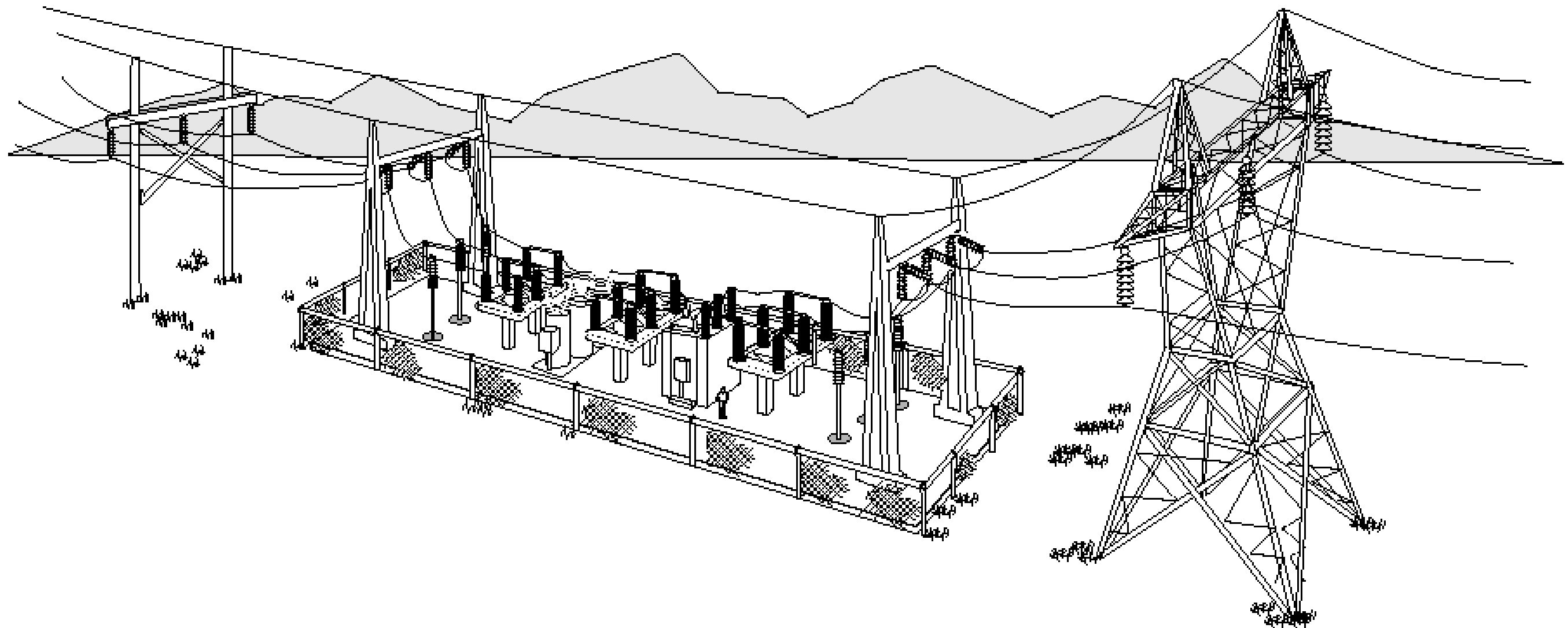




Western Area
Power Administration

CONSTRUCTION STANDARDS STANDARD DRAWINGS



February 2021

SAFETY
A HABIT TO LIVE BY

CONSTRUCTION STANDARD DRAWINGS
DIVISION 15

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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

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

DIMENSIONS

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

COVER (SEE NOTES 1, 2)

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

REFERENCES

- 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

- 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.
- 90° HOOKS SHALL HAVE A 90° BEND AND AN EXTENSION OF AT LEAST 12-BAR DIAMETERS.
- 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.
- 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.
- MINIMUM INSIDE BEND DIAMETERS ARE TO BE AS SPECIFIED IN TABLE 2, TYP.

REINFORCEMENT DOWELS

- 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

- 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)

- 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

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

EMBEDDED MATERIALS

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

PLACING

- 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.
- 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.
- IN NO CASE SHOULD BARS BE BENT TO GREATER THAN 6 TO 1 SLOPE.
- 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)

- 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)

- ALL CONSTRUCTION JOINTS (CJ), EXPANSION JOINTS (EJ) AND CONTROL JOINTS (SCJ, TCJ) SHALL BE PROVIDED WHERE SHOWN ON THE DESIGN DRAWINGS.
- 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.
- ADDITIONAL JOINTS MAY BE USED IF APPROVED BY THE COR AND ENGINEER.

SPLICES

- UNLESS OTHERWISE SHOWN, THE MINIMUM LENGTH OF LAP FOR SPLICING PARALLEL BARS IN TENSION SHALL BE AS GIVEN IN TABLE 3, CLASS B.
- UNLESS OTHERWISE SHOWN, THE MINIMUM LENGTH OF LAP FOR CIRCULAR COLUMN AND DRILLED PIER TIES SHALL BE AS GIVEN IN TABLE 5.
- 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.
- 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".
- 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.
- WHEN REINFORCING BARS OF DIFFERENT SIZE ARE TO BE SPLICED, THE LENGTH OF LAP SHALL BE GOVERNED BY THE SMALLER DIAMETER BAR.
- SPLICES ARE TO BE MADE SO THAT THE GIVEN DISTANCES TO FACE OF CONCRETE WILL BE MAINTAINED.

BENT BARS

- 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.
- 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	[10]	0.375	0.11	0.376	
4	[13]	0.500	0.20	0.668	
5	[16]	0.625	0.31	1.043	
6	[19]	0.750	0.44	1.502	
7	[22]	0.875	0.60	2.044	
8	[25]	1.000	0.79	2.670	
9	[29]	1.128	1.00	3.400	
10	[32]	1.270	1.27	4.303	
11	[36]	1.410	1.56	5.313	
14	[43]	1.693	2.25	7.65	
18	[57]	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 (Ld) AND LAP LENGTH (INCHES)

BAR SIZE	SEE FOOTNOTES 1 THRU 6											
	F'c =3000 PSI				F'c =4000 PSI				F'c =5000 PSI			
	Ld OR CLASS A LAP		CLASS B LAP		Ld OR CLASS A LAP		CLASS B LAP		Ld OR CLASS A LAP	CLASS B LAP		
ENGLISH	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

- MINIMUM DEVELOPMENT LENGTH IS 12".
- (*) LAP SPLICES ARE NOT PERMITTED FOR BARS LARGER THAN NO. 11.
- 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.
- 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.
 - NORMAL WEIGHT CONCRETE AND GRADE 60 REINFORCING BARS.
 - UNCOATED OR ZINC-COATED (GALVANIZED) REINFORCEMENT.
 - $\psi_T = 1.3$ FOR TOP BARS (GREATER THAN 12" OF CONCRETE BELOW HORIZONTAL REINFORCEMENT) AND $\psi_T = 1.0$ FOR OTHER BARS.
 - VALUES IN TABLE 3 ARE FOR DEFORMED BARS IN TENSION.
- TABLE 3 VALUES ARE APPLICABLE IF:
 - 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
 - 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.
 - OTHERWISE, THE VALUES OF TABLE 3 SHALL BE MULTIPLIED BY 1.5.
- CLASS A LAP SPLICE = $1.0 \times L_d$. CLASS B LAP SPLICE = $1.3 \times L_d$.

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

BAR SIZE	SEE FOOTNOTES 1 AND 2		
	F'c =3000 PSI	F'c =4000 PSI	F'c =5000 PSI
ENGLISH			
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

- MINIMUM HOOK DEVELOPMENT LENGTH SHOULD NOT BE LESS THAN THE LARGER OF 8-BAR DIAMETERS OR 6".
- 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.
 - NORMAL WEIGHT CONCRETE AND GRADE 60 REINFORCING BARS.
 - UNCOATED OR ZINC-COATED (GALVANIZED) REINFORCEMENT.
 - $\psi_0 = 1.0$. 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.
 - $\psi_R = 1.0$. 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.

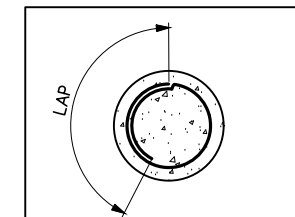
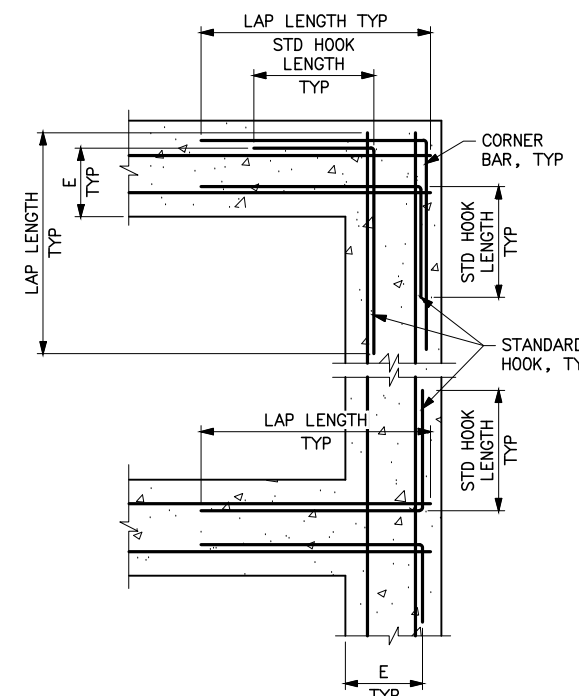


TABLE 5 - CIRCULAR TIE LAPS FOR DRILLED PIERS & COLUMNS



TYPICAL CORNER & INTERSECTION DETAILS

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
- OCWE = 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

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

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

SUPERSEDES DWG NO. 01 2004A

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

CONCRETE STANDARDS GENERAL OUTLINE AND REINFORCEMENT NOTES

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

AUGUST 1, 2006 01 2004-1

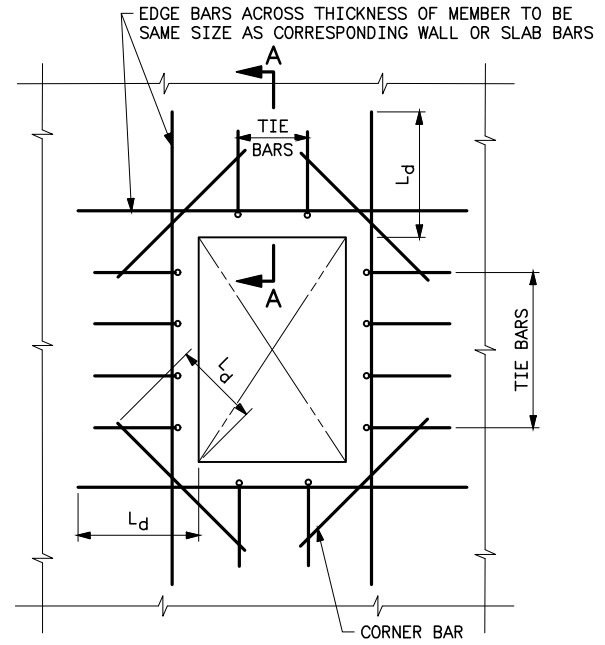
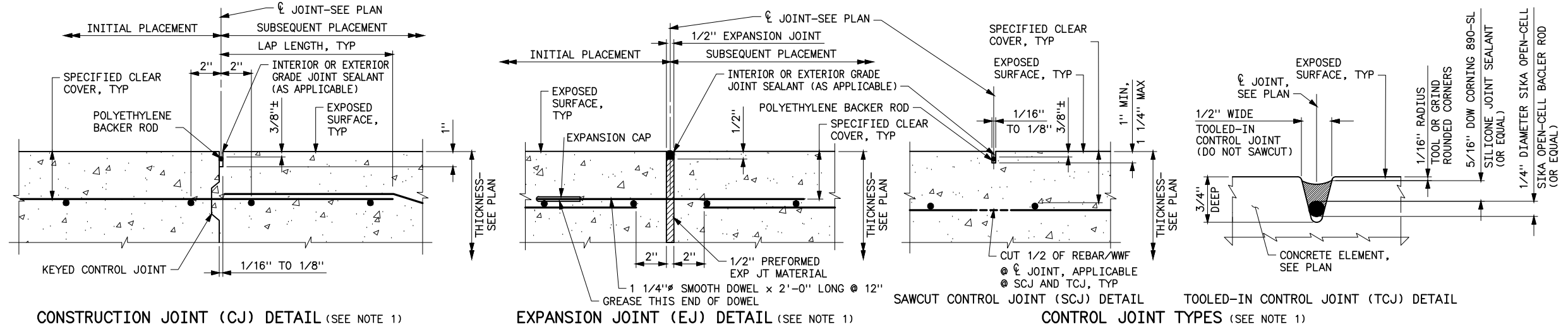
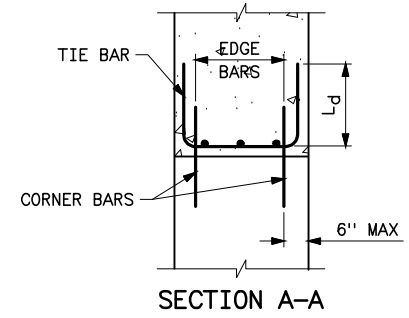


TABLE FOR REINFORCEMENT AROUND OPENINGS

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

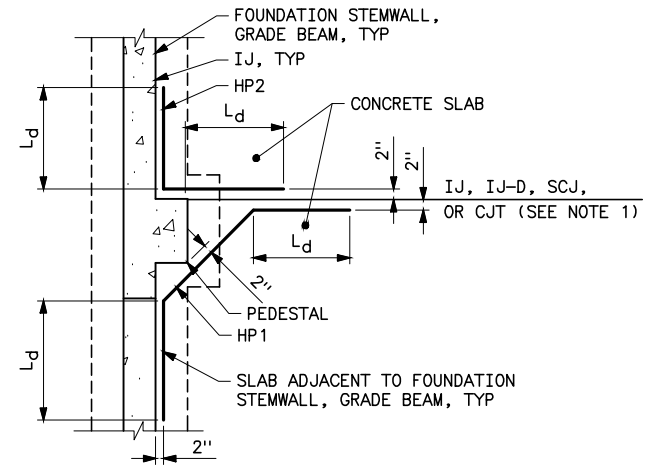
- OMIT EDGE AND TIE BARS ALONG SIDES OF OPENINGS WHERE DIMENSION IS LESS THAN 1'-6".
- OMIT CORNER BARS AT SIDES OF OPENINGS ADJACENT TO FLOORS, WALLS, OR BEAMS.
- CORNER BARS REQUIRED IF EITHER DIMENSION OF OPENING IS GREATER THAN 1'-6".
- USE CORNER BARS IN FACE OF RECESSES DEEPER THAN 4" IF EITHER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

ADDITIONAL REINFORCEMENT AROUND OPENINGS

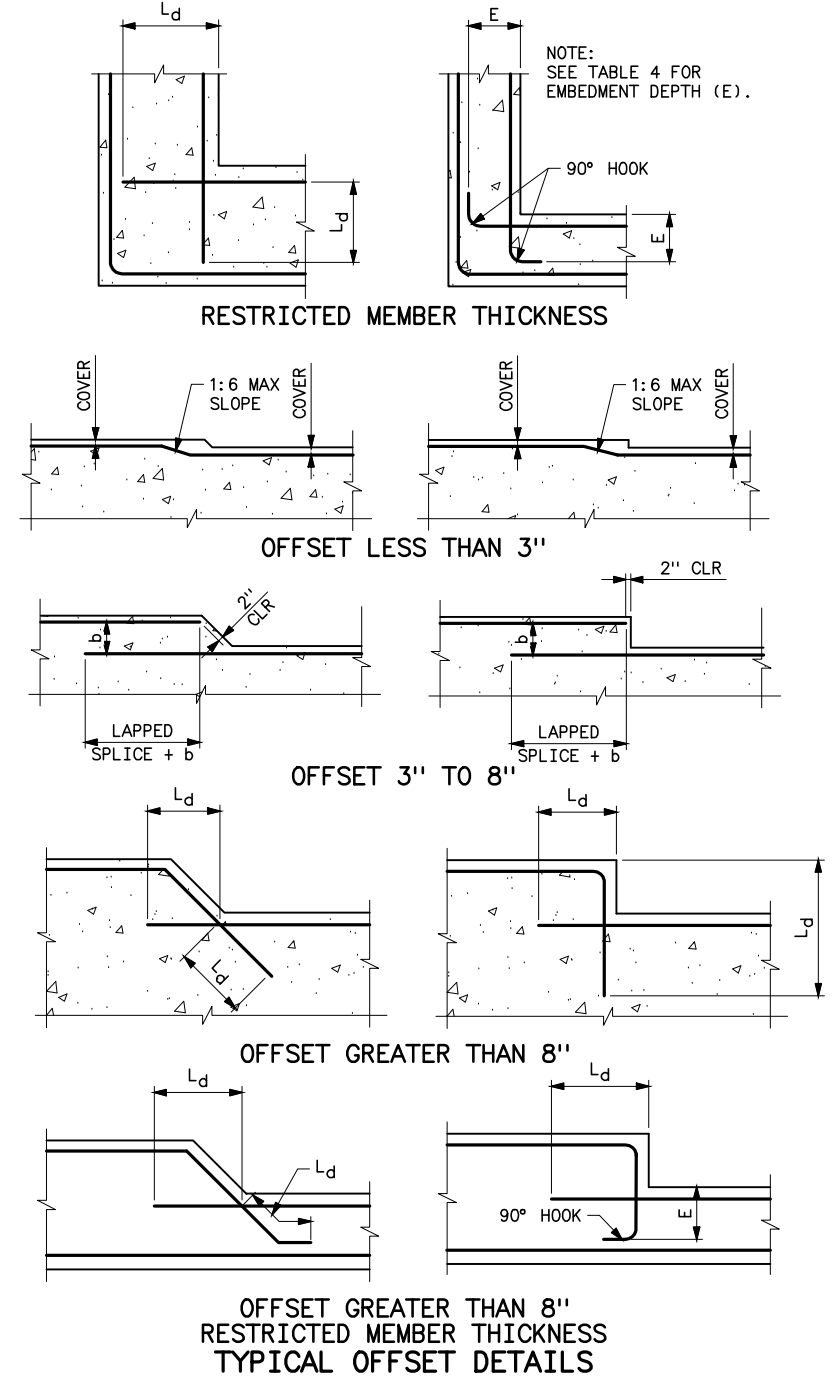


HAIRPIN BAR SCHEDULE

HP1	
HP2	
HP3	
HP4	



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



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

D	10-8-20 A7-JAS	REVISIONS COORDINATED WITH NOTE 1 AND UPDATED REINFORCEMENT STDS PER ACI 318-19 & ACI 318R-19.
C	11-1-17 A7-JAS	MINOR REVISIONS-CONTROL JOINT TYPES, JOINT EJSF, AND HAIRPIN DETAILS.
B	9-27-16 A7-RBP	UPDATED REINFORCEMENT STANDARDS WITH ACI 318-14 CODE.
A	9-17-13 A7-OF	MINOR REVISIONS.

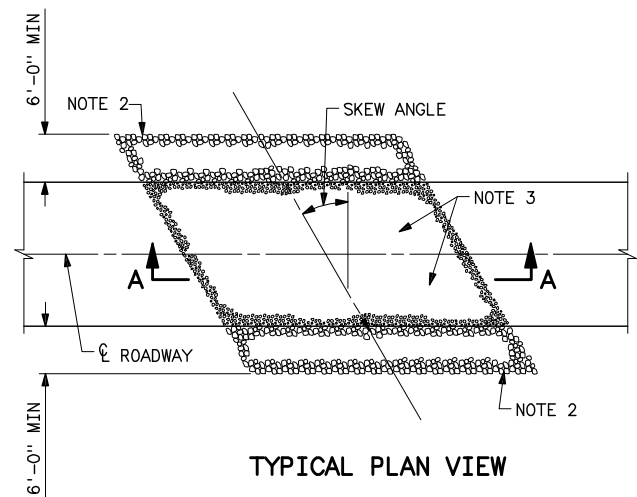
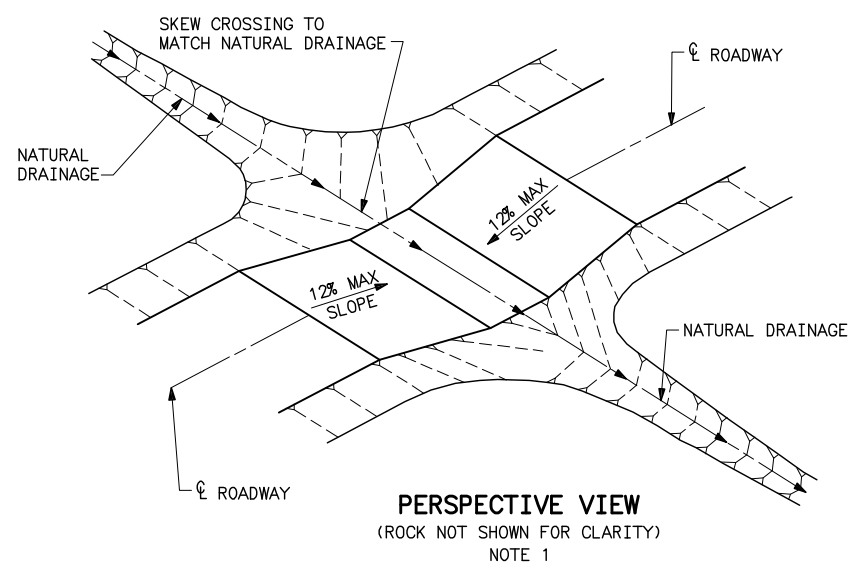
SUPERSEDES DWG NO. 01 2004A (IN PART)

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

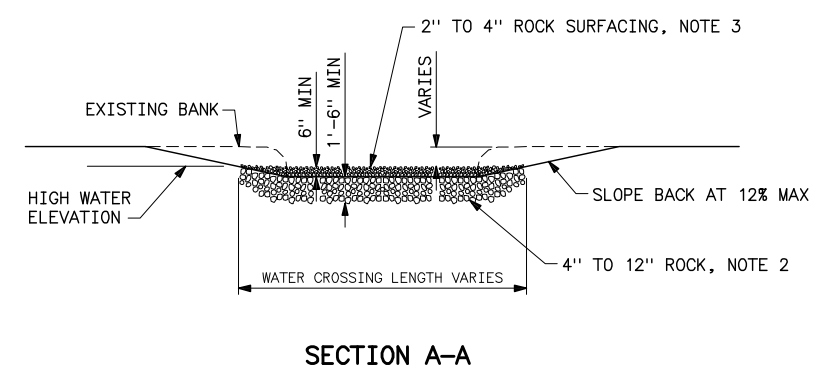
**CONCRETE STANDARDS
 GENERAL OUTLINE AND
 REINFORCEMENT NOTES**

DESIGNED J.A. SCHREIBER APPROVED D. HANSON
 ELECTRICAL ENGINEERING MANAGER

Plotted By: Denton Oct 08, 2020 - 7:16am S:\projects\mifsec\StandardDrawings\Drawings\DrawingsReadyForFinal\Scripts\01_2004_2d.dwg Last Saved By: Denton, Debra on 10/8/2020 7:15 AM



- 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	REVISED TITLE BLOCK ONLY.
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
STANDARD DESIGNS SITWORK TYPICAL WATER CROSSING		
DESIGNED <u>BOBBY G. HAGLER</u>		APPROVED <u>DOUGLAS HANSON</u> CIVIL ENGINEERING MANAGER
CA	FEBRUARY 27, 1995	01 2005

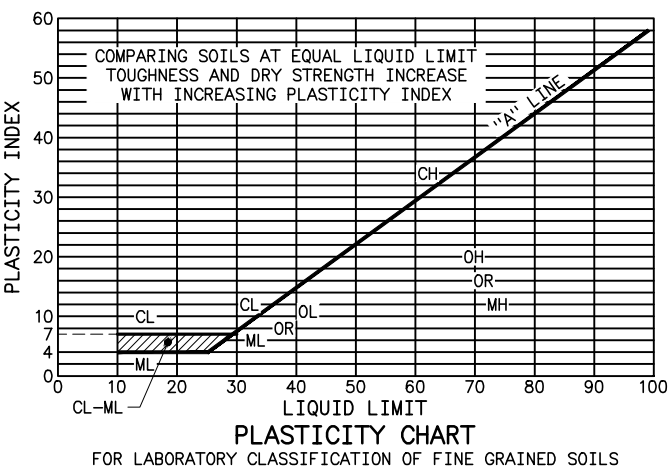
Sep. 26, 2012 - 1:22pm Plot Led By: larpman S:\projects\misc\StandardDrawings\Final\01_2005b.dwg Last Saved By: see1a IMAGE\$

UNIFIED SOIL CLASSIFICATION
INCLUDING IDENTIFICATION AND DESCRIPTION

FIELD IDENTIFICATION PROCEDURES (EXCLUDING PARTICLES LARGER THAN 3 INCHES AND BASING FRACTIONS ON ESTIMATED WEIGHTS)		GROUP SYMBOLS ^{L1}	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 ^{L2}	GRAVELS MORE THAN HALF OF COURSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE	CLEAN GRAVELS (LITTLE OR NO FINES)	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES; LITTLE OR NO FINES.	$C_u = \frac{d_{60}}{d_{10}} \text{ GREATER THAN } 4$ $C_c = \frac{(d_{30})^2}{d_{10} \times d_{60}} \text{ BETWEEN ONE AND } 3$	
		GRAVELS WITH APPRECIABLE AMOUNT OF FINES	GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES; LITTLE OR NO FINES.		
	SANDS MORE THAN HALF OF COURSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE (FOR VISUAL CLASSIFICATIONS, THE 1/4" SIZE MAY BE USED AS EQUIVALENT TO THE NO. 4 SIEVE SIZE)	CLEAN SANDS (LITTLE OR NO FINES)	SW	WELL GRADED SANDS, GRAVELLY SANDS; LITTLE OR NO FINES.		
		SANDS WITH APPRECIABLE AMOUNT OF FINES	SP	POORLY GRADED SANDS, GRAVELLY SANDS; LITTLE OR NO FINES.		
	FINE GRAINED SOILS MORE THAN HALF OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE IS ABOUT THE SMALLEST PARTICLE VISIBLE TO THE NAKED EYE	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS WITH SLIGHT PLASTICITY		<p>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.</p> <p>FOR UNDISTURBED SOILS ADD INFORMATION ON STRATIFICATION, DEGREE OF COMPACTNESS, CEMENTATION, MOISTURE CONDITIONS AND DRAINAGE CHARACTERISTICS.</p> <p>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)</p>
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS		
SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50	OL	ORGANIC SILTS AND ORGANIC SILT-CLAYS OF LOW PLASTICITY				
	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS				
HIGHLY ORGANIC SOILS	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS				
	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY				
IDENTIFICATION PROCEDURES ON FRACTION SMALLER THAN NO. 40 SIEVE SIZE						
		DRY STRENGTH (CRUSHING CHARACTERISTICS)	DILATANCY (REACTION TO SHAKING)	TOUGHNESS (CONSISTENCY NEAR PLASTIC LIMIT)		
		NONE TO SLIGHT	QUICK TO SLOW	NONE		
		MEDIUM TO HIGH	NONE TO VERY SLOW	MEDIUM		
		SLIGHT TO MEDIUM	SLOW	SLIGHT		
		SLIGHT TO MEDIUM	SLOW TO NONE	SLIGHT TO MEDIUM		
		HIGH TO VERY HIGH	NONE	HIGH		
		MEDIUM TO HIGH	NONE TO VERY SLOW	SLIGHT TO MEDIUM		
HIGHLY ORGANIC SOILS		READILY IDENTIFIED BY COLOR, ODOR, SPONGY FEEL AND FREQUENTLY BY FIBROUS TEXTURE	P+	PEAT AND OTHER HIGHLY ORGANIC SOILS		

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:-
LESS THAN 5% MORE THAN 12% 5% TO 12%



^{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

FIELD IDENTIFICATION PROCEDURES FOR FINE GRAINED SOILS OR FRACTIONS
THESE PROCEDURES ARE TO BE PERFORMED ON THE MINUS NO. 40 SIEVE SIZE PARTICLES, APPROXIMATELY 1/64 IN. FOR FIELD CLASSIFICATION PURPOSES, SCREENING IS NOT INTENDED; SIMPLY REMOVE BY HAND THE COARSE PARTICLES THAT INTERFERE WITH THE TESTS.

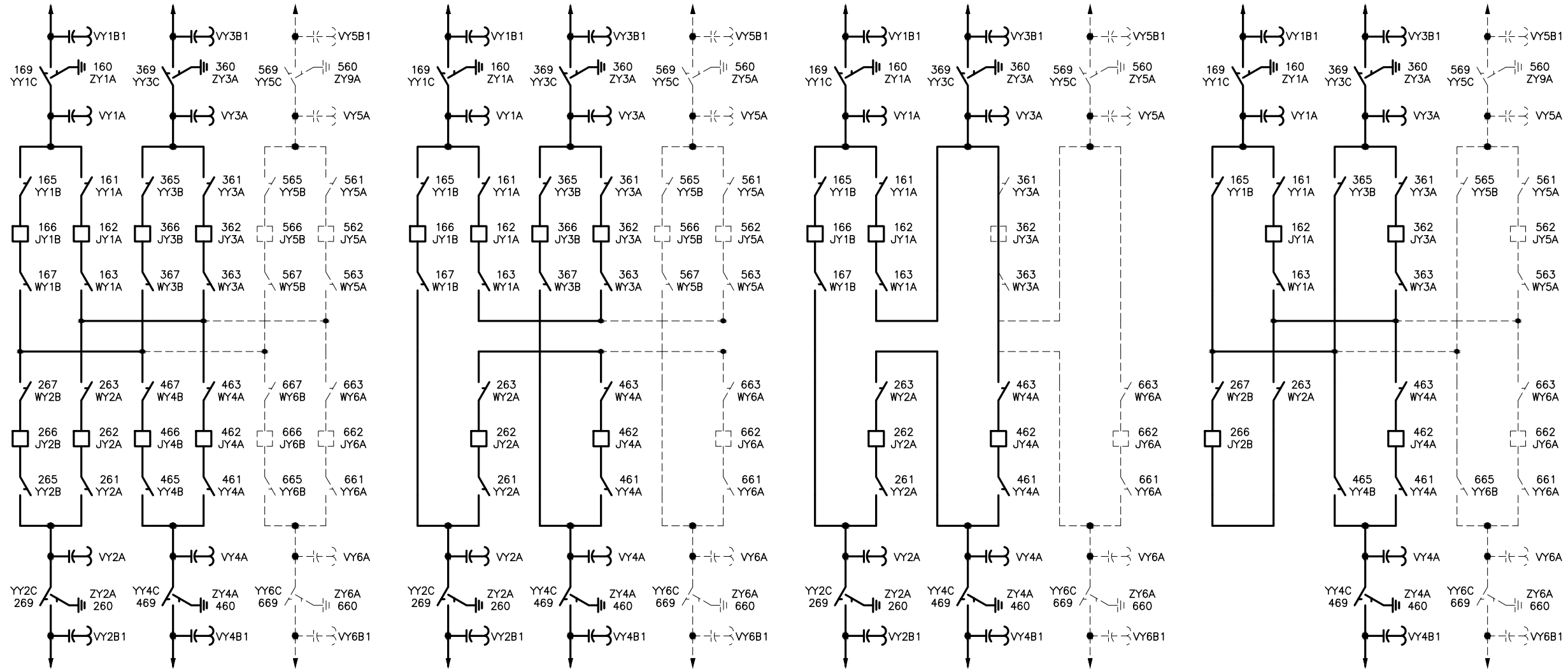
DILATANCY (REACTION TO SHAKING)
AFTER REMOVING PARTICLES LARGER THAN NO. 40 SIEVE SIZE, PREPARE A PAT OF MOIST SOIL WITH A VOLUME OF ABOUT ONE-HALF CUBIC INCH. ADD ENOUGH WATER IF NECESSARY TO MAKE THE SOIL SOFT BUT NOT STICKY.
PLACE THE PAT IN THE OPEN PALM OF ONE HAND AND SHAKE HORIZONTALLY, STRIKING 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 DISAPPEARS 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 ROLLED 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.

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

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DOUBLE BREAKER DOUBLE BUS
OUTSIDE TAKEOFF

BREAKER AND A HALF
OUTSIDE TAKEOFF

RING BUS - FUTURE BREAKER AND A HALF
OUTSIDE TAKEOFF

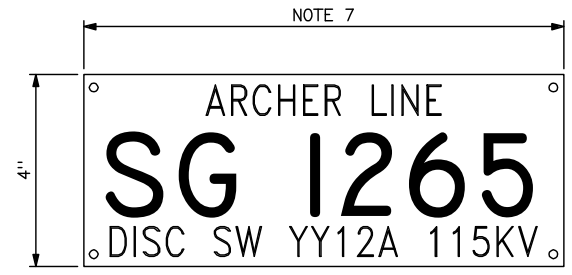
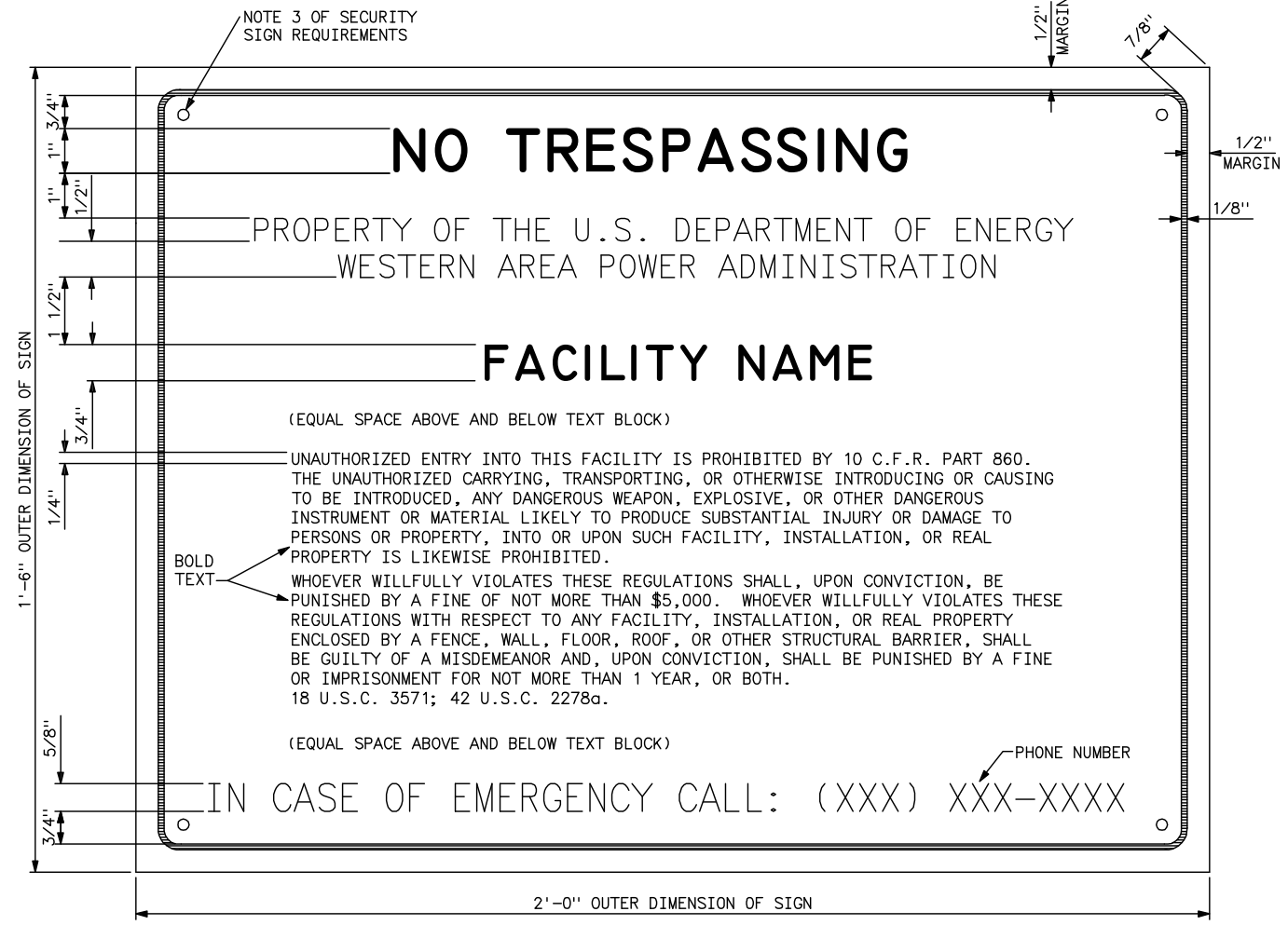
MAIN AND TRANSFER BUS
OUTSIDE TAKEOFF

NOTES

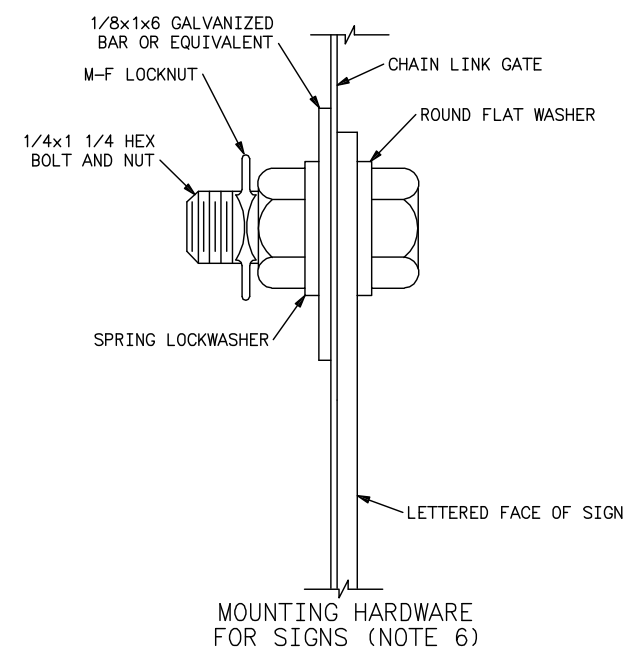
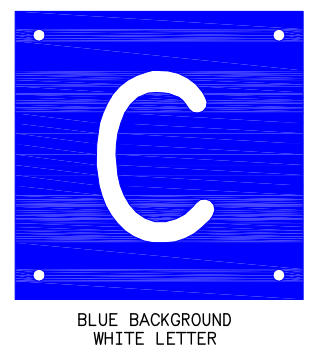
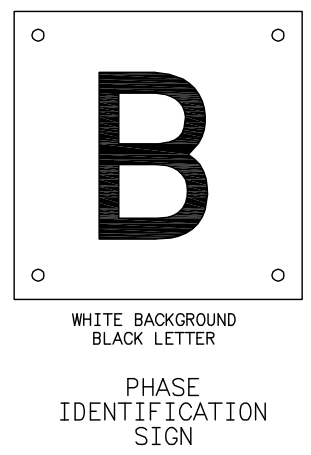
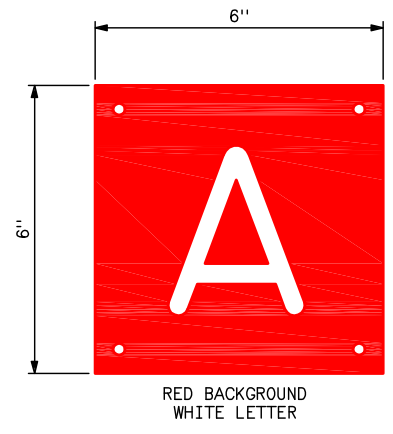
1. THE INTENT OF ALL OUTSIDE TAKE OFF CONFIGURATIONS ARE TO BE FULLY DEVELOPED UP TO A DOUBLE BREAKER DOUBLE BUS DESIGN, EVEN THOUGH THEY MAY NEVER BE EXPANDED AS SUCH. DESIGNATIONS AND OPERATING NUMBERS SHOULD BE USED TO REFLECT THIS FINAL DESIGN.
2. OPERATING NUMBERS AND DESIGNATIONS PROVIDED ARE FOR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

Plotted By: denton Apr 03, 2012 - 3:36pm
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A	4-3-12 A7-RMJ	REVISED BKR & A HALF AND RING BUS LAYOUTS TO CONFORM TO OPERATING NUMBER STANDARDS.
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS SWITCHING DIAGRAM OPERATING NUMBERS BUS CONFIGURATIONS		
DESIGNED RICARDO MORENO JR.		APPROVED ROSS M. CLARK ELECTRICAL ENGINEERING MANAGER
A	SEPTEMBER 15, 2009	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	NO. 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 (b) 13,200 (e)	(c) (c) (c) (c)	(c) (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) (a) 6,300 (e)	(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 (e)	(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 (e)	(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 (e)	3,500 (f)	22 22 23	5,000 5,000 (a) 6,400	(c) 4,800 4,800	(c) 4,800 (e)	(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%

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B	5-14-99 A3-0P	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	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-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	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)	(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.

