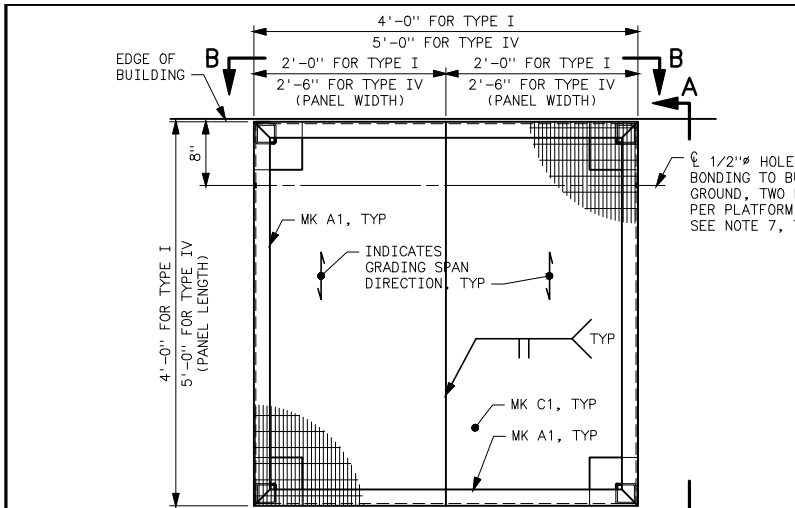
SECTION B-B
SECTION B-B SIM

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"x3 1/2" BOLT	-	4
APPROXIMATE TOTAL WEIGHT ONE PLATFORM - 1015			

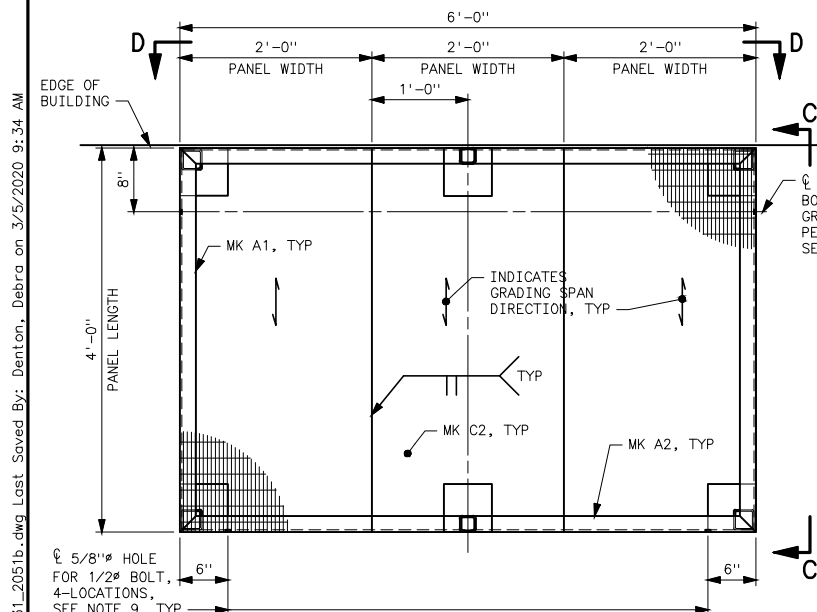
- NOTES
1. GALVANIZE MATERIAL AFTER FABRICATION.
 2. STRUCTURAL STEEL: ASTM A36.
 3. FABRICATED MATERIAL SHALL BE STRAIGHT, TRUE, AND FREE FROM TWISTS AND WARPS.
 4. WELD ARE TYPICAL FOR SIMILAR CONDITIONS.
 5. ATTACH GRATING TO FRAMES WITH STANDARD CLIPS.
 6. GRATING FOR STEPS SHALL BE WELDED TO FRAMES.
 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

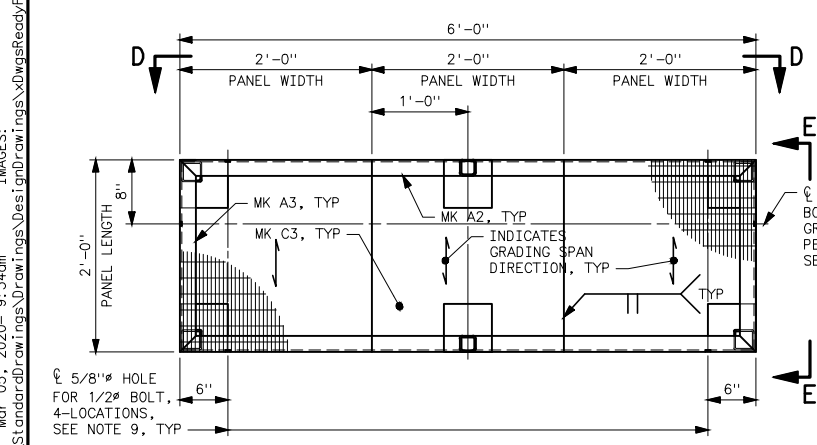
Plotted By: denton Mar 05, 2020 - 9:34am S:\projects\Wisc\StandardDrawings\Drawings\DesignReadyForFinal\Scripts\31_2051b.dwg Last Saved By: Denton, Debra on 3/5/2020 9:34 AM IMAGES:



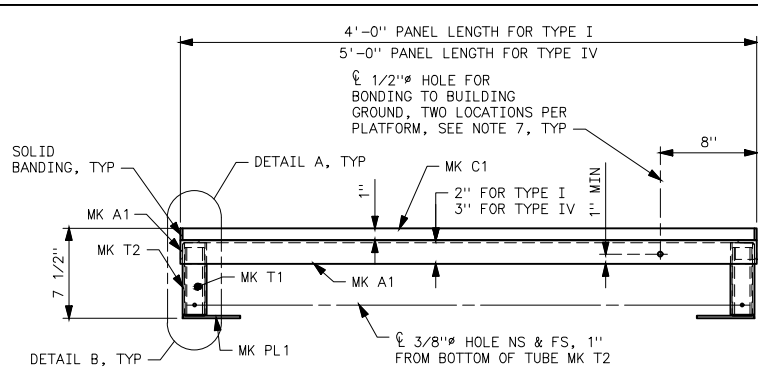
PLAN
BUILDING ENTRANCE PLATFORM - TYPES I & IV
FRAME ~ MK FR1 FOR TYPE I & MK FR4 FOR TYPE IV



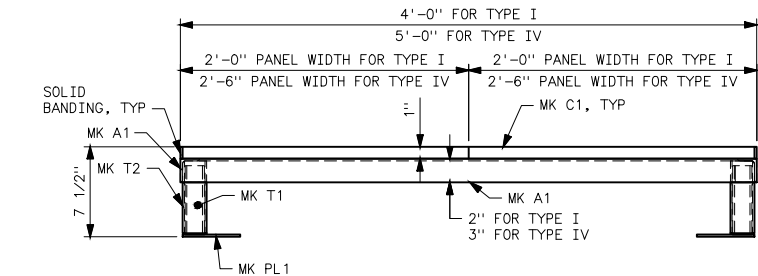
PLAN
BUILDING ENTRANCE PLATFORM - TYPE II
FRAME ~ MK FR2



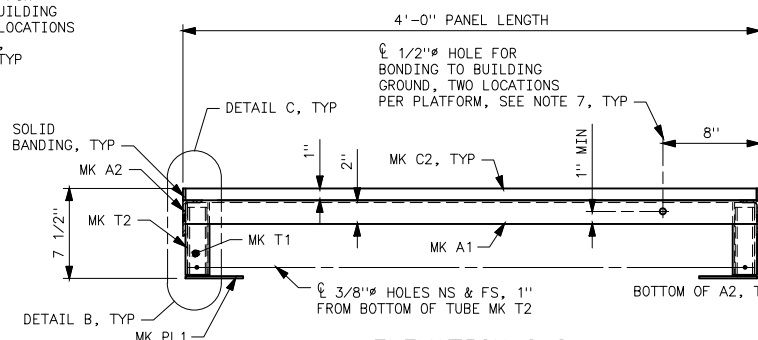
PLAN
BUILDING ENTRANCE PLATFORM - TYPE III
FRAME ~ MK FR3



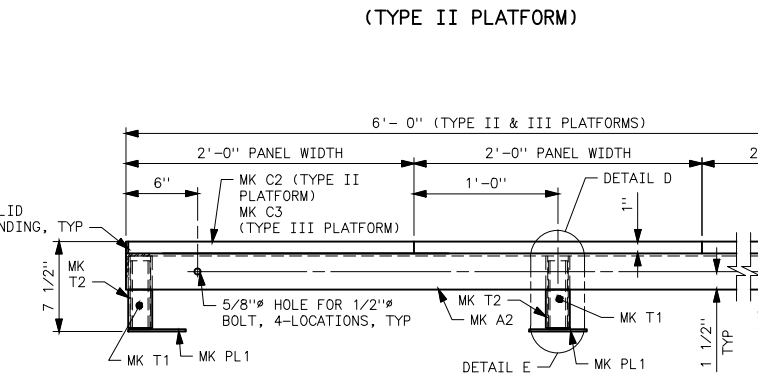
ELEVATION A-A
TYPE I (4'-0") & TYPE IV (5'-0") PLATFORM



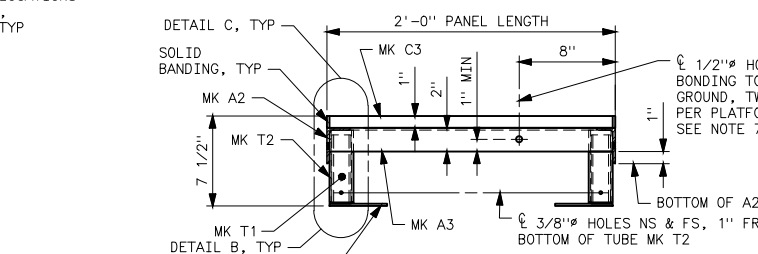
ELEVATION B-B
TYPE I (4'-0") & TYPE IV (5'-0") PLATFORM



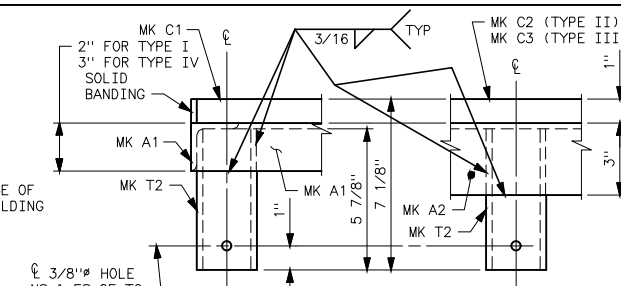
ELEVATION C-C
(TYPE II PLATFORM)



ELEVATION D-D
(TYPE II AND III PLATFORMS)

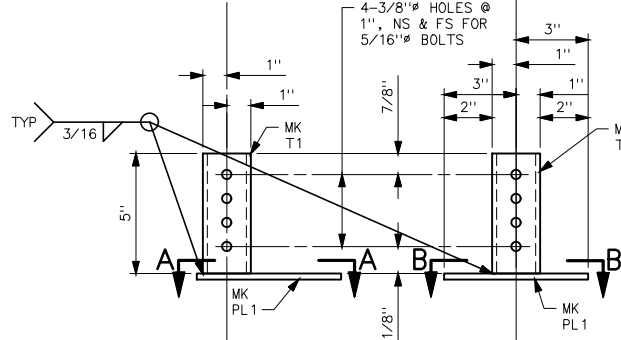


ELEVATION E-E
(TYPE III PLATFORM)



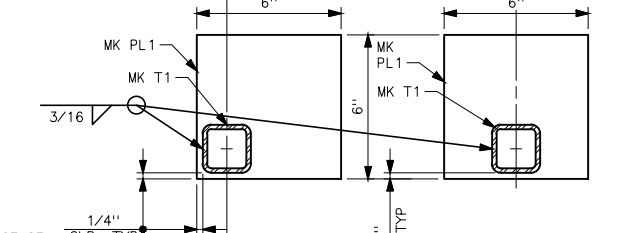
DETAIL A

DETAIL D



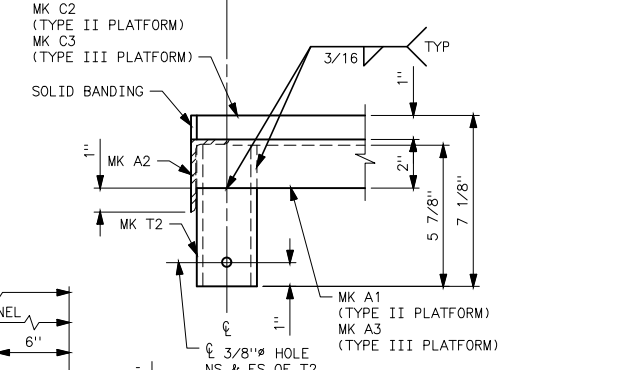
DETAIL B

DETAIL E



SECTION A-A
PLAN

SECTION B-B
PLAN



DETAIL C

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" THRU-BOLTS AT HOLES PROVIDED IN 3" LEG OF L 3x2x1/4.