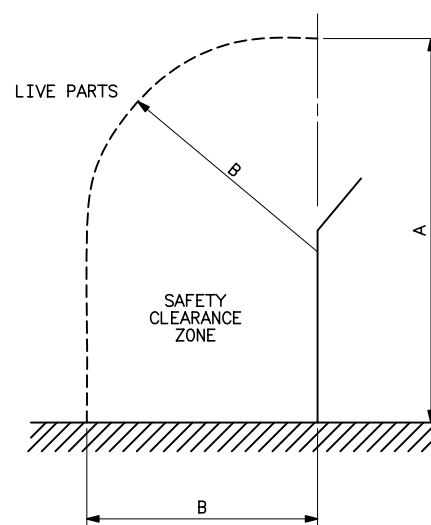
NOTES

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 119 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**

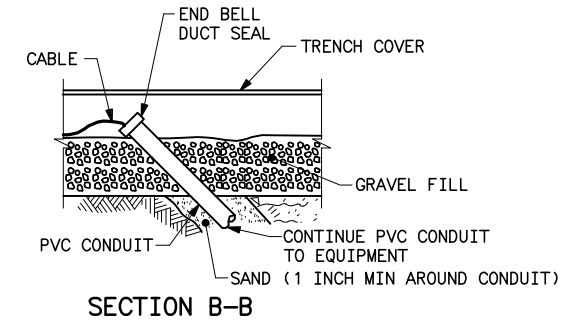
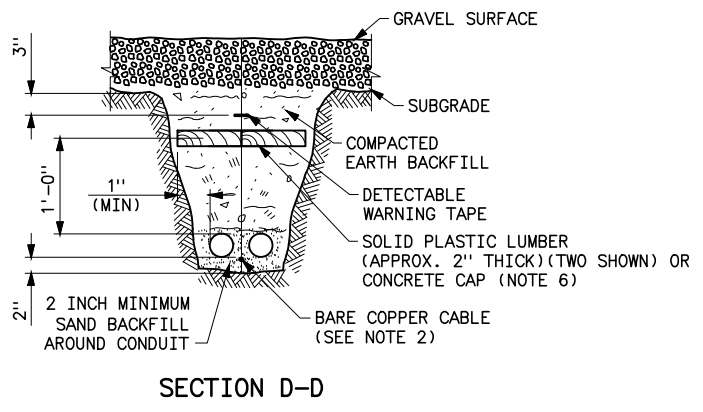
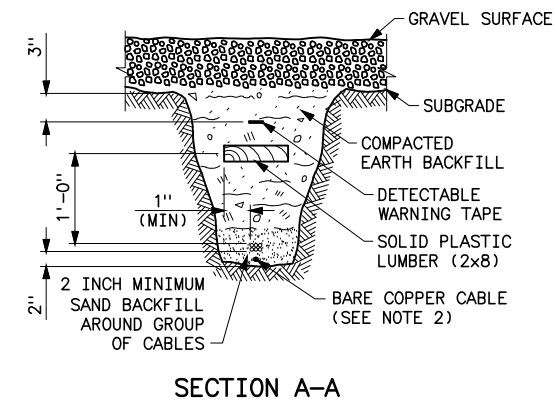
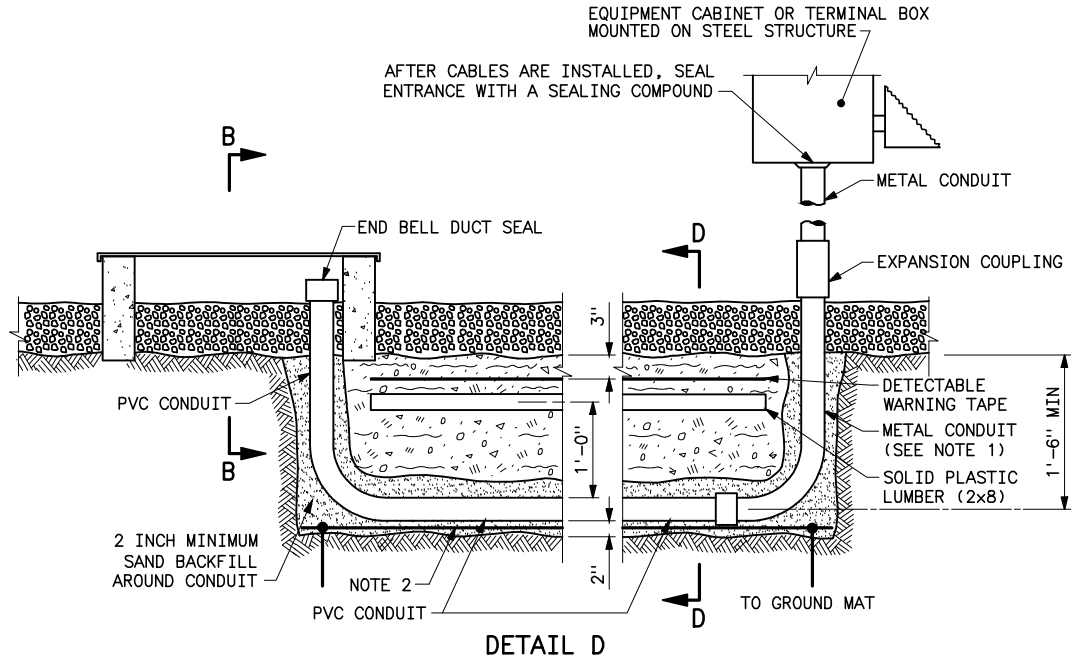
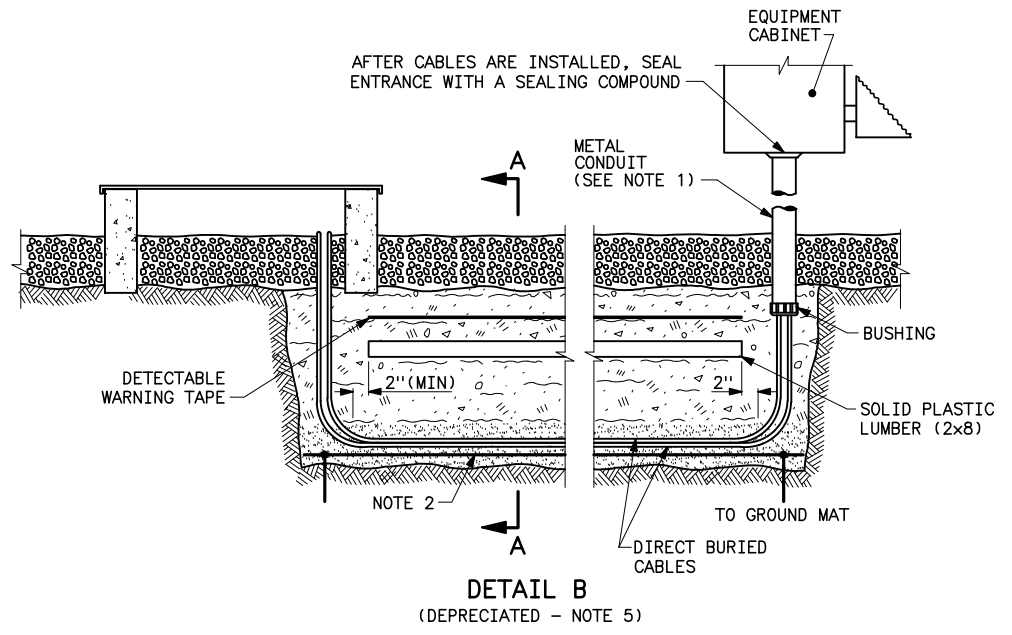
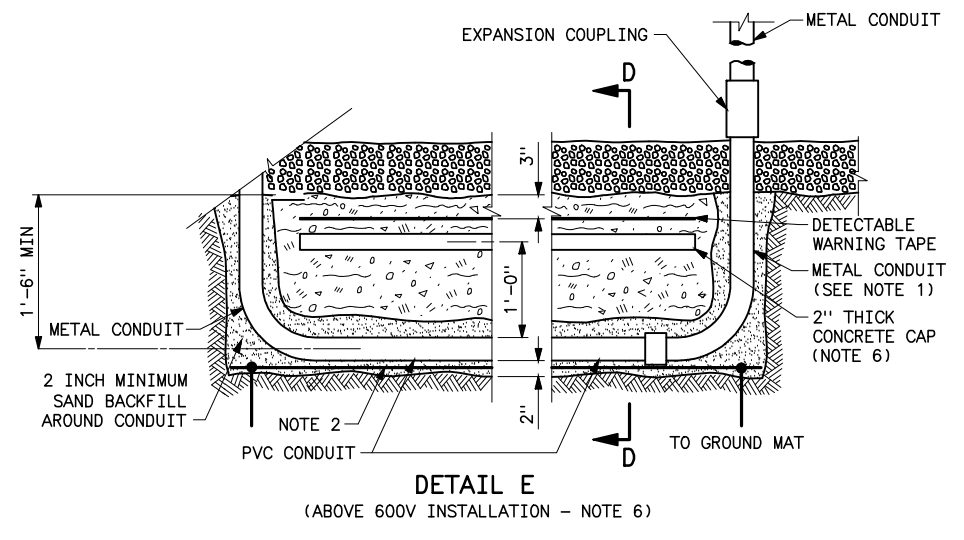
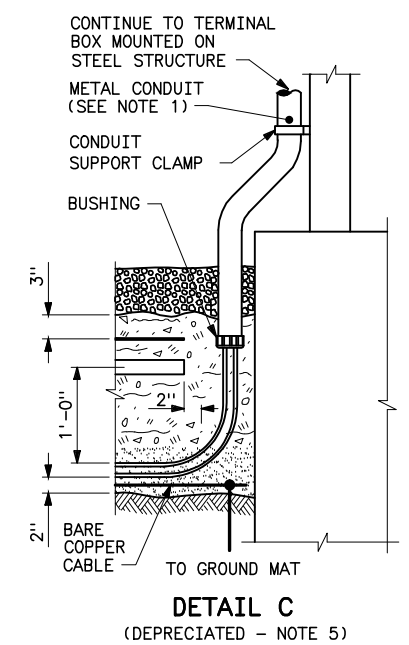
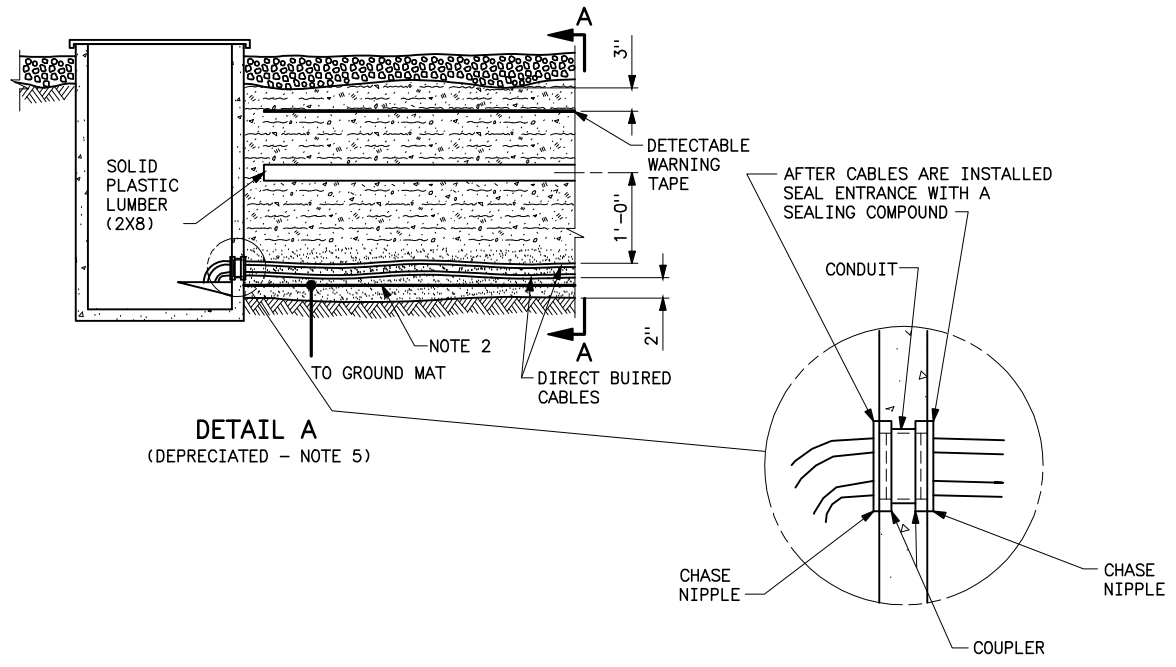
E	7-20-06 A7-RC	REVISED TABLE A, COLUMN (6) FOR 242 AND 362KV
D	3-12-01 A7-RMC	ADDED FIG 1 AND ASSOCIATED DIMENSIONS TABLE B.
C	8-18-00 A3-RMC	REDRAWN, REVISED COLUMN 4 TO AGREE WITH NEMA SG-6, ADDED LINE 12, AND ADDED NOTES.

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



- NOTES**
- 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.
 - 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.
 - 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.
 - 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.
 - REFRAIN FROM USING DIRECT BURIED METHODS FOR NEW INSTALLATIONS.
 - 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

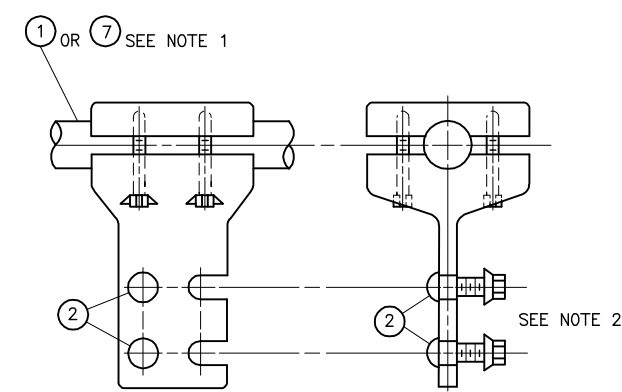
UNITED STATES DEPARTMENT OF ENERGY
WESTERN AREA POWER ADMINISTRATION
CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO

**SUBSTATION STANDARDS
BURIED INSULATED CABLES
AND CONDUIT
TYPICAL DETAILS**

DESIGNED BUREC	APPROVED ROSS M. CLARK ELECTRICAL ENGINEERING MANAGER
MAY 18, 1979	31 1006

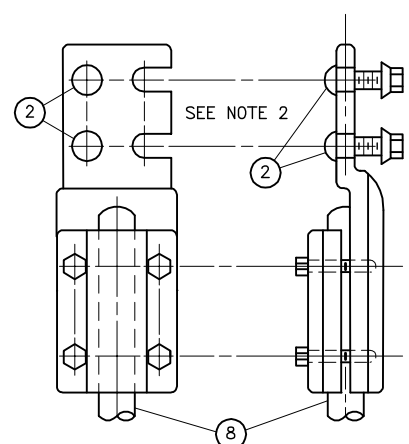
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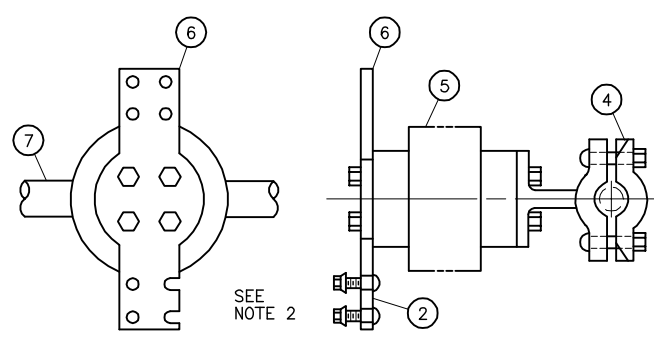
DETAIL A

HOT-LINE T-CONNECTOR (NTS)



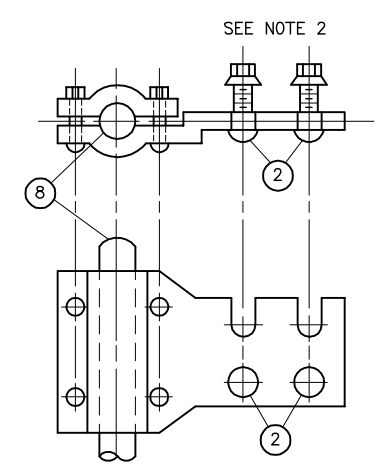
DETAIL C

HOT-LINE STUD TO PAD CONNECTOR (NTS)



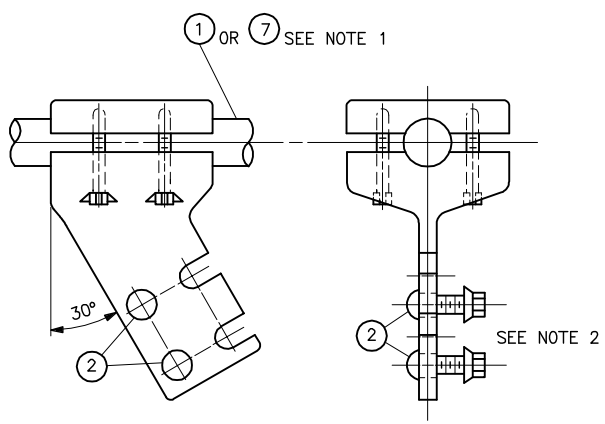
DETAIL E

STAND OFF INSULATOR ASSEMBLY (NTS)



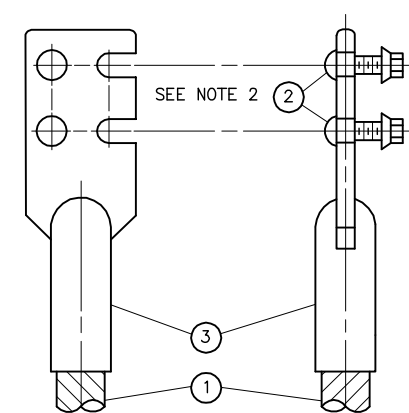
DETAIL G

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



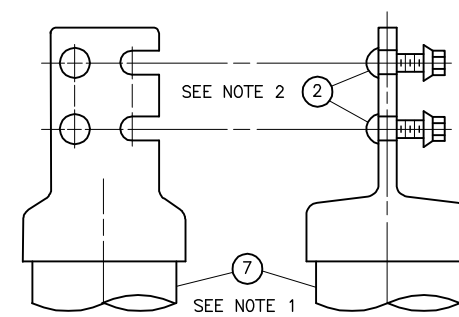
DETAIL B

30° HOT-LINE T-CONNECTOR (NTS)



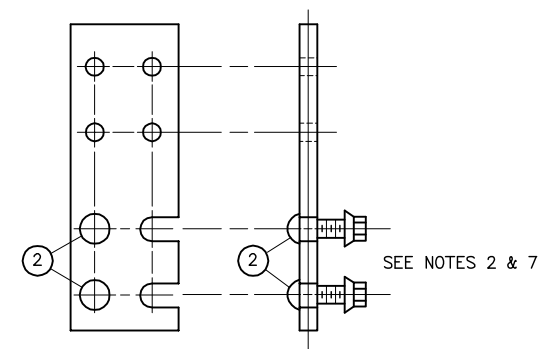
DETAIL D

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

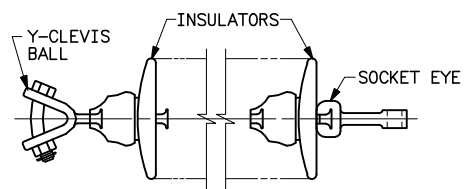
UNITED STATES DEPARTMENT OF ENERGY
WESTERN AREA POWER ADMINISTRATION
CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO

**SUBSTATION STANDARDS
HOT-LINE FITTINGS
DETAILS**

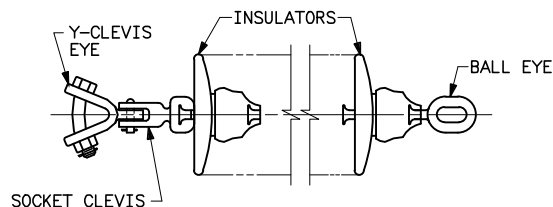
DESIGNED BUREC _____ APPROVED ROSS M. CLARK
ELECTRICAL ENGINEERING MANAGER

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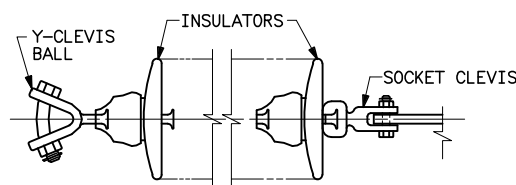
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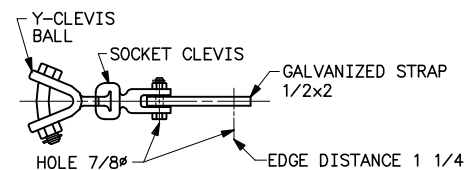
ASSEMBLY A



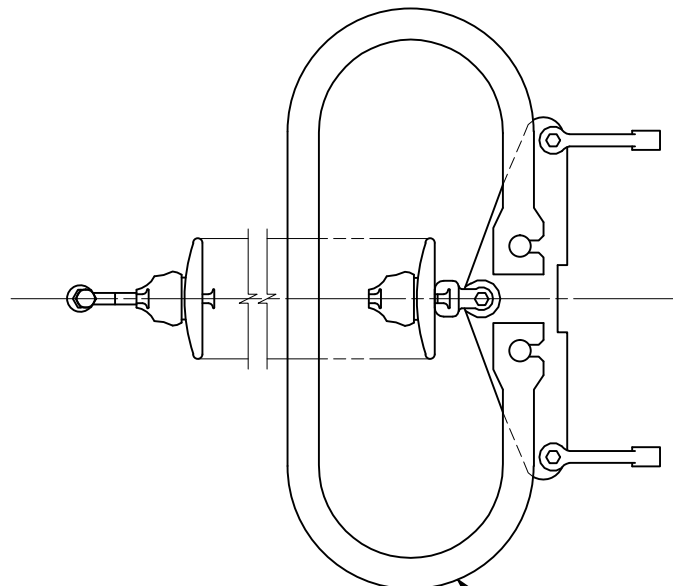
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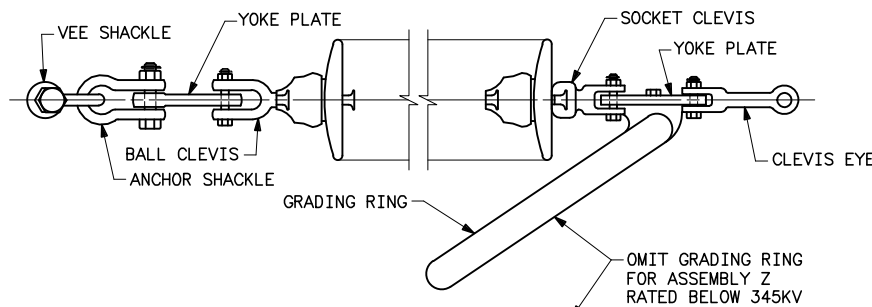
ASSEMBLY D



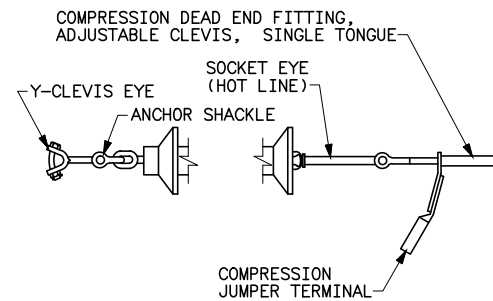
ASSEMBLY E



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)

GROUNDED NEUTRAL SYSTEM		
RATED SYSTEM VOLTAGE KV	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-FIBERGLASS 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

TYPICAL GROUND MAT DETAILS (NOTE 2)