BILL OF MATERIAL				
PLATFORM – TYPE I				
MARK NO.		DESCRIPTION	LENGTH	NO. REQUIRED
FR1		FRAME		1
	T1	HSS 2x2x3/16	0'-5"	4
	T2	HSS 2 1/2x2 1/2x3/16	0'-5 7/8"	4
	A1	L 2x2x1/4	4'-0"	4
	PL1	PL 1/4x6x6	–	4
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"	2
	5/16"#x3 1/2" BOLT		–	4
APPROXIMATE TOTAL WEIGHT ONE PLATFORM – 170 LB				
PLATFORM – TYPE II				
MARK NO.		DESCRIPTION	LENGTH	NO. REQUIRED
FR2		FRAME		1
	T1	HSS 2x2x3/16	0'-5"	6
	T2	HSS 2 1/2x2 1/2x3/16	0'-5 7/8"	6
	A1	L 2x2x1/4	4'-0"	2
	A2	L 3x2x1/4 (LLV)	6'-0"	2
	PL1	PL 1/4x6x6	–	6
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"	3
	5/16"#x3 1/2" BOLT		–	6
APPROXIMATE TOTAL WEIGHT ONE PLATFORM – 250 LB				
PLATFORM – TYPE III				
MARK NO.		DESCRIPTION	LENGTH	NO. REQUIRED
FR3		FRAME		1
	T1	HSS 2x2x3/16	0'-5"	6
	T2	HSS 2 1/2x2 1/2x3/16	0'-5 7/8"	6
	A2	L 3x2x1/4 (LLV)	6'-0"	2
	A3	L 2x2x1/4	2'-0"	2
	PL1	PL 1/4x6x6	–	6
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"	3
	5/16"#x3 1/2" BOLT		–	6
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"# CONNECTION BOLTS W/LOCKNUTS & WASHERS			2	
APPROX TOTAL WEIGHT ONE TYPE II & III PLATFORM – 420 LB				
PLATFORM – TYPE IV				
MARK NO.		DESCRIPTION	LENGTH	NO. REQUIRED
FR4		FRAME		1
	T1	HSS 2x2x3/16	0'-5"	4
	T2	HSS 2 1/2x2 1/2x3/16	0'-5 7/8"	4
	A1	L 3x2x1/4	5'-0"	4
	PL1	PL 1/4x6x6	–	4
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"	2
	5/16"#x3 1/2" BOLT		–	4
APPROXIMATE TOTAL WEIGHT ONE PLATFORM – 250 LB				

B	3-5-20 A7-JAS	ADDED TYPE IV (5'-0") PLATFORM AND LEGS TO 6'-0" PLATFORMS.
A	4-7-17 A7-JAS	GRATING & PLATFORM REVISIONS; ADDED PROVISIONS FOR INCLUDING TYPE II COMBINED W/NEW TYPE III.
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS SERVICE BUILDING STRUCTURAL BUILDING ENTRY PLATFORMS		
DESIGNED J.A. SCHREIBER APPROVED DOUG HANSON CIVIL ENGINEERING MANAGER		
SEPTEMBER 27, 2016	31	2051



NOTE 5

NOTE 4

BOLLARDS, NOTE 10, TYP

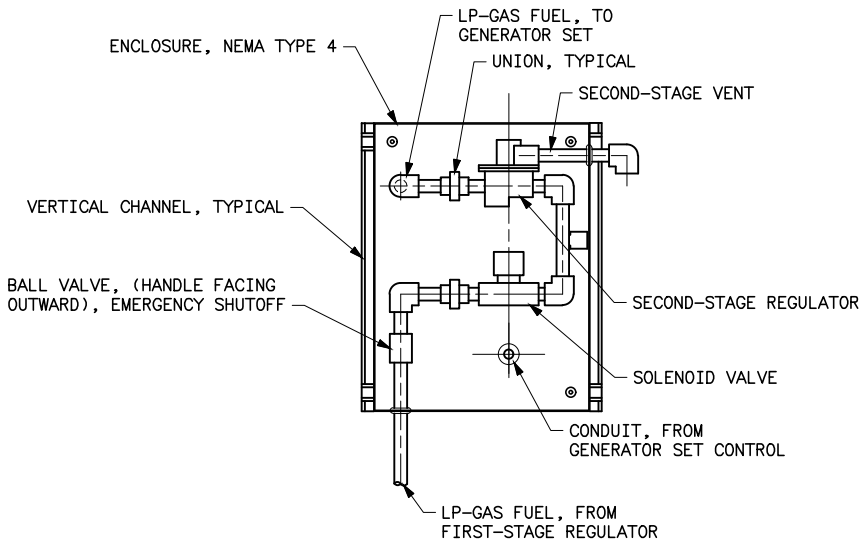
NOTES

LP-GAS CONTAINER

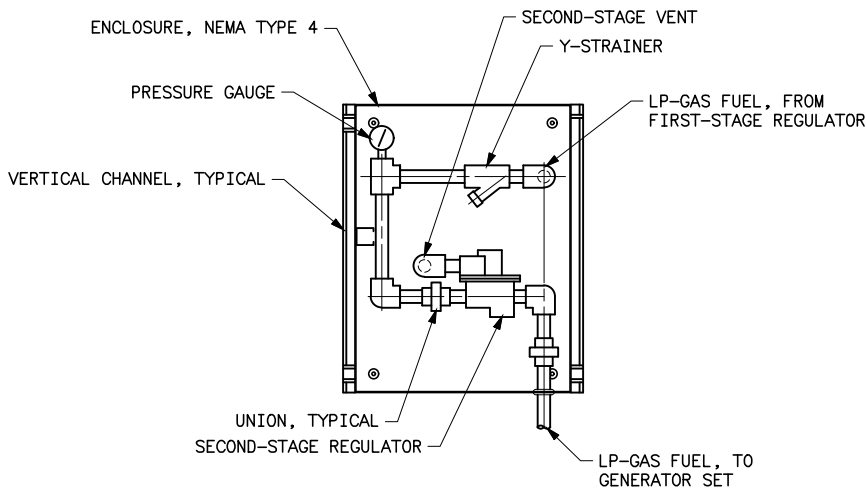
1. UNLESS OTHERWISE SPECIFIED, THE LP-GAS CONTAINER SHALL BE AN ASME HORIZONTAL VESSEL INSTALLED PERMANENTLY ABOVEGROUND.
2. THE CONTAINER SHALL CONFORM TO THE LATEST EDITION AND ADDENDA OF THE ASME CODE FOR PRESSURE VESSELS, SECTION VIII, DIVISION 1 AND COMPLIES WITH THE LATEST EDITION OF NFPA 58, CHAPTER 5.
3. THE CONTAINER SHALL BE RATED AT 250 PSIG FROM -20°F TO 125°F. THE SIZE OF THE CONTAINER SHALL BE BASED ON THE VAPORIZATION CAPACITY EQUAL TO (OR GREATER THAN) THE FULL LOAD REQUIREMENT OF THE GENERATOR SET AT 0°F (OR AN OUTDOOR TEMPERATURE DETERMINED BY THE REGION).
4. THE CONTAINER SHALL BE LOCATED WITH RESPECT TO ANY ADJACENT CONTAINERS, IMPORTANT BUILDINGS, GROUP OF BUILDINGS, OR LINE OF ADJOINING PROPERTY THAT CAN BE BUILT UPON.
5. THE CONTAINER AND ANY OF ITS PARTS SHALL NOT BE LOCATED WITHIN 6 FEET OF A VERTICAL PLANE BENEATH OVERHEAD ELECTRIC POWER LINES THAT ARE OVER 600 VOLTS, NOMINAL.
6. FOR ADDITIONAL INSTALLATION REQUIREMENTS, REFERENCE THE LATEST EDITION OF NFPA 58, CHAPTER 6.

LP-GAS SECOND-STAGE ENCLOSURE

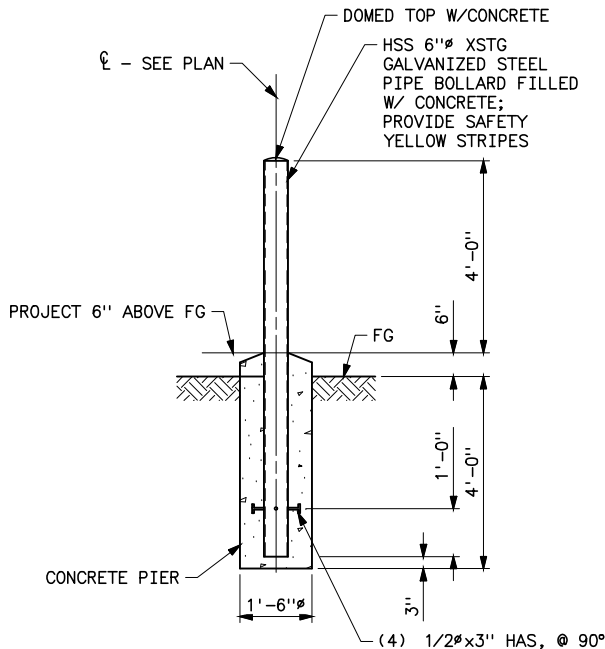
7. UNLESS OTHERWISE SPECIFIED, THE SECOND-STAGE REGULATOR SHALL BE INSTALLED AND PROTECTED IN A NEMA TYPE 4 ENCLOSURE.
8. THE ENCLOSURE SHALL NOT BE LOCATED WITHIN 5 FEET OF ANY SOURCE OF IGNITION OR ANY MECHANICAL VENTILATION AIR INTAKE.
9. FOR ADDITIONAL INSTALLATION REQUIREMENTS, REFERENCE THE LATEST EDITION OF NFPA 58, CHAPTER 6.
10. BOLLARDS ARE REQUIRED AT FOUNDATION CORNERS AND ADJACENT TO EACH SIDE OF BURIED GAS PIPING. SEE PIPE BOLLARD DETAIL THIS SHEET, TYPICAL.



SECOND-STAGE ENCLOSURE
(FOR GENERATOR SET WITHIN BUILDING STRUCTURE)



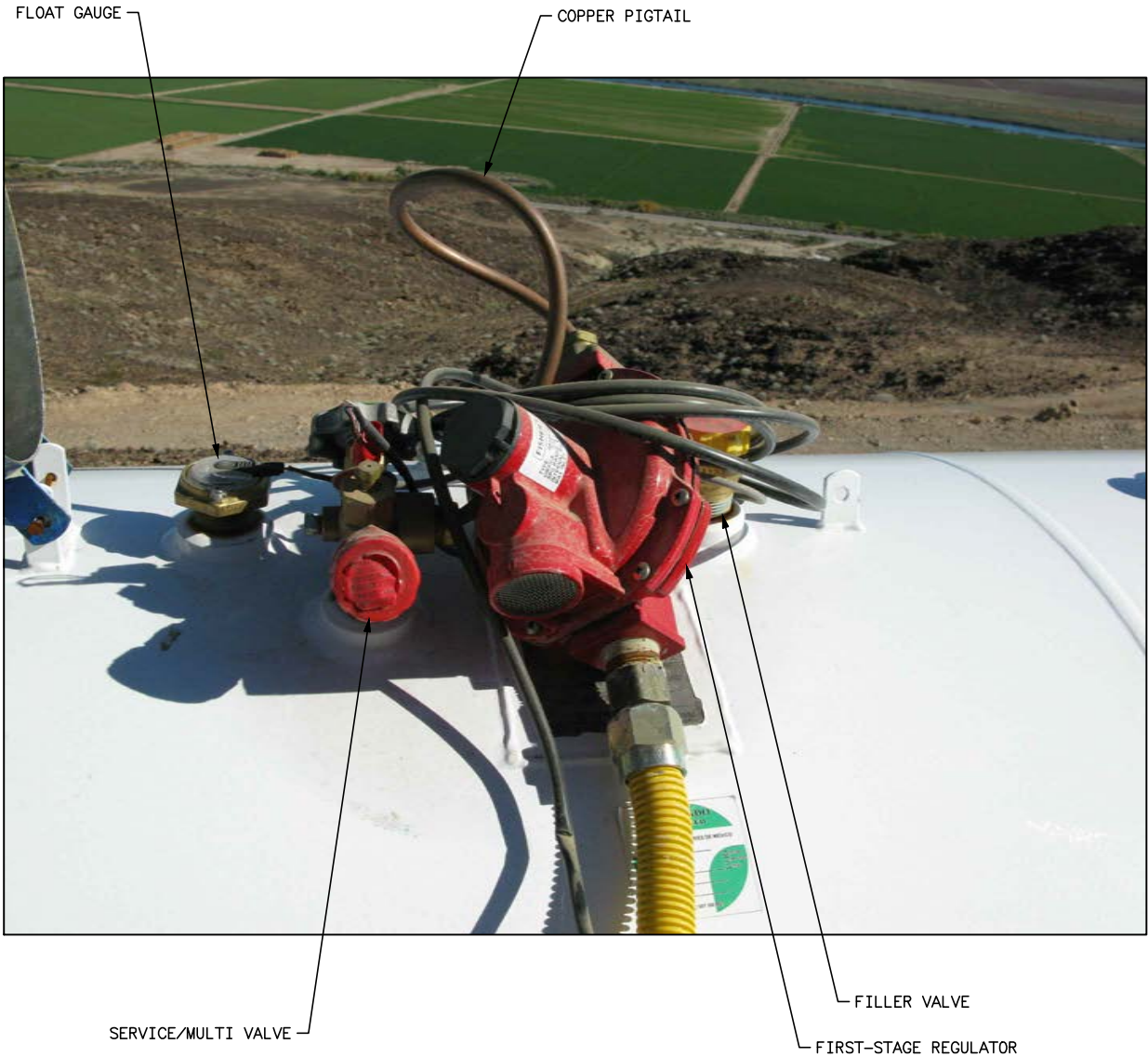
SECOND-STAGE ENCLOSURE
(FOR GENERATOR SET W/WEATHER PROTECTIVE ENCLOSURE)



PIPE BOLLARD DETAIL

A	10-5-20 A7-JAS	NON MECHANICAL REVISIONS. ADDED PIPE BOLLARD DETAIL.	
	UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
	FACILITIES STANDARD TYPICAL INSTALLATION LP-GAS SYSTEM ARRANGEMENT		
DESIGNED <u>R.L. PASCUA</u>		APPROVED <u>DOUG HANSON</u> CIVIL ENGINEERING MANAGER	
C A E	OCTOBER 19, 2016	31	3300

Plotted By: denton, Oct 19, 2016- 1:05pm
S:\projects\misc\standard\drawings\DrawingsReadyForFinal\Scripts\31_3301.dwg Last Saved By: Denton, Debra on 10/19/2016 1:05 PM
IMAGES: S:\projects\Buildings\BlackPointCommBldg, 201\ProjectData\Photos\120513_RLP\IMG_0796.JPG; S:\projects\Buildings\BlackPointCommBldg, 201\ProjectData\Photos\120513_RLP\IMG_0798.JPG;



NOTES

LP-GAS APPURTENANCES

- 1. UNLESS OTHERWISE SPECIFIED, THE FIRST-STAGE REGULATOR SHALL BE INSTALLED AND PROTECTED WITHIN THE CONTAINER DOME.
- 2. THE REGULATOR SHALL BE CONNECTED TO THE SERVICE/MULTI VALVE WITH A COPPER PIGTAIL. THE REGULATOR OUTLET PIPING SHALL COMPLY WITH THE LATEST EDITION OF NFPA 58, CHAPTER 6.
- 3. THE FLOAT GAUGE SHALL BE CONFIGURED WITH A HALL EFFECT TWINSITE SENDER FOR DIRECT AND REMOTE FUEL LEVEL MONITORING.
- 4. FOR GENERATOR SETS INSTALLED PERMANENTLY WITHIN THE BUILDING STRUCTURE, A Y-STRAINER AND PRESSURE GAUGE SHALL BE INSTALLED NEAR THE FIRST-STAGE REGULATOR; UNDER THE CONTAINER DOME OR IN A SEPARATE ENCLOSURE.

UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO			
FACILITIES STANDARD TYPICAL INSTALLATION LP-GAS CONTAINER APPURTENANCES			
DESIGNED R.L. PASCUA		APPROVED DOUG HANSON CIVIL ENGINEERING MANAGER	
C_A_E	OCTOBER 19, 2016	31	3301

XREF(S):

Plotted By: Denton Oct 05, 2020 - 3:17pm
S:\projects\Misc\StandardDrawings\Drawings\DesignReady\ForFinal\Scripts\31_3302a.dwg Last Saved By: Denton, Debra on 10/5/2020 3:17 PM
IMAGES: S:\projects\Buildings\BlackPointCommBldg\2011\ProjectData\Photos\120513_RLP\IMG_0790.JPG



NOTES

GENERATOR SET

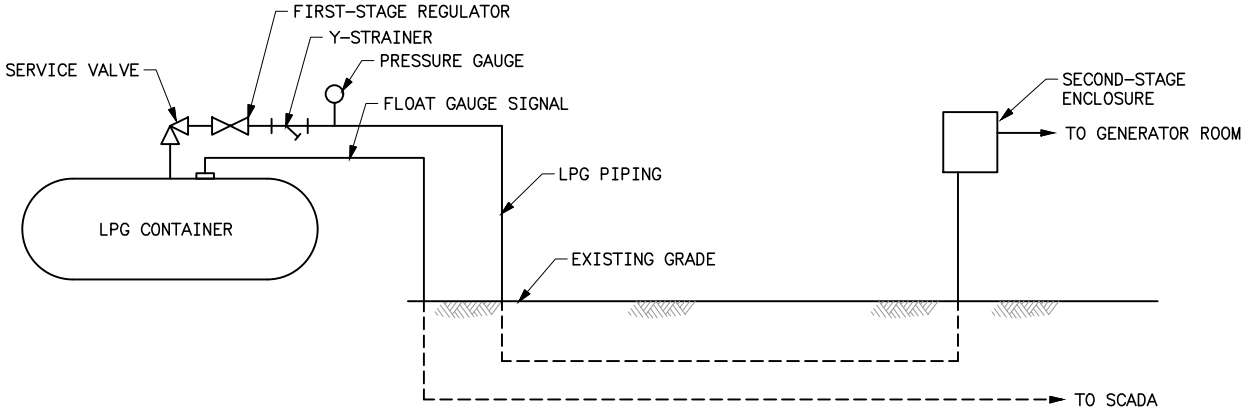
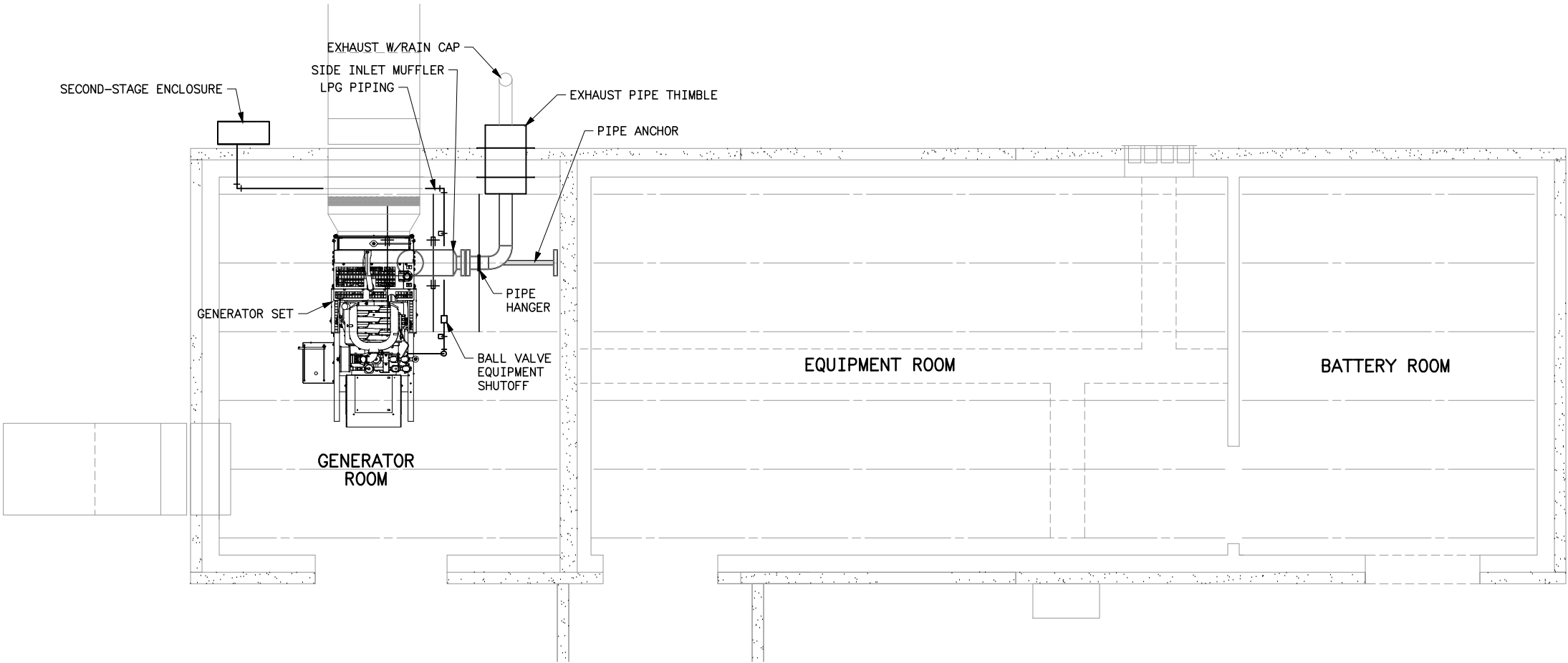
- 1. UNLESS OTHERWISE SPECIFIED, THE GENERATOR SET SHALL BE CSA CERTIFIED, UL 2200 LISTED AND INSTALLED PERMANENTLY WITHIN THE BUILDING STRUCTURE OR LOCATED PERMANENTLY OUTDOORS WITH A WEATHER PROTECTIVE ENCLOSURE.
- 2. FOR ENGINE AND FUEL SUPPLY REQUIREMENTS, REFERENCE THE LATEST EDITION OF NFPA 37, CHAPTER 4. VERIFY SITE SPECIFIC REQUIREMENTS FOR EQUIPMENT PAD.
- 3. THE GENERATOR SET SHALL COMPLY WITH THE LATEST EDITION OF NFPA 110, CHAPTER 4 AND CONFORM TO A LEVEL 1 SYSTEM. THE INSTALLATION AND TESTING SHALL COMPLY WITH THE MANUFACTUER'S INSTRUCTIONS.

TRANSFER SWITCH

- 4. UNLESS OTHERWISE SPECIFIED, THE TRANSFER SWITCH SHALL BE UL1008 LISTED AND INSTALLED PERMANENTLY WITHIN THE BUILDING STRUCTURE (WITH A NEMA TYPE 1 ENCLOSURE) OR LOCATED PERMANENTLY OUTDOORS (WITH A NEMA TYPE 4 ENCLOSURE).
- 5. THE TRANSFER SWITCH SHALL BE CAPABLE OF COMMUNICATING WITH REMOTE MONITORING AND SCADA.
- 6. THE TRANSFER SWITCH SHALL COMPLY WITH THE LATEST EDITION OF NFPA 110, CHAPTER 4 AND CONFORM TO A LEVEL 1 SYSTEM. THE INSTALLATION AND TESTING SHALL COMPLY WITH THE MANUFACTUER'S INSTRUCTIONS.
- 7. BOLLARDS ARE REQUIRED AT FOUNDATION CORNERS AND ADJACENT TO EACH SIDE OF BURIED GAS PIPING. SEE PIPE BOLLARD DETAIL ON 31 3300, TYPICAL.

A	10-5-20 A7-JAS	NON-MECHANICAL REVISIONS. ADDED PIPE BOLLARDS.	
	UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
	FACILITIES STANDARD TYPICAL INSTALLATION GENERATOR SET & TRANSFER SWITCH		
DESIGNED <u>R.L. PASCUA</u> _____		APPROVED <u>DOUG HANSON</u> CIVIL ENGINEERING MANAGER _____	
C/A	OCTOBER 19, 2016	31	3302

XREF(S):



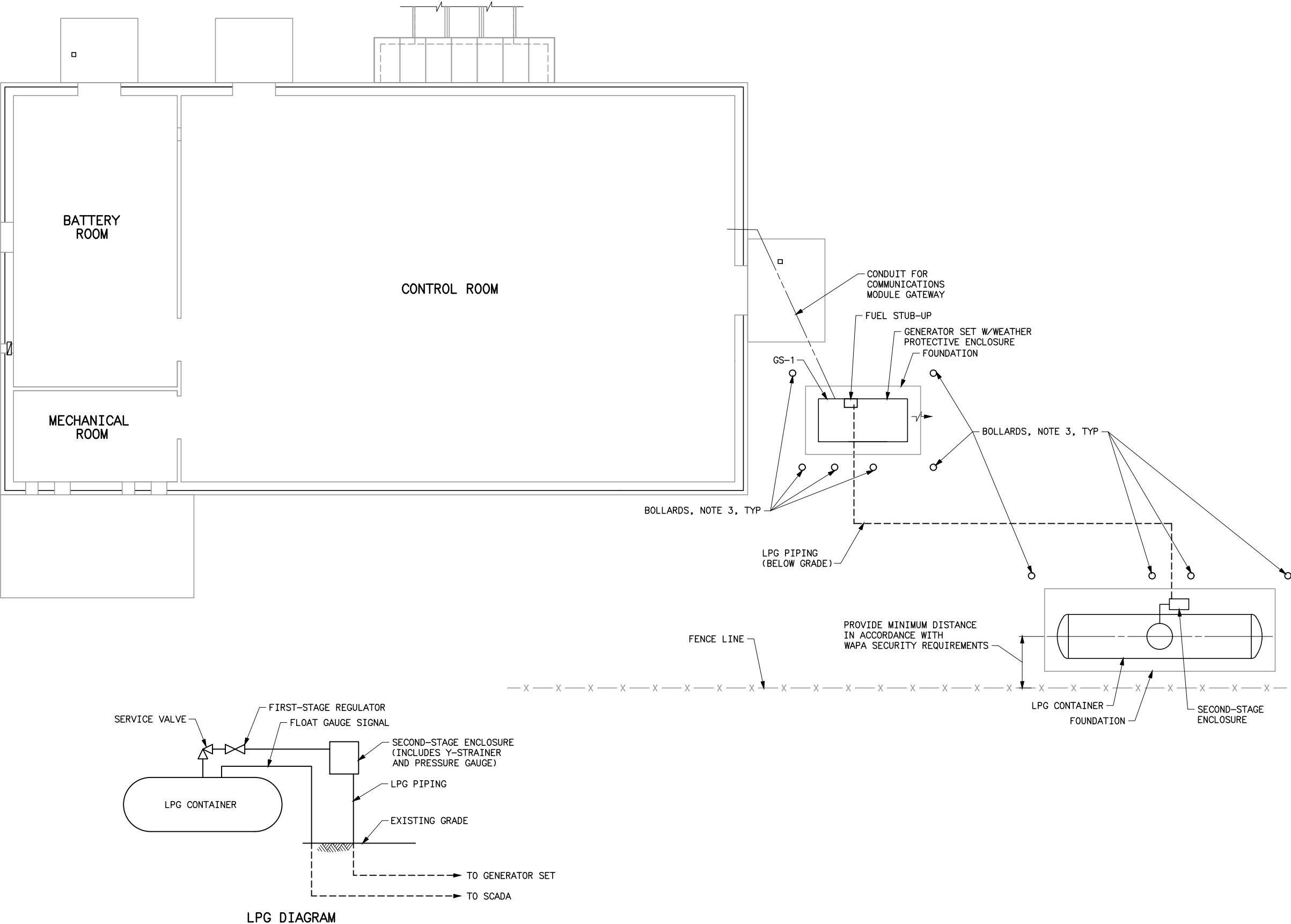
LPG DIAGRAM

UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
FACILITIES STANDARD TYPICAL INSTALLATION GENERATOR ROOM		
DESIGNED R.L. PASCUA	APPROVED DOUG HANSON CIVIL ENGINEERING MANAGER	
CAE	OCTOBER 19, 2016	31 3303

Plotted By: denton Oct 19, 2016 1:09pm
S:\projects\misc\StandardDrawings\Drawings\DesignReadyForFinal\Scripts\31_3303.dwg Last Saved By: Denton, Debra on 10/19/2016 1:07 PM

XREF(S):

Plotted By: Denton Oct 05, 2020 3:19pm
S:\projects\misc\StandardDrawings\Drawings\DesignReadyForFinal\Scripts\31_3304a.dwg Last Saved By: Denton, Debra on 10/5/2020 3:19 PM