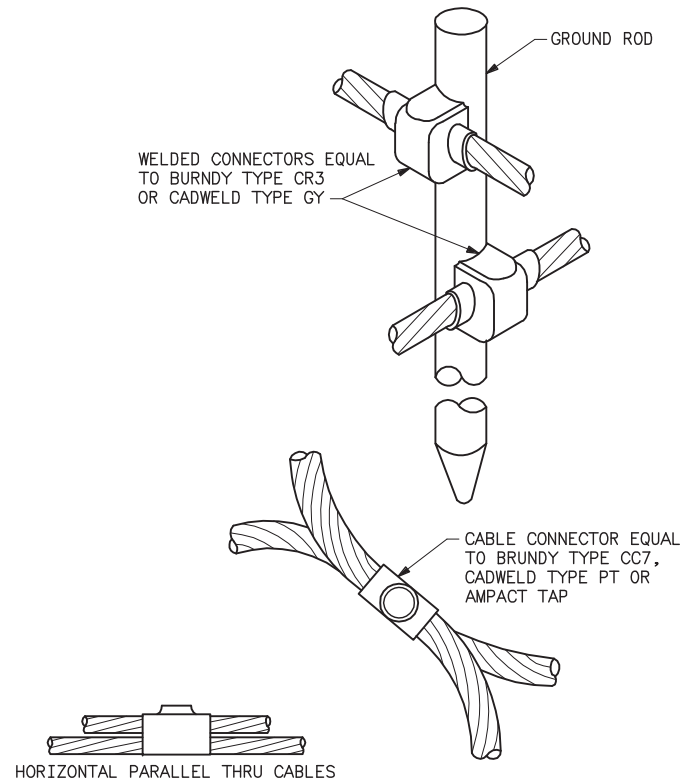


FIGURE 1

TYPICAL GROUNDING DETAILS FOR LIGHTING CABINET OR MISCELLANEOUS POWER

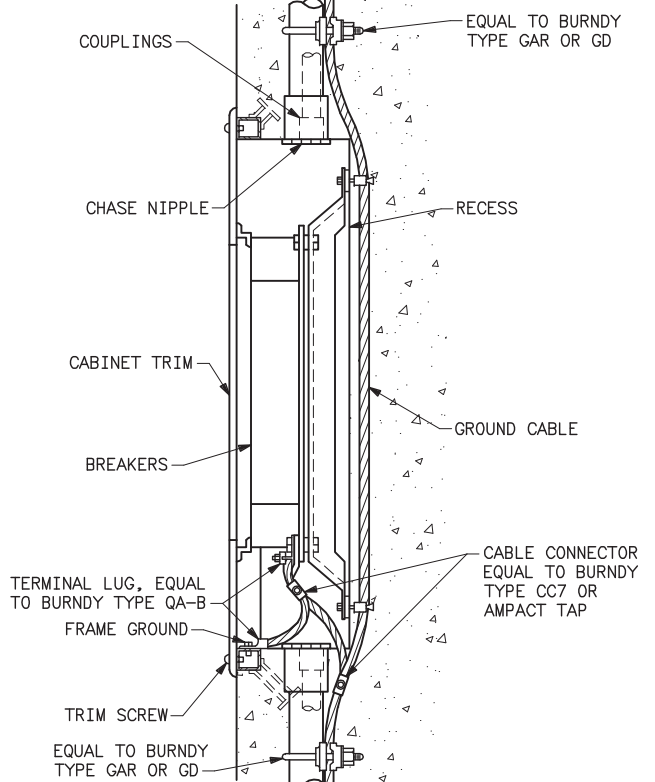


FIGURE 3

TYPICAL GROUNDING DETAILS FOR FLOOR FRAMES

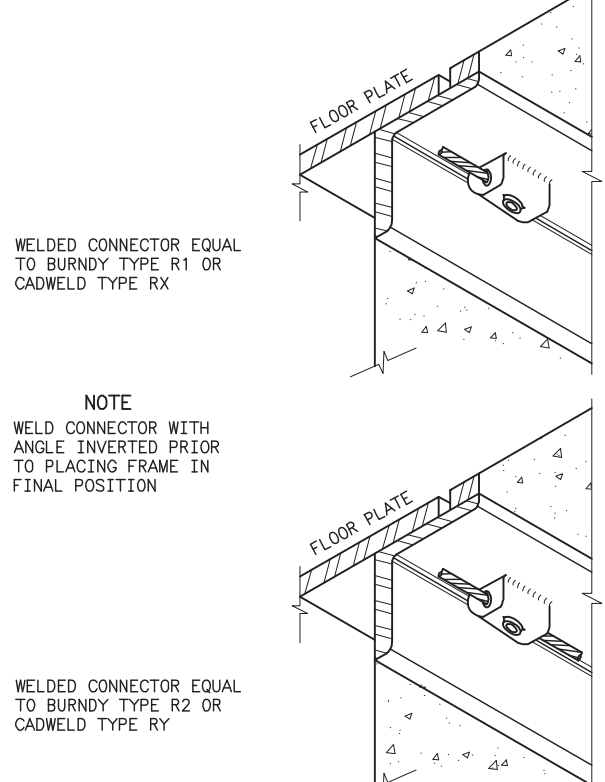


FIGURE 5

TYPICAL GROUNDING DETAILS FOR OIL TANK

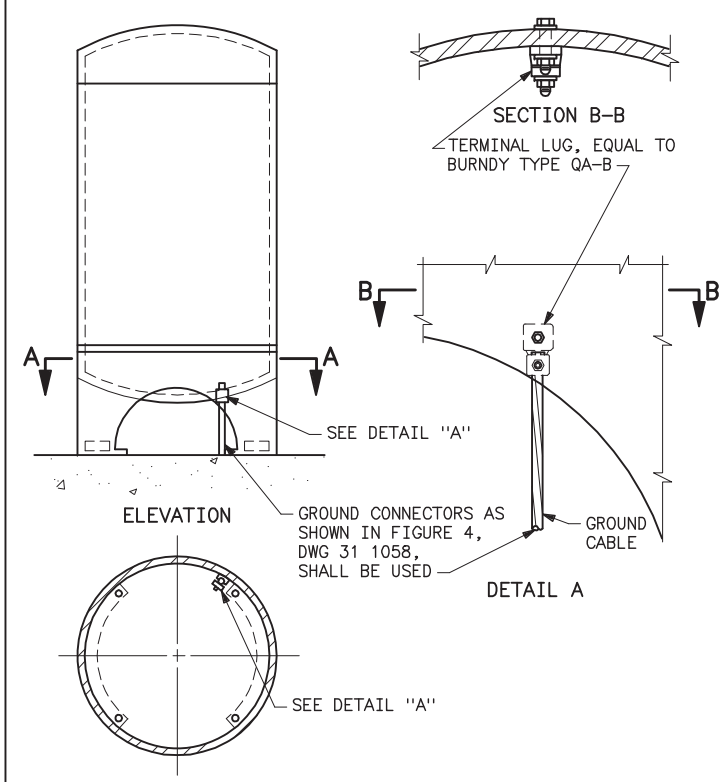


FIGURE 7

TYPICAL GROUNDING DETAILS FOR POWER OUTLET PLUG RECEPTACLE

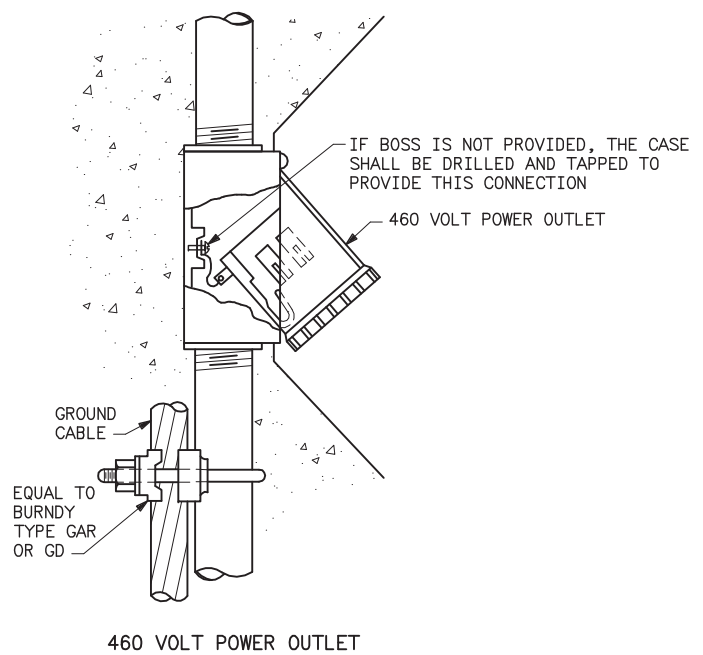


FIGURE 2

TYPICAL GROUNDING DETAILS FOR RAILS

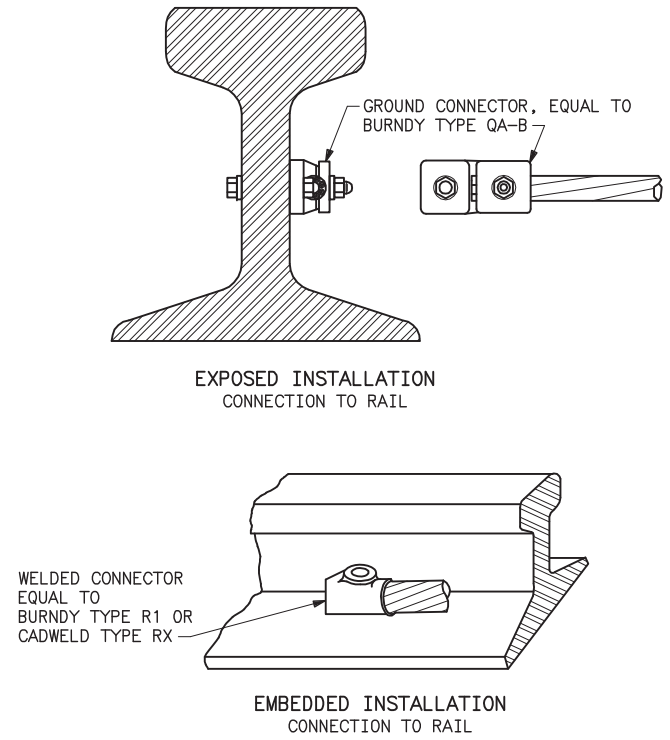


FIGURE 4

TYPICAL GROUNDING DETAILS FOR RAILING POST BASES AND HANDRAIL SUPPORTS

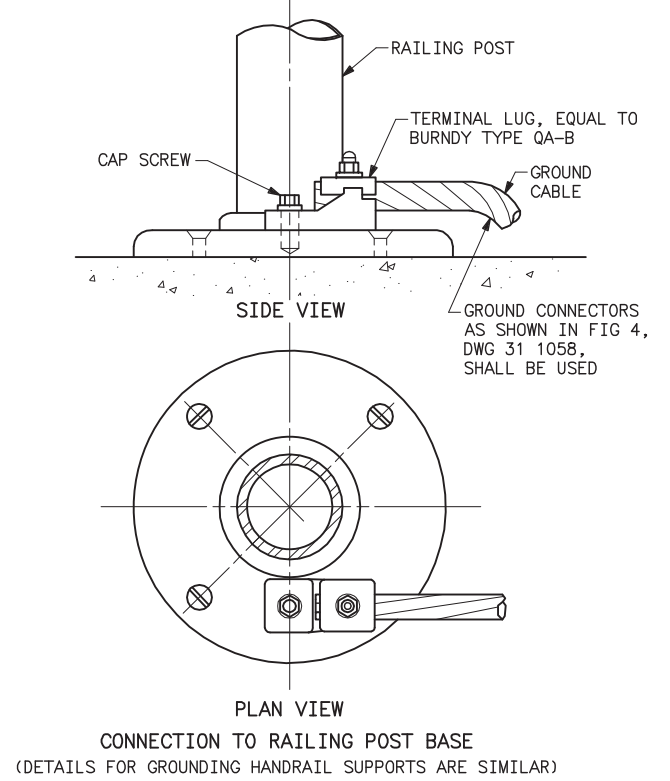


FIGURE 6

NOTES

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

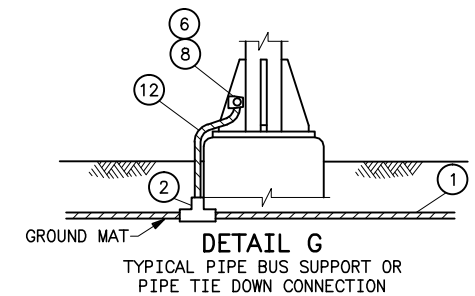
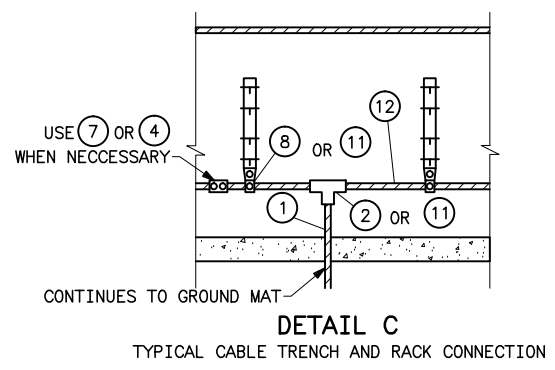
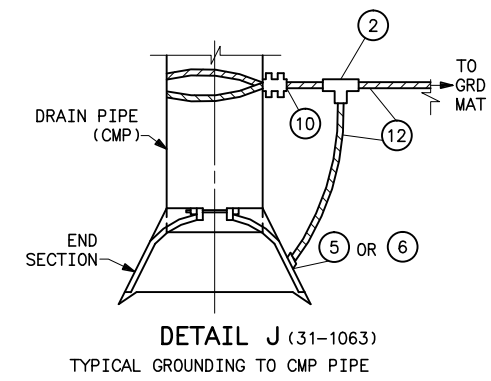
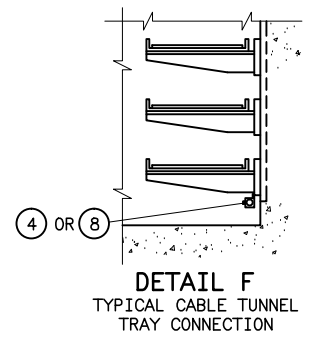
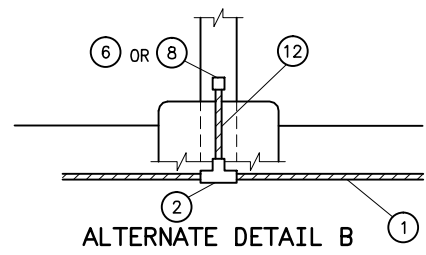
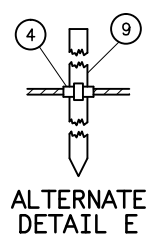
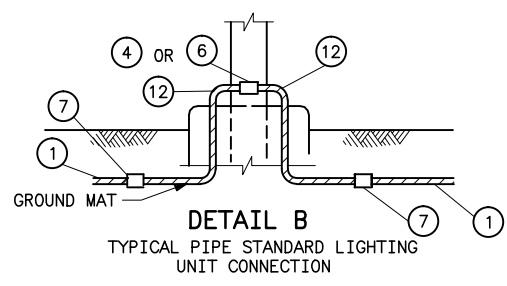
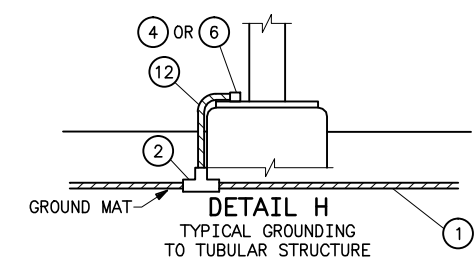
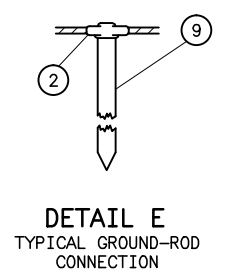
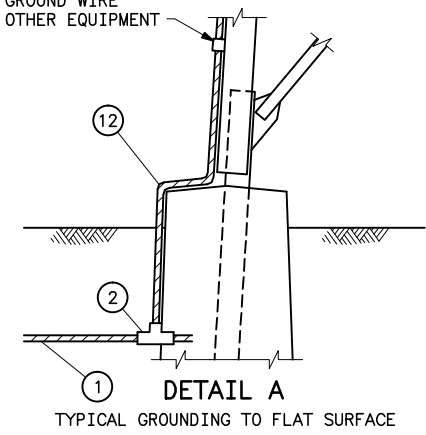
REFERENCE DRAWING

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
DATE	MAY 18, 1979	31 1059

Plotted By: see la Feb 15, 2012 - 8: 58am
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USE (5) (6) OR (8) ON APPROX 5-0 CENTERS WHEN GROUND WIRE CONTINUES TO OTHER EQUIPMENT



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

- ALL GROUND CABLES TO BE STUBBED OUT APPROXIMATELY WHERE INDICATED AND OF SUFFICIENT LENGTH TO BOLT TO EQUIPMENT WHEN INSTALLED.
- 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.
- ALL PAINT, ENAMEL, AND SCALE SHALL BE REMOVED FROM POINT OF CONTACT ON METAL SURFACES BEFORE APPLYING GROUND CONNECTIONS.
- ALL BOLTS, MACHINE SCREWS, NUTS AND WASHERS USED IN MAKING GROUNDING CONNECTIONS SHALL BE COPPER ALLOY, SIMILAR TO EVERDUR, UNLESS OTHERWISE NOTED.
- 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

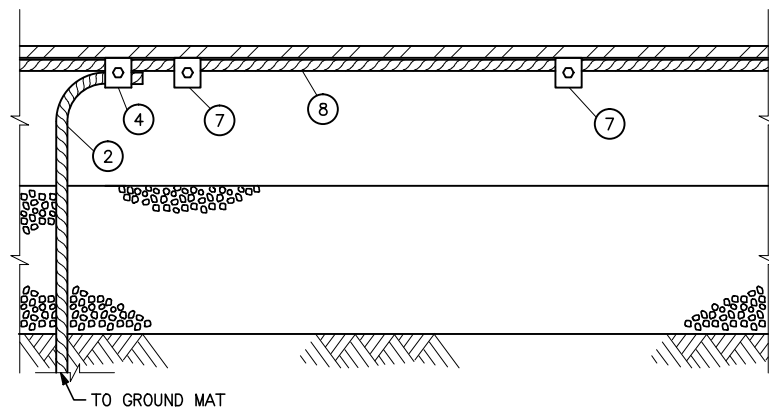
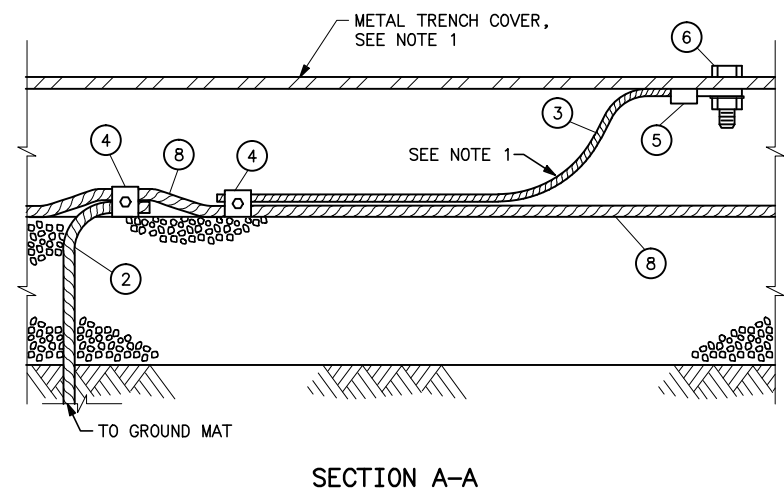
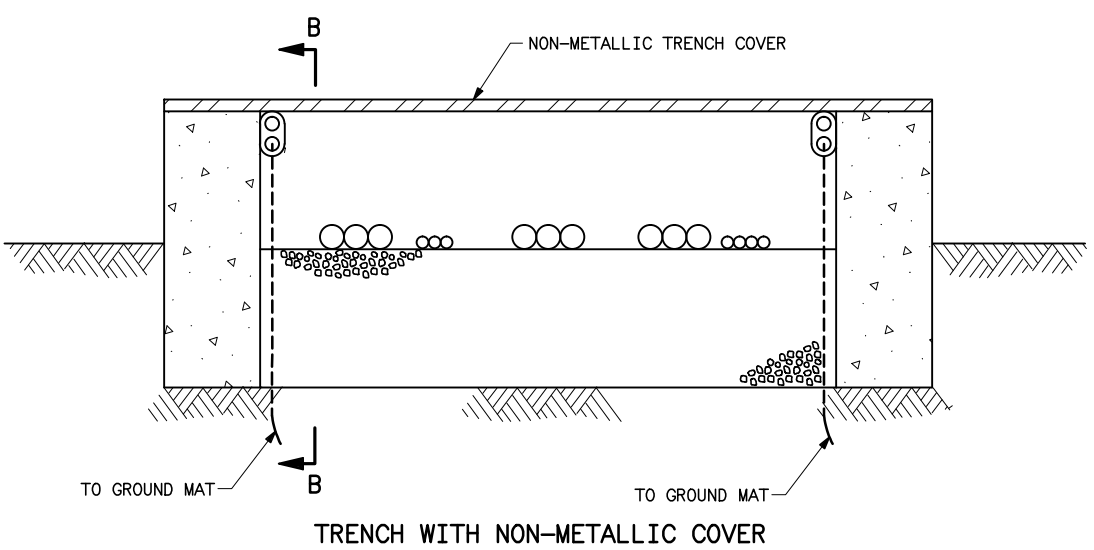
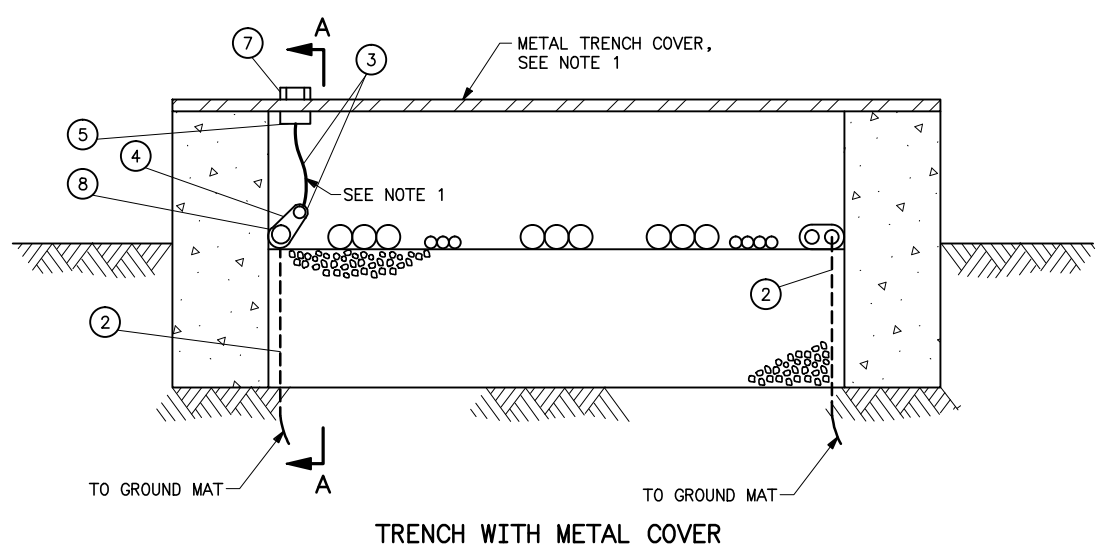
SUBSTATION STANDARDS
GROUNDING DETAILS

DESIGNED BUREC _____ APPROVED ROSS M. CLARK
ELECTRICAL ENGINEERING MANAGER

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XREF(S):



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

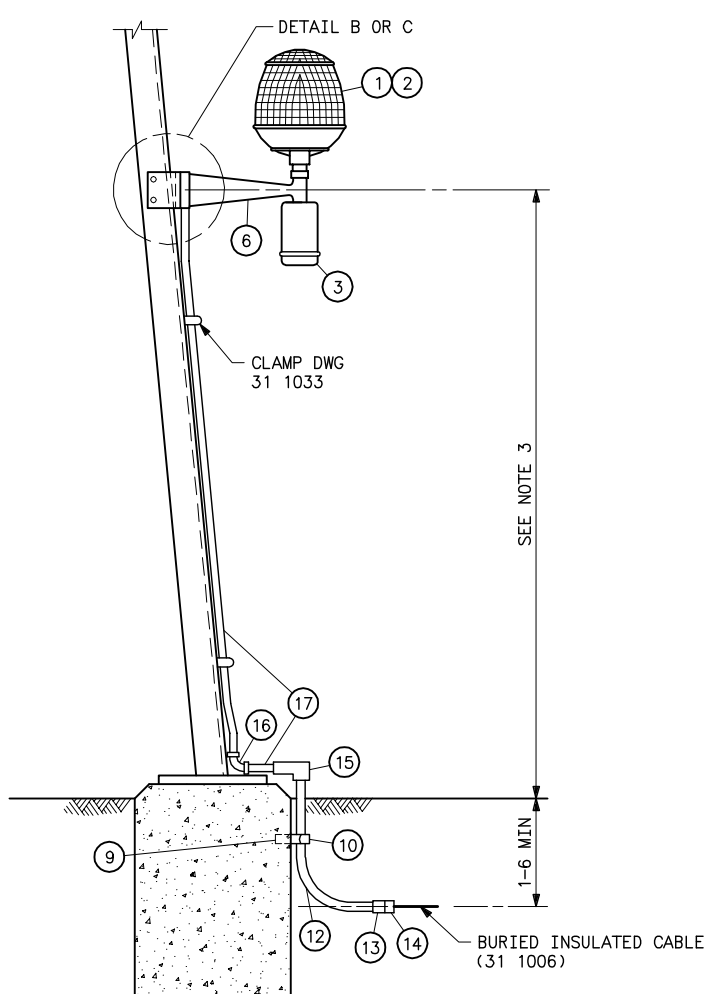
SUBSTATION STANDARDS
CABLE TRENCH GROUNDING

DESIGNED BUREC _____ APPROVED ROSS M. CLARK
ELECTRICAL ENGINEERING MANAGER

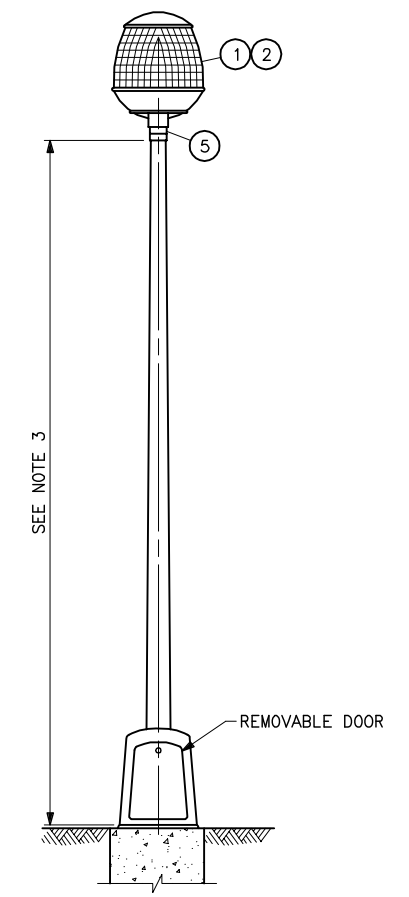
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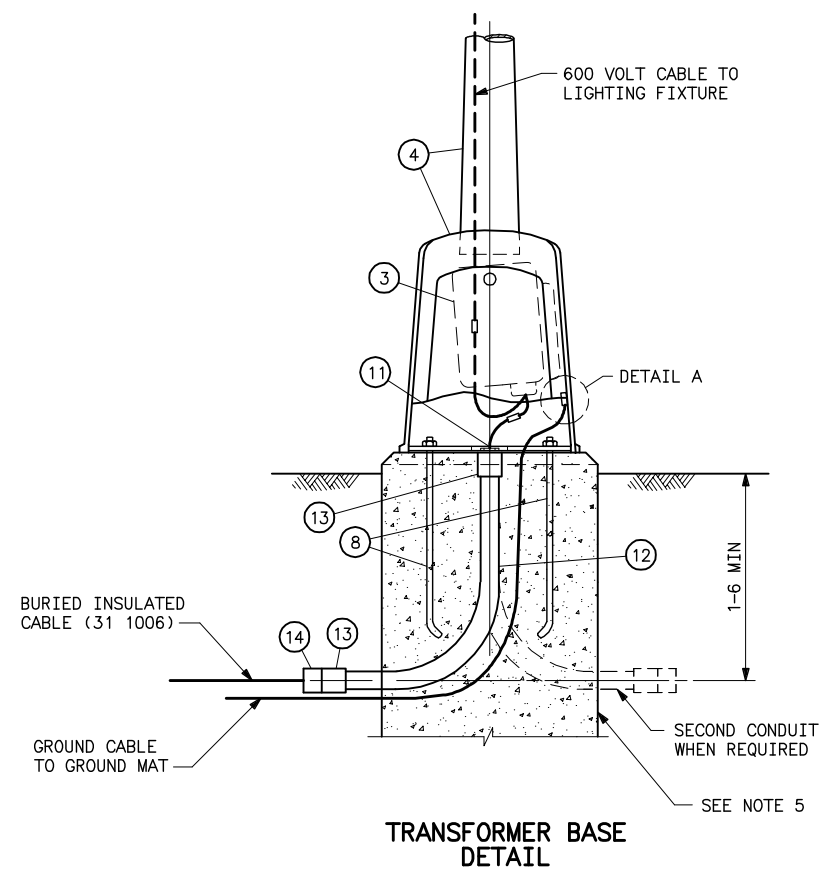
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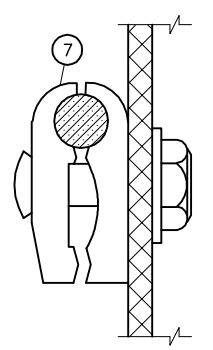
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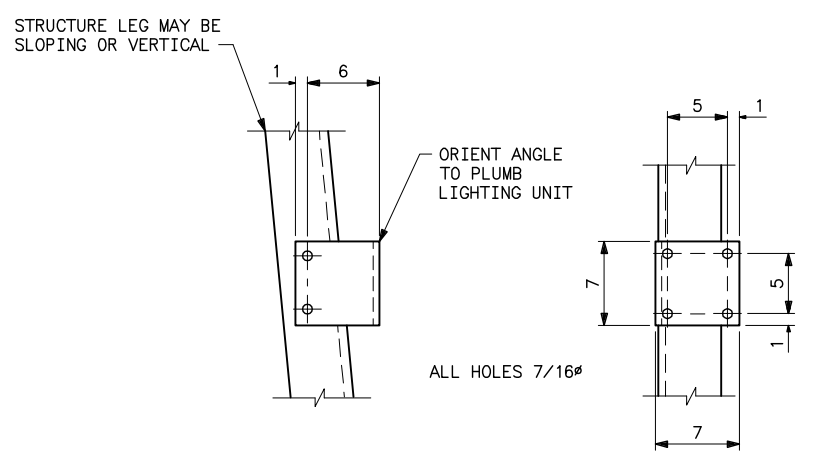
TAPERED POLE TYPE LIGHTING UNIT



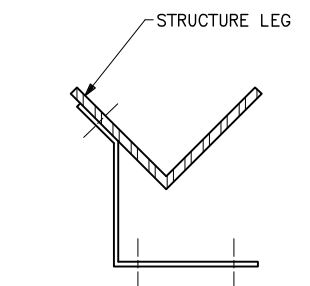
TRANSFORMER BASE DETAIL



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

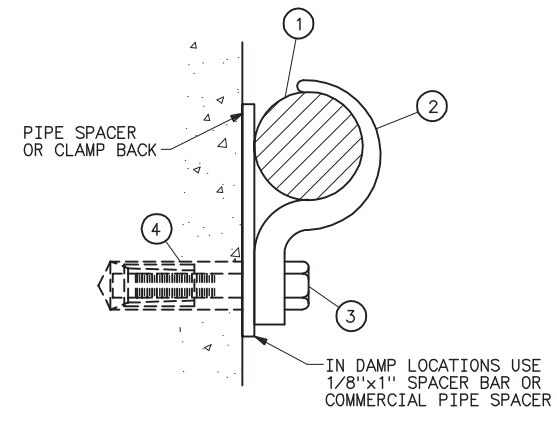
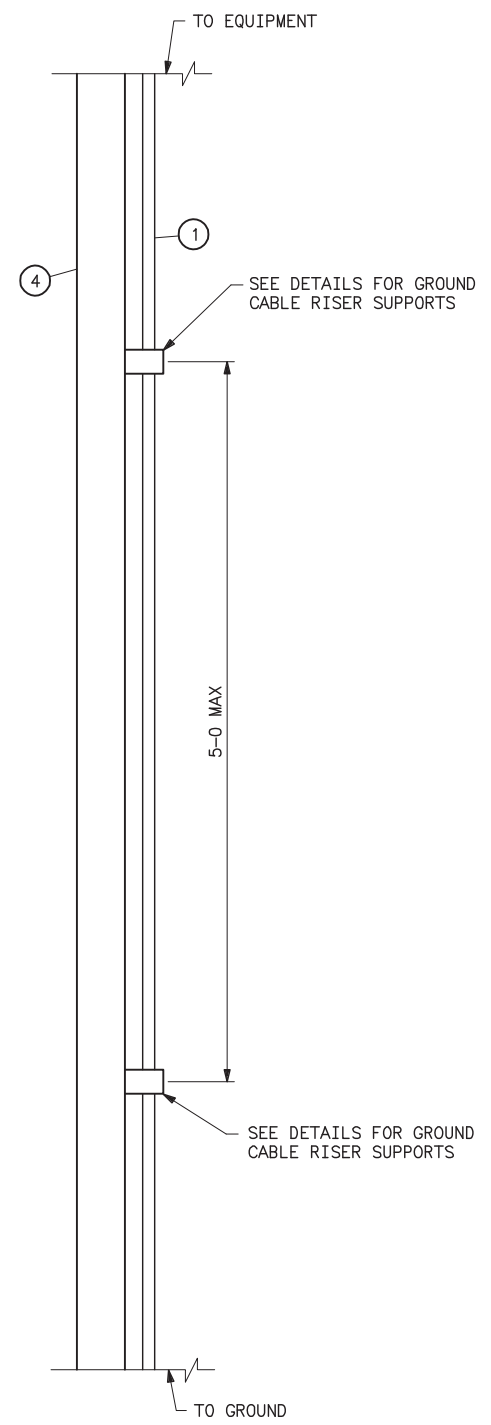
SUBSTATION STANDARDS
LIGHTING FIXTURE
POLE AND BRACKET MOUNTING

DESIGNED BUREC _____ APPROVED ROSS M. CLARK
ELECTRICAL ENGINEERING MANAGER

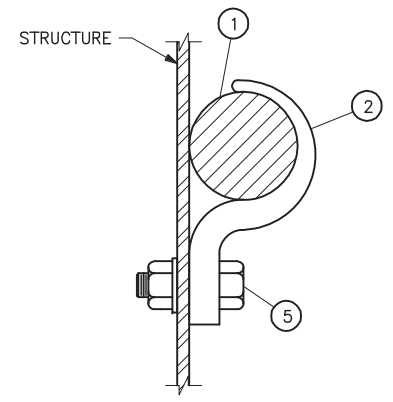
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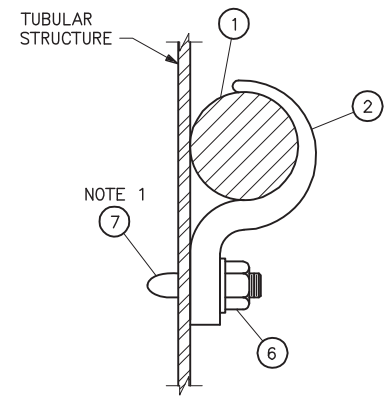
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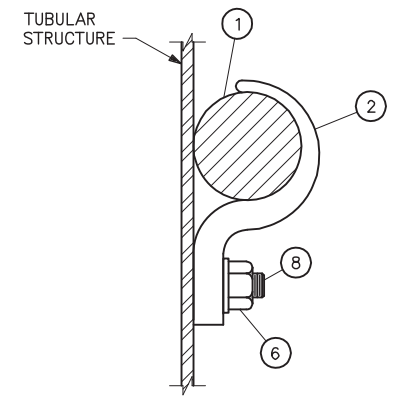
CABLE CLAMPING ON CONCRETE SURFACE
DETAIL A



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.

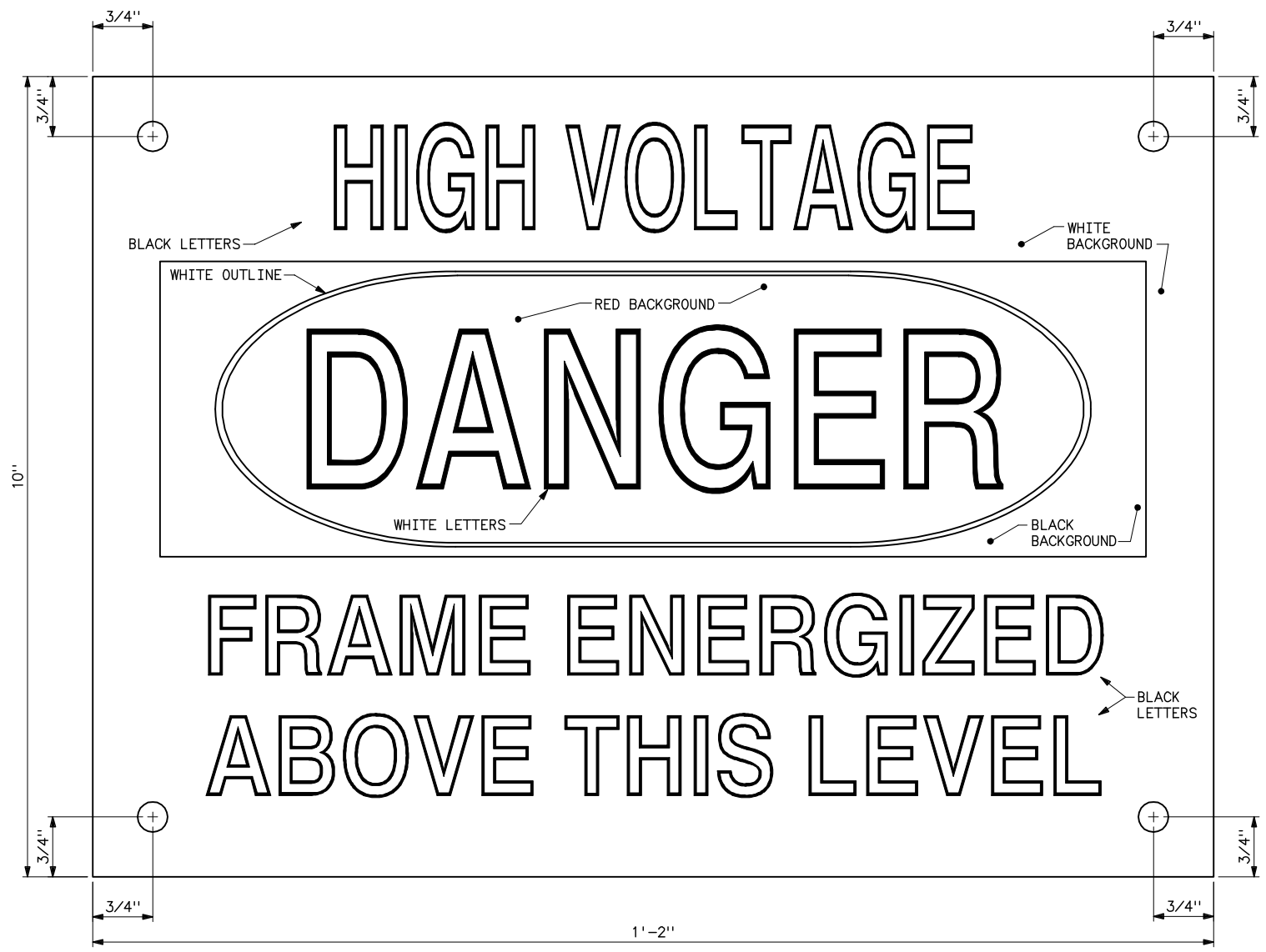
SUPERSEDES DWG NO. 40-D-6309

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

**SUBSTATION STANDARD
GROUND CABLE ON TUBULAR
STEEL STRUCTURES
SUPPORT DETAILS**

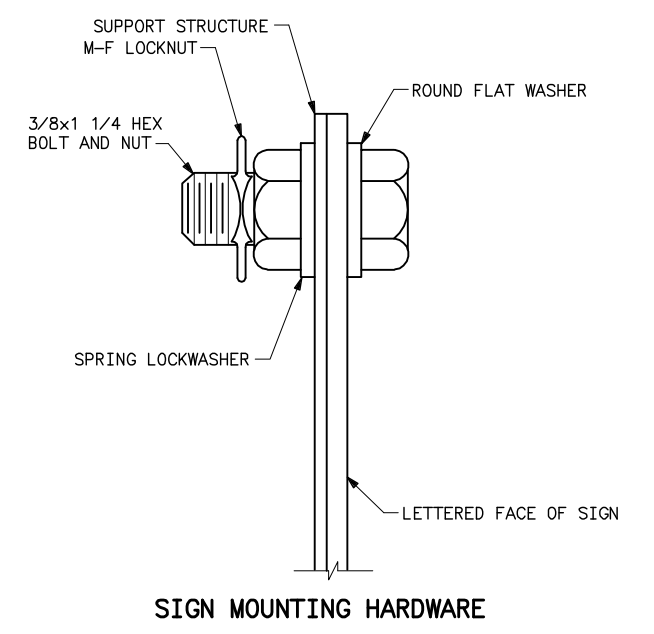
DESIGNED BUREC _____ APPROVED ROSS M. CLARK
ELECTRICAL ENGINEERING MANAGER

CA	JULY 16, 1979	31	1077
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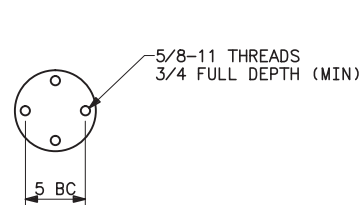
NOTES

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.

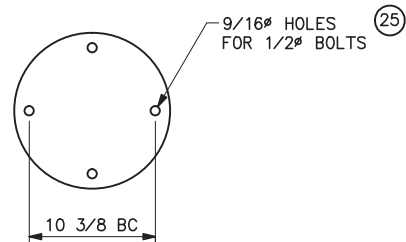


C	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.
B	5-14-99 A3-OP	REDRAWN AND REVISED
SUPERSEDES DWG NO. 40-D-6273		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS DANGER SIGN FOR SHUNT CAPACITORS		
DESIGNED C.J. DVORAK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

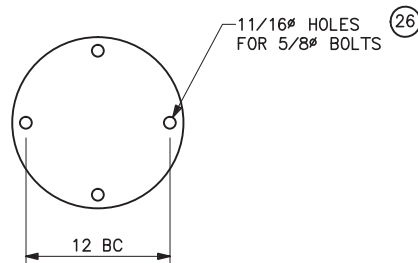
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END CAP FOR ALL INSULATOR STACKS



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

- COLOR SHALL BE LIGHT GRAY (ANSI 70).
- BIL RATINGS ARE FOR INSULATOR ASSEMBLIES. UNITS MAY BE ASSEMBLED WITH OR WITHOUT RAIN SHIELDS.
- 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

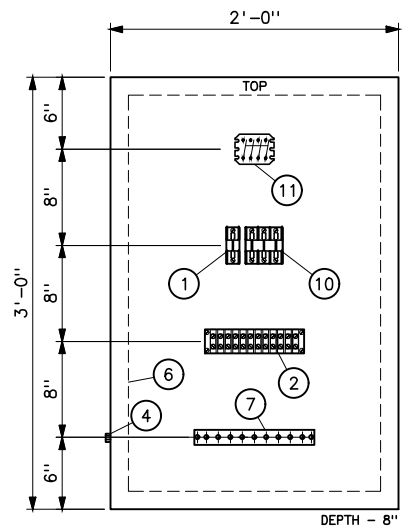
STATION STANDARDS
 STACKING POST INSULATORS

DESIGNED D.R. TORGENSON	APPROVED GERALD D. BIRNEY	
	DIRECTOR, DIVISION OF	
	SUBSTATION DESIGN	
NOVEMBER 3, 1986	31	1081

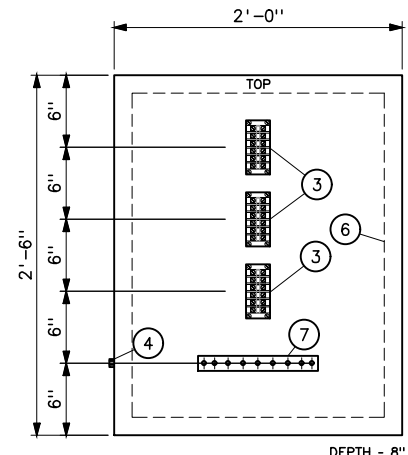
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TABLE NO. 1		
EQUIPMENT	FUSE HOLDER	FUSE
V.T.	BUSSMANN 0.1 TO 30A. 250V CAT. NO. HM25030-3SR	10A REN SUPER LAG
C.C.V.T METERING	BUSSMANN 0.1 TO 30A. 250V CAT. NO. HM25030-3SR	10A NON BUSS TRON
C.C.V.T. RELAY	BUSSMANN 0.1 TO 30A. 250V CAT. NO. H2M5030-3SR	10A NON BUSS TRON

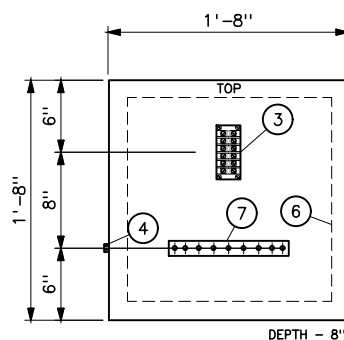
REFERENCE MATERIALS	
ITEM NO.	DESCRIPTION
1	1-POLE FUSE BLOCK, BUSSMANN HM25030-1SR OR EQUAL, WITH FUSE PER TABLE NO. 1
2	12-POINT TERMINAL BLOCK, G.E. CAT. NO. EB25B12
3	6-POINT TERMINAL BLOCK, SHORT CIRCUITING TYPE, G.E. CAT. NO. EB27B06SC
4	GROUND CONNECTOR, BURNDY MECHANICAL TYPE K2C WITH 2-EVERDUR 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.



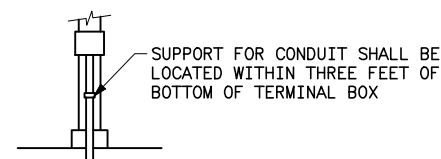
TYPE A
(FOR SINGLE-PHASE VOLTAGE TRANSFORMERS OR COUPLING CAPACITOR VOLTAGE TRANSFORMERS)
(TYPICAL)



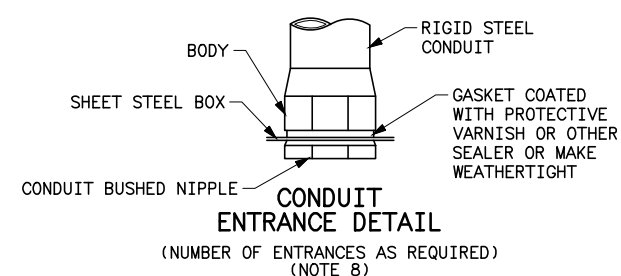
TYPE C
(FOR 3-PHASE CURRENT TRANSFORMERS)
(TYPICAL)



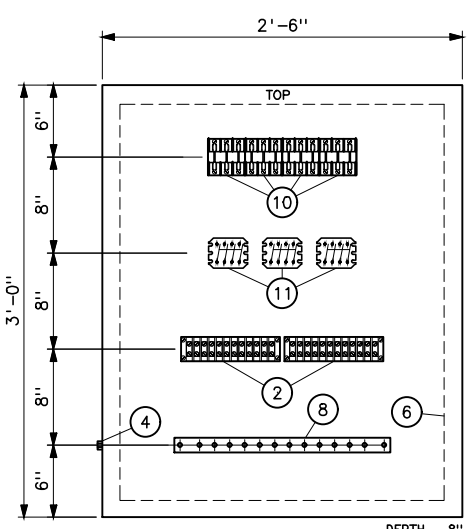
TYPE D
(FOR SINGLE-PHASE CURRENT TRANSFORMERS)
(TYPICAL)



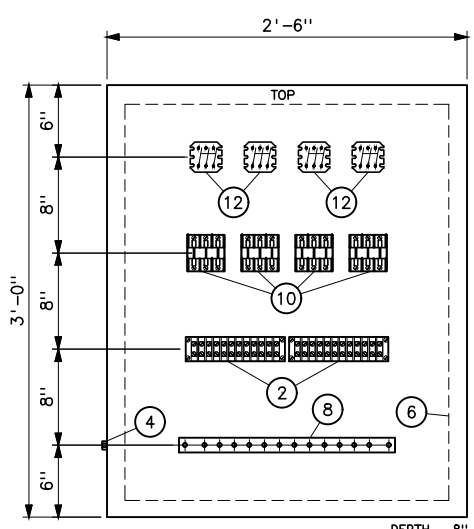
DETAIL A
(CONDUIT SUPPORT TO BE ADDED TO ALL TERMINAL BOXES)



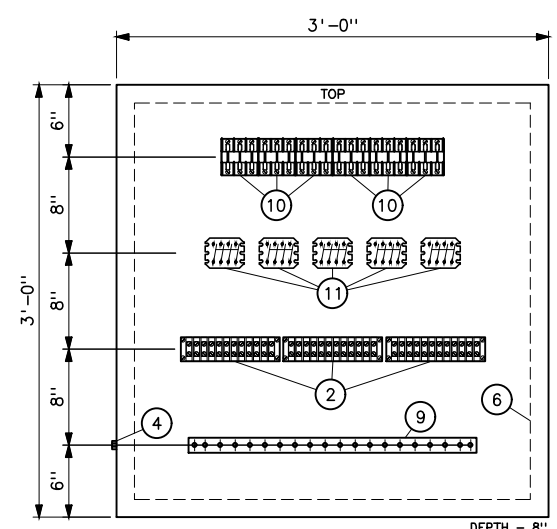
CONDUIT ENTRANCE DETAIL
(NUMBER OF ENTRANCES AS REQUIRED)
(NOTE 8)



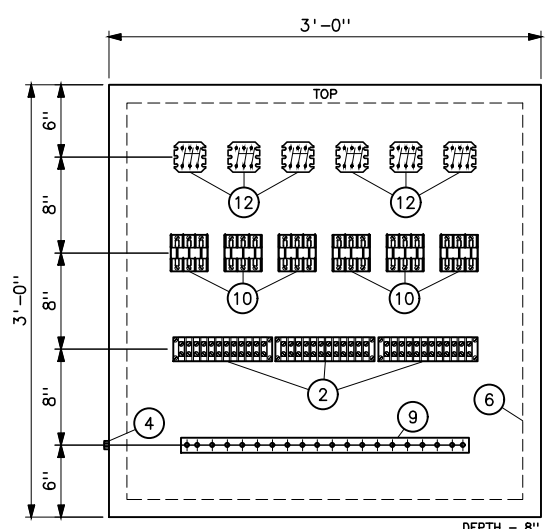
TYPE F (OPTION 1)
(FOR 3-PHASE VOLTAGE TRANSFORMERS OR COUPLING CAPACITOR VOLTAGE TRANSFORMERS)
(DSW ONLY)



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)

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

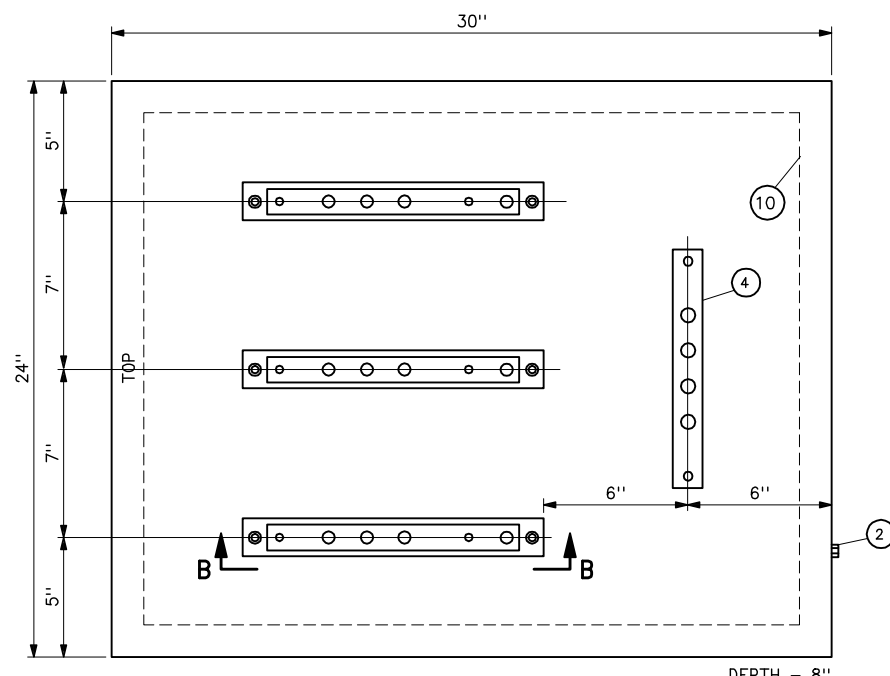
UNITED STATES DEPARTMENT OF ENERGY
WESTERN AREA POWER ADMINISTRATION
CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO

SUBSTATION STANDARDS

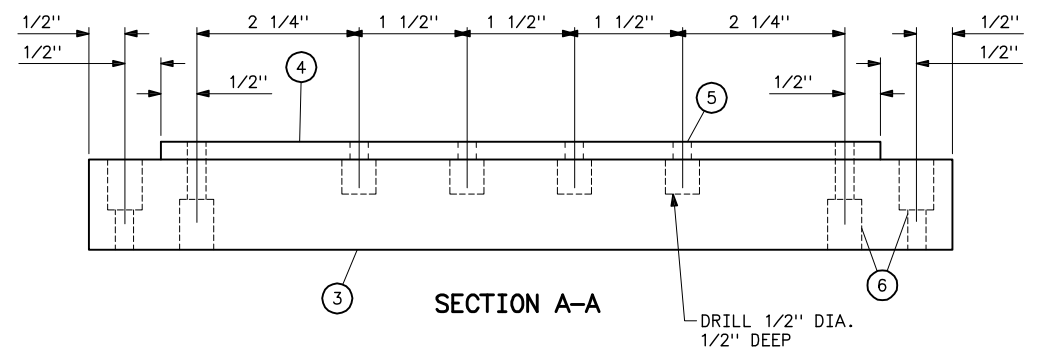
TERMINAL AND FUSE BOXES

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

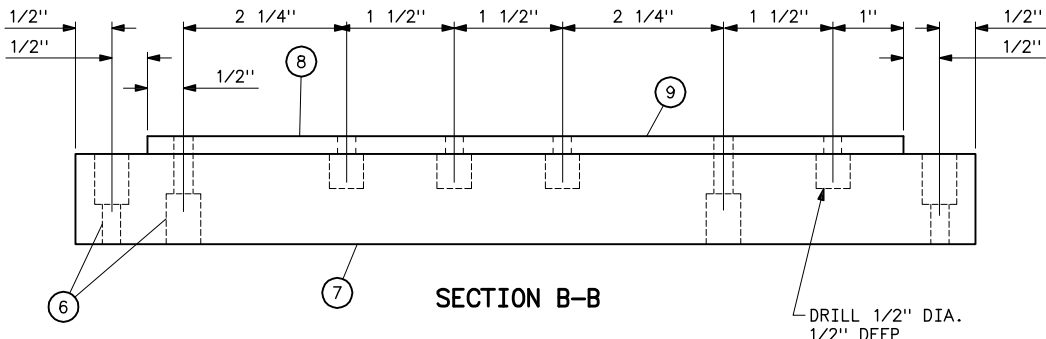
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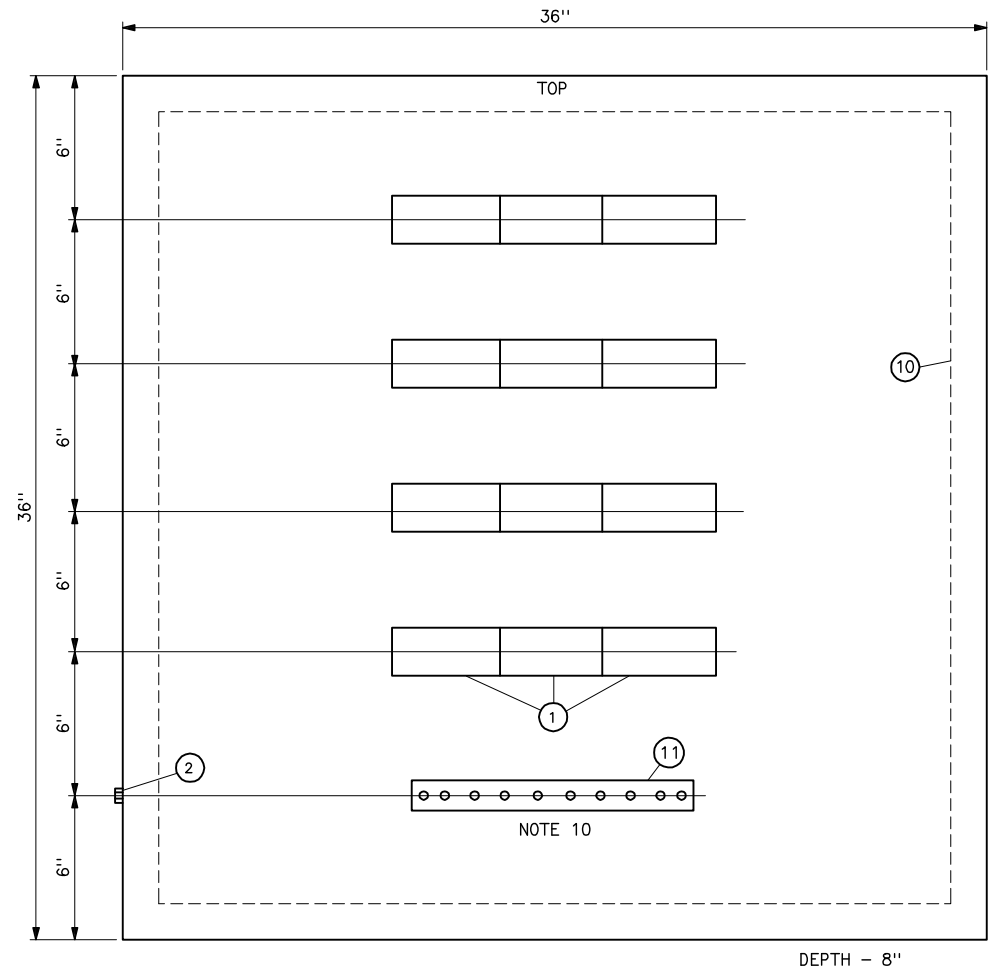
TYPE H



SECTION A-A

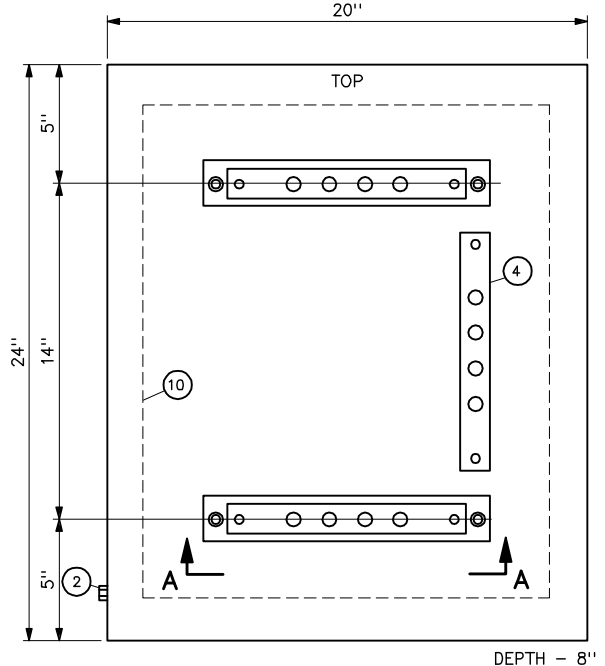


SECTION B-B



TYPE K

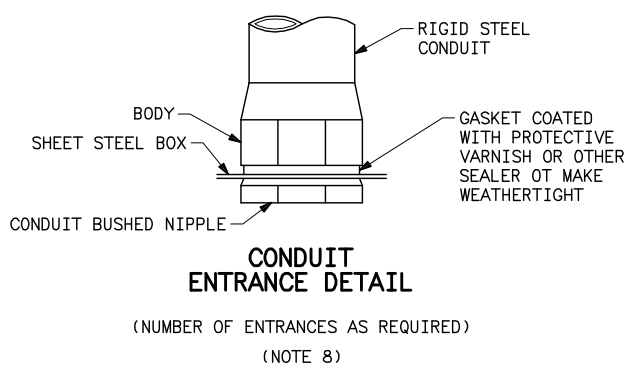
(FOR MULTIPLE WINDING CURRENT TRANSFORMERS)



TYPE G

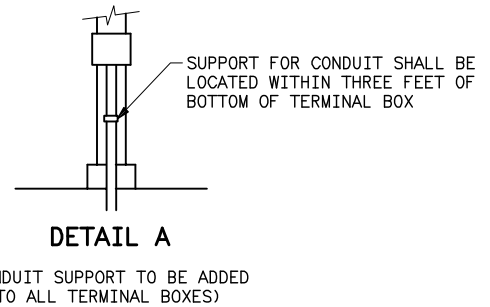
NOTES

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



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.

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

Jul 15, 2006 9:14am Plotted By: jankowski on Mar 22, 2006 2:26pm
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CATALOG NUMBER	ANSI TR 267 EQUIV NOTE 1	ITEM NUMBER 1				ANSI TR 267 EQUIV NOTE 1	ITEM NUMBER 2				ANSI TR 278 EQUIV NOTE 1	ITEM NUMBER 3				ANSI TR 267 EQUIV NOTE 1	ITEM NUMBER 4				ANSI TR 289 EQUIV NOTE 1	ITEM NUMBER 5				ANSI 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	NGK-LOCKE	LAPP	NEWELL	VICTOR		
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
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	90000	75000	90000	75000	90000	75000	75000	90000	90000	75000	75000
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
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

CATALOG NUMBER	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 REQD	ITEM NUMBER 12 (TAPERED)			
	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		
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		10.4375/9.6875/9.25	14.125/12	12.5/11.75/10.5		
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	20000	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	40000	60000	60000	40000	40000	90000	90000	60000	60000	40000	40000	60000	100000	60000	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	60000	60000	75000	90000	90000	
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	
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

- 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.
- 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-OP	REVISED ANSI COLUMN HEADINGS TO REFER TO ADDED NOTE 1
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - GOLDEN, COLORADO		
SUBSTATION STANDARDS STACKING POST INSULATORS UPRIGHT M & E RATINGS		
DESIGNED	R. TORGERSON	RECOMMENDED R.H. RICHARDSON
DRAWN	A. J. ARMSTRONG	APPROVED G.C. WEGNER
CHECKED	R.A. JOHNSON	ACT. DIRECTOR, DIVISION OF SUBSTATION DESIGN
DATE	JANUARY 24, 1990	31 1087

Mar 22, 2006 - 2:26pm Plotted By: Seela IMAGES: S:\Engineering\Standard Drawings\31\1087a.dwg Last Saved By: TAS on Mar 22, 2006 - 2:26pm

CATALOG NUMBER	ITEM NUMBER 13					ITEM NUMBER 14					ITEM NUMBER 15					ITEM NUMBER 16					ITEM NUMBER 17					ITEM NUMBER 18				
	ANSI TR 267 EQUIV NOTE 1	NGK-LOCKE	LAPP	NEWELL	VICTOR	ANSI TR 267 EQUIV NOTE 1	NGK-LOCKE	LAPP	NEWELL	VICTOR	ANSI TR 278 EQUIV NOTE 1	NGK-LOCKE	LAPP	NEWELL	VICTOR	ANSI TR 287 EQUIV NOTE 1	NGK-LOCKE	LAPP	NEWELL	VICTOR	ANSI TR 289 EQUIV NOTE 1	NGK-LOCKE	LAPP	NEWELL	VICTOR	ANSI TR 295 EQUIV NOTE 1	NGK-LOCKE	LAPP	NEWELL	VICTOR
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
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
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
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

CATALOG NUMBER	ITEM NUMBER 19					ITEM NUMBER 20					ITEM NUMBER 21					ITEM NUMBER 22					ITEM NUMBER 23					MIN REQD	ITEM NUMBER 24				
	ANSI TR 308 EQUIV NOTE 1	NGK-LOCKE	LAPP	NEWELL	VICTOR	ANSI TR 316 EQUIV NOTE 1	NGK-LOCKE	LAPP	NEWELL	VICTOR	ANSI TR 369 EQUIV NOTE 1	NGK-LOCKE	LAPP	NEWELL	VICTOR	ANSI TR 373 EQUIV NOTE 1	NGK-LOCKE	LAPP	NEWELL	VICTOR	ANSI TR 391 EQUIV NOTE 1	NGK-LOCKE	LAPP	NEWELL	VICTOR		ANSI TR 391 EQUIV NOTE 1	NGK-LOCKE	LAPP	NEWELL	VICTOR
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		
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	20000	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	40000	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		
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		
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)

- 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.
- ALL POST INSULATOR ASSEMBLIES ARE HIGH STRENGTH EXCEPT ITEMS (21 AND 22) ARE EXTRA-HIGH STRENGTH AND (23 AND 24) ARE STANDARD STRENGTH.

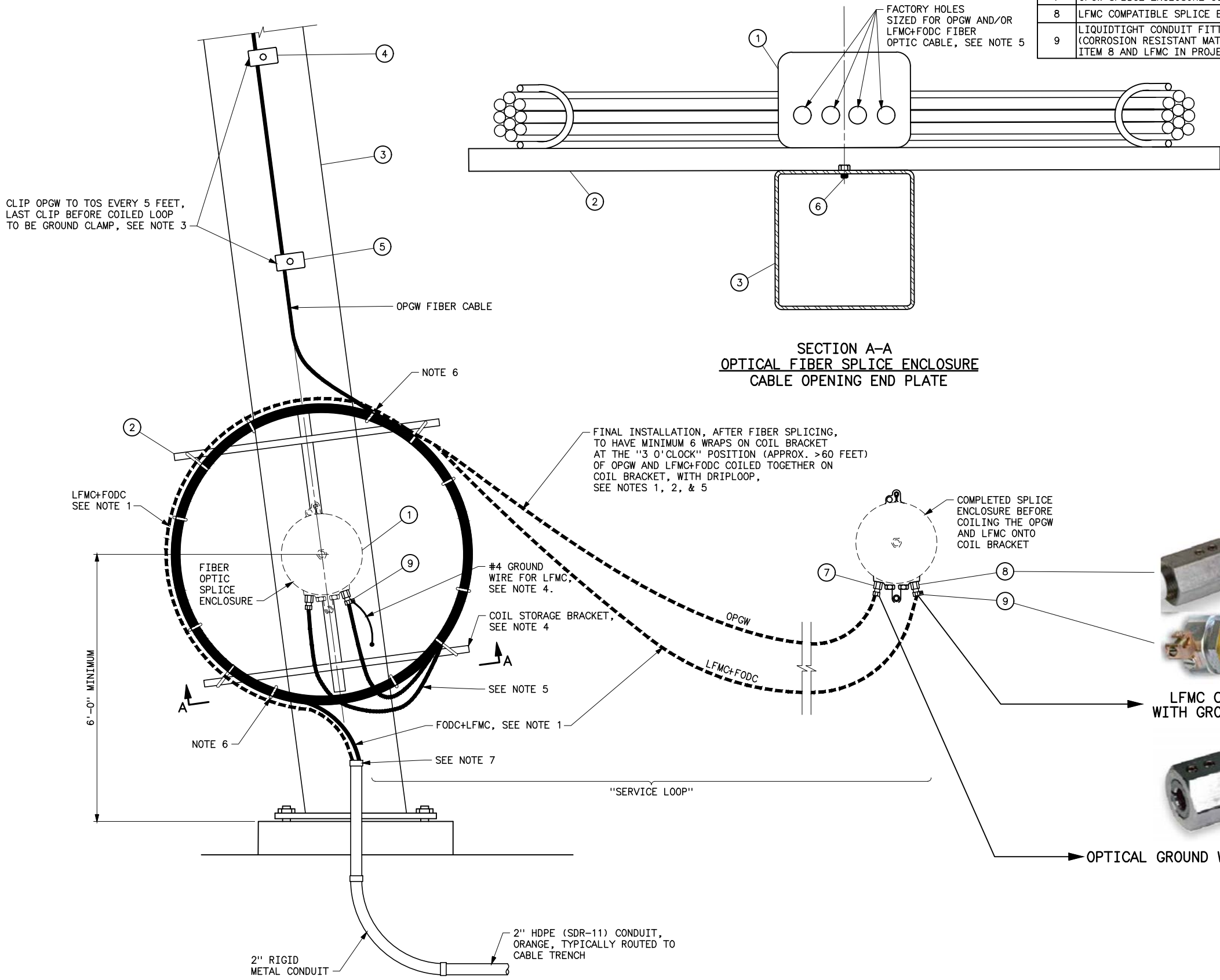
REFERENCE DRAWINGS

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

A	5-14-99 A3-OP	REVISED ANSI COLUMN HEADINGS TO REFER TO ADDED NOTE 1
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - GOLDEN, COLORADO		
SUBSTATION STANDARDS STACKING POST INSULATORS UNDERHUNG M & E RATINGS		
DESIGNED	R. TORGERSON	RECOMMENDED R.H. RICHARDSON
DRAWN	A. J. ARMSTRONG	APPROVED G.C. WEGNER
CHECKED	R.A. JOHNSON	DIRECTOR, DIVISION OF SUBSTATION DESIGN
DATE	JANUARY 24, 1990	31 1088

Mar 22, 2006 - 2:26pm Plotted By: Seela IMAGES:
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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

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



LFMC CONNECTOR WITH GROUNDING LUG



OPTICAL GROUND WIRE CONNECTOR KIT

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

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

**SUBSTATION STANDARDS
FIBER OPTIC CABLE MOUNTING**

DESIGNED JOHN FLEURY ----- APPROVED ROSS CLARK
ELECTRICAL ENGINEERING MANAGER

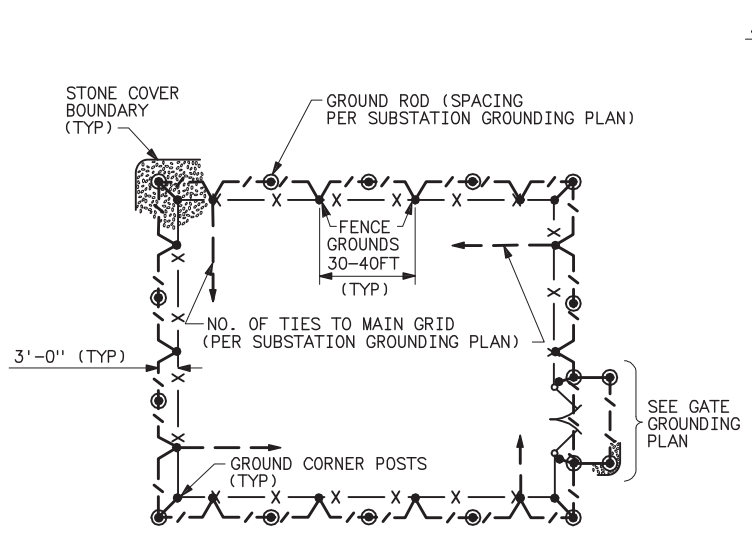
NOVEMBER 1, 2010	31	1097
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Plotted By: seela Nov 20, 2019 11:36am S:\projects\Transmission\lines\Stegal\l\wayside.2019\Drawings\DesignDrawings\DrawingsReadyForFinal\Scr\pts\31_1097a.dwg Lost Saved By: Seela, Holly (CONTR) on 11/20/2019 11:36 AM

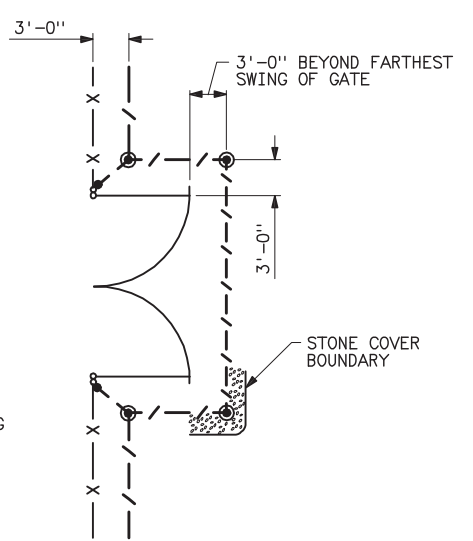
XREF(S):

EXPLANATION

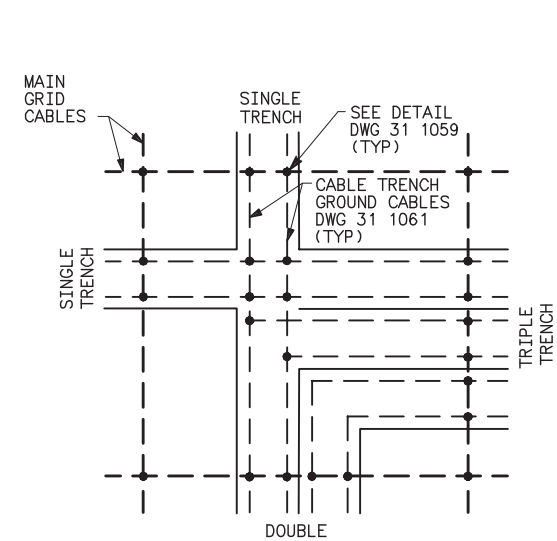
- COPPER GROUND CABLE (BURIED)
- /-/- COPPER-CLAD STEEL GROUND CABLE (BURIED)
- COPPER GROUND CABLE (EXPOSED)
- COPPER GROUND CABLE (IN TRENCH)
- X- FENCE
- ⊙ GROUND ROD
- ⊙ ELECTRICAL GROUNDING CONNECTION
- ⊕ GROUND CABLE RISER



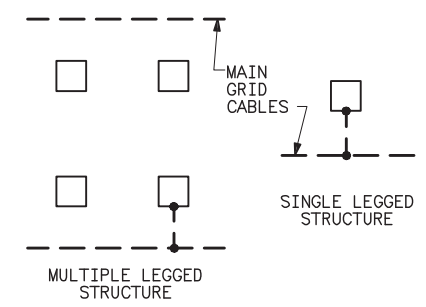
FENCE GROUNDING PLAN



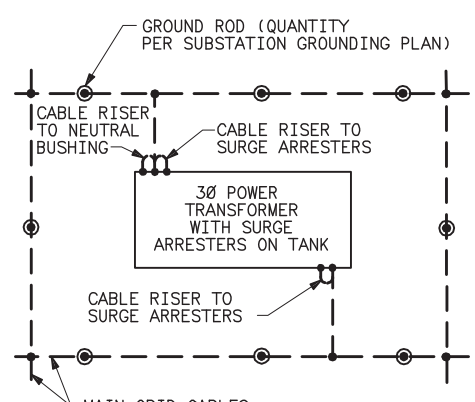
FENCE GATE GROUNDING PLAN



CABLE TRENCH GROUNDING PLAN

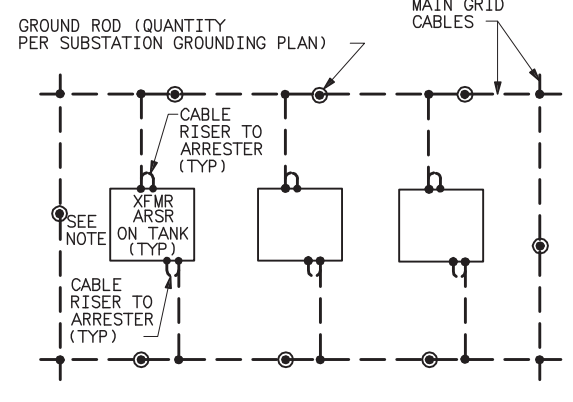


STRUCTURE GROUNDING PLAN



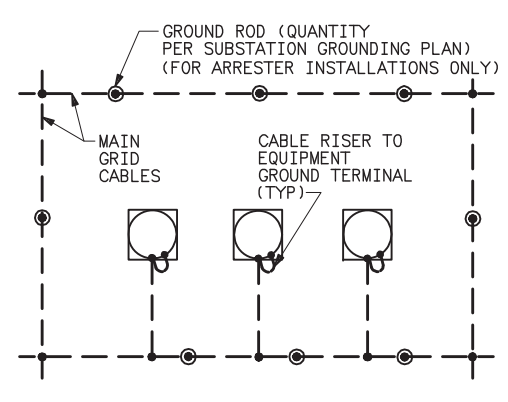
3-PHASE POWER TRANSFORMER GROUNDING PLAN

NOTE
1. SIMILAR FOR 3 PH SHUNT REACTOR

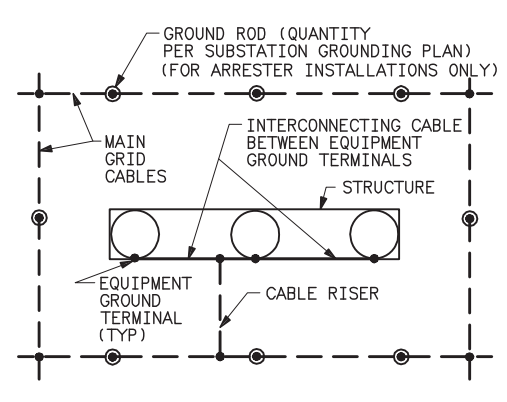


3 SINGLE-PHASE POWER TRANSFORMERS GROUNDING PLAN

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

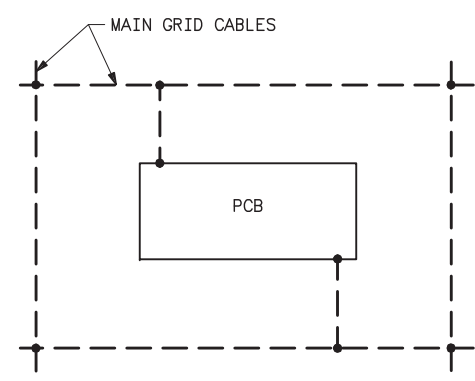


STRUCTURE MOUNTED INSTRUMENT TRANSFORMERS AND SURGE ARRESTERS GROUNDING PLAN

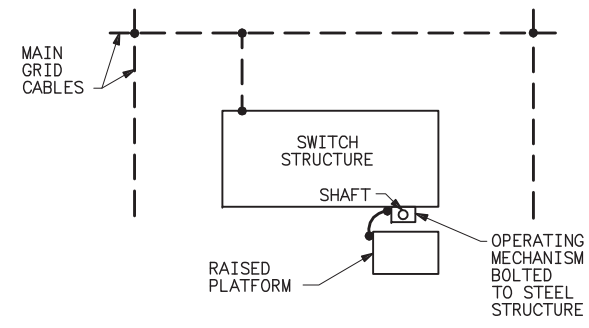
- NOTES**
- ALL GROUNDING SHALL BE INSTALLED IN ACCORDANCE WITH THE SUBSTATION WORKING DRAWINGS, THE STANDARD SUBSTATION GROUNDING DRAWINGS AND THE STANDARD INSTALLATION SPECIFICATION SECTION ON GROUNDING.
 - WHEN TWO OR MORE CABLE TRENCHES ARE LOCATED ADJACENT TO EACH OTHER, EACH TRENCH SHALL BE GROUNDED 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.
 - NO. 4/0 AWG MINIMUM SIZE COPPER GROUND CABLES SHALL BE RUN DIRECTLY FROM THE GROUND GRID TO THE GROUND BLADES OF AIR SWITCHES.
 - 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

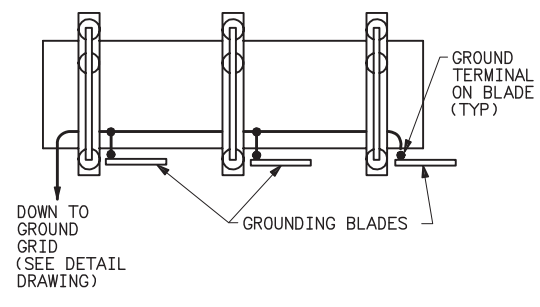


POWER CIRCUIT BREAKER GROUNDING PLAN



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

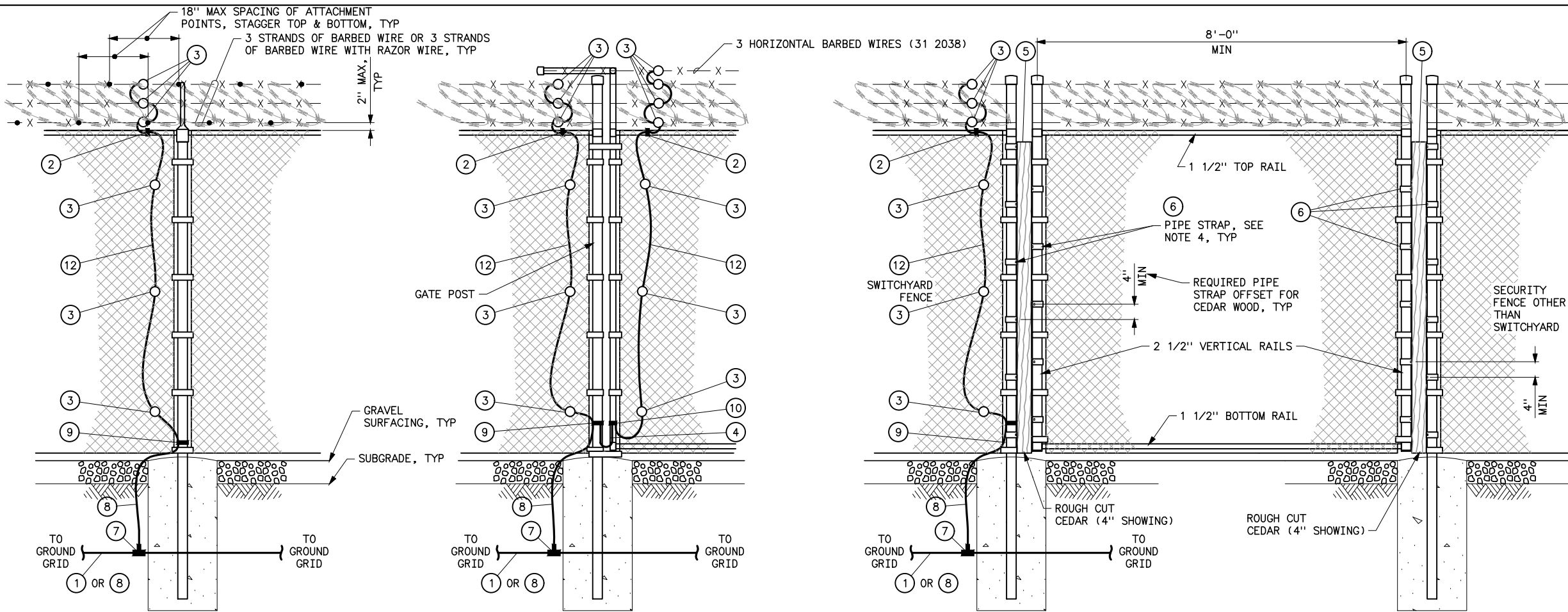
B	11-10-11 A7-RMJ	REVISED GATE DETAILS AND REFERENCE DRAWINGS.
A	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.