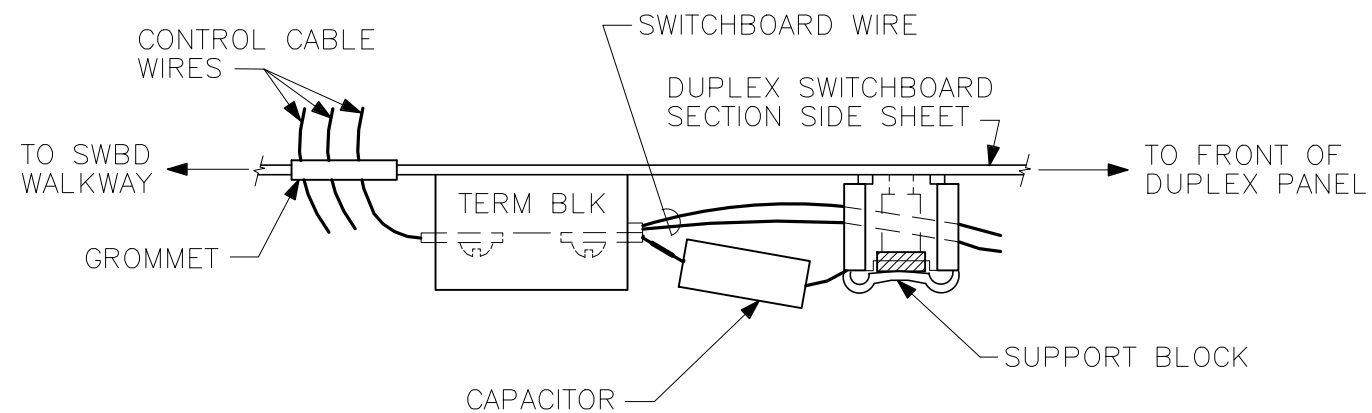


NOTES

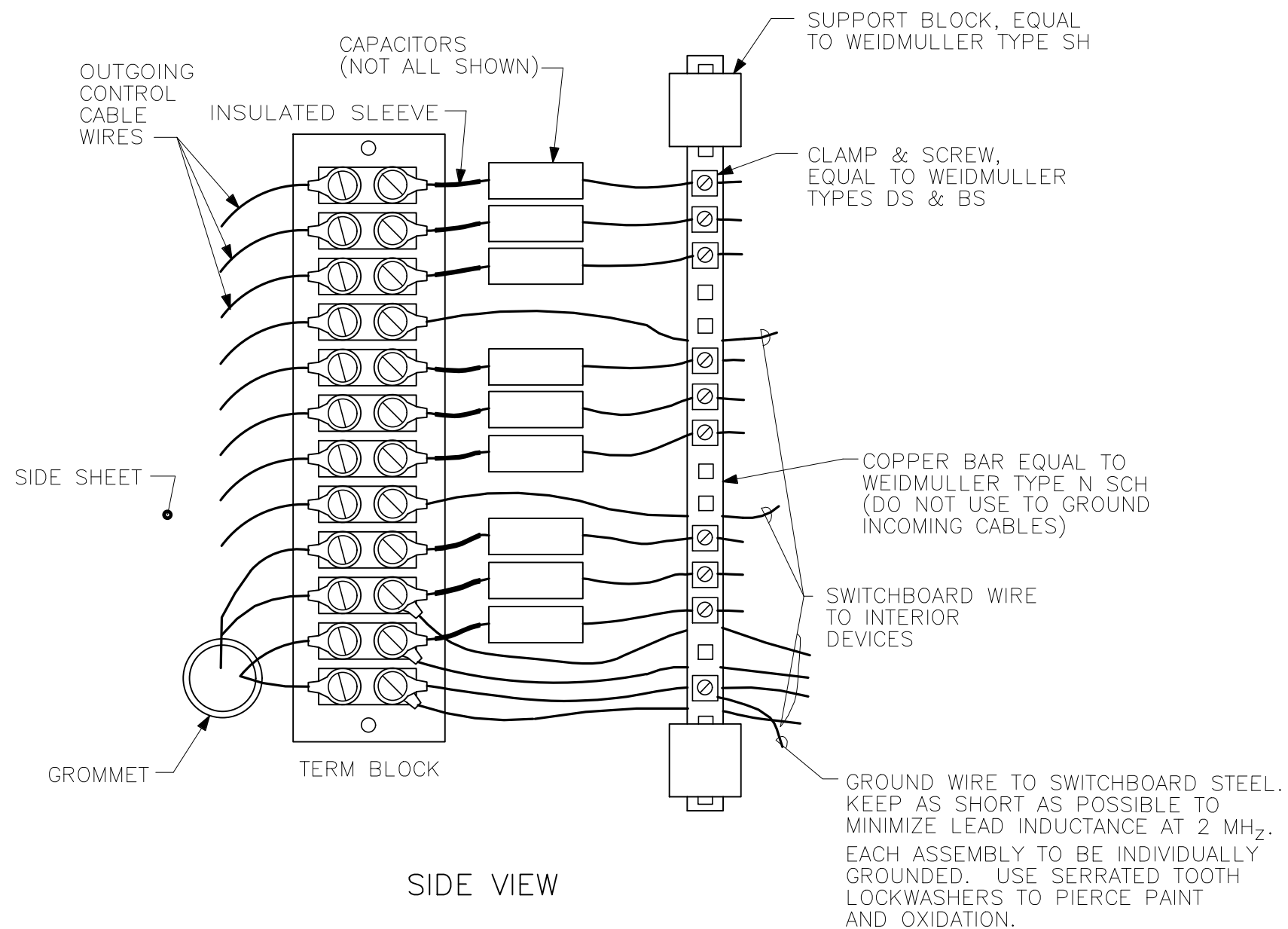
- 1. POWER AND/OR CONTROL CABLES NOT SHOWN ON THIS DRAWING, SEE CONDUIT PLAN.
- 2. ANY PIPING OR CONDUITS BURIED UNDERGROUND SHALL CONFORM TO STANDARD DRAWING 31 1006.
- 3. PROVIDE PROTECTIVE BOLLARDS EACH SIDE OF BURIED GAS LINE WHERE SHOWN ADJACENT TO TANK & GENERATOR. SEE PIPE BOLLARD DETAIL ON 31 3300, TYPICAL.
- 4. COMPLY WITH NFPA 58: LIQUEFIED PETROLEUM GAS CODE.

A	10-5-20 A7-JAS	REVISED TITLE BLOCK. NON-MECHANICAL REVISIONS. ADDED PIPE BOLLARDS.	
	UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
	FACILITIES STANDARD TYPICAL INSTALLATION MISCELLANEOUS DETAILS		
	DESIGNED <u>R.L. PASQUA</u> APPROVED <u>DOUG HANSON</u> CIVIL ENGINEERING MANAGER		
	DATE	OCTOBER 19, 2016	31

XREF(S):



TOP VIEW



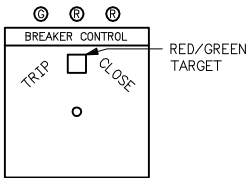
SIDE VIEW

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 MHz 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.

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 <u>GERALD D. BIRNEY</u> DIRECTOR, DIVISION OF SUBSTATION DESIGN	
C A _F	MARCH 14, 1979	31	4001

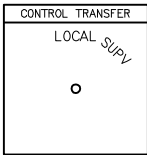
BREAKER CONTROL
182CS*



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

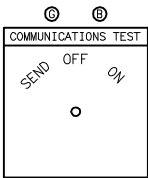
CONTROL TRANSFER
43-182CS*



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

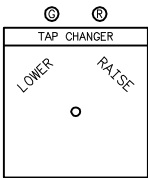
COMMUNICATIONS TEST
BCCS*



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

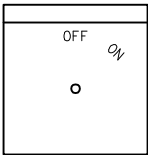
RAISE/LOWER CONTROL
84-KV1ACS*



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

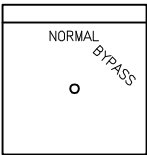
DIFFERENTIAL CONTROL
87TB1CS*



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

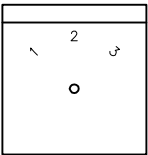
BREAKER BYPASS CONTROL
182BCS*



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 STOPED 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.

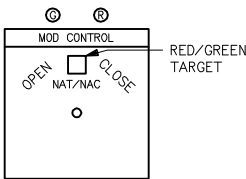
NOTES

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

- Ⓢ AC OR DC POTENTIAL INDICATION
- Ⓣ INDICATES EQUIPMENT IN-SERVICE OR ENERGIZED OR TAP CHANGER FULLY LOWERED
- Ⓤ INDICATES EQUIPMENT OUT-OF-SERVICE OR DE-ENERGIZED OR TAP CHANGER FULLY RAISED
- Ⓦ INDICATES COMMUNICATION TRIP SIGNAL
- Ⓡ INDICATES RECLOSER OR COMMUNICATION IN-SERVICE

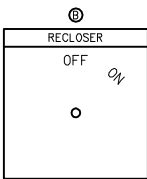
MOD CONTROL
181CS*



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

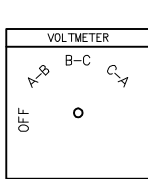
RECLOSER CONTROL
79-182CS*



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

BLACK, OVAL HANDLE
ALL POSITIONS MAINTAINED

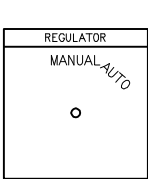
VOLTMETER SELECT
VUIACS*



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

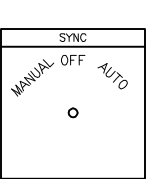
REGULATOR CONTROL
90-KVIACS*



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

BLACK, OVAL HANDLE
ALL POSITIONS MAINTAINED

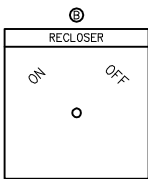
SYNC
25-182CS*



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

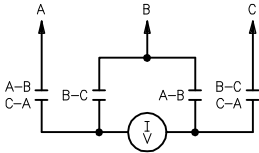
BLACK, OVAL HANDLE
REMOVABLE ONLY IN "OFF"
POSITION
ALL POSITIONS MAINTAINED

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
VOLTAGE TRANSFORMER AC SCHEMATIC	VU1ACS
TRANSFORMER DC CONTROL SCHEMATIC	84-KV1ACS
DIFFERENTIAL DC SCHEMATIC	90-KV1ACS
	87B1CS
	87TB1CS
	182BCS

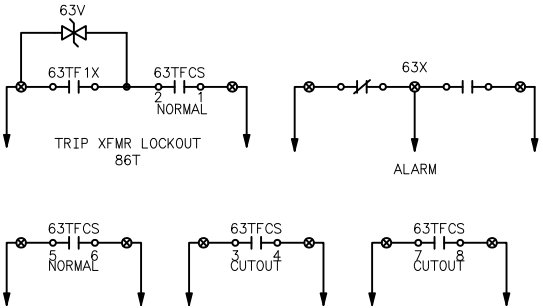
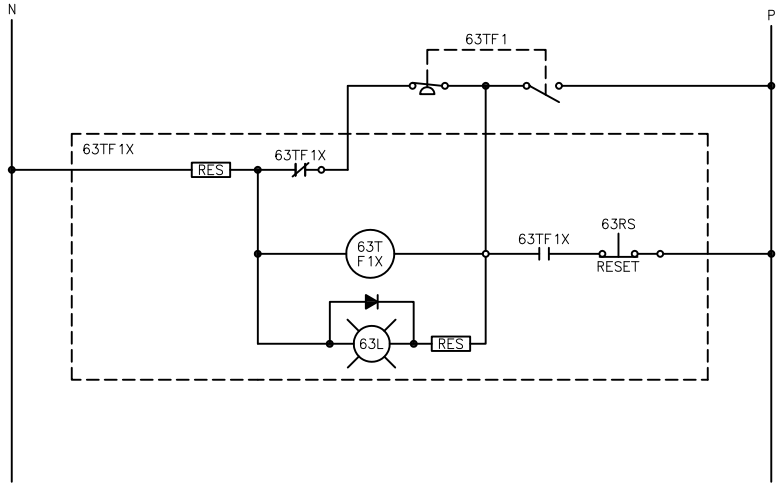
D	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.	
C	4-24-96 A3-RPD	REDRAWN ON CAE	
B	10-10-83 A2-DEV	REVISED AND REDRAWN TO UPDATE STANDARD AND INCLUDE WAREHOUSE STOCK DEVELOPMENTS	
SUPERSEDES DWG NO. E40-D-5324			
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE — LAKEWOOD, COLORADO			
SUBSTATION STANDARDS CONTROL SWITCHES ESCUTCHEONS, LAMPS AND DEVELOPMENTS			
DESIGNED <u>KIM DAM</u> _____ APPROVED <u>W.A. JACOBY</u> SUBSTATION CONTROL DESIGN MANAGER			
A	OCTOBER 10, 1983	31	4003

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

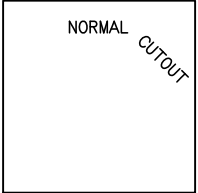
NOTES

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"

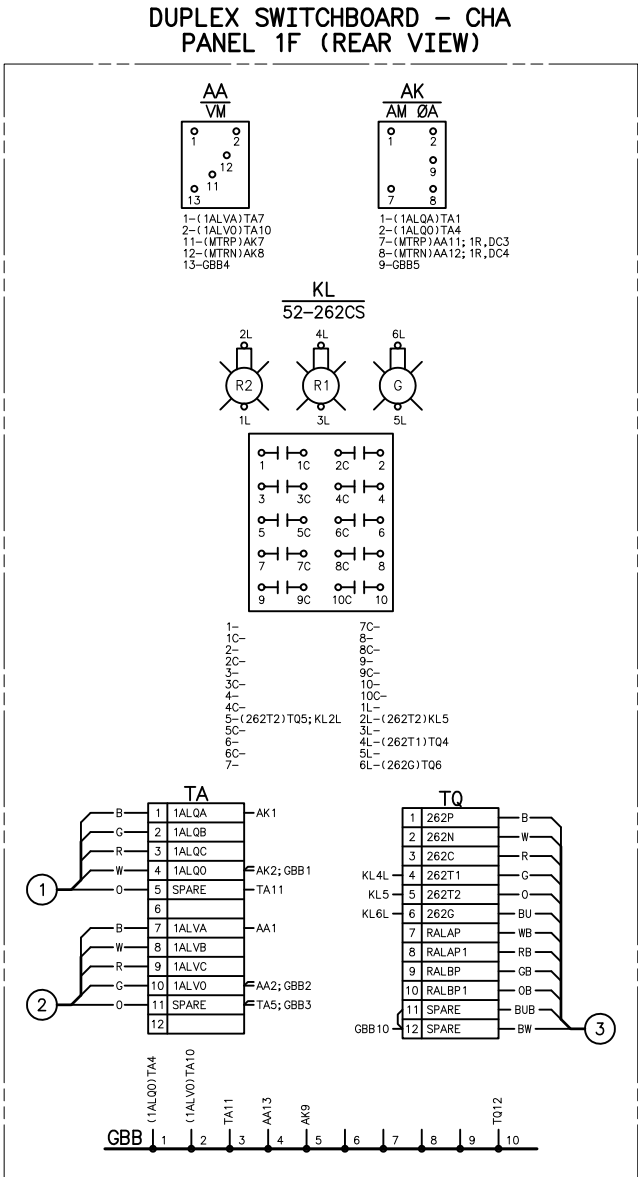
ESCUTCHEON
ENGRAVING



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 ROY G. GEARHART		APPROVED W.A. JACOBY 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

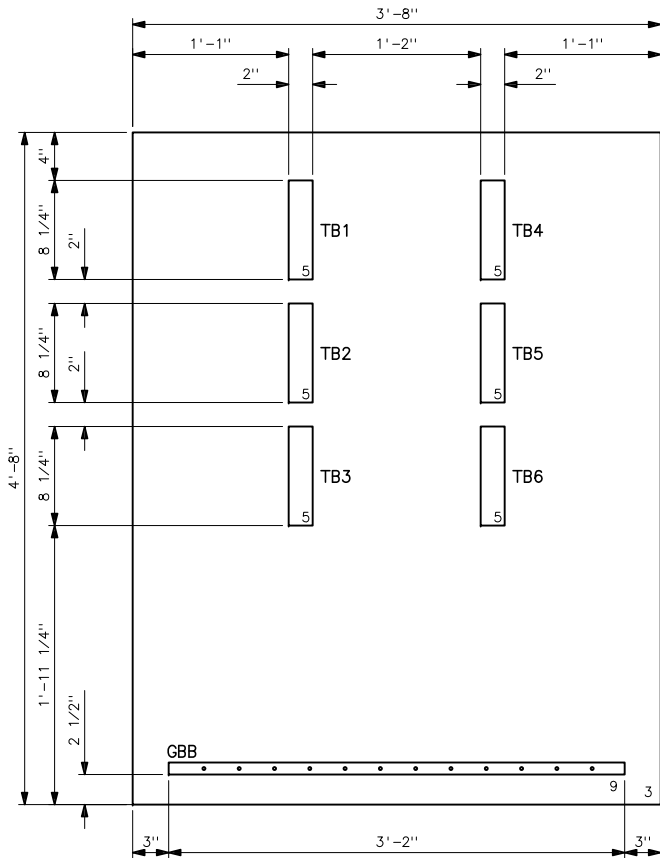
1. COPPER BRAID SHIELD AND ALL SPARE CONDUCTORS OF CABLE SHALL BE GROUNDED AT BOTH ENDS.

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

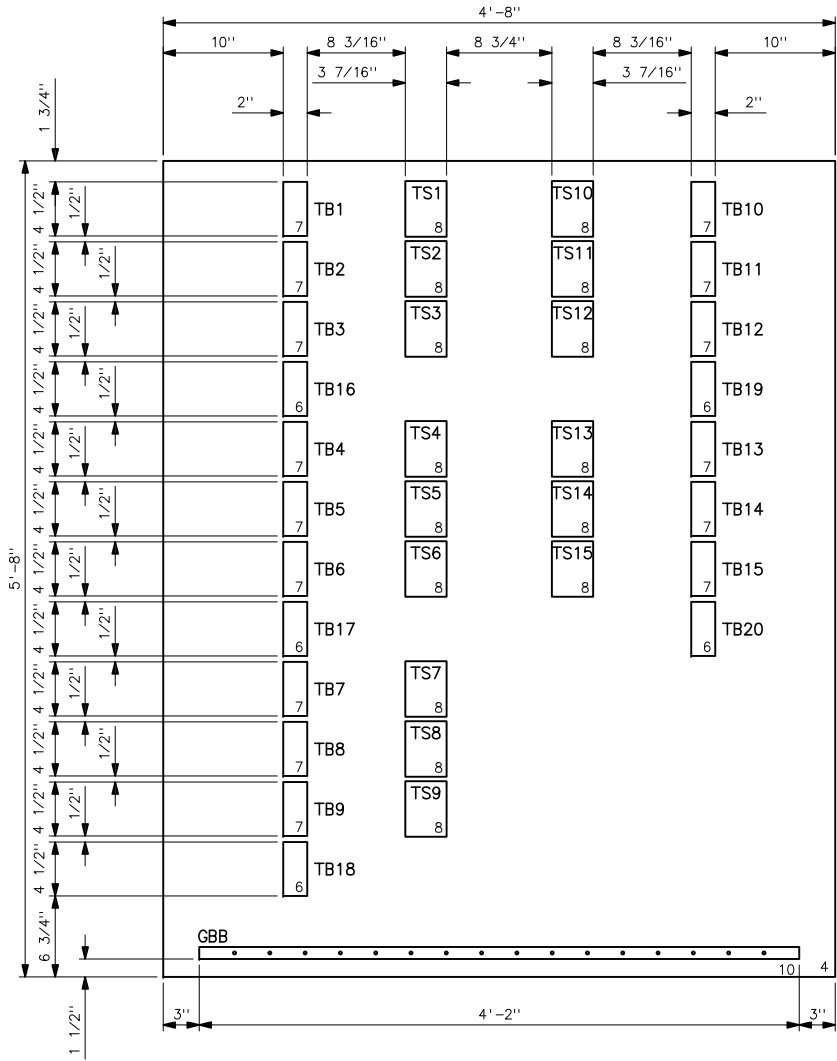
COLOR SCHEME FOR MIMIC BUSES		
VOLTAGE	COLOR	APPROXIMATE COLOR NO. FEDERAL STANDARD 595
GROUND BUS	WHITE	17875
480 VOLT	BRIGHT BLUE	15123
2.4 KILOVOLT	DARK BLUE	15045
4.16 KILOVOLT	LIGHT GREEN	14533
6.9 KILOVOLT	BRIGHT GREEN	14187
11.5 KILOVOT	BLUE GREEN	14325
11.95 KILOVOLT	BLUE GREEN	14325
12.47 KILOVOLT	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



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	

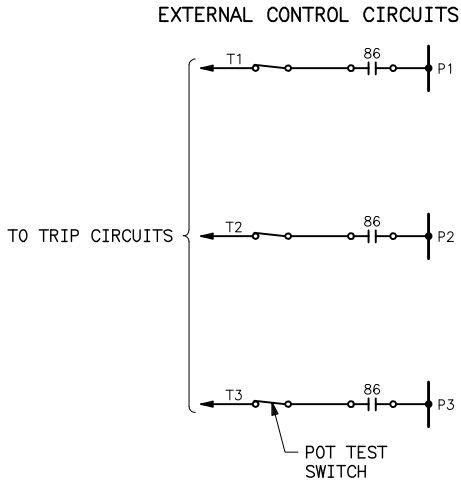
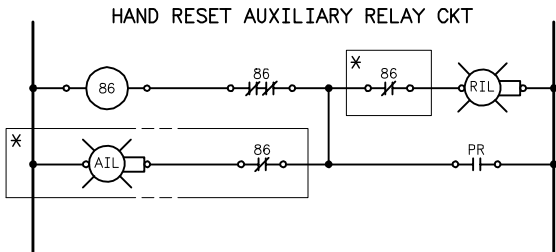
NOTES

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.

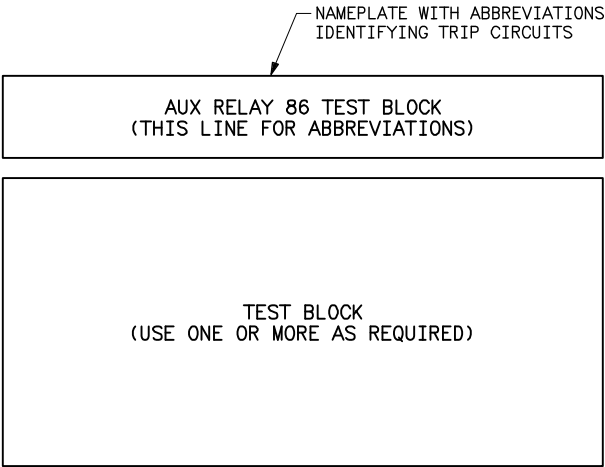
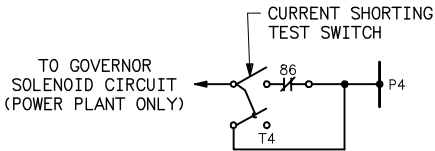
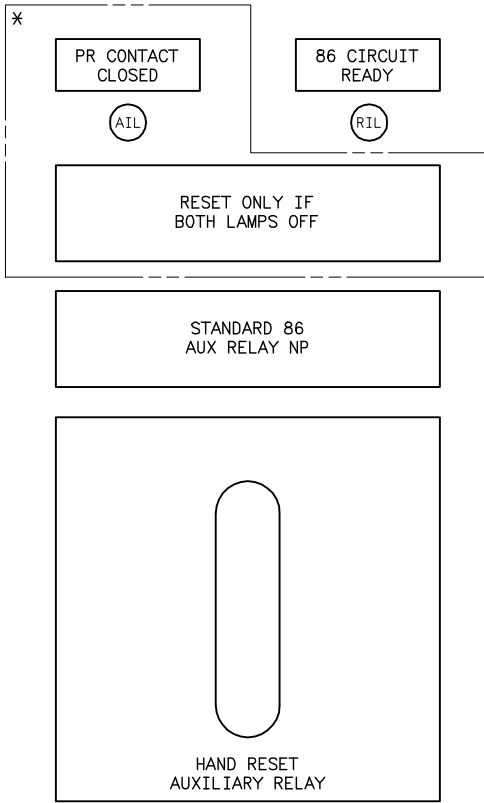
B	6-25-12 A7-DF	MINOR REVISIONS, CONVERTED DIMENSIONS AND UPDATED TITLE BLOCK TO CURRENT STANDARD.	
	4-24-96 A3-RPD	REVISED AND REDRAWN TO UPDATE STANDARD DWG.	
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO			
CONTROL STANDARDS TYPICAL 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

EXPLANATION

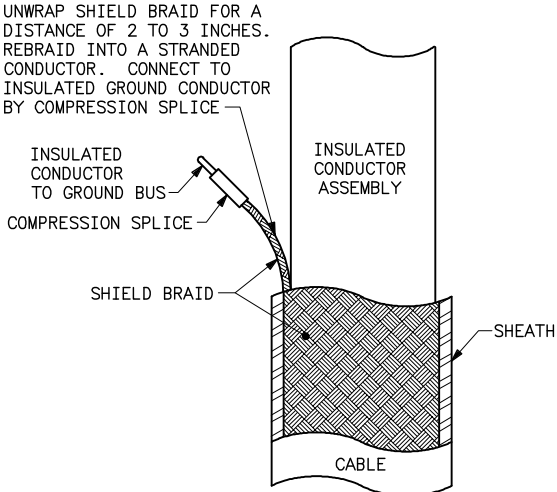
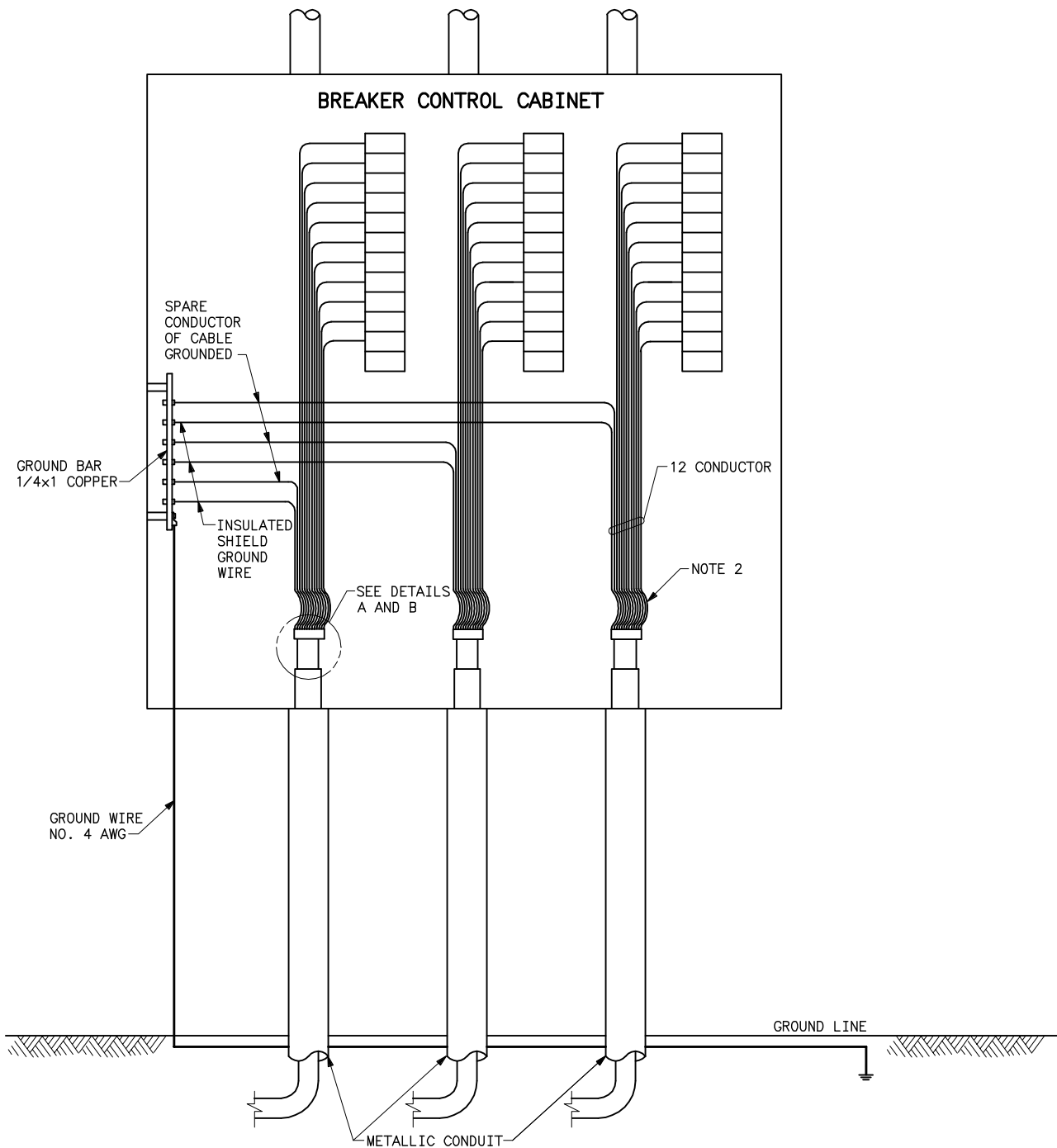
* _ _ _ _ INDICATES AMBER LAMP MONITOR CIRCUIT IS REQUIRED ONLY IF THE PR CONTACT IS A MAINTAINED TYPE SUCH AS ANOTHER HAND RESET AUXILIARY RELAY CONTACT OR A TEMPERATURE RELAY CONTACT, ETC. IF AMBER LAMP MONITOR CIRCUIT IS NOT REQUIRED, THE RED LAMP AND LAMP NAMEPLATE SHALL BE CENTERED ABOVE THE AUX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



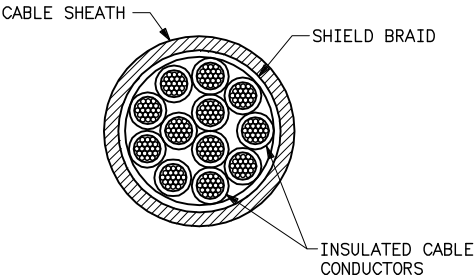
DESIRED LOCATION OF LAMPS AND NAMEPLATES



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	AUGUST 20, 1979		31 5103



DETAIL A
LONGITUDINAL CABLE SECTION



DETAIL B
CABLE CROSS SECTION

NOTES

- 1. THIS DRAWING SHOWS THE PREFERRED METHOD OF GROUNDING THE CABLE SHIELD. IF APPROVED BY THE CONTRACTING OFFICER, OTHER METHODS MAY BE USED.
- 2. SLACK CABLES SHALL BE PROVIDED SO THAT ALL CABLES WILL BE IN SUFFICIENT LENGTH TO REACH THE FARTHEST TERMINAL IN THE CABINET.