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

SUBSTATION STANDARDS GROUNDING PLANS TYPICAL COMPONENTS

DESIGNED BY: PERKINS APPROVED BY: ROSS M. CLARK
ELECTRICAL ENGINEERING MANAGER

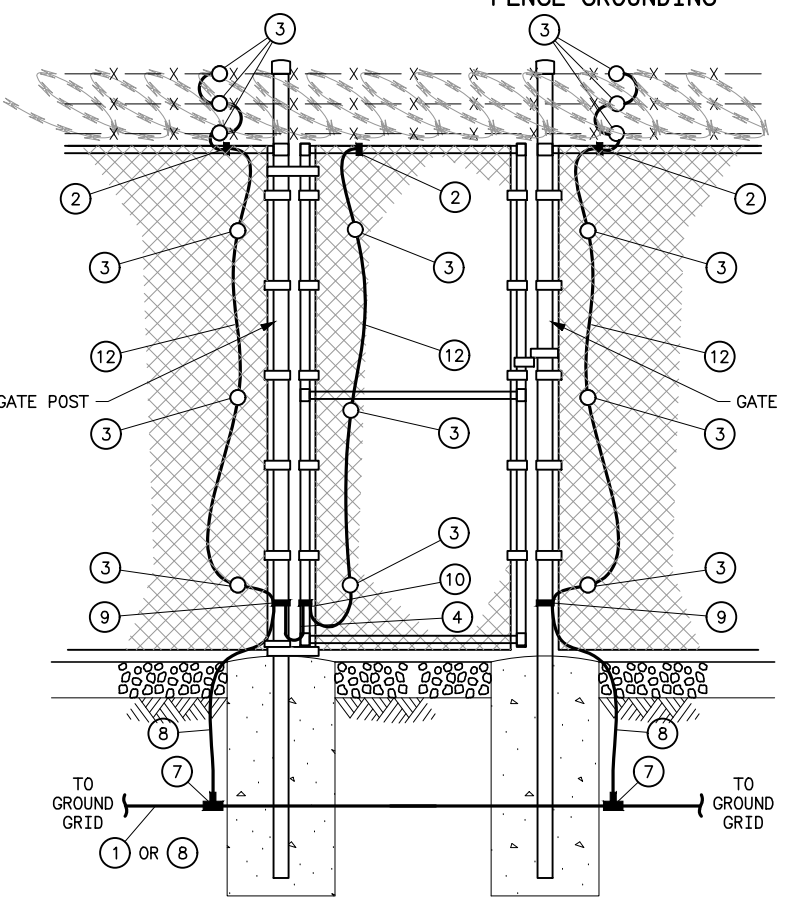
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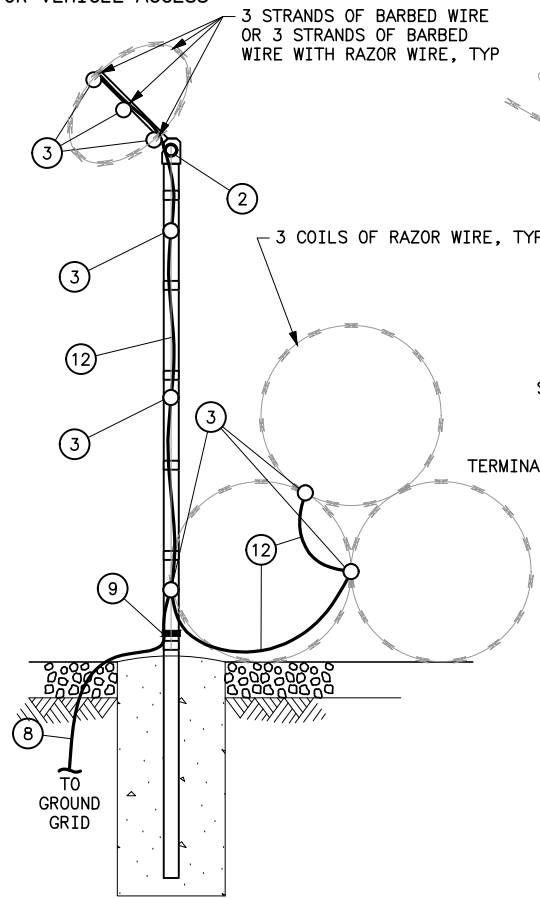
TYPICAL FENCE POST

DETAIL A
FENCE GROUNDING

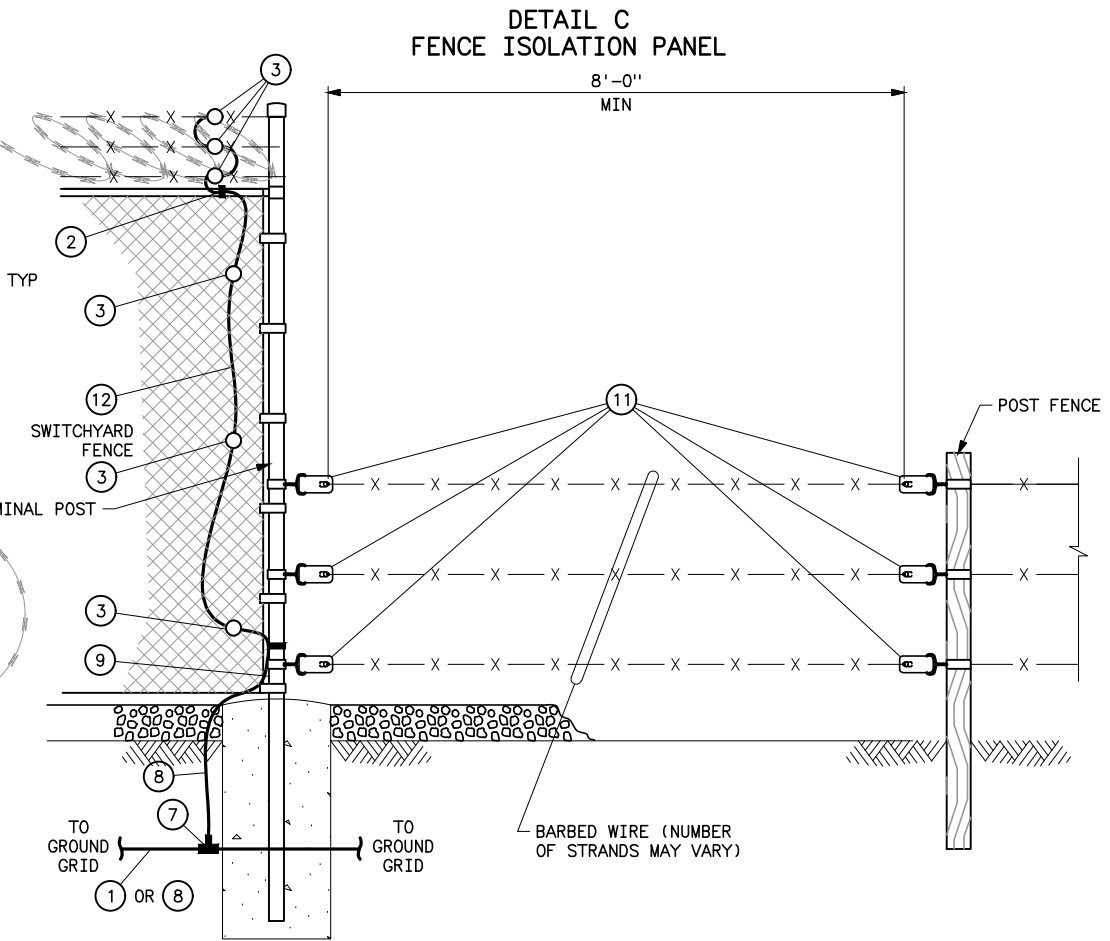
TYPICAL SWING GATE
FOR VEHICLE ACCESS



DETAIL B
PERSONNEL GATE



DETAIL E
RAZOR WIRE GROUNDING



DETAIL C
FENCE ISOLATION PANEL

DETAIL D
BARBED WIRE TERMINATION ON SUBSTATION

REFERENCE MATERIALS

ITEM NO.	DESCRIPTION
1	COPPER CABLE, BARE, #4/0 AWG
2	COPPER CABLE TO PIPE CLAMP, BURNDY TYPE GAR
3	SERVIT CONNECTOR OR BRASS SPLIT BOLT
4	COPPER BRAIDED CABLE, BURNDY
5	4"x6" ROUGH CUT CEDAR POST (NOTE 3)
6	GALVANIZED HEAVY DUTY TWO HOLE PIPE STRAP WITH TWO 2 1/2" GALVANIZED LAG BOLTS (NOTE 3)
7	COMPRESSION CABLE TO CABLE CONNECTOR OR TEE CONNECTOR, DMC POWER GC721, GC731, GC732, GC733 OR EQUAL
8	COPPER CLAD CABLE, BARE (NOTE 5)
9	FENCE POST CONNECTOR (NOTE 2)
10	BRAIDED CABLE TO PIPE CLAMP
11	GUY STRAIN INSULATORS, LAPP #8502-70 OR EQUAL, a.k.a. "JOHNNY BALLS"
12	COPPER CLAD CABLE, BARE (NOTE 6)

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).

REFERENCE DRAWING

GROUNDING PLANS-TYPICAL COMPONENTS... 31 1500

D	2-23-21 A7-RMJ	REVISED ITEMS NO. 8 & 12 IN THE REFERENCE MATERIALS TABLE AND ADDED NOTES 5 & 6.
C	9-27-16 A7-RMJ	REDRAWN, REVISED DETAIL D, ADDED DETAIL E. INCLUDED RAZOR WIRE AND REDUCED SECURITY GAPS.
B	11-1-13 A7-RMJ	ADDED DETAIL D & ITEM 12. REVISED DETAILS B, C, NOTES AND REFERENCE MATERIALS. MINOR CORRECTIONS.
A	7-30-09 A7-RC	ADDED 7 CONDUCTOR NO. 5 COPPERWELD CABLE.

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

SUBSTATION STANDARDS
FENCE GROUNDING
CONNECTIONS
DETAILS

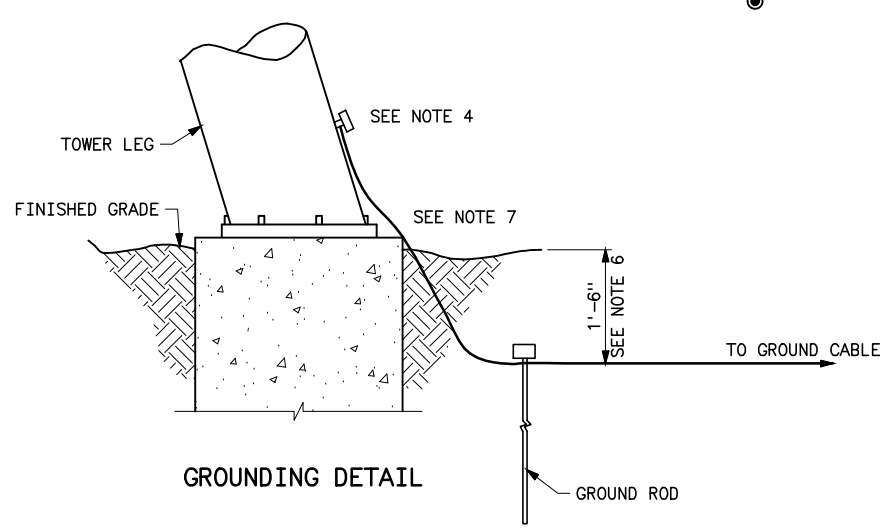
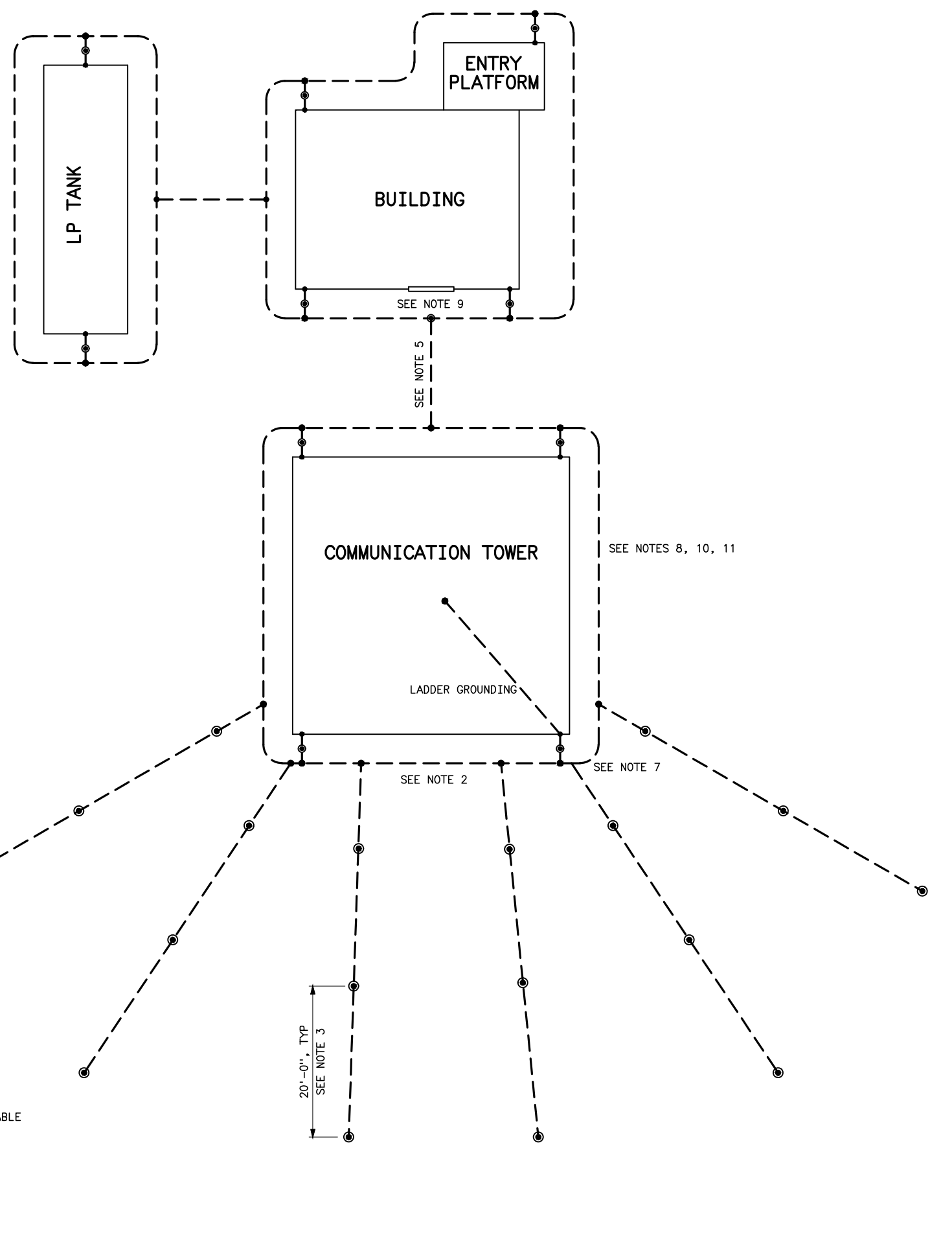
DESIGNED JEFFREY T. HEIN APPROVED ROSS M. CLARK
ELECTRICAL ENGINEERING MANAGER

MARCH 10, 2004	31	1501
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Plotted By: denton Oct 25, 2016 11:01am S:\projects\Misc\StandardDrawings\Drawings\DrawingsReadyForFinal\Scripts\31_1502.dwg Last Saved By: Denton, Debra on 10/25/2016 11:01 AM



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

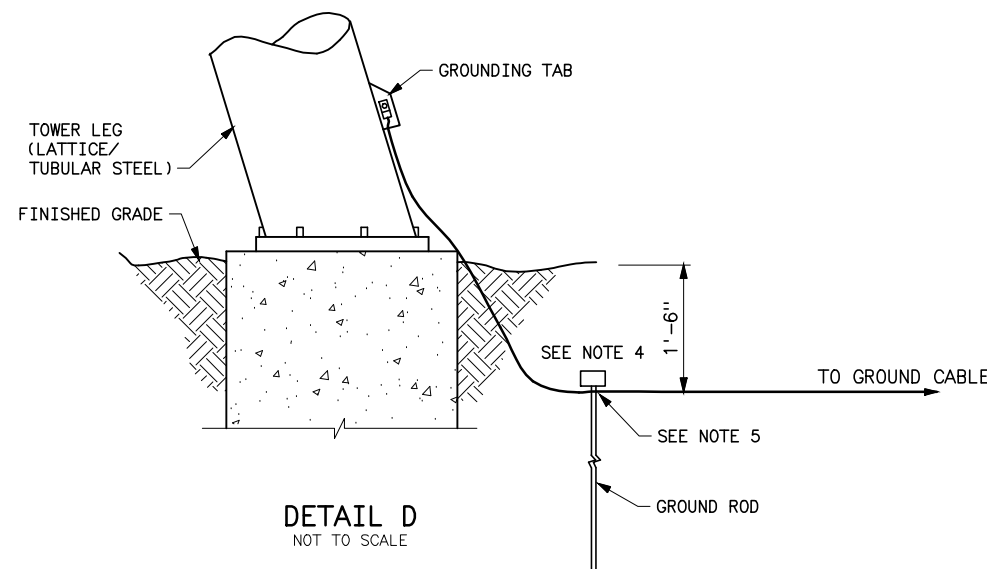
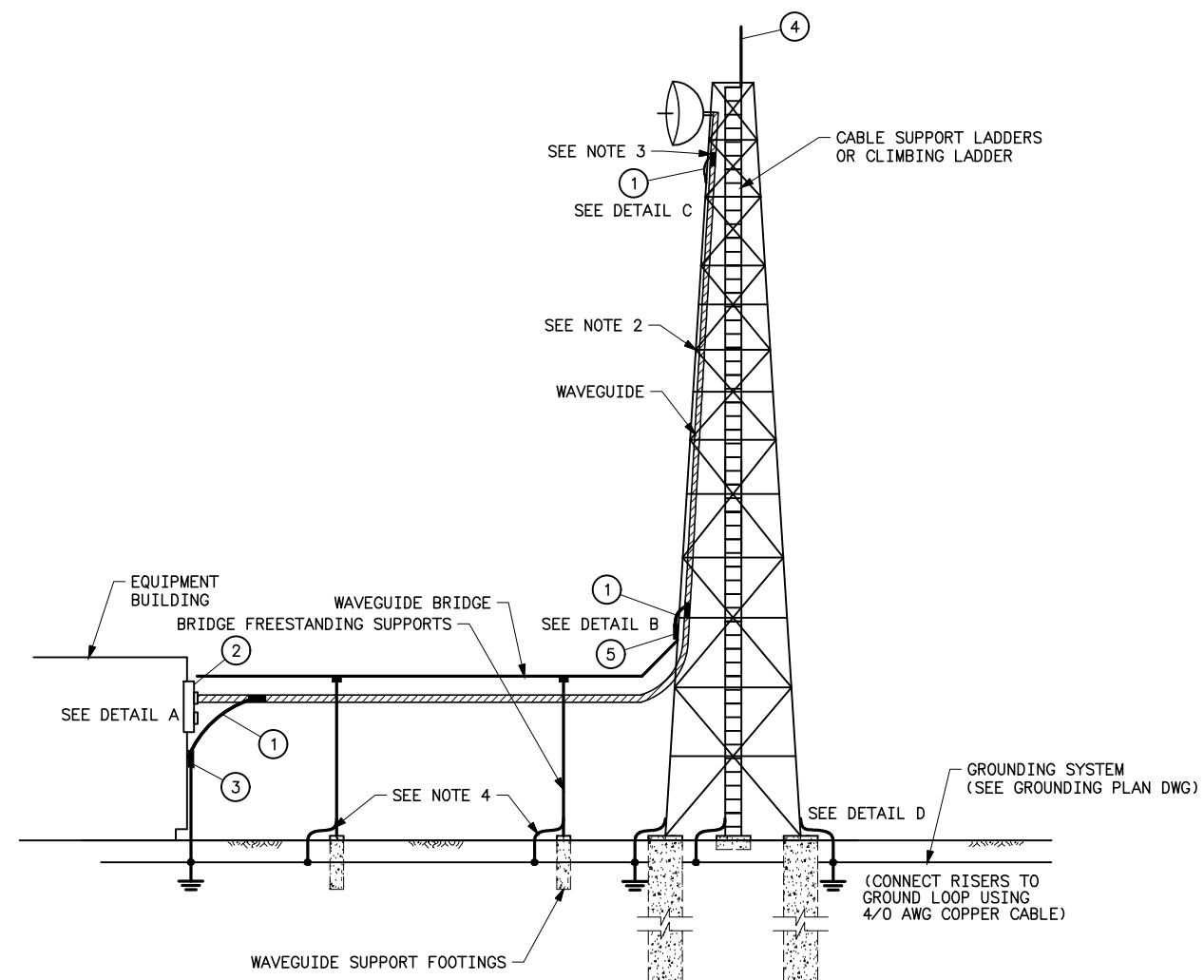
SUBSTATION STANDARDS-GROUNDING DETAILS	31 1060
MICROWAVE TOWER GROUNDING	31 1503
GROUNDING-SUBSTATION DETAILS	31 1504
GROUNDING-REMOTE DETAILS	31 1505

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 HAMAL	SYSTEM CONTROL MANAGER
DATE: OCTOBER 25, 2016	NO. 31	1502

XREF(S):

REFERENCE MATERIALS

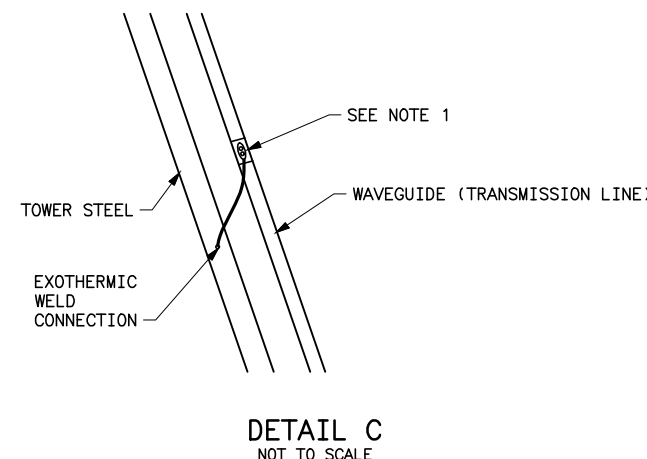
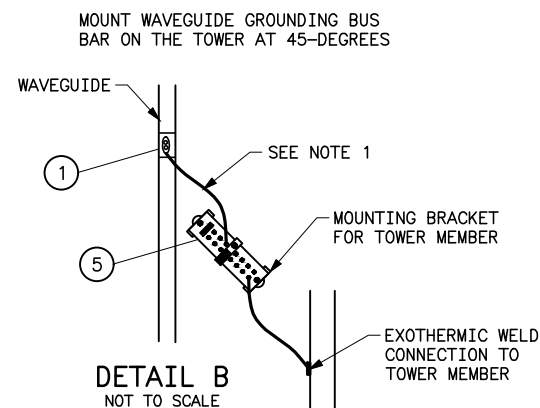
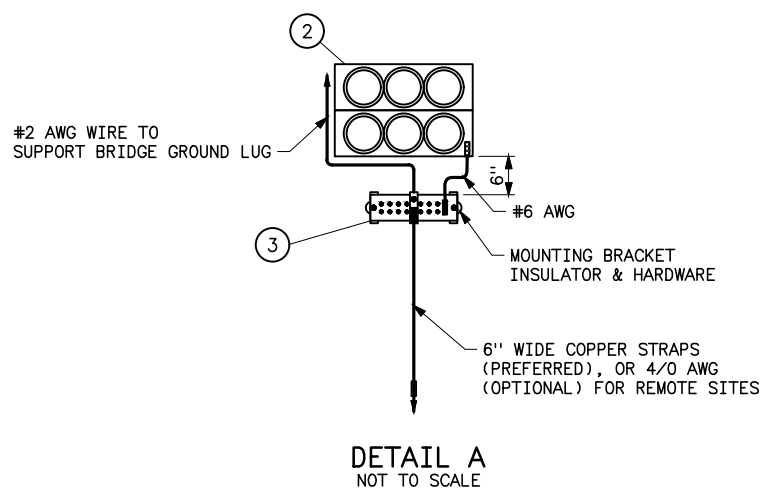
ITEM NO.	DESCRIPTION
1	WAVEGUIDE GROUNDING KIT
2	WAVEGUIDE ENTRY PANEL
3	COPPER GROUND BAR WITH INSULATED WALL MOUNT
4	LIGHTNING ROD WITH TOWER BONDING KIT
5	COPPER GROUND BAR WITH TOWER MOUNTING BRACKET



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

DATE	ISSUE	NO.
OCTOBER 25, 2016		31 1503

LEGEND

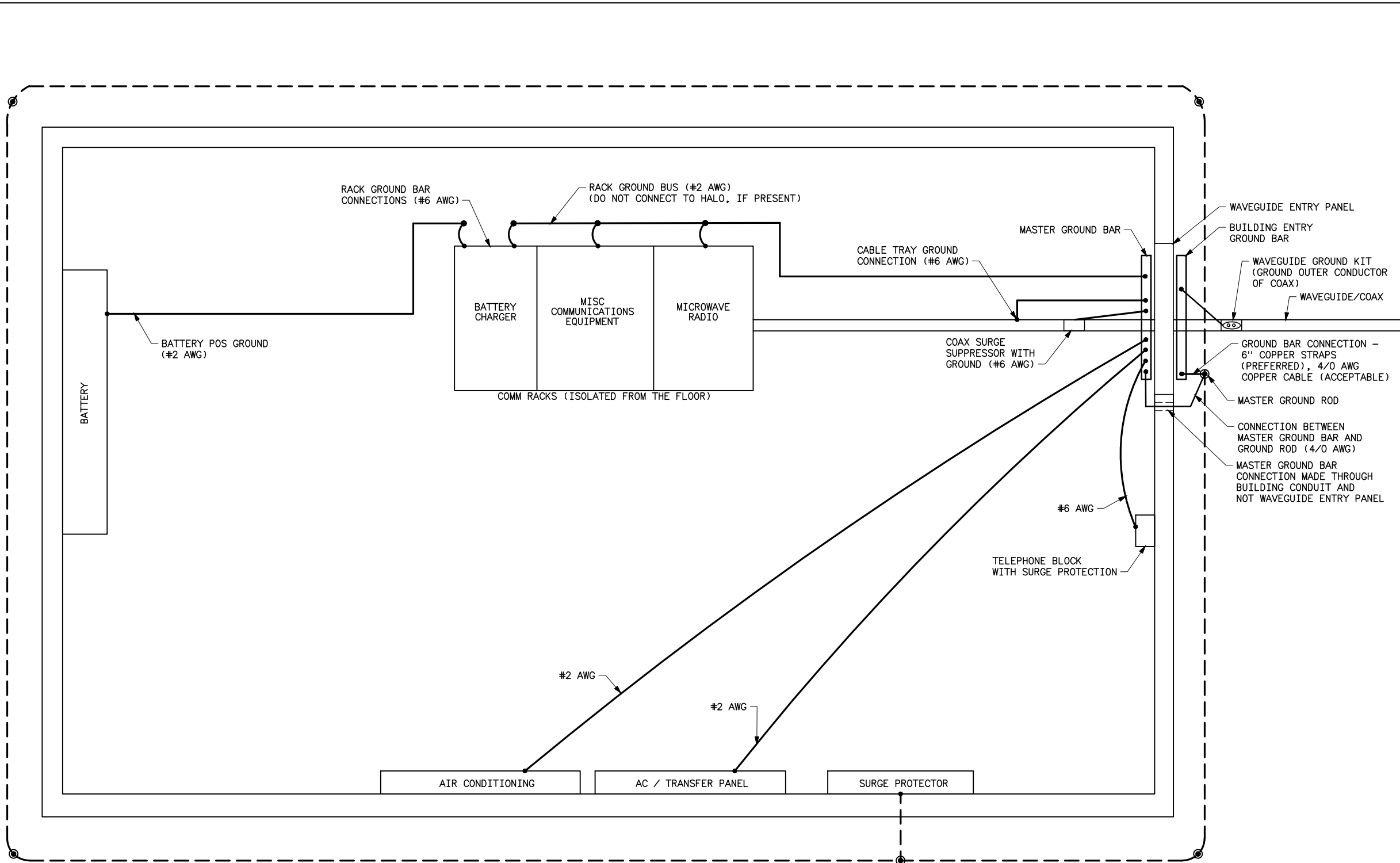
- ⊙-----10'-0" GROUND ROD
- NO. 4/0 AWG STRANDED BARE COPPER GROUND CABLE
- ELECTRICAL CONNECTION TO THE GROUND WIRE

NOTES

1. GROUNDING PROCEDURES SHALL BE IN ACCORDANCE WITH STANDARD TIA/EIA 607.
2. EQUIPMENT GROUNDS SHALL BE CONNECTED TO THE GROUND BAR ON THE RACK. REFER TO DRAWING 53 7050.
3. 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.
4. EACH ROW OF COMMUNICATIONS EQUIPMENT SHALL HAVE AN INDIVIDUAL GROUND BUS THAT IS ATTACHED TO THE MASTER GROUND BAR.
5. DO NOT INSTALL BARE GROUND WIRES IN METALLIC CONDUITS, RACEWAYS, OR CABLE TRAYS. USE ONLY INSULATED WIRES.
6. THE BUILDING ENTRY GROUND BAR, WAVEGUIDE ENTRY PORT, AND THE MASTER GROUND BAR CAN BE REPLACED BY A COMPLETE COPPER ENTRY PORT, POLYPHASE ENTRANCE PANEL OR EQUAL.
7. CONNECT GROUND WIRES FROM COAXIAL CABLE SURGE SUPPRESSORS TO THE MASTER GROUND BAR IF PRESENT.
8. LOCATE THE GROUND BARS 6-INCHES BELOW THE WAVEGUIDE ENTRY PORT.
9. 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.
10. 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.
11. ENSURE THAT DISSIMILAR METALS ARE NOT CONNECTED TOGETHER WITHOUT USING LUGS OR SPLIT BOLTS DESIGNATED FOR THIS PURPOSE.
12. CONNECT GROUNDING CONDUCTORS USING EXOTHERMIC WELD, PRESSURE TYPE CRIMP CONNECTORS, BOLTED COMPRESSION CLAMPS, OR SPLIT BOLT CONNECTORS. CORRECTLY SIZE CONNECTORS TO CONDUCTORS.
13. 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

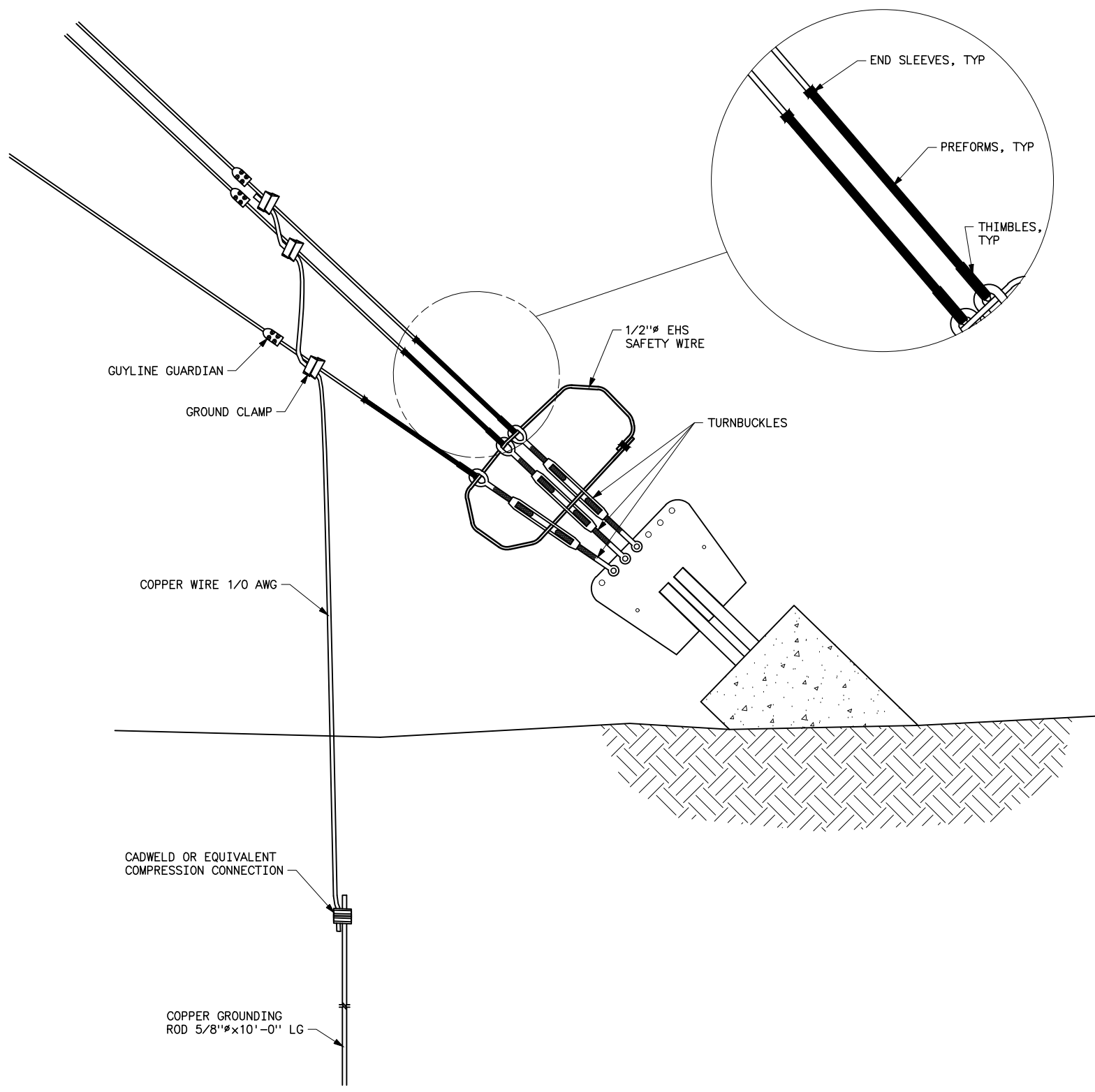
SUBSTATION STANDARDS-GROUNDING DETAILS	31 1060
GROUNDING PLAN	31 1502
MICROWAVE TOWER GROUNDING	31 1503
COMMUNICATIONS RACK-LAYOUT & DETAILS	53 7050



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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 SCOTT JOHNSON		APPROVED DAN HAMAI SYSTEM CONTROL MANAGER
C/AE	OCTOBER 25, 2016	31 1505

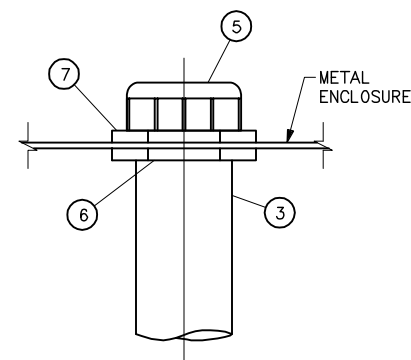


- NOTES**
1. ALL GUY ATTACHMENT HARDWARE TO BE PROPERLY SIZED FOR EACH GUY STRAND.
 2. GROUNDING ROD IS TO BE AT LEAST 4'-0" AWAY FROM GUY ANCHOR.
 3. GROUND CLAMPS SHALL BE BRONZE, STAINLESS STEEL OR BRASS.

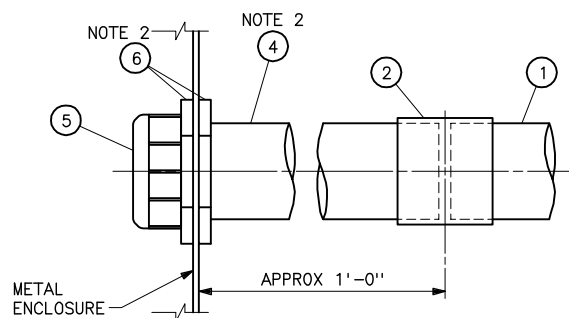
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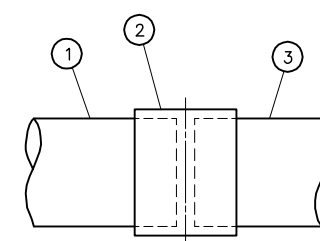
A	12-4-18 A7-SJ	CONNECTION REVISIONS.
SUPERSEDES DWG NO. 41 7006		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
COMMUNICATIONS STANDARD GUY TOWER GROUNDING ANCHOR GROUND DETAILS		
DESIGNED S. JOHNSON		APPROVED DAN HAMAI SYSTEM CONTROL MANAGER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



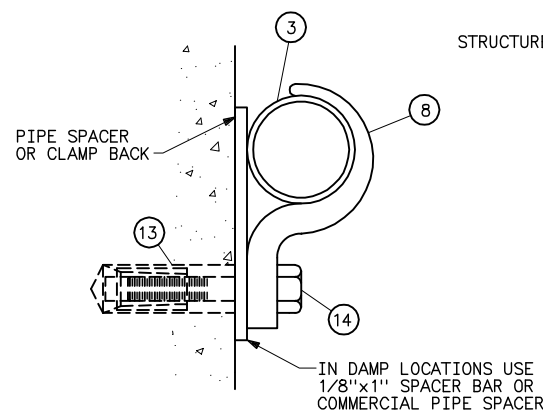
**METALLIC CONDUIT TERMINATION IN METAL ENCLOSURE
DETAIL A**



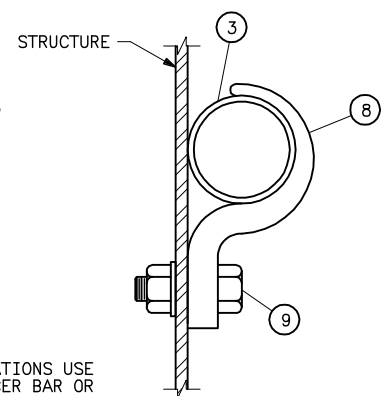
**NON-METALLIC CONDUIT TERMINATION IN METAL ENCLOSURE
DETAIL B**



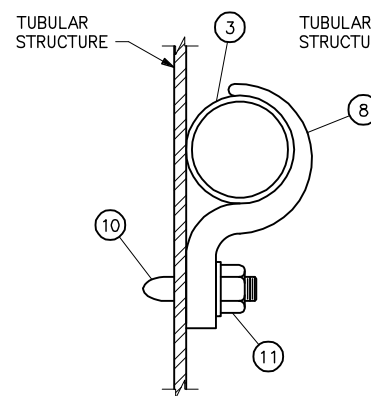
**CONNECTING RIGID STEEL AND PVC CONDUIT
DETAIL C**



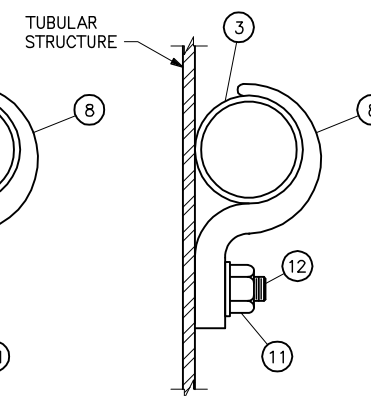
**CONDUIT CLAMPING ON CONCRETE SURFACE
DETAIL D**



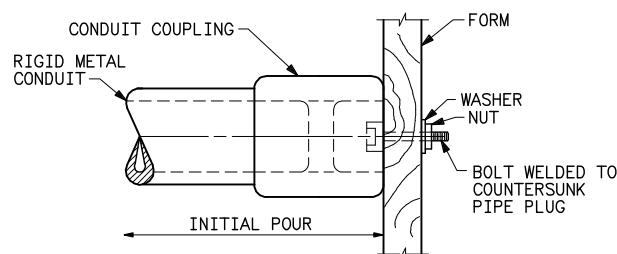
**CONDUIT CLAMPING ON METALLIC STRUCTURE
(BOTH SIDES ACCESSIBLE)
DETAIL E**



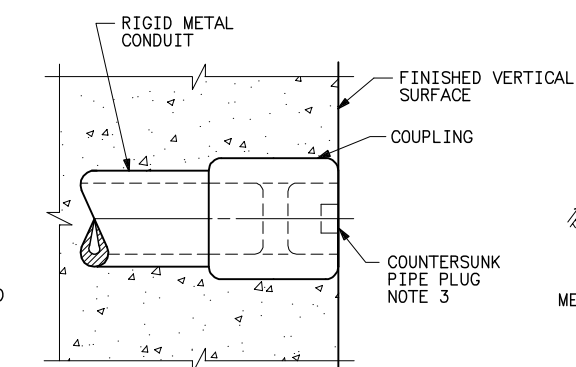
**CONDUIT CLAMPING ON TUBULAR STEEL STRUCTURE
DETAIL F**



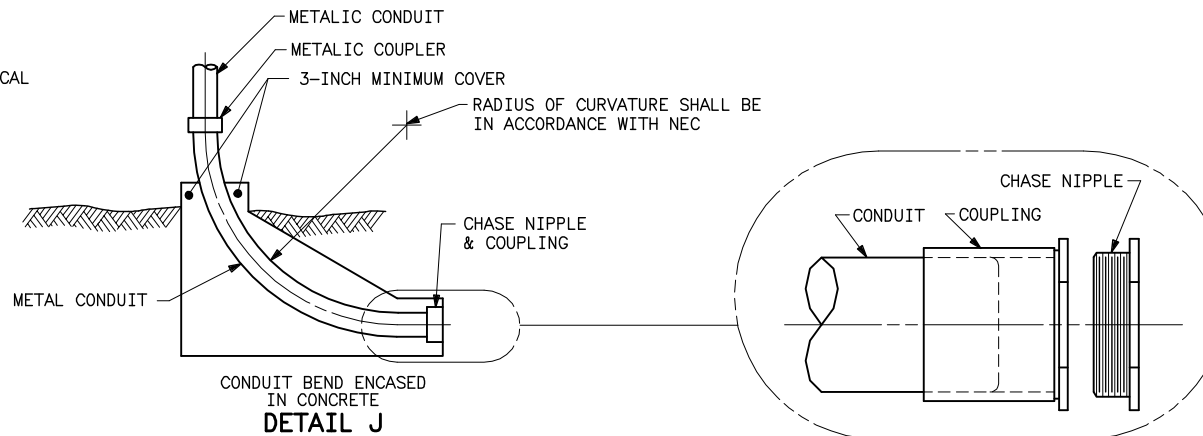
DETAIL G



**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

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

A 7-15-03
A7-RC REVISED TITLE BLOCK ONLY.

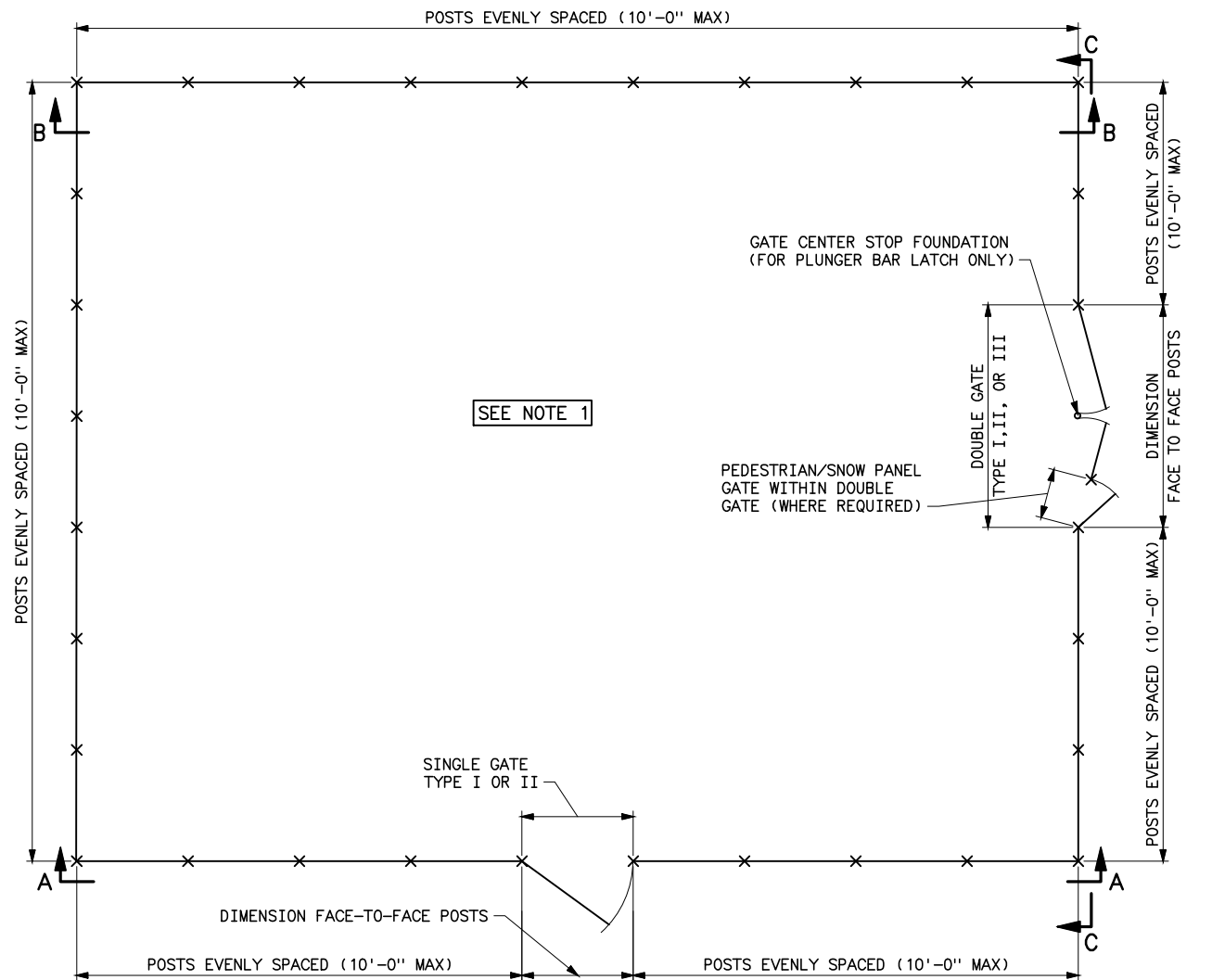
SUPERSEDES DWG NO. 31-1027, 31-1028, 31-1033, 31-1034 AND (IN PART) 31-1077

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

**SUBSTATION STANDARDS
CONDUIT INSTALLATION
DETAILS**

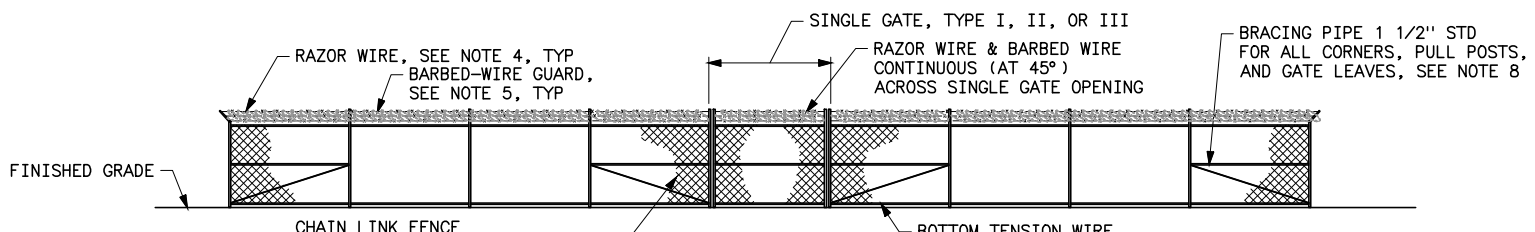
DESIGNED BUREC APPROVED ROSS M. CLARK
ELECTRICAL ENGINEERING MANAGER

MAY 14, 1999 31 1700

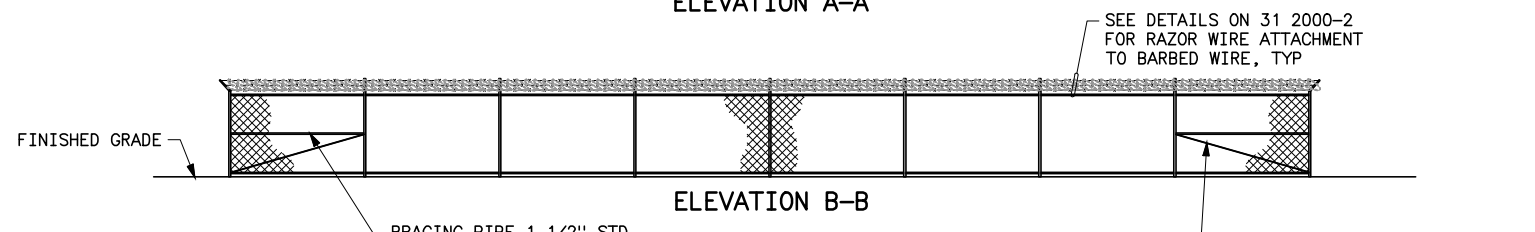


SEE NOTE 1

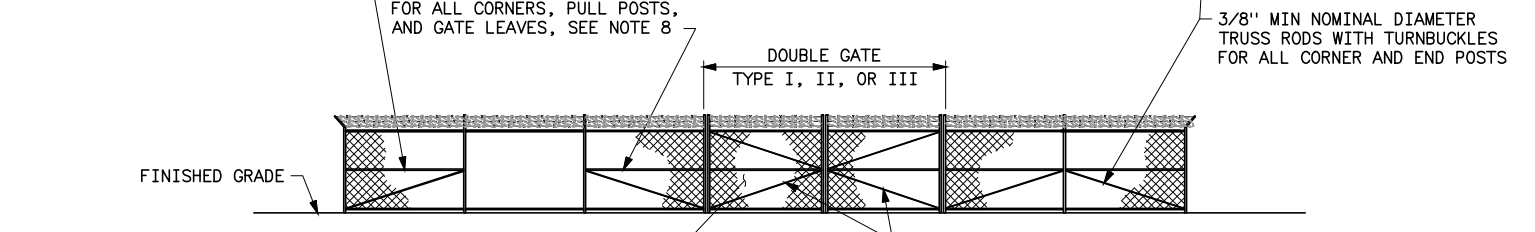
TYPICAL PLAN



ELEVATION A-A



ELEVATION B-B



ELEVATION C-C

NOTES

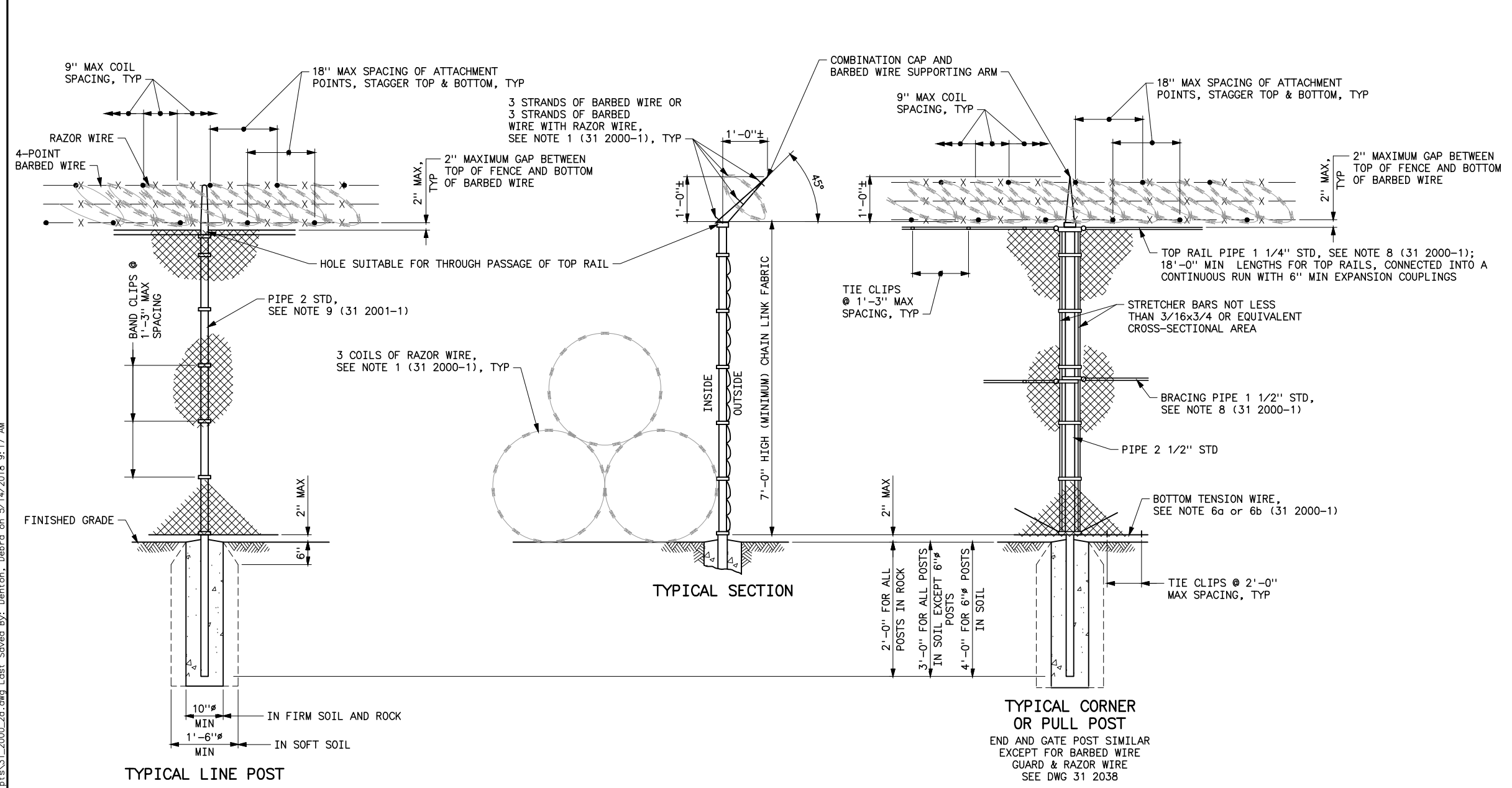
1. SEE DRAWINGS AND SPECIFICATIONS FOR DESIGNATION OF FENCE AS "STANDARD CHAIN LINK FENCE" OR "HIGH SECURITY CHAIN LINK FENCE".
 - a. "STANDARD CHAIN LINK FENCE" SHALL CONSIST OF STANDARD CHAIN LINK FENCE FABRIC, GATES, AND GUARD OF THREE STRANDS OF BARBED WIRE.
 - b. "HIGH SECURITY CHAIN LINK FENCE" 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.
2. SEE SPECIFIC "SITE PLAN", "GRADING PLAN", OR "GRADING AND PLOT PLAN" FOR OVERALL FENCE DIMENSIONS; AND SIZE, LOCATION, AND SWING OF GATES.
3. CHAIN LINK FENCE FABRIC SHALL HAVE BARBED-SELVAGE TOP AND BOTTOM, EXCEPT THAT GATE FILLER FABRIC SHALL HAVE KNUCKLED SELVAGE AT BOTTOM.
 - a. STANDARD CHAIN LINK FENCE FABRIC: ASTM A 392, 2-INCH MESH, 11-GAGE NOMINAL WIRE DIAMETER AFTER COATING.
 - b. 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.
4. SECURITY RAZOR / CONCERTINA TYPE WIRE:
 - a. 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.
 - b. 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.
5. 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.
6. BOTTOM TENSION WIRE & GALVANIZED STEEL TIES:
 - a. 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.
 - b. 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.
7. ON LONG RUNS, PROVIDE BRACED PULL POSTS AS REQUIRED FOR PROPER STRETCHING OF FABRIC.
8. 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.
9. 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.
10. 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.
11. FENCE POSTS, TOP RAILS, AND BRACES: ASTM F 1083, SCHEDULE 40 STEEL PIPE.
12. ALL JOINTS BETWEEN TUBULAR GATE FRAME MEMBERS SHALL BE WELDED.
13. 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.
14. 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.
15. 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.
16. 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.
17. 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 JERRY SCHREIBER		APPROVED DOUG HANSON CIVIL ENGINEERING MANAGER
SEPTEMBER 27, 2016	31	2000-1

Plotted By: denton May 14, 2018 9:17am
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NOTE
1. REFERENCE NOTES ON 31 2000-1.

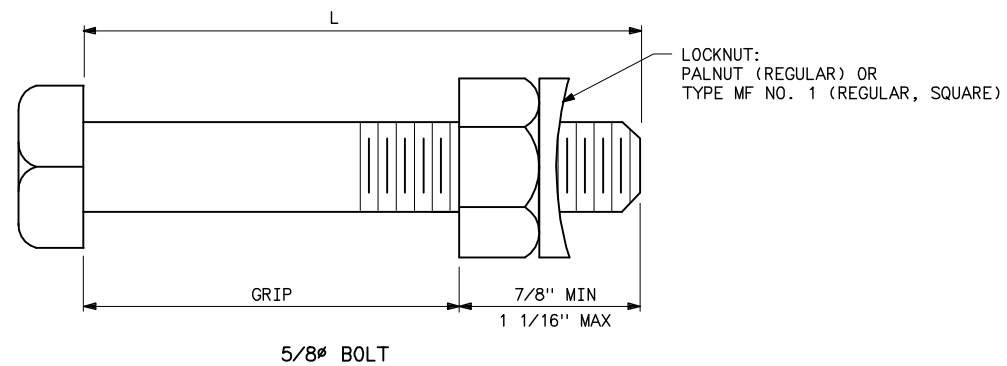
REFERENCE DRAWINGS

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

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
SEPTEMBER 27, 2016	31	2000-2

Plotted By: denton May 14, 2018 - 9:18am
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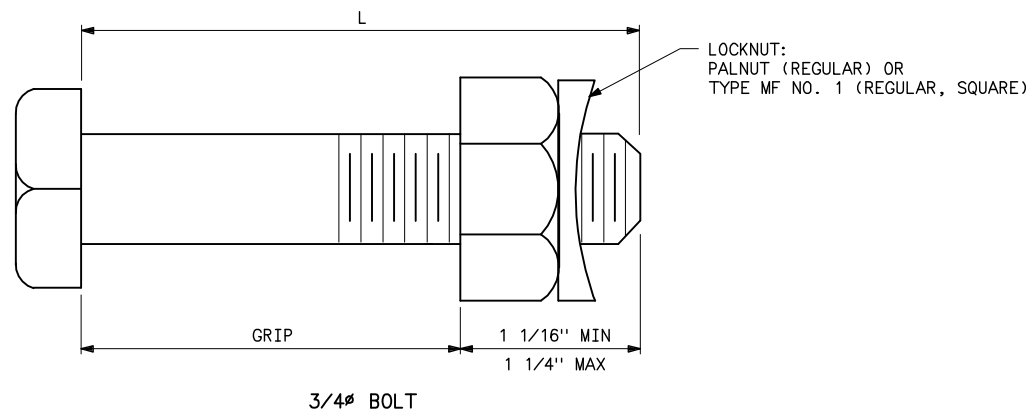


BOLT LENGTHS REQUIRED FOR VARIOUS GRIPS

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

NOTE

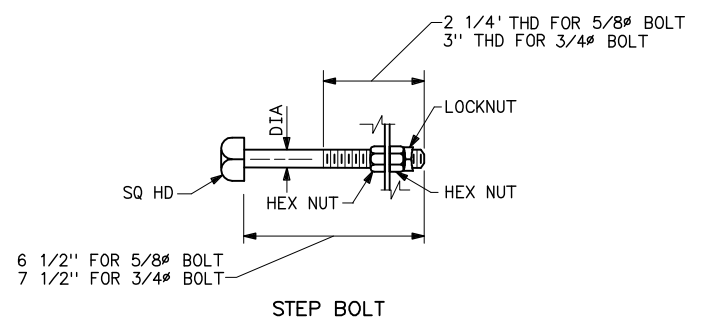
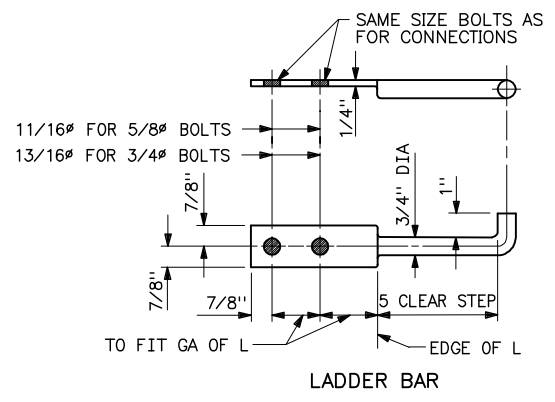
1. GRIP INCLUDES FILLS AND BEVEL WASHERS WHERE USED.



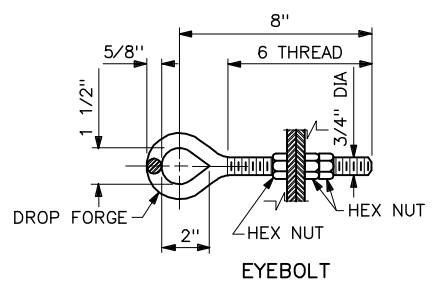
BOLT LENGTHS REQUIRED FOR VARIOUS GRIPS

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

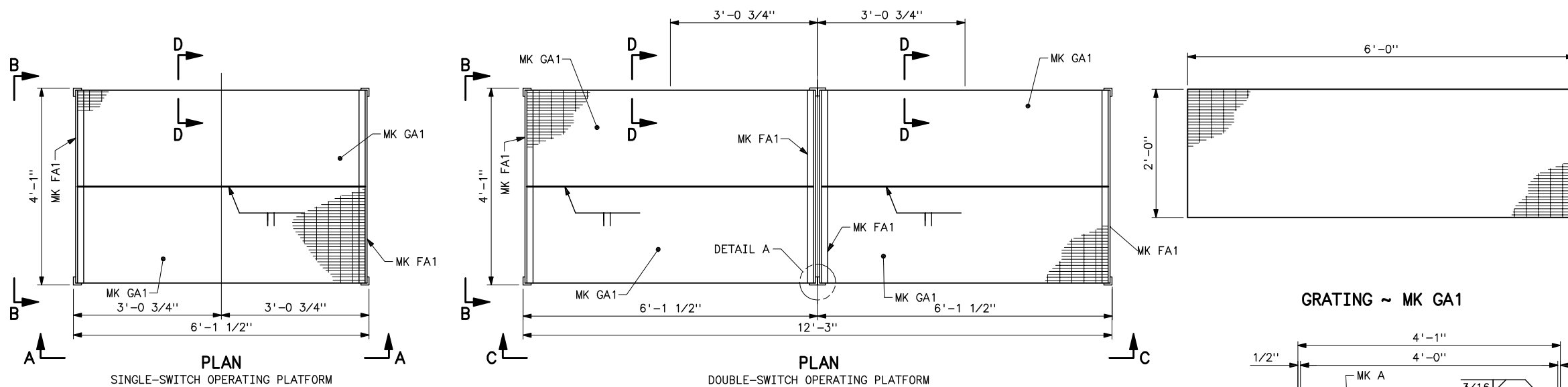
C	7-15-03 A7-DH	REVISED TITLE BLOCK ONLY.
B	8-28-89 AZ-GB	REDRAWN AND REVISED ON CAE.
SUPERSEDES DWG NO. E40-D-5665		
<small>UNITED STATES DEPARTMENT OF ENERGY</small> WESTERN AREA POWER ADMINISTRATION <small>CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO</small>		
SUBSTATION STANDARDS 5/8 & 3/4 DIA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



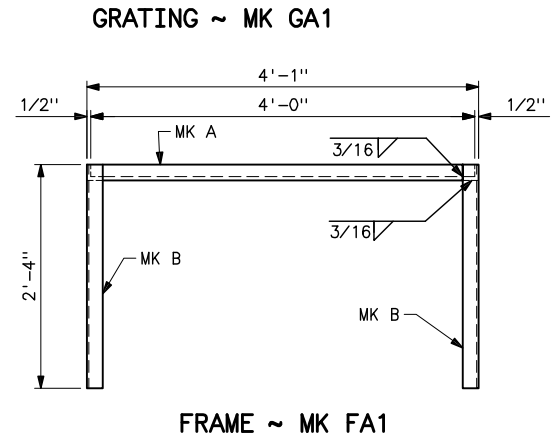
NOTE
1. ALL MATERIAL TO BE GALVANIZED.



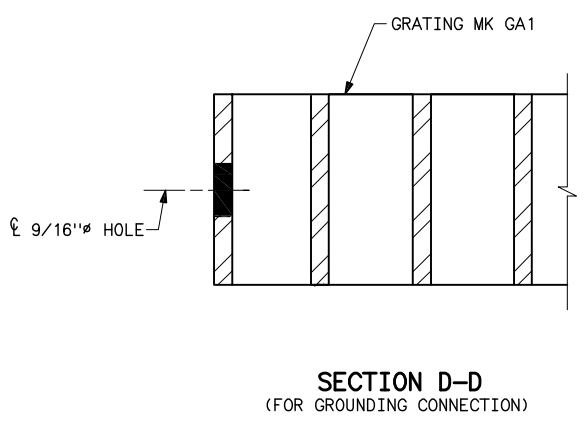
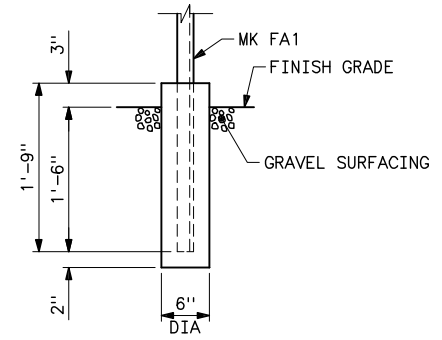
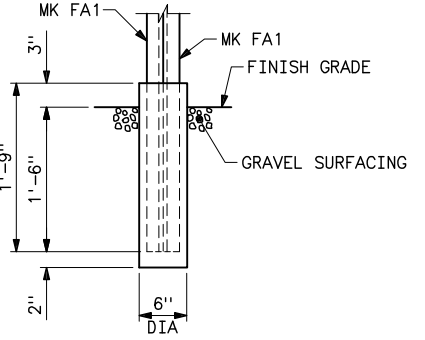
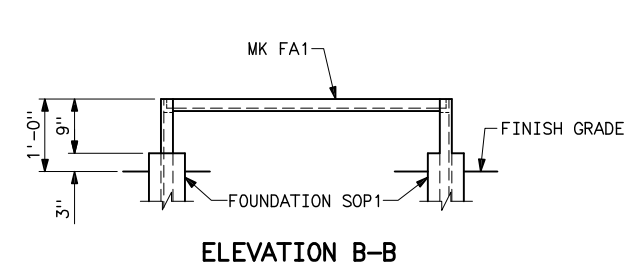
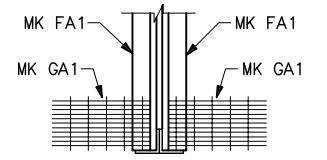
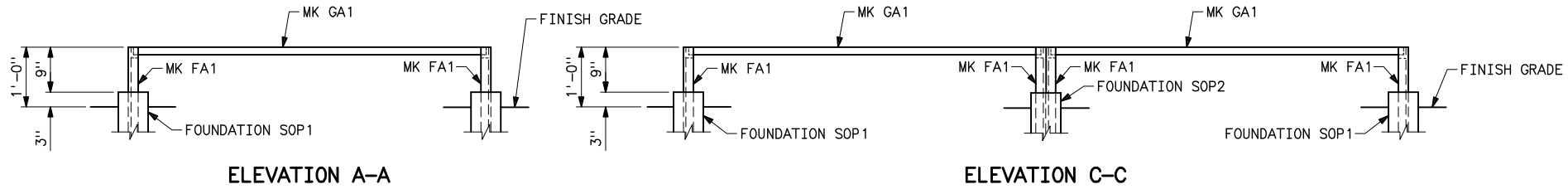
D	9-12-12 A7-DH	MINOR REVISION.
C	7-15-03 A7-DH	REVISED TITLE BLOCK ONLY.
B	8-15-89 A2-	REDRAWN AND REVISED ON CAE
SUPERSEDES DWG NO. E40-D-5155		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS TYPICAL EYEBOLT 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.



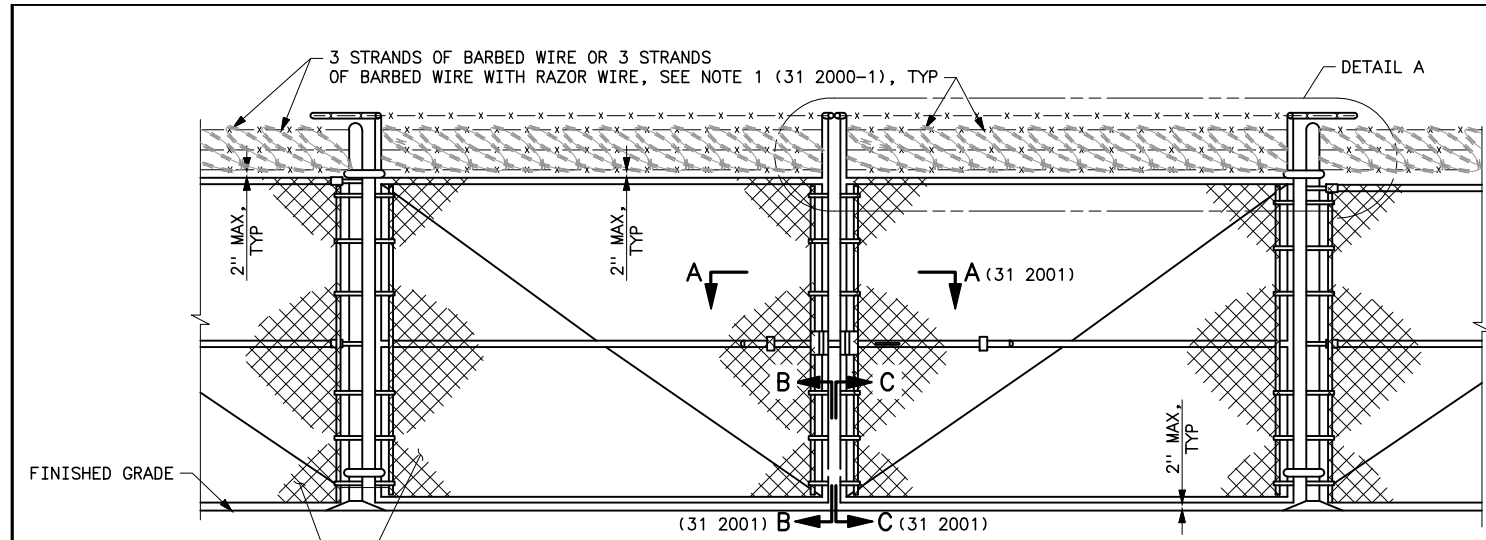
REFERENCE DRAWING
 SWITCH OPERATING PLATFORMS—
 ELECTRICAL DESIGN AND DETAILS _____ 31 1075

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

Plotted By: denton Jul 12, 2011 - 3:00pm
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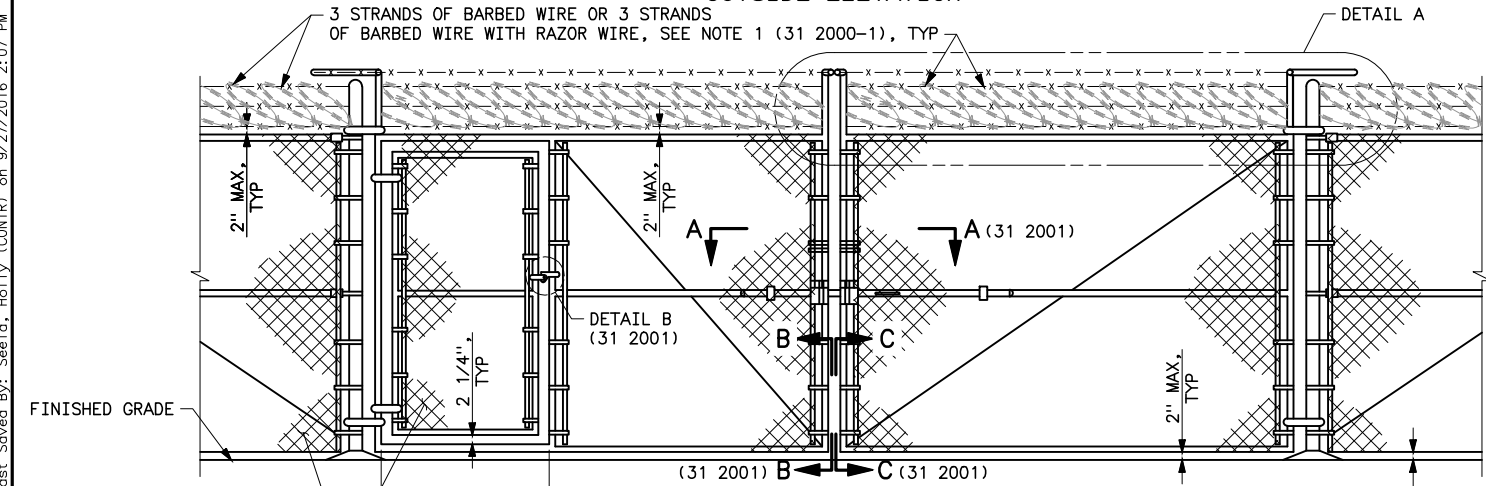
GATE FRAMES AND POSTS