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 CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO			
SUBSTATION STANDARDS PCB CONTROL CABINETS SHIELDED CABLE GROUNDING			
DESIGNED BUREC _____ APPROVED W. A. JACOBY _____ FOR DIRECTOR, DIVISION OF SUBSTATION DESIGN			
A E	MARCH 14, 1979	31	6000

NEMA IDENTIFICATION COLOR CODE FOR CONTROL CABLES

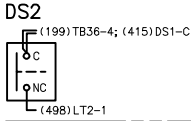
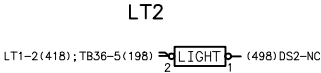
CABLE	NUMBER	ABBRE- VIATION	BASE	TRACER	TRACER
2/C	1	B	BLACK		
	2	W	WHITE		
3/C	3	R	RED		
5/C	4	G	GREEN		
	5	O	ORANGE		
7/C	6	BU	BLUE		
	7	WB	WHITE	BLACK	
9/C	8	RB	RED	BLACK	
	9	GB	GREEN	BLACK	
12/C	10	OB	ORANGE	BLACK	
	11	BUB	BLUE	BLACK	
	12	BW	BLACK	WHITE	
16/C	13	RW	RED	WHITE	
	14	GW	GREEN	WHITE	
	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

Mar 22, 2006- 2:35pm Plotted By: See la S:\Engineering\Standard Drawings\3\3\1_B011b.dwg Last Saved By: palmer IMAGES:



1	41	RL1-1; 94X1-T1
2	41A	63AX-T1
3	44	RL4-1; 94X2-T1
4	44A	63CX-T1
5		
6		

1		
2		
3		
4	199	DS2-C
5	198	TB26-5
6	197	TB26-6

1	42	RL2-1; 94X1-T2
2	42A	63AX-T2
3	45	94X2-T2; RL5-1
4	45A	63CX-T2
5		
6		

1		
2		
3		
4	299	TB16-4
5	298	TB36-5
6	297	TB26-6

1	43	94X1-T3; RL3-1
2	43A	63AX-T3
3	46	94X2-T3; RL6-1
4	46A	63CX-T3
5		
6		

1	3	8-8-2
2	4	8-8-4
3	521	
4	399	8-7-2
5	398	TB26-5
6	397	

1	83	63BX-M3
2	82	63BX-T3
3	81	94X2-M4
4	80	94X2-T4
5	79	52X3C-T4
6	78	52X3C-M4

1	84	63DX-1
2	85	63DX-T3
3	86	63EX-1
4	87	63EX-T3
5	88	63FX-2
6	89	63FX-6

1	101	1TBP10-12
2	102	1TBP10-11; 52X1B-B4
3	103	1TBP10-10
4	104	1TBP10-9; 8-8-4
5	105	1TBP10-8
6	106	1TBP10-7; TB30-6
7	107	1TBP10-6; 27-1-T1
8	108	1TBP10-5; 27-1-R1
9	109	1TBP10-4; 62-4-3
10	110	1TBP10-3; 42-1-C1
11	111	1TBP10-2; TB30-11
12	112	1TBP10-1; TB30-12

1	196	1TBP2-7
2	195	1TBP2-8
3	194	1TBP2-9
4	193	1TBP2-10
5	192	1TBP2-11
6	191	1TBP2-12
7	190	1TBP3-1
8	189	1TBP3-2
9	188	1TBP3-3
10	187	1TBP3-4
11	186	1TBP3-5
12	185	1TBP3-6

1	201	2TBP10-12
2	202	2TBP10-11; 52X2B-B4
3	203	2TBP10-10
4	204	2TBP10-9; TB20-4
5	205	2TBP10-8
6	206	2TBP10-7; TB40-6
7	207	2TBP10-6; 27-1-T2
8	208	2TBP10-5; 27-1-R2
9	209	2TBP10-4; 62-5-3
10	210	2TBP10-3; 62-2-L1
11	211	2TBP10-2; TB20-11
12	212	2TBP10-1; TB40-12

1	296	2TBP2-7
2	295	2TBP2-8
3	294	2TBP2-9
4	293	2TBP2-10
5	292	2TBP2-11
6	291	2TBP2-12
7	290	2TBP3-1
8	289	2TBP3-2
9	288	2TBP3-3
10	287	2TBP3-4
11	286	2TBP3-5
12	285	2TBP3-6

1	301	3TBP10-12
2	302	3TBP10-11; 52X3B-B4
3	303	3TBP10-10
4	304	3TBP10-9; TB30-4
5	305	3TBP10-8
6	306	3TBP10-7; TB30-6
7	307	3TBP10-6; 27-1-T3
8	308	3TBP10-5; 27-1-R3
9	309	3TBP10-4; 62-6-3
10	310	3TBP10-3; 62-3-L1
11	311	3TBP10-2; TB30-11
12	312	3TBP10-1; TB30-12

1	396	3TBP2-7
2	395	3TBP2-8
3	394	3TBP2-9
4	393	3TBP2-10
5	392	3TBP2-11
6	391	3TBP2-12
7	390	3TBP3-1
8	389	3TBP3-2
9	388	3TBP3-3
10	387	3TBP3-4
11	386	3TBP3-5
12	385	3TBP3-6

1	77	52X3C-R4
2	76	52X3C-T3
3	75	52X3C-M3
4	74	52X3C-R3
5	73	52X2C-T4
6	72	52X2C-M4
7	71	52X2C-R4
8	70	52X2C-T3
9	69	52X2C-M3
10	68	52X2C-R3
11	67	52X1C-T4
12	66	52X1C-M4

1	90	63GX-2
2	91	63GX-6
3	92	63HX-2
4	93	63HX-6
5	94	631AX-2
6	95	631AX-6
7	96	632AX-2
8	97	632AX-6
9	98	633AX-2
10	99	633AX-6
11	501	8-1-NC
12	502	8-1-C

1	113	1TBP9-12; TB29-1
2	114	1TBP9-11; 63AX-B1
3	115	1TBP9-10; TB29-3
4	116	1TBP9-9; TB29-4
5	117	1TBP9-8; TB20-11
6	118	1TBP9-7; 631AX-L1
7	119	1TBP9-6; 23-1-2
8	120	1TBP9-5; TB29-8
9	121	1TBP9-4
10	122	1TBP9-3
11	123	1TBP9-2
12	124	1TBP9-1; 42-1-L3

1	184	1TBP3-7
2	183	1TBP3-8
3	182	1TBP3-9
4	181	1TBP3-10
5	180	1TBP3-11
6	179	1TBP3-12
7	178	1TBP4-1
8	177	1TBP4-2
9	176	1TBP4-3
10	175	1TBP4-4
11	174	1TBP4-5
12	173	1TBP4-6

1	213	2TBP9-12; TB19-1
2	214	2TBP9-11; TB39-2
3	215	2TBP9-10; TB39-3
4	216	2TBP9-9; TB39-4
5	217	2TBP9-8; TB39-5
6	218	2TBP9-7; 632AX-L1
7	219	2TBP9-6; TB39-7
8	220	2TBP9-5; TB19-8
9	221	2TBP9-4
10	222	2TBP9-3
11	223	2TBP9-2
12	224	2TBP9-1; 42-2-L3

1	284	2TBP3-7
2	283	2TBP3-8
3	282	2TBP3-9
4	281	2TBP3-10
5	280	2TBP3-11
6	279	2TBP3-12
7	278	2TBP4-1
8	277	2TBP4-2
9	276	2TBP4-3
10	275	2TBP4-4
11	274	2TBP4-5
12	273	2TBP4-6

1	313	3TBP9-12; TB29-1
2	314	3TBP9-11; TB29-2
3	315	3TBP9-10; TB29-3
4	316	3TBP9-9; TB29-4
5	317	3TBP9-8; TB29-5
6	318	3TBP9-7; 633AX-L1
7	319	3TBP9-6; TB29-7
8	320	3TBP9-5; TB29-8
9	321	3TBP9-4
10	322	3TBP9-3
11	323	3TBP9-2
12	324	3TBP9-1; 42-3-L3

1	384	3TBP3-7
2	383	3TBP3-8
3	382	3TBP3-9
4	381	3TBP3-10
5	380	3TBP3-11
6	379	3TBP3-12
7	378	3TBP4-1
8	377	3TBP4-2
9	376	3TBP4-3
10	375	3TBP4-4
11	374	3TBP4-5
12	373	3TBP4-6

1	503	52X1C-R4
2	504	52X1C-T3
3	505	52X1C-M3
4	506	52X1C-R3
5	507	43-86
6	508	43-85
7	509	43-82
8	510	43-81
9	511	43-76; TB17-1
10	512	43-77; TB08-7
11	513	43-72
12	514	43-73

1	503	8-1-NO
2	504	8-2-NC
3	505	8-2-C
4	506	8-2-NO
5	507	8-3-NC
6	508	8-3-C
7	509	8-3-NO
8	510	27-4-8
9	511	27-4-1
10	512	27-4-3
11	513	27-5-4
12	514	27-5-1

1	125	1TBP8-6; CTR-1-2
2	126	1TBP8-5; 63FX-L1
3	127	1TBP8-4; 52X3A-M4
4	128	1TBP8-3
5	129	1TBP8-2
6	130	1TBP8-1
7	131	1TBP7-12
8	132	1TBP7-11; 63AX-M1
9	133	1TBP7-10; 52Y-1-M3
10	134	1TBP7-9; RL4-2
11	135	1TBP7-8; TB37-12
12	136	1TBP7-7; TB28-11

1	172	1TBP4-7
2	171	1TBP4-8
3	170	1TBP4-9
4	169	1TBP4-10
5	168	1TBP4-11
6	167	1TBP4-12
7	166	1TBP5-1
8	165	1TBP5-2
9	164	1TBP5-3
10	163	1TBP5-4
11	162	1TBP5-5
12	161	1TBP5-6

1	225	2TBP8-6; TB38-1
2	226	2TBP8-5; 63GX-L1
3	227	2TBP8-4; TB38-3
4	228	2TBP8-3
5	229	2TBP8-2
6	230	2TBP8-1
7	231	2TBP7-12
8	232	2TBP7-11; RL2-2
9	233	2TBP7-10; 52Y-2-M3
10	234	2TBP7-9; 63CX-M2
11	235	2TBP7-8; TB38-12
12	236	2TBP7-7; TB18-11

1	272	2TBP4-7
2	271	2TBP4-8
3	270	2TBP4-9
4	269	2TBP4-10
5	268	2TBP4-11
6	267	2TBP4-12
7	266	2TBP5-1
8	265	2TBP5-2
9	264	2TBP5-3
10	263	2TBP5-4
11	262	2TBP5-5
12	261	2TBP5-6

1	325	3TBP8-6; TB28-1
2	326	3TBP8-5; 63HX-L1
3	327	3TBP8-4; TB40-11
4	328	3TBP8-3
5	329	3TBP8-2
6	330	3TBP8-1
7	331	3TBP7-12
8	332	3TBP7-11; RL3-2
9	333	3TBP7-10; 52Y-3-M3
10	334	3TBP7-9; 63CX-M3
11	335	3TBP7-8; TB28-12
12	336	3TBP7-7

1	372	3TBP4-7
2	371	3TBP4-8
3	370	3TBP4-9
4	369	3TBP4-10
5	368	3TBP4-11
6	367	3TBP4-12
7	366	3TBP5-1
8	365	3TBP5-2
9	364	3TBP5-3
10	363	3TBP5-4
11	362	3TBP5-5
12	361	3TBP5-6

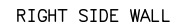
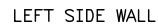
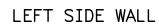
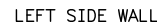
1	515	27-5-3
2	516	27-6-4
3	517	27-6-1
4	518	27-6-3
5	519	27-7-4
6	520	27-7-1

1	515	27-5-3
2	516	27-6-4
3	517	27-6-1
4	518	27-6-3
5	519	27-7-4
6	520	27-7-1

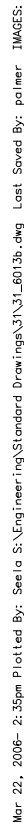
1	137	1TBP7-6; TB27-1
2	138	1TBP7-5; 94X-1
3	139	1TBP7-4; TB27-3
4	140	1TBP7-3; 62-1X-5
5	141	1TBP7-2; R1-1
6	142	1TBP7-1; 43-56
7	143	1TBP6-12; TB27-6
8	144	1TBP6-11; 52X1B-B1
9	145	1TBP6-10; R2-2
10	146	1TBP6-9; 43-62
11	147	1TBP6-8; TB27-10
12	148	1TBP6-7; TB38-11

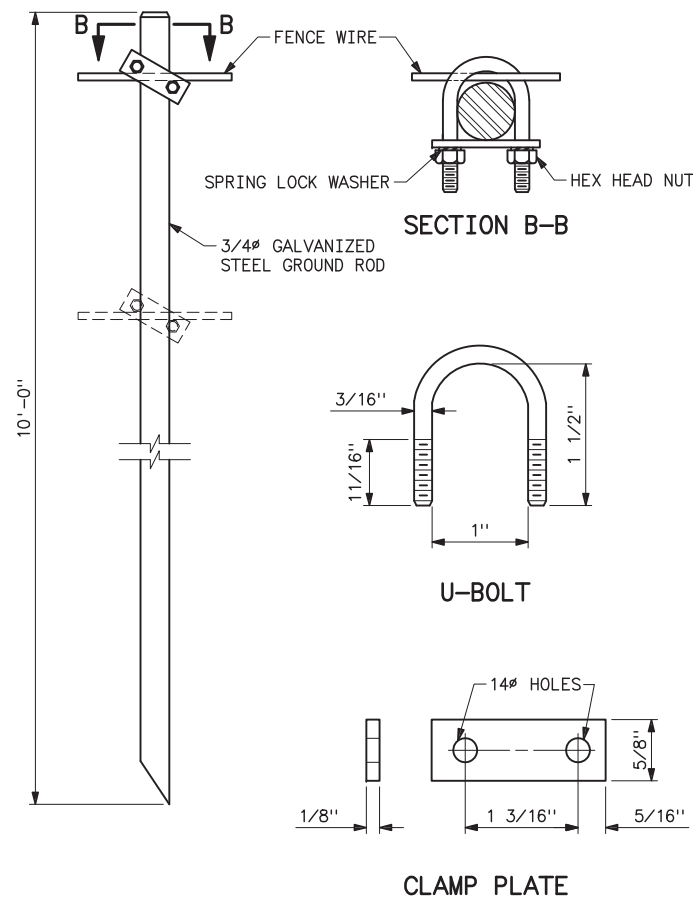
1	160	1TBP5-7
2	159	1TBP5-8
3	158	1TBP5-9
4	157	1TBP5-10
5	156	1TBP5-11
6	155	1TBP5-12; TB22-7
7	154	1TBP6-1; 43-22
8	153	1TBP6-2; 52X1A-R1
9	152	1TBP6-3; TB16-1
10	151	1TBP6-4; TB22-11
11	150	1TBP6-5; 43-66
12	149	1TBP6-6; TB27-12

TB27			
TB37-1	1	237	2TBP7-6; TB17-1
TB37-2	2	238	2TBP7-5; TB17-2
TB17-3	3	239	2TBP7-4; TB37-3
	4	240	2TBP7-3; 62-2X-5
	5	241	2TBP7-2; R3-1
	6	242	2TBP7-1; TB37-7
	7	243	2TBP6-12; TB17-6
	8	244	2TBP6-11; 52XBZ-B
	9	245	2TBP6-10; R4-2
	10	246	2TBP6-9; TB37-11
	11	247	2TBP6-8; TB17-10
	12	248	2TBP6-7; TB32-12