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



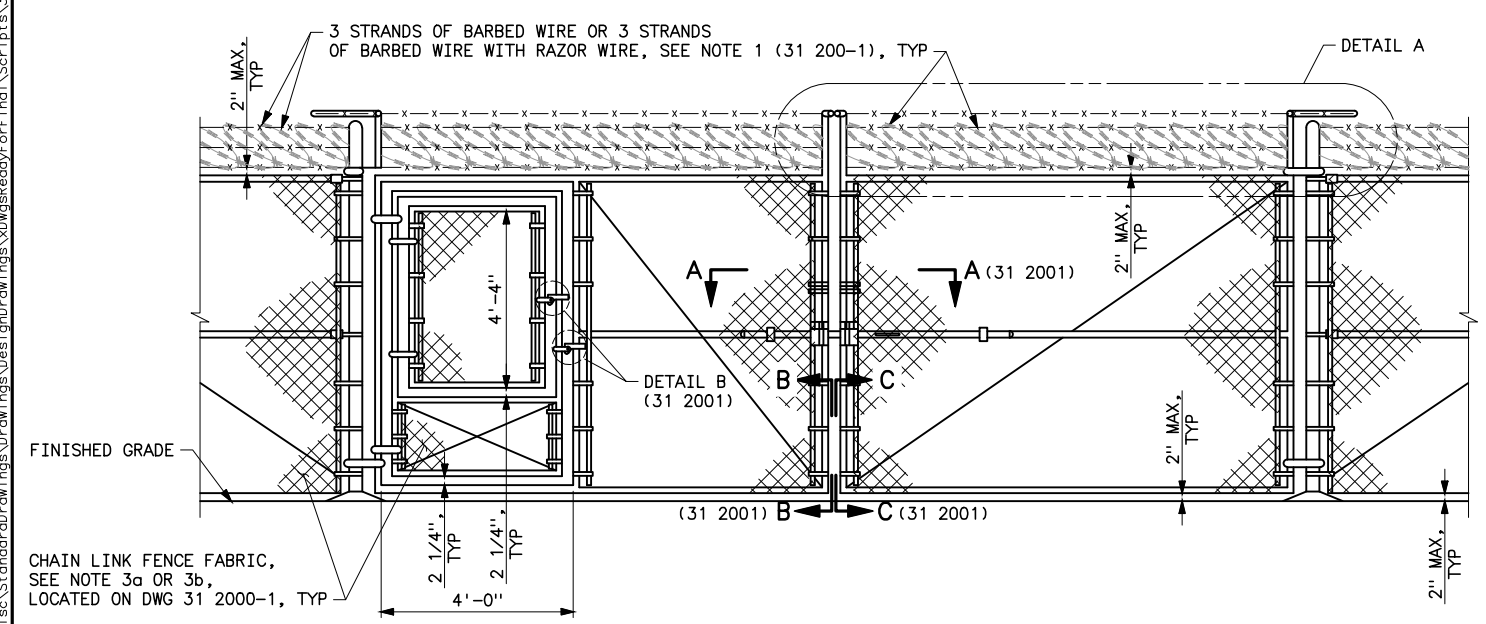
DOUBLE GATE-TYPE I OUTSIDE ELEVATION

CHAIN LINK FENCE FABRIC, SEE NOTE 3a OR 3b, LOCATED ON DWG 31 2000-1, TYP



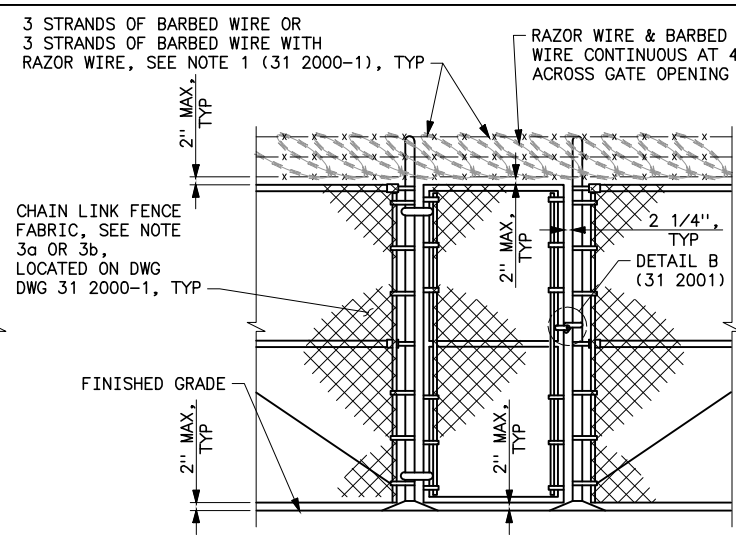
DOUBLE GATE-TYPE II OUTSIDE ELEVATION

CHAIN LINK FENCE FABRIC, SEE NOTE 3a OR 3b, LOCATED ON DWG 31 2000-1, TYP

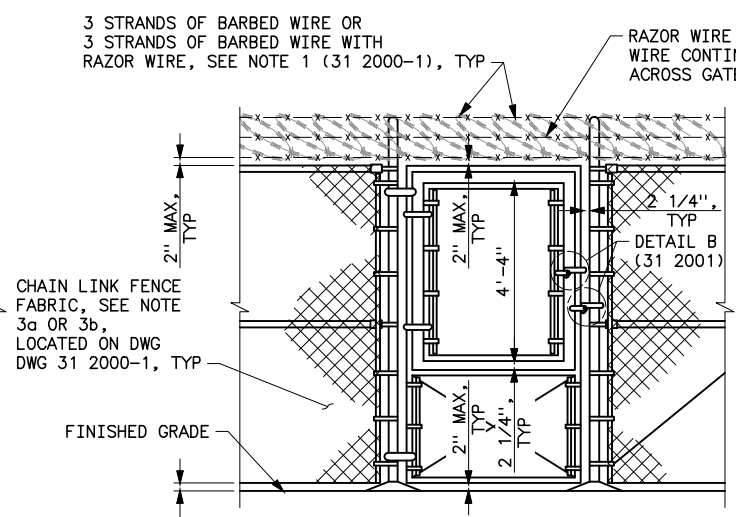


DOUBLE GATE-TYPE III OUTSIDE ELEVATION

CHAIN LINK FENCE FABRIC, SEE NOTE 3a OR 3b, LOCATED ON DWG 31 2000-1, TYP

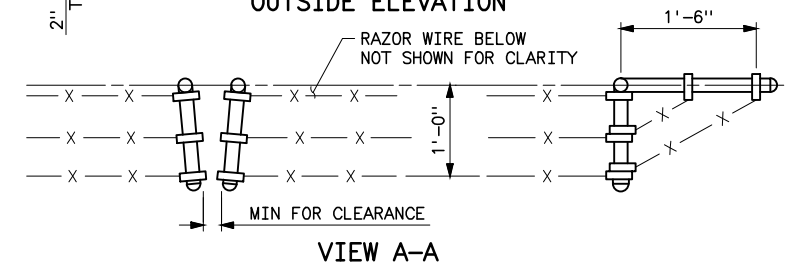


SINGLE GATE-TYPE I OUTSIDE ELEVATION

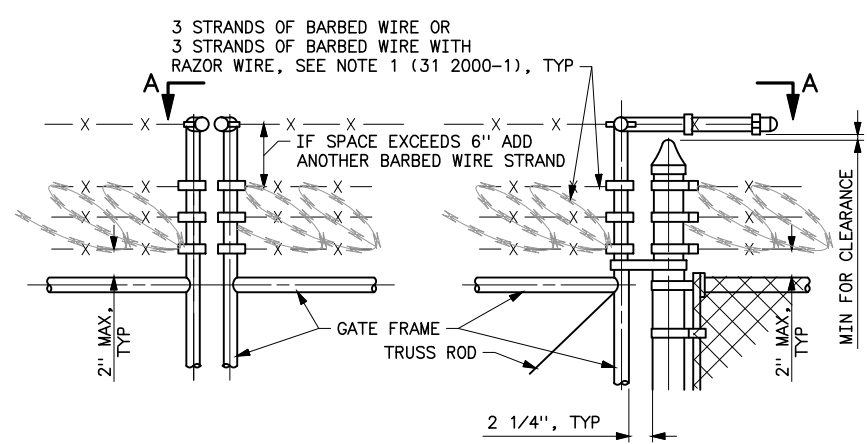


SINGLE GATE-TYPE II OUTSIDE ELEVATION

CHAIN LINK FENCE FABRIC, SEE NOTE 3a OR 3b, LOCATED ON DWG 31 2000-1, TYP



VIEW A-A



DOUBLE GATE BARBED WIRE & RAZOR WIRE GUARD DETAIL A

NOTES

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

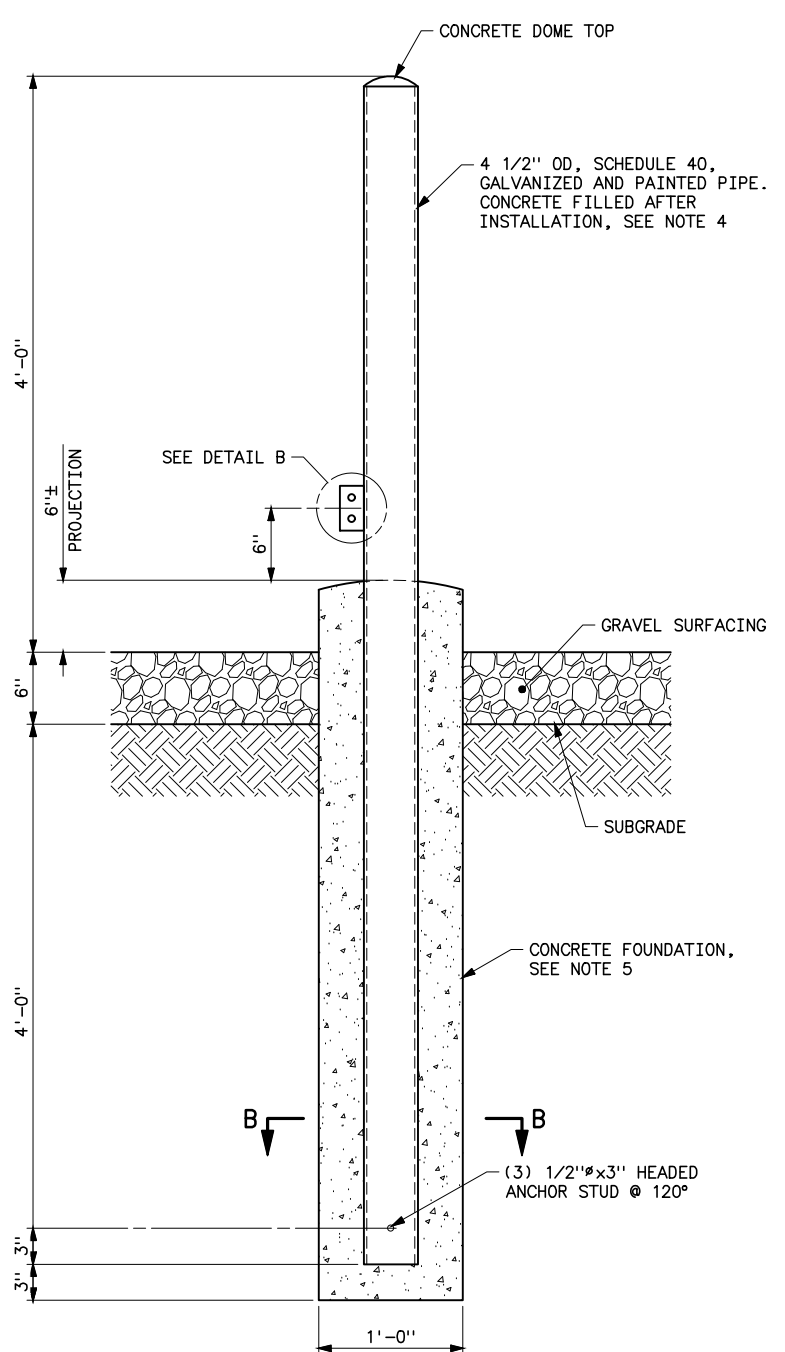
REFERENCE DRAWINGS

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

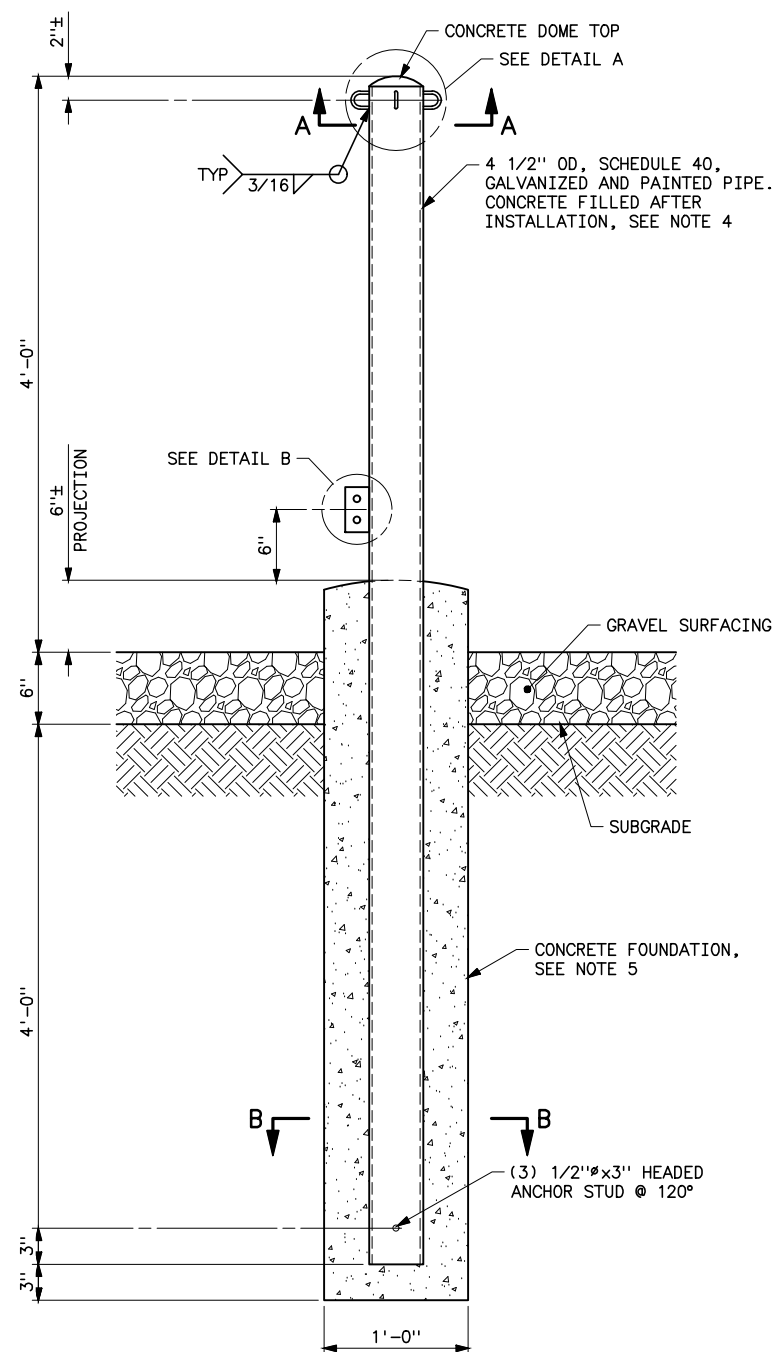
B	9-27-16 A7-JAS	GENERAL REVISIONS TO INCORPORATE OSEM WAPA ORDER 470.1H, 2016.
A	7-15-03 A7-DH	REVISED TITLE BLOCK ONLY.
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS CHAIN-LINK FENCE SWING GATES		
DESIGNED 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
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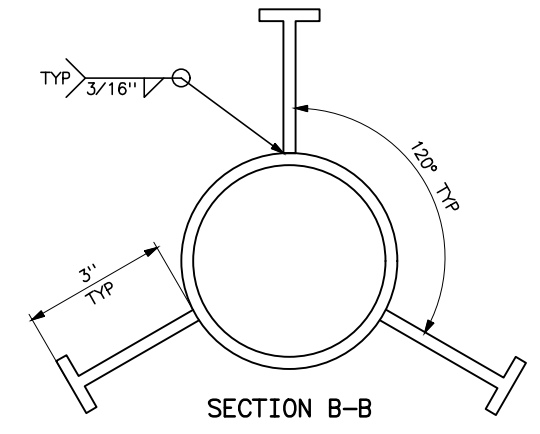
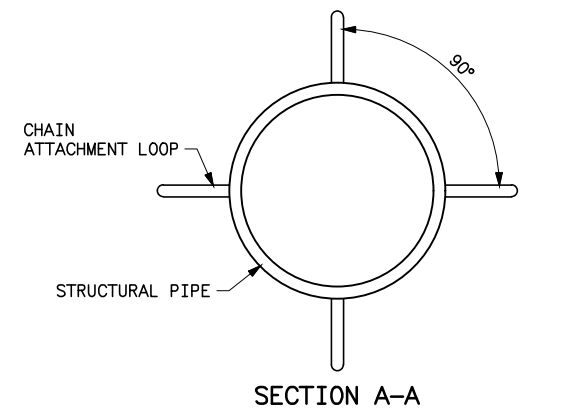
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DETAIL WITHOUT CHAIN CONNECTIONS
TYPE I

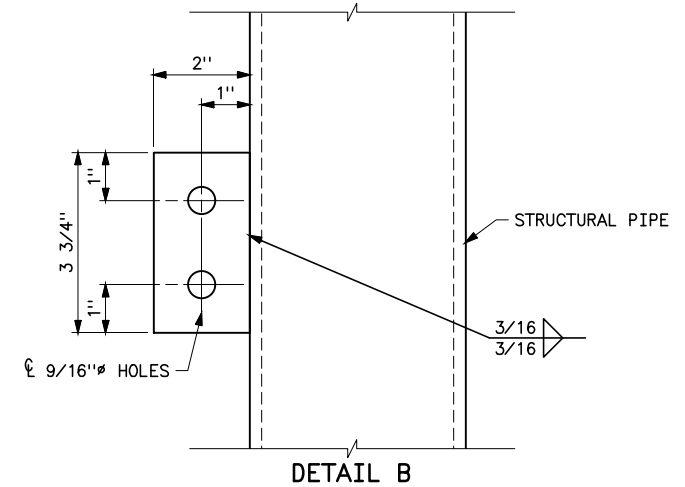
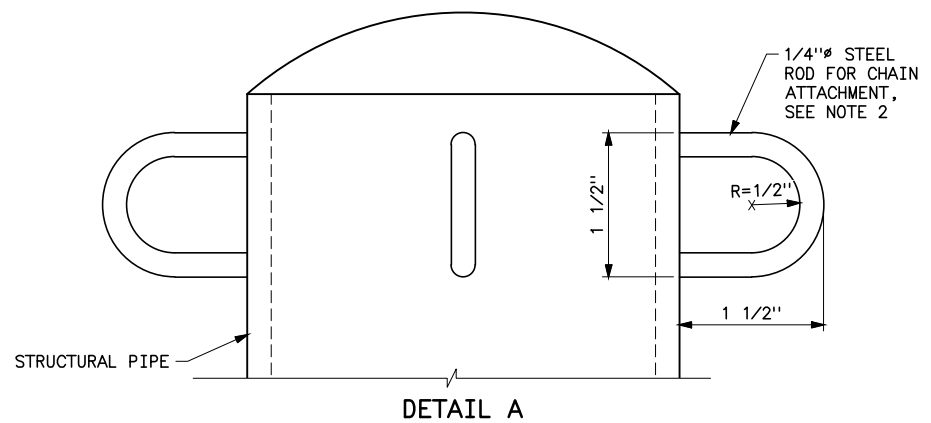


DETAIL WITH CHAIN CONNECTIONS
TYPE II
(SEE NOTE 1)



NOTES

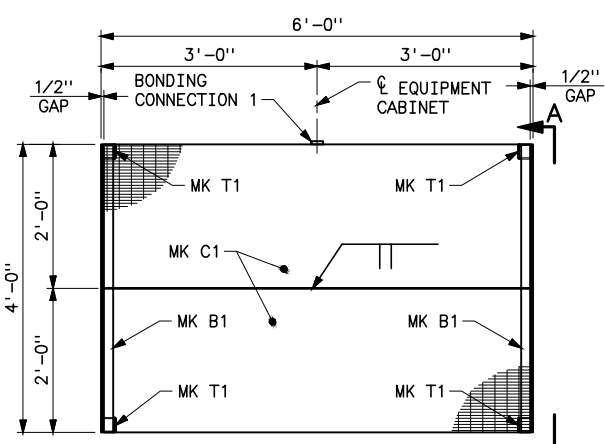
1. CHAIN SHALL BE ASTM A413, GRADE 30, PROOF COIL 3/8" LINK CHAIN COATED WITH A SAFETY YELLOW POLYURETHANE ELASTOMER COATING WITH REMOVABLE CLASPS AT EACH END SECTION.
2. STRUCTURAL STEEL SHALL BE ASTM A36, UNLESS OTHERWISE NOTED.
3. STRUCTURAL PIPE SHALL BE ASTM A500, GRADE B, UNLESS OTHERWISE NOTED.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



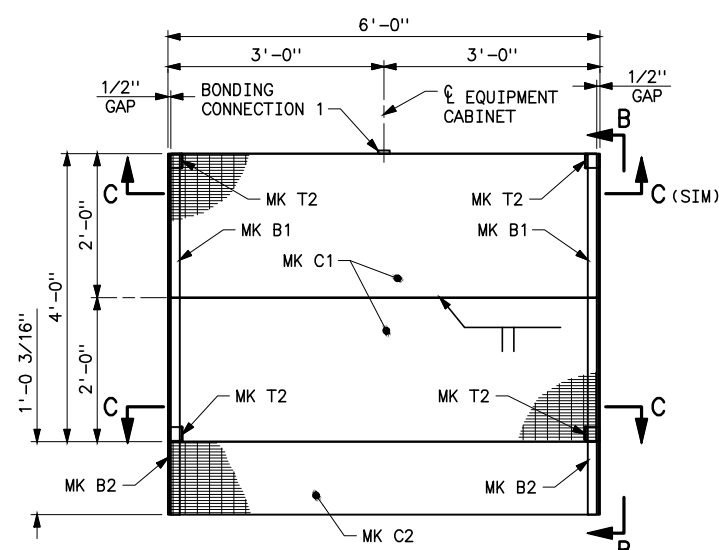
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS BOLLARD DETAILS		
DESIGNED BY: PERRY	APPROVED: DOUG HANSON CIVIL ENGINEERING MANAGER	
DATE: DECEMBER 19, 2016	31	2043

Plotted By: Seela Jan 30, 2017 12:26pm
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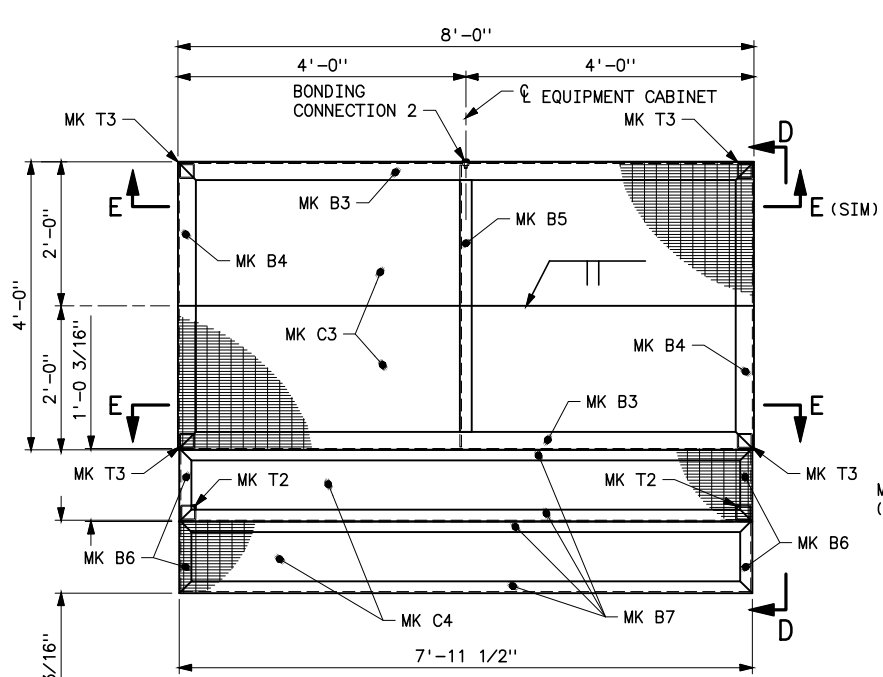
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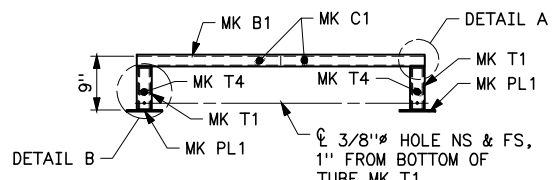
PLAN
EQUIPMENT CABINET PLATFORM - TYPE I



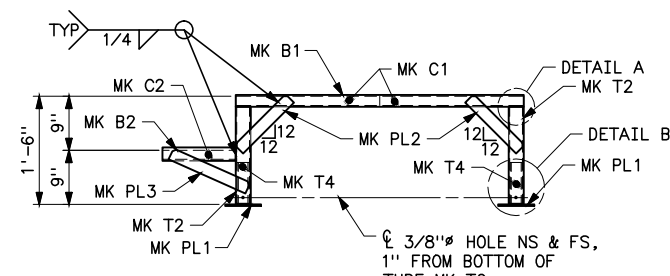
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EQUIPMENT CABINET PLATFORM - TYPE II



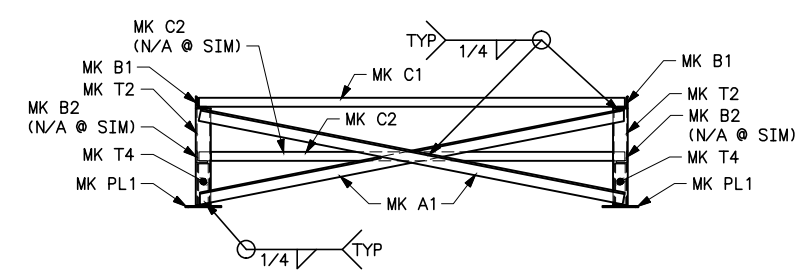
PLAN
EQUIPMENT CABINET PLATFORM - TYPE III



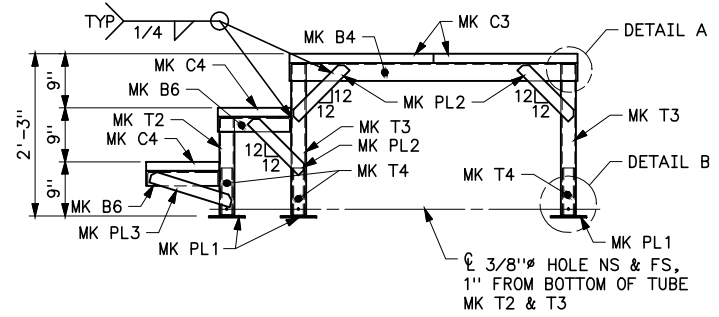
ELEVATION A-A
FRAME ~ MK FR1



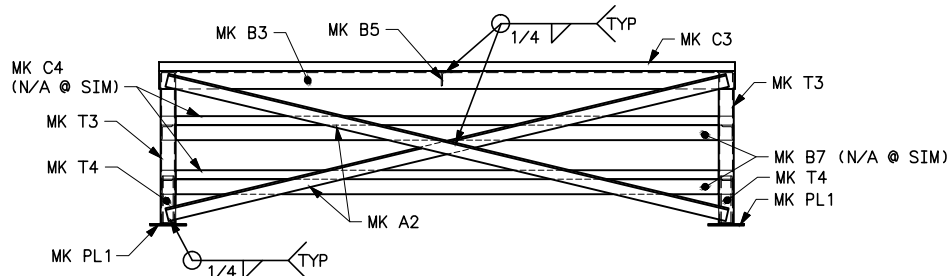
ELEVATION B-B
FRAME ~ MK FR2



SECTION C-C
SECTION C-C SIM



ELEVATION D-D
FRAME ~ MK FR3

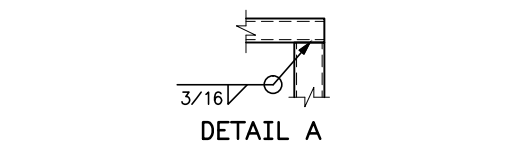


SECTION E-E
SECTION E-E SIM

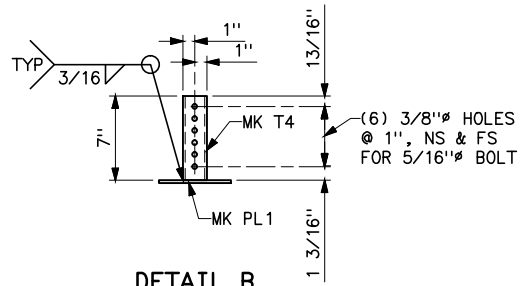
BILL OF MATERIAL			
EQUIPMENT CABINET PLATFORM - TYPE I			
MARK NO.	DESCRIPTION	LENGTH	NO. REQUIRED
FR1	FRAME		
T1	HSS 2 1/2x2 1/2x3/16	0'-7 1/8"	4
T4	HSS 2x2x1/4	0'-7"	4
B1	L 2x2x1/4	4'-0"	2
PL1	PL 6x6x1/4	-	4
PL4	PL 2x2 5/8x3/16	-	1
C1	SERRATED GRATING 1 1/2"x3/16" BARS, 1 3/16" C TO C, 2'-0" WIDE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

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			

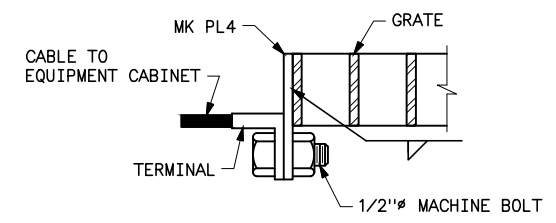
BILL OF MATERIAL			
EQUIPMENT CABINET PLATFORM - TYPE III			
MARK NO.	DESCRIPTION	LENGTH	NO. REQUIRED
FR3	FRAME		
T2	HSS 2 1/2x2 1/2x3/16	1'-4 1/8"	2
T3	HSS 2 1/2x2 1/2x3/16	2'-1 1/8"	4
T4	HSS 2x2x1/4	0'-7"	6
A2	L 2x2x1/4	8'-0"	4
B3	L 3x3x1/4	8'-0"	2
B4	L 3x3x1/4	4'-0"	2
B5	L 2 1/2x2x1/4 (LLV)	3'-11 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			



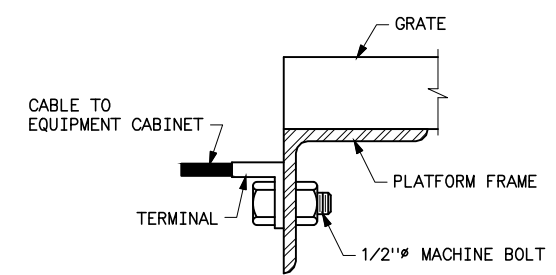
DETAIL A



DETAIL B



BONDING CONNECTION 1



BONDING CONNECTION 2

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

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.

DESIGNED CHARLIE GARCIA APPROVED DOUG HANSON CIVIL ENGINEERING MANAGER

SUPERSEDES DWG NO. 61 2950

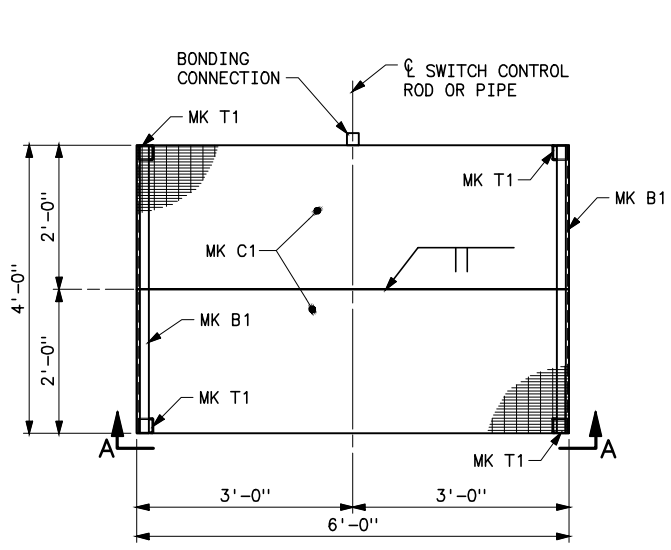
UNITED STATES DEPARTMENT OF ENERGY
WESTERN AREA POWER ADMINISTRATION
CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO

**SUBSTATION STANDARD
EQUIPMENT CABINET PLATFORMS
STEEL DESIGN AND DETAILS**

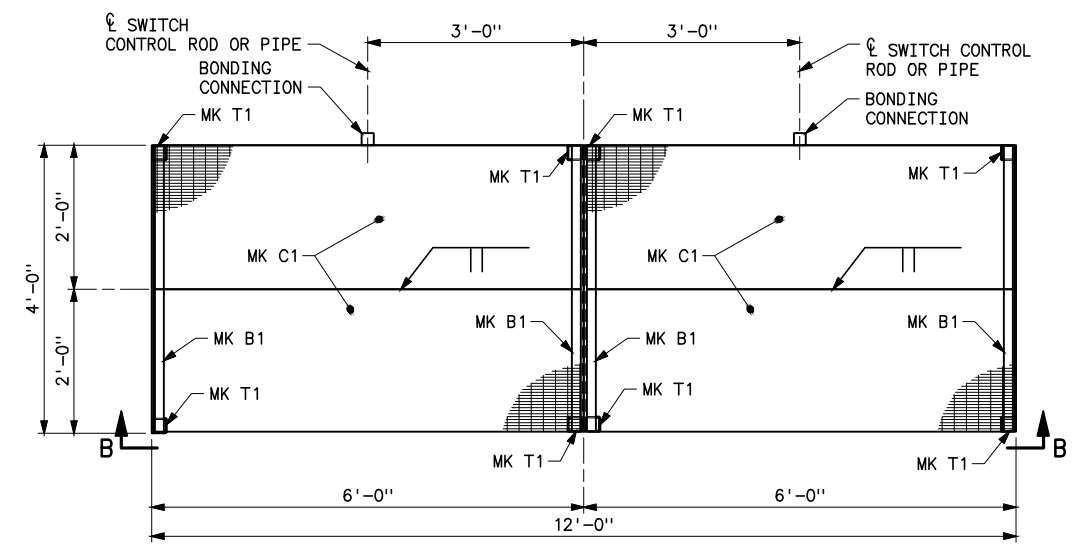
APRIL 28, 2003 31 2044

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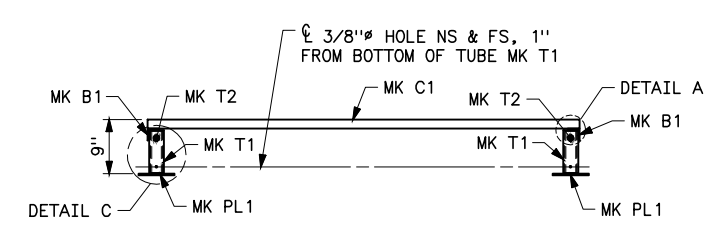
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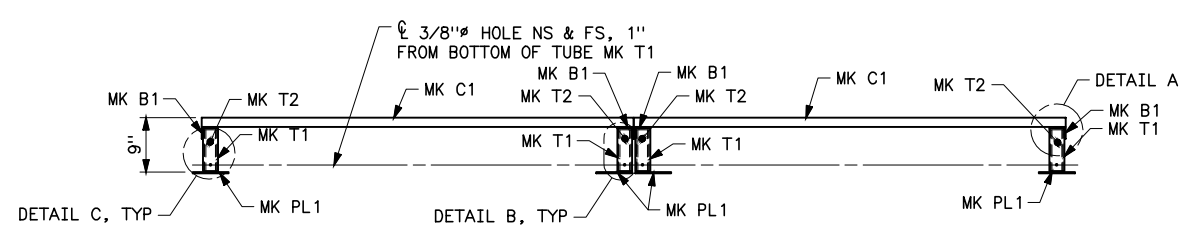
PLAN
SINGLE PLATFORM - TYPE I



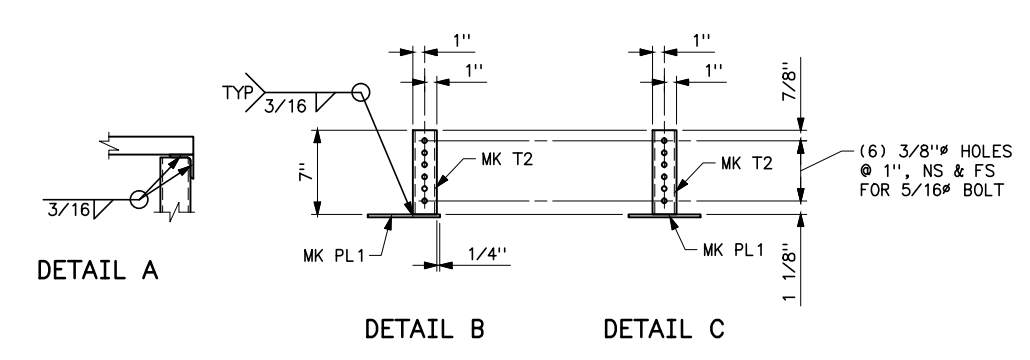
PLAN
DOUBLE PLATFORM - TYPE II



ELEVATION A-A
FRAME ~ MK FR1



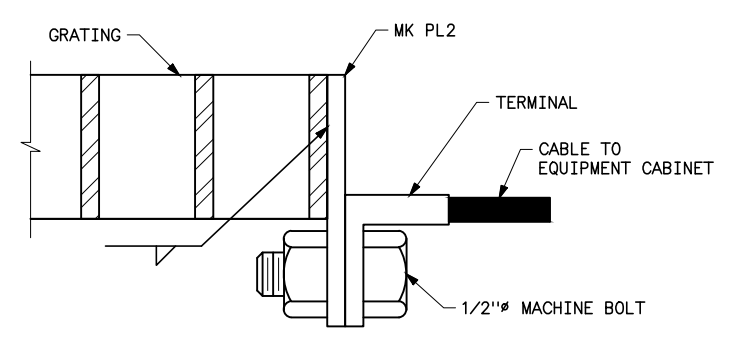
ELEVATION B-B
FRAME ~ MK FR2



DETAIL A

DETAIL B

DETAIL C



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"x3 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"x3 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**

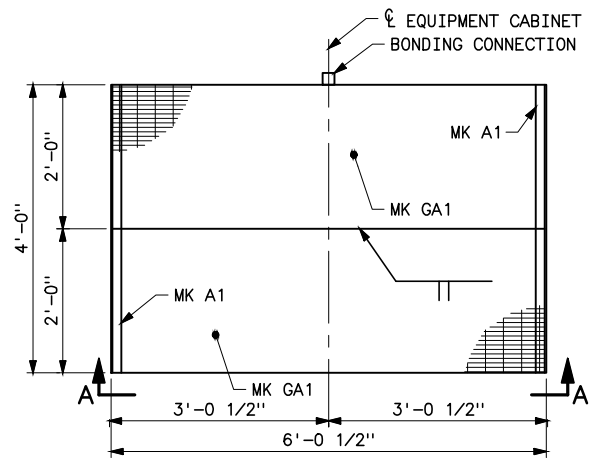
DESIGNED CHARLIE GARCIA APPROVED DOUG HANSON
CIVIL ENGINEERING MANAGER

APRIL 28, 2003	31	2045
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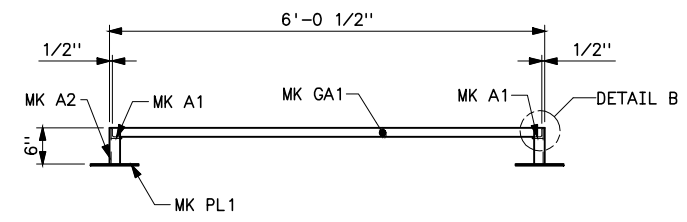
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BILL OF MATERIAL

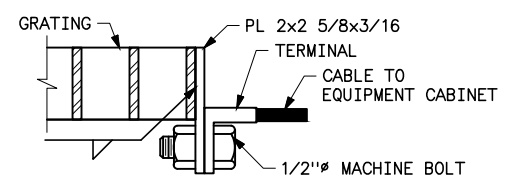
MARK NO.	DESCRIPTION	LENGTH (FT-IN)	NO. REQUIRED	BLACK WT (LBS)
SINGLE SWITCH OPERATING PLATFORM-TYPE IV				
FA2	FRAME		3	
A1	L 1 3/4x1 3/4x1/4	4'-0"	2	22.2
A2	L 1 3/4x1 3/4x1/4	0'-6"	4	6.4
PL1	PL 8x8x1/4	-	4	27.2
GA1	SERRATED GRATING, 1 1/2x3/16 BARS, 1 3/16" C TO C, 2'-0" WIDE	6'-0"	2	259.2
TOTAL WEIGHT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



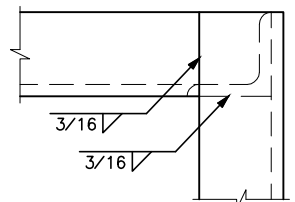
PLAN
SINGLE SWITCH OPERATING PLATFORM - TYPE IV



ELEVATION A-A
FRAME ~ MK FA2



BONDING CONNECTION



DETAIL B

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.