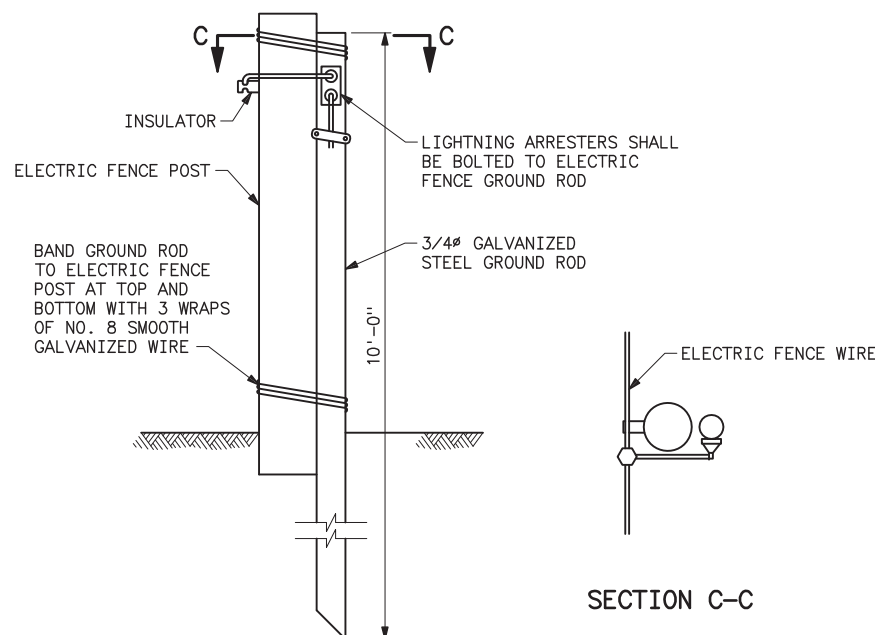


B	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.
A	7-27-99 A3-CLC	REMOVED REFERENCE DRAWINGS
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS TYPICAL POWER CIRCUIT BREAKER WIRING DIAGRAM (SH 2 OF 3)		
DESIGNED WFR _____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





NON-ELECTRIC FENCE GROUNDING



ELECTRIC FENCE GROUNDING

NOTES

1. GROUND RODS AND HARDWARE SHALL BE MADE OF STEEL AND GALVANIZED IN ACCORDANCE WITH ASTM DESIGNATION A 153.
2. CLAMP ASSEMBLY INCLUDES U-BOLT, CLAMP PLATE, TWO SPRING LOCKWASHERS AND TWO HEX NUTS.
3. USE ONE CLAMP ASSEMBLY, FOR EACH FENCE WIRE.
4. ELECTRIC FENCES SHALL BE GROUNDED ONLY THROUGH LIGHTNING ARRESTERS AS SHOWN. LIGHTNING ARRESTERS SHALL BE ESPECIALLY DESIGNED FOR USE WITH ELECTRIC FENCES. GROUND RODS SHALL BE DRIVEN AS CLOSE AS POSSIBLE TO, AND BONDED TO, ELECTRIC FENCE POSTS.
5. REMOVE SCALE AND RUST AND THEN COAT WITH NO-OXIDE COMPOUND, ALL FENCE WIRE SURFACES WHICH CONTACT CLAMP ASSEMBLIES.

Mar 23, 2006- 10:57am Plotted By: Seela S:\Engineering\Standard Drawings\41-1011c.dwg Lost Saved By: palmer IMAGES:

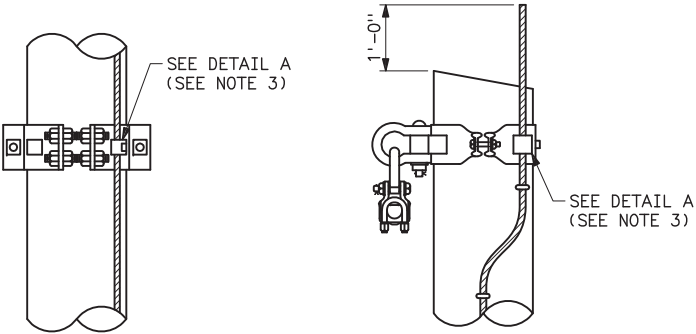
C	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.	
B	7-13-99 A3-RMC	REDRAWN.	
SUPERSEDES DWG NO. E40-D-5017			
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO			
TRANSMISSION LINE STANDARDS TRANSMISSION LINES FENCE GROUNDING HARDWARE			
DESIGNED <u>BUREC</u> _____ APPROVED <u>ROSS M. CLARK</u> _____ ELECTRICAL ENGINEERING MANAGER			
C A E	AUGUST 6, 1979	41	1011

MATERIALS LIST

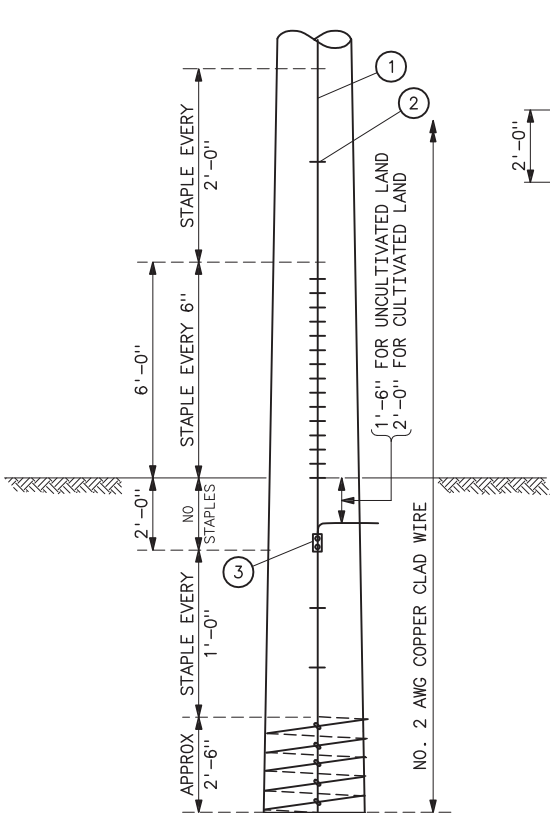
ITEM NO.	DESCRIPTION
1	NO.2 AWG, 30% CONDUCTIVITY, COPPER CLAD WIRE
2	GALVANIZED 2-INCH BARBED STAPLES
3	CLAMP, PARALLEL GROOVE, 2-BOLT COPPER ALLOY
4	POLE BOTTOM PLATE (BLACKBURN NO. GP 110 OR EQUAL) ATTACHED TO POLE
5	GROUNDING CLIP ASSEMBLY (INCLUDES BONDING CLIP, CARRIAGE BOLT, NUT, AND LOCKNUT)
6	BONDING CLIP (EQUAL TO BROOKS MANU. BC SERIES OR HUGHES BROS. NO. 2727)
7	MACHINE BOLT, 1/2x3
8	LOCKNUT FOR 1/2" BOLT
9	CADWELD, THERMOWELD OR EQUAL EXOTHERMIC TYPE CONNECTION
10	GROUND ROD, COPPER-CLAD STEEL 5/8x8 FT

NOTES

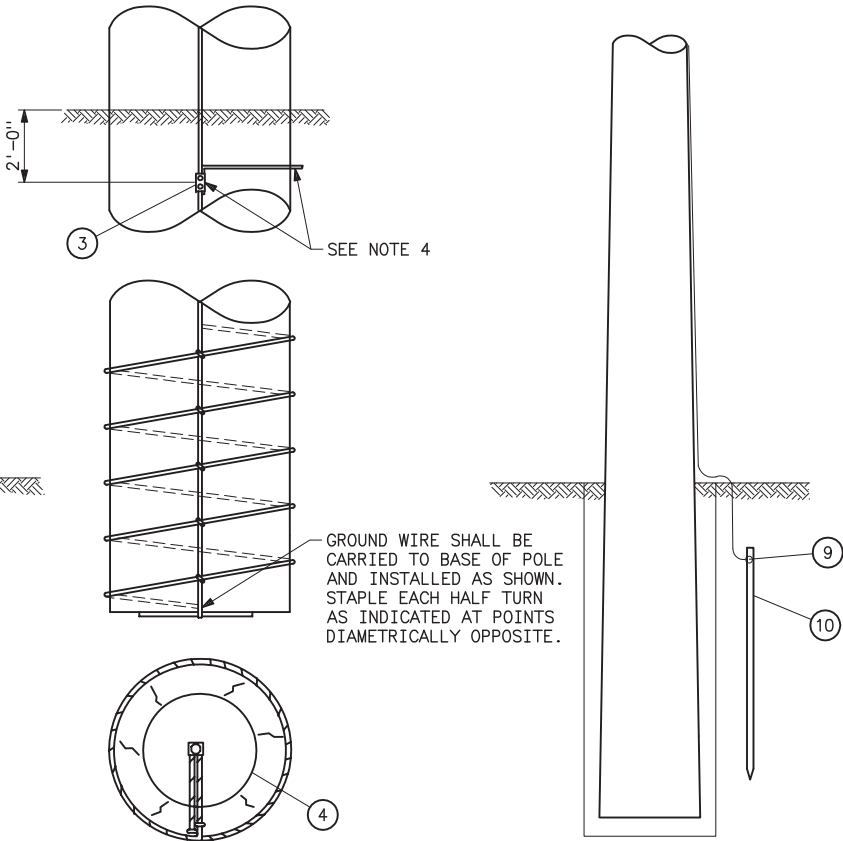
1. INSTALL GROUND WIRE AS INDICATED ON INDIVIDUAL STRUCTURE DRAWINGS.
2. PARALLEL GROOVE CLAMP, BONDING CLIP AND JUMPER FOR BONDING TO CROSSARM IS REQUIRED FOR 230KV STRUCTURES ONLY.
3. USE ONE GROUNDING CLIP ASSEMBLY PER POLE BAND.
4. UNDERGROUND POLE-TO-POLE GROUND WIRE TIE IS REQUIRED FOR ALL STRUCTURES EXCEPT FOR THOSE THAT HAVE STEEL ANGLE BONDING.
5. USE GROUND ROD ONLY WHEN SPECIFIED. THE TOP OF THE GROUND ROD SHALL BE PLACED A MINIMUM OF 6 INCHES BELOW GROUND LEVEL.



POLE BAND BONDING



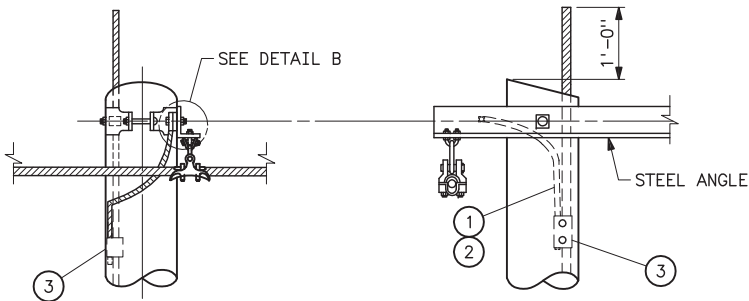
GROUND WIRE ATTACHMENT DETAILS



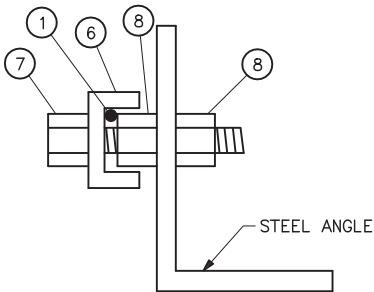
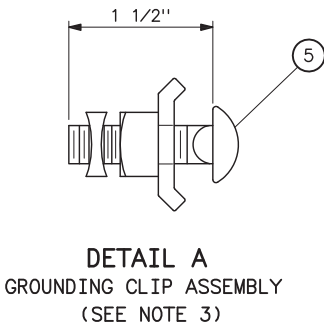
POLE BUTT WRAPPING DETAIL