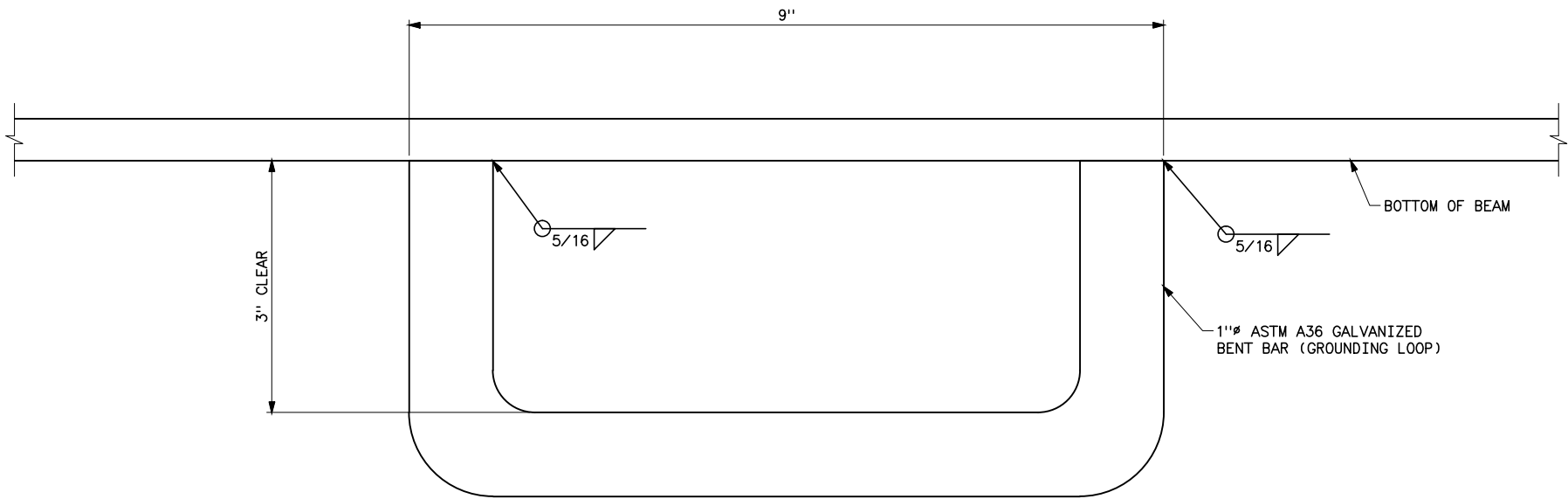
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A	9-27-16 A7-JAS	CHANGED THE WORDING GROUNDING CONNECTION TO BONDING CONNECTION.
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS SWITCH OPERATING PLATFORMS STEEL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

XREF(S):

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.



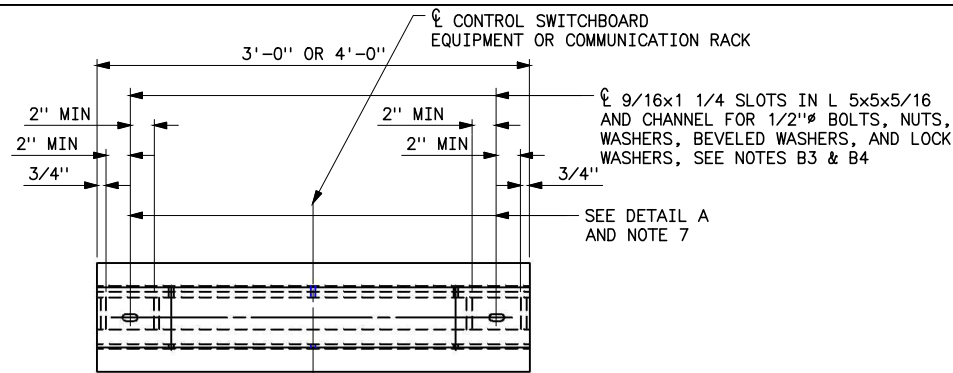
ELEVATION

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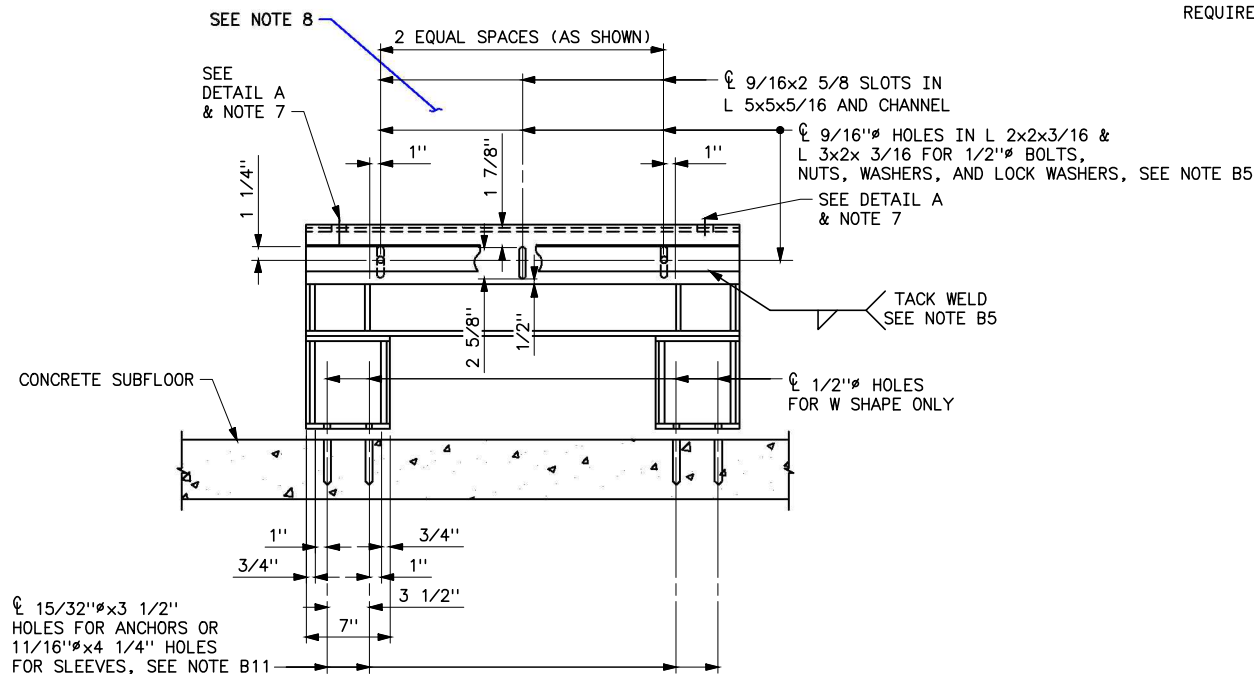
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS GROUNDING LOOP		
DESIGNED	TERRY BURLEY	APPROVED
DOUG HANSON	CIVIL ENGINEERING MANAGER	
FEBRUARY 13, 2006	31	2047

OPTION B: W SHAPE & CHANNEL COMBINATIONS

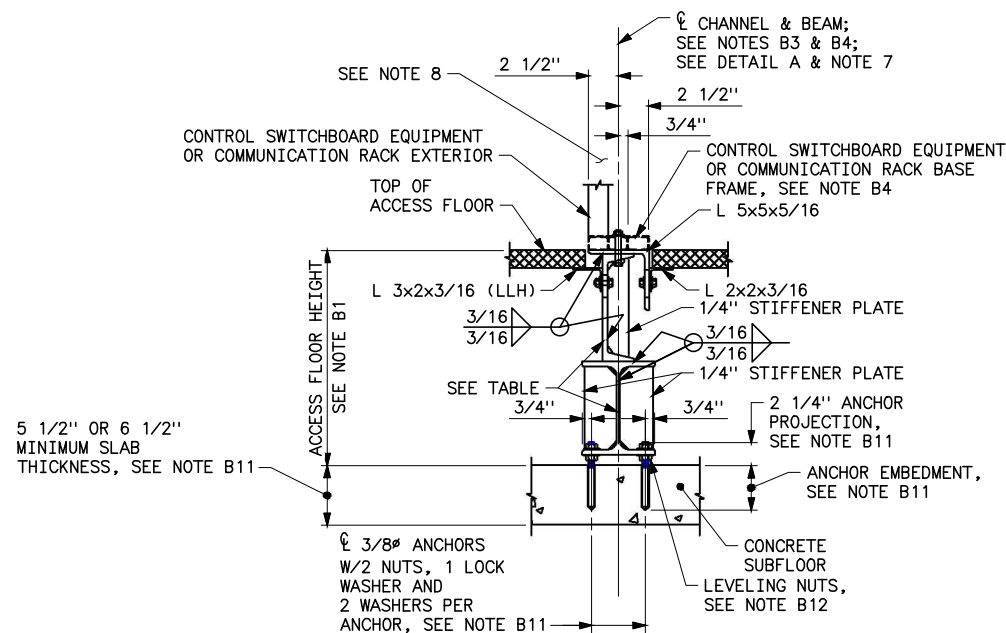
ACCESS FLOOR HEIGHT (IN)	W SHAPE	CHANNEL	TOTAL BASE HEIGHT (IN)		ESTIMATED WEIGHT (LBS)	
			MIN	MAX	4-FT BASE	3-FT BASE
12	W 4x13	MC 7x19.1	12.0	12.6	175	140
15	W 5x19	C 9x20	15.0	15.6	180	145
16	W 6x20	C 9x20	16.0	16.6	185	150
17	W 6x20	C 10x20	17.0	17.6	185	150
18	W 8x24	C 9x20	17.7	18.3	190	155
19	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



PLAN AT TOP

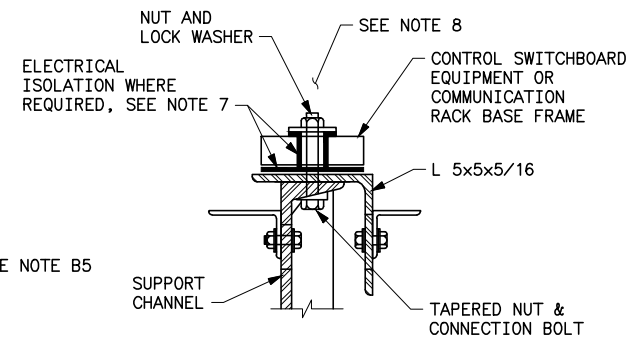


ELEVATION



SECTION

**ANCHORAGE THROUGH STEEL FRAME INTO FLOOR SLAB BELOW
OPTION B: RIGID STEEL BASE FRAME SYSTEM**



DETAIL A
ISOLATION DETAIL

GENERAL NOTES

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

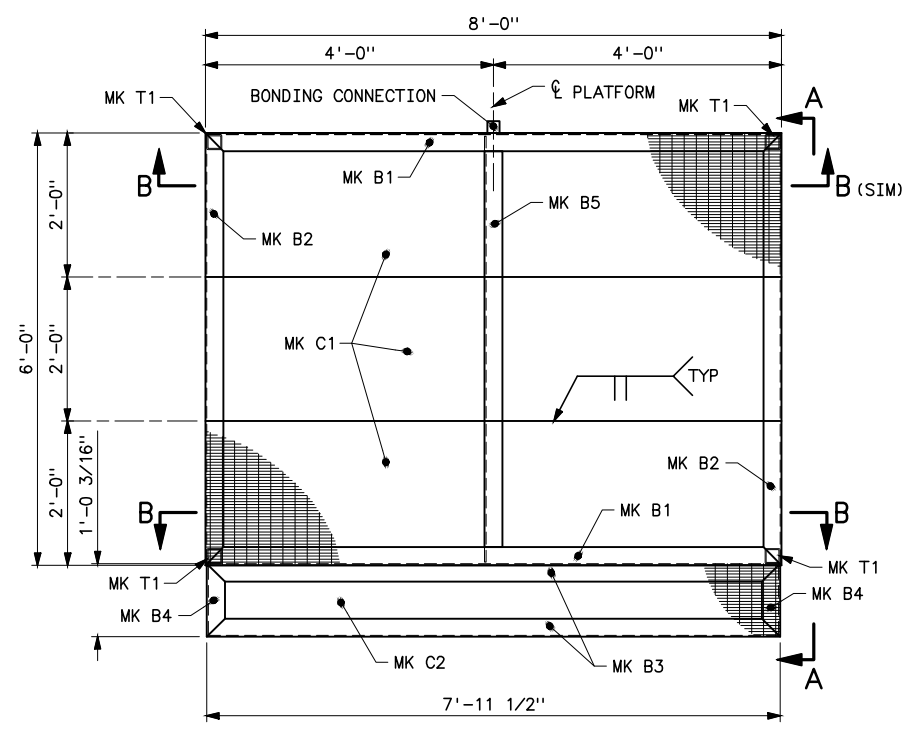
OPTION B NOTES

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

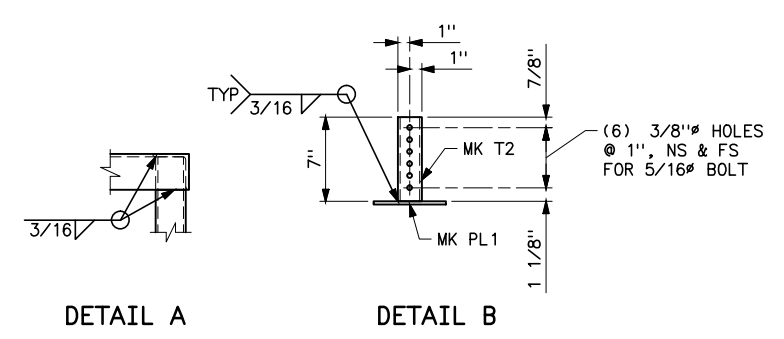
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SUPERSEDES DWG NO. 31_2049A (IN PART)		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS CONTROL SWITCHBOARD EQUIPMENT & COMMUNICATION RACK BASE ANCHORAGE DETAILS (SHEET 2 OF 2)		
DESIGNED BY: HAGLER/J. SCHREIBER — APPROVED BY: HANSON CIVIL ENGINEERING MANAGER		
DATE	OCTOBER 13, 2016	31 2049-2

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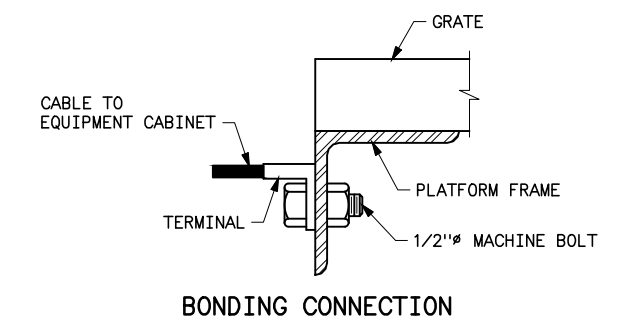
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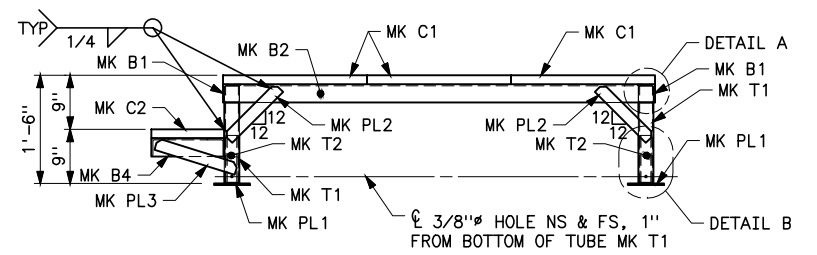
PLAN
TRANSFORMER PLATFORM - TYPE I



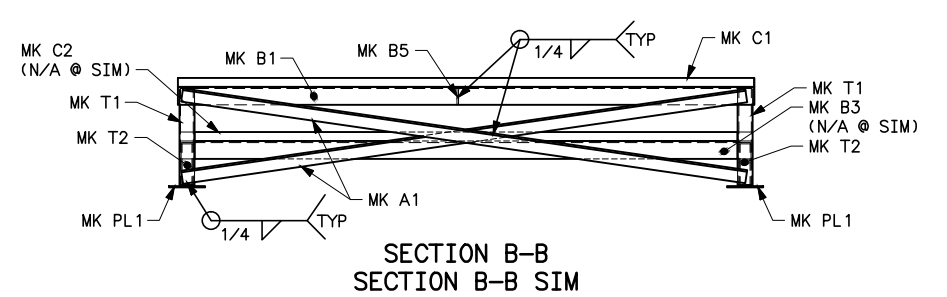
DETAIL A DETAIL B



BONDING CONNECTION



ELEVATION A-A
FRAME ~ MK FR1



SECTION B-B
SECTION B-B SIM

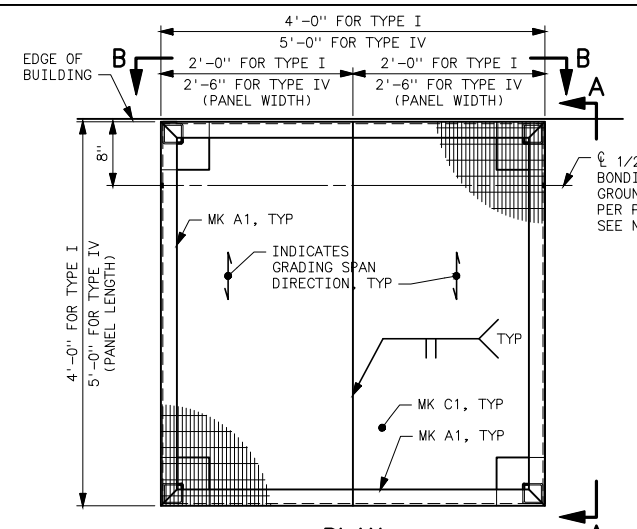
TRANSFORMER PLATFORM - TYPE I			
MARK NO.	DESCRIPTION	LENGTH	NO. REQUIRED
FR1	FRAME		
T1	HSS 2 1/2x2 1/2x3/16	1'-4 1/8"	4
T2	HSS 2x2x3/16	0'-7"	4
A1	L 2x2x1/4	7'-11"	4
B1	L 3x3x1/4	8'-0"	2
B2	L 3x3x1/4	6'-0"	2
B3	L 3x3x1/4	7'-11 1/2"	2
B4	L 3x3x1/4	1'-0 3/16"	2
B5	L 2 1/2x2x1/4 (LLV)	5'-11 1/2"	1
PL1	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.

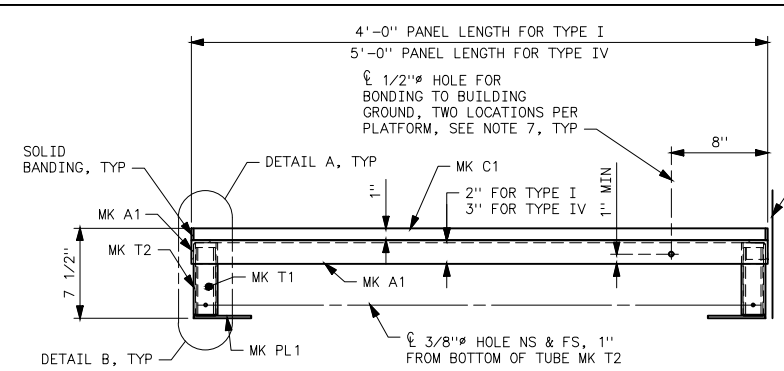
B	9-27-16 A7-JAS	CHANGED THE WORDING GROUNDING CONNECTION TO BONDING CONNECTION.
A	7-31-13 A7-JAS	MINOR CORRECTIONS & CLARIFICATIONS.
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARD TRANSFORMER PLATFORMS STEEL DESIGN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

Plotted By: Seela Sep 27, 2016 2:10pm
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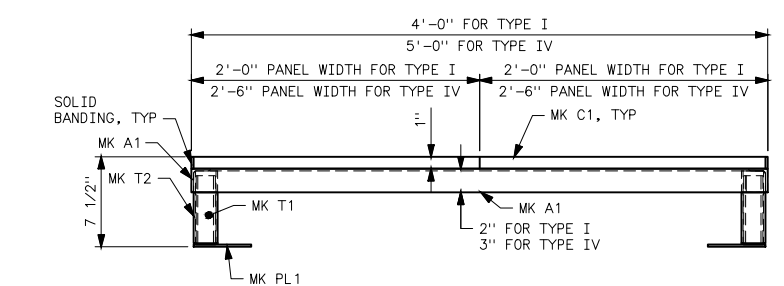
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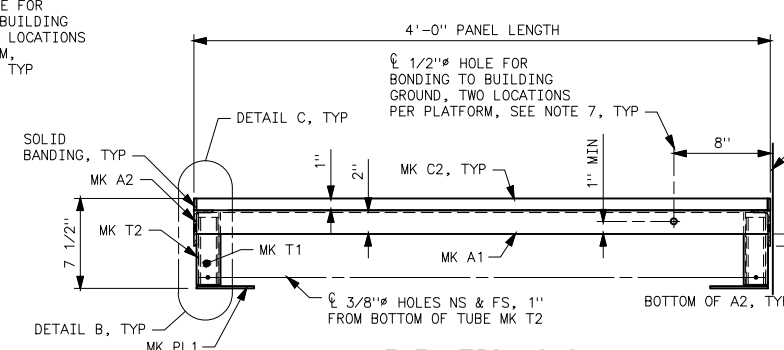
PLAN BUILDING ENTRANCE PLATFORM - TYPES I & IV FRAME ~ MK FR1 FOR TYPE I & MK FR4 FOR TYPE IV



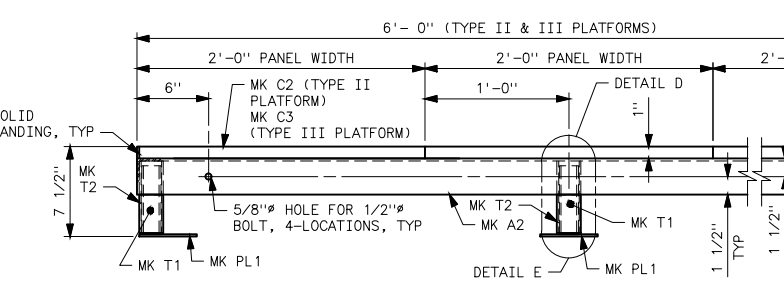
ELEVATION A-A TYPE I (4'-0'') & TYPE IV (5'-0'') PLATFORM



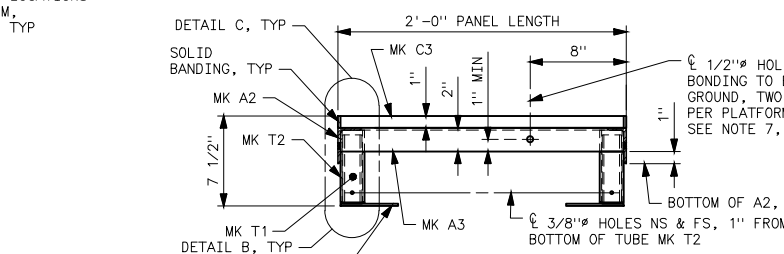
ELEVATION B-B TYPE I (4'-0'') & TYPE IV (5'-0'') PLATFORM



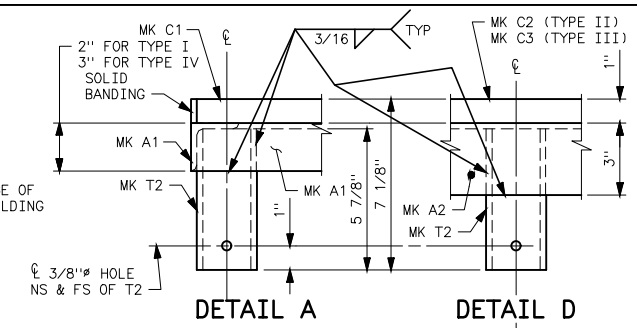
ELEVATION C-C (TYPE II PLATFORM)



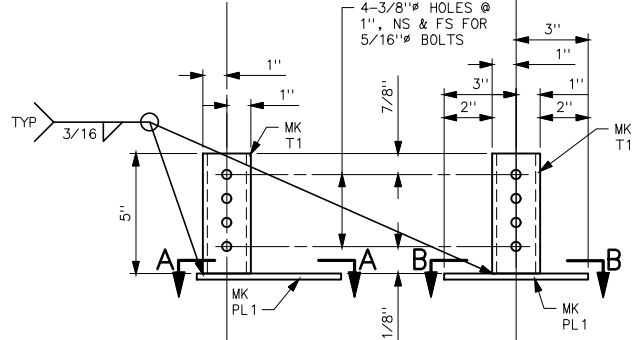
ELEVATION D-D (TYPE II AND III PLATFORMS)



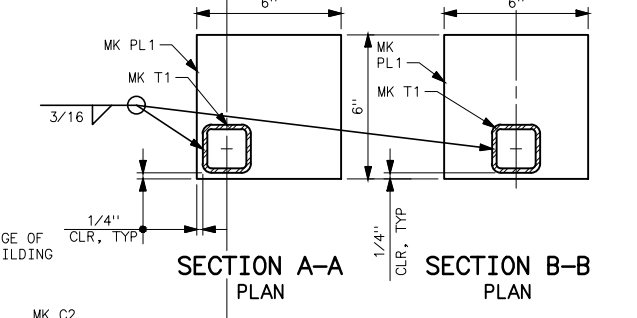
ELEVATION E-E (TYPE III PLATFORM)



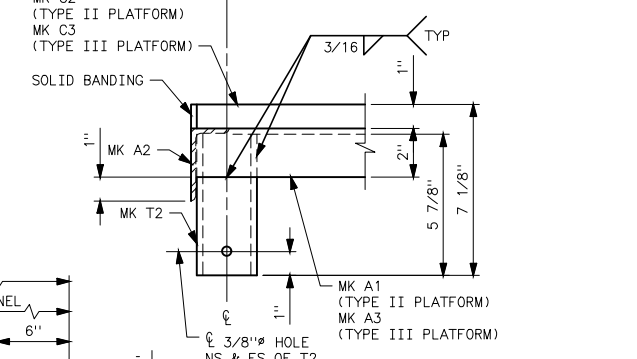
DETAIL A DETAIL D



DETAIL B DETAIL E



SECTION A-A PLAN SECTION B-B PLAN



DETAIL C

NOTES

- DESIGN BASIS: 100 PSF LL.
- GALVANIZE ALL MATERIALS AFTER FABRICATION.
- STRUCTURAL STEEL: ASTM A36 (PLATES & SHAPES), ASTM A500 GRADE B (HSS TUBES).
- FABRICATED MATERIAL SHALL BE STRAIGHT, TRUE, AND FREE FROM TWISTS AND WARPS.
- WELDS ARE TYPICAL FOR SIMILAR CONDITIONS.
- WELD GRATING TO FRAME.
- INCLUDE PROVISIONS FOR CONNECTING PLATFORMS TO BUILDING GROUND.
- PROVIDE SOLID BAND AROUND ALL PERIMETER EDGES OF GRATING, SEE DETAILS A & C.
- 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			
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			
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			
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			

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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

XREF (S):



NOTE 5
NOTE 4

NOTES

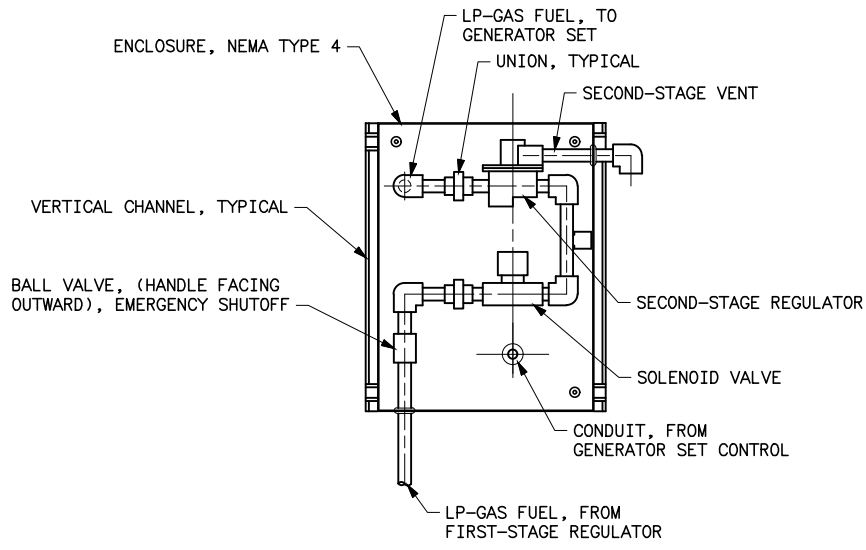
LP-GAS CONTAINER

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.

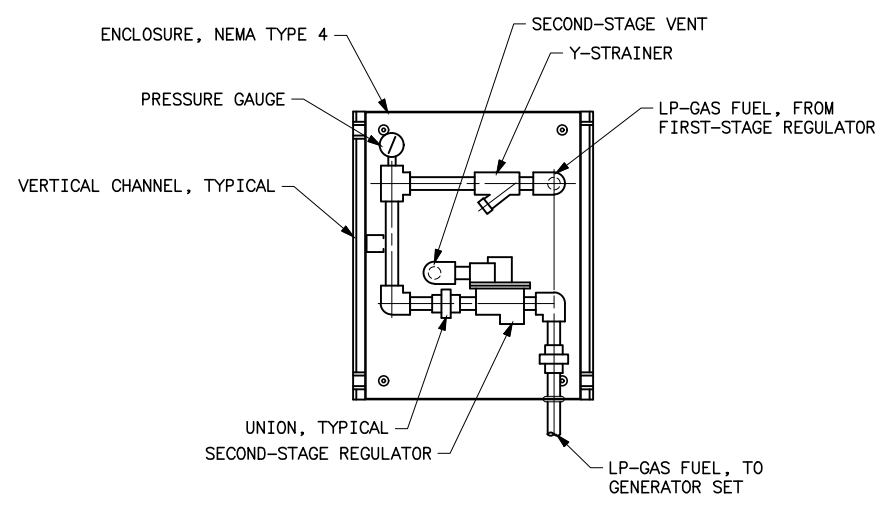
LP-GAS SECOND-STAGE ENCLOSURE

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.

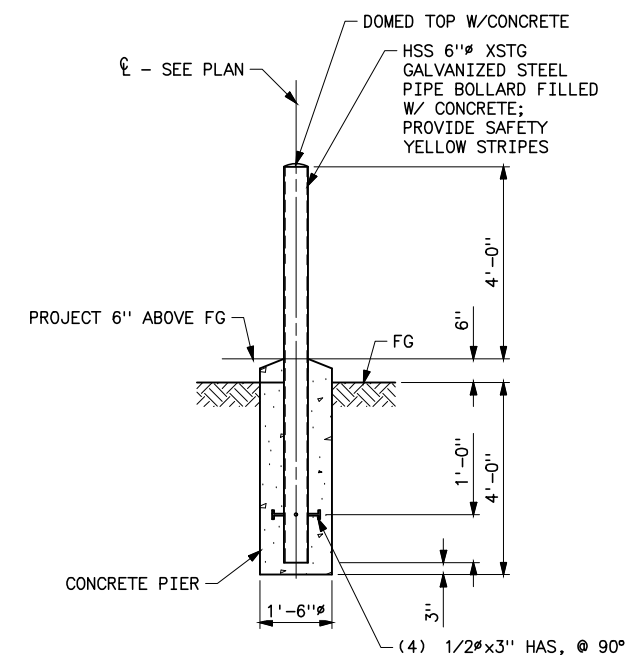
BOLLARDS, NOTE 10, TYP



**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 R.V. PASCUA	APPROVED DOUG HANSON CIVIL ENGINEERING MANAGER	
DATE OCTOBER 19, 2016	NO. OF SHEETS 31	TOTAL SHEETS 3300

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NOTES

GENERATOR SET

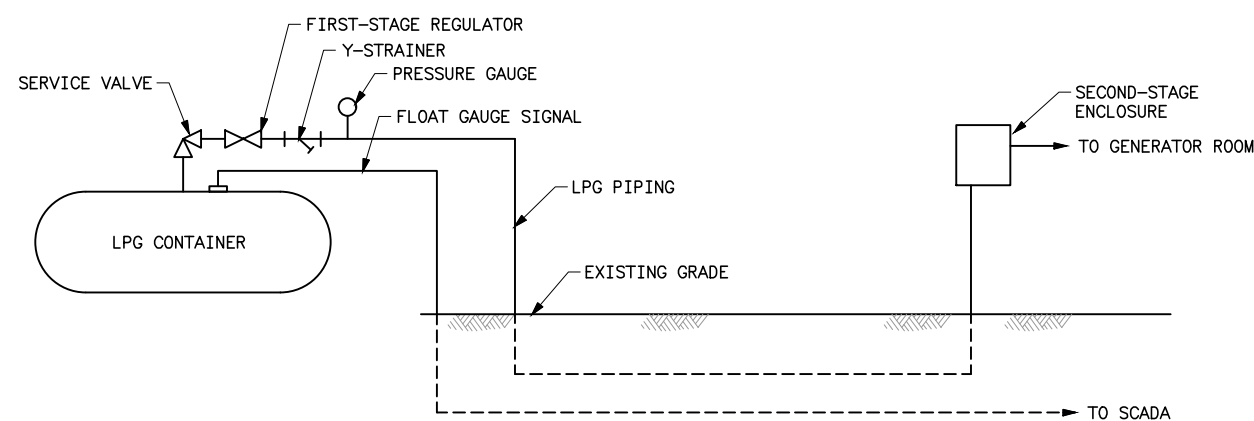