GROUND ROD DETAIL

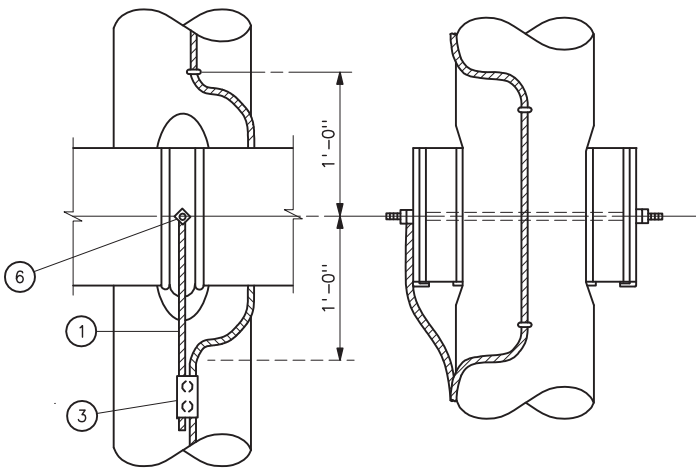
SEE NOTE 5



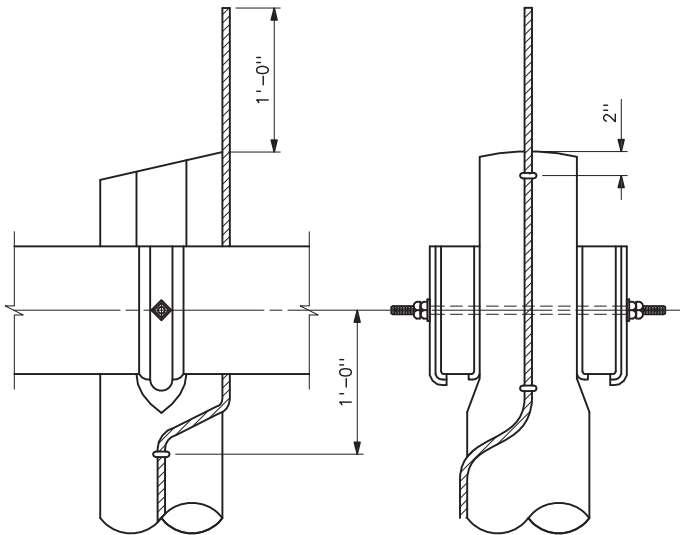
STEEL ANGLE BONDING



DETAIL B
BONDING CLIP ASSEMBLY

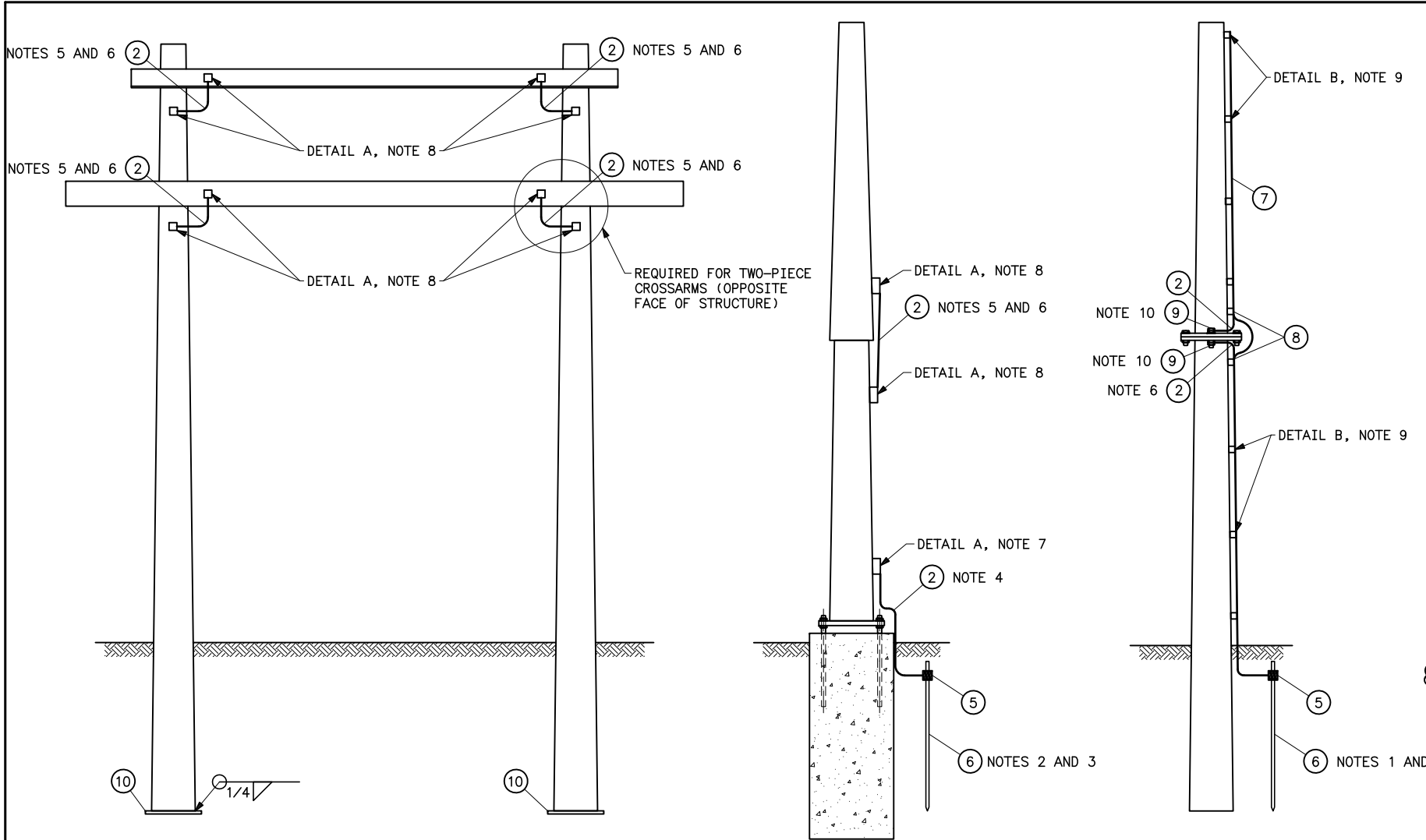


CROSSARM DETAIL
AND BONDING
FOR STRUCTURE WITH OGW
(SEE NOTE 2)



CROSSARM DETAIL AND BONDING
FOR STRUCTURE WITHOUT OGW

C	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.	
B	5-18-95 A2-RMC	REDRAWN.	
SUPERSEDES DWG NO. 40-D-4978			
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO			
TRANSMISSION LINE STANDARDS WOOD POLE STRUCTURES GROUNDING DETAILS			
DESIGNED <u>SRR</u> _____		APPROVED <u>ROSS M. CLARK</u> CHIEF, TRANSMISSION LINE BRANCH	
C A F	AUGUST 6, 1979	41	1012

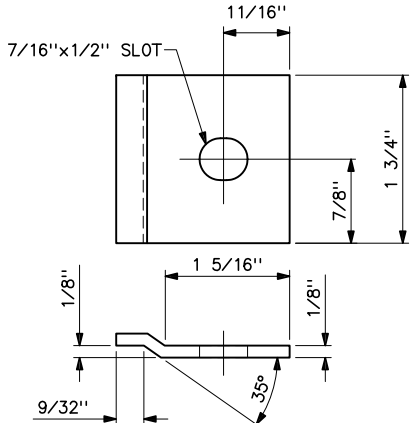
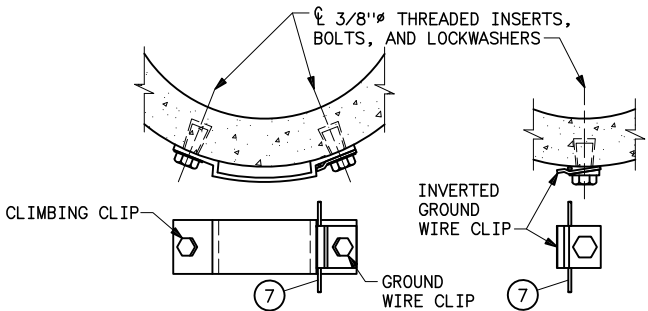
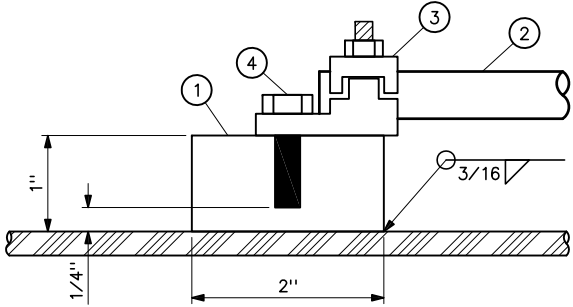


WEATHERING STEEL H-FRAME
NATIVE BACKFILL
NOTE 13

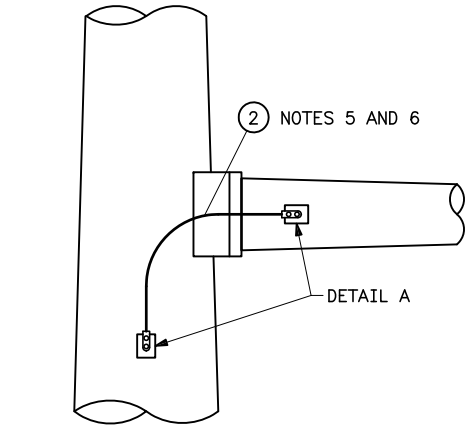
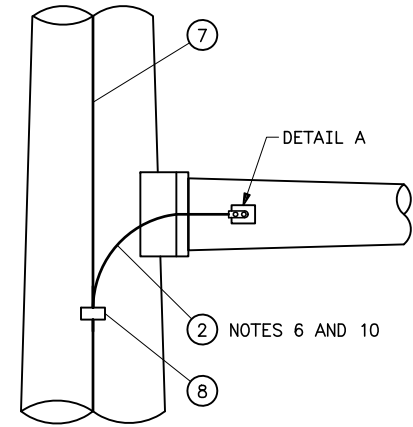
WEATHERING STEEL POLE
CONCRETE FOUNDATION OR CONCRETE BACKFILL
NOTE 13

CONCRETE POLE
NATIVE BACKFILL

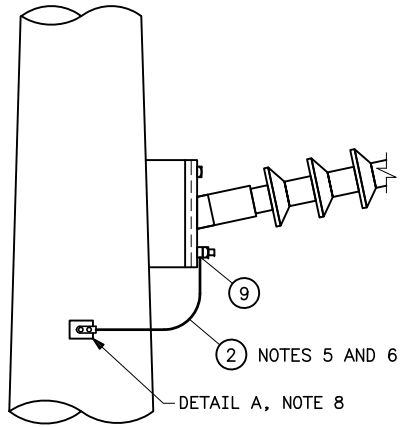
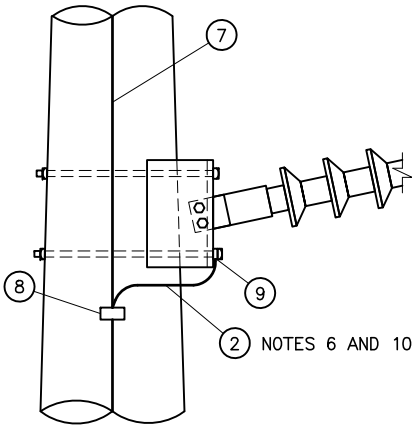
MATERIAL LIST	
ITEM NO.	DESCRIPTION
1	STAINLESS STEEL GROUND PLATE 2"x2"x1" CENTER DRILLED AND TAPPED FOR 3/8"Ø BOLT - INSTALL AS SHOWN IN DETAIL A
2	PIGTAIL JUMPER, NO. 2 AWG, 30% CONDUCTIVITY, COPPER CLAD WIRE, LENGTH AS REQUIRED
3	TERMINAL SUITABLE FOR NO. 2 AWG COPPER WIRE (BURNDY TYPE QDA OR EQUAL) WITH CONTACT SEALANT
4	3/8"Ø STAINLESS STEEL HEX HEAD BOLT, LENGTH AS NECESSARY TO ATTACH TERMINAL
5	CADWELD, THERMOWELD OR EQUAL EXOTHERMIC TYPE CONNECTION
6	GROUND ROD, COPPER COVERED STEEL 5/8"Øx8 FEET
7	CONTINUOUS CONCRETE POLE GROUND WIRE, NO. 2 AWG, 30% CONDUCTIVITY, COPPER CLAD WIRE
8	SPLIT-BOLT CONNECTOR (BURNDY TYPE KSA OR EQUAL) WITH CONTACT SEALANT
9	BONDING CLIP (EQUAL TO BROOKS MANUFACTURING BC SERIES OR HUGHES BROTHERS NO. 2727)
10	1/2"-THICK STAINLESS STEEL WELDED HERMETICALLY-SEALED BEARING PLATE



- NOTES
- GROUND RODS ARE REQUIRED FOR ALL CONCRETE POLES.
 - GROUND RODS ARE REQUIRED FOR ALL WEATHERING STEEL POLES WITH CONCRETE FOUNDATIONS OR CONCRETE BACKFILL.
 - PLACE TOP OF GROUND ROD A MINIMUM OF 6" BELOW GROUND LINE.
 - PIGTAIL JUMPERS ARE REQUIRED BETWEEN POLE SHAFTS AND GROUND RODS ON WEATHERING STEEL POLE SHAFTS WITH CONCRETE FOUNDATIONS OR CONCRETE BACKFILL.
 - PIGTAIL JUMPERS ARE REQUIRED ON WEATHERING STEEL STRUCTURES ACROSS ALL SLIP JOINTS AND BOLTED CONNECTIONS, INCLUDING DAVIT ARM, CROSSARM, AND POST INSULATOR CONNECTIONS.
 - LENGTHS AND LOCATIONS OF PIGTAIL JUMPERS SHALL NOT INTERFERE WITH CLIMBING.
 - GROUND PLATES ARE REQUIRED 2 FEET ABOVE GROUND LINE ON ALL WEATHERING STEEL POLE SHAFTS WITH CONCRETE FOUNDATIONS OR CONCRETE BACKFILL.
 - WEATHERING STEEL STRUCTURES SHALL HAVE GROUND PLATES ON EITHER SIDE OF SLIP JOINTS AND BOLTED CONNECTIONS, INCLUDING FLANGE JOINTS, DAVIT ARM, AND CROSSARM CONNECTIONS, AND ON THE POLE SHAFT ADJACENT TO POST INSULATOR CONNECTIONS.
 - ATTACH CONTINUOUS GROUND WIRE EVERY 5 FEET (MINIMUM) TO FULL LENGTH OF CONCRETE POLES WITH GALVANIZED STEEL GROUND WIRE CLIPS, THREADED INSERTS BOLTS, AND LOCKWASHERS.
 - ATTACH ALL SPLICE PLATES, CONDUCTOR ATTACHMENTS, DAVIT ARMS, AND POST INSULATOR BASES TO THE GROUND WIRE ON CONCRETE POLES WITH PIGTAIL JUMPERS.
 - COMPOSITE STEEL AND CONCRETE POLES SHALL HAVE A CONTINUOUS GROUND WIRE RUNNING THE FULL LENGTH OF THE CONCRETE SECTION, ATTACHED TO THE STEEL SECTION WITH A GROUND PLATE.
 - CADWELD MAY BE SUBSTITUTED FOR GROUNDING METHOD SHOWN IN DETAIL A.
 - FOR WEATHERING-STEEL STRUCTURES, AFTER INSTALLING FIXED CLIMBING RUNG SECTIONS WITH BOLTS, NUTS, AND LOCKNUTS, SPOT WELD THE RUNG SECTION MOUNTING PLATES TO THE CLIPS ON THE POLE SHAFTS. WELDING SHALL BE SUFFICIENT TO PROVIDE ELECTRICAL CONTINUITY BETWEEN CLIMBING RUNG SECTIONS AND THE POLE SHAFT. PREFERRED WELDING ROD SERIES IS E8018-C3. OTHER ACCEPTABLE SERIES ARE E8018-C1 AND E8018-C2.



DAVIT ARM GROUNDING



POST INSULATOR GROUNDING

K	09-9-09 A7-BGH	ADDED NOTE 13 FOR GROUNDING REQUIREMENTS FOR WEATHERING-STEEL FIXED CLIMBING RUNG SECTIONS.
J	04-5-07 A7-BGH	REVISED GROUNDING REQUIREMENTS FOR WEATHERING STEEL POLE WITH CONCRETE BACKFILL.
I	02-11-05 A7-BGH	DELETED GROUNDING REQUIREMENTS FOR GALVANIZED AND METALLIZED STRUCTURES. REVISED GROUNDING REQUIREMENTS FOR WEATHERING STEEL STRUCTURES AND NOTES.
H	07-15-03 A7-DH	REVISED TITLE BLOCK ONLY.
G	03-30-98 A3-BH	REDRAWN AND REVISED.
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
TRANSMISSION LINE STANDARDS WEATHERING STEEL AND CONCRETE POLE STRUCTURES GROUNDING DETAILS		
DESIGNED BOBBY HAGLER APPROVED DOUG HANSON CIVIL ENGINEERING MANAGER		
CA	APRIL 20, 1984	41 1015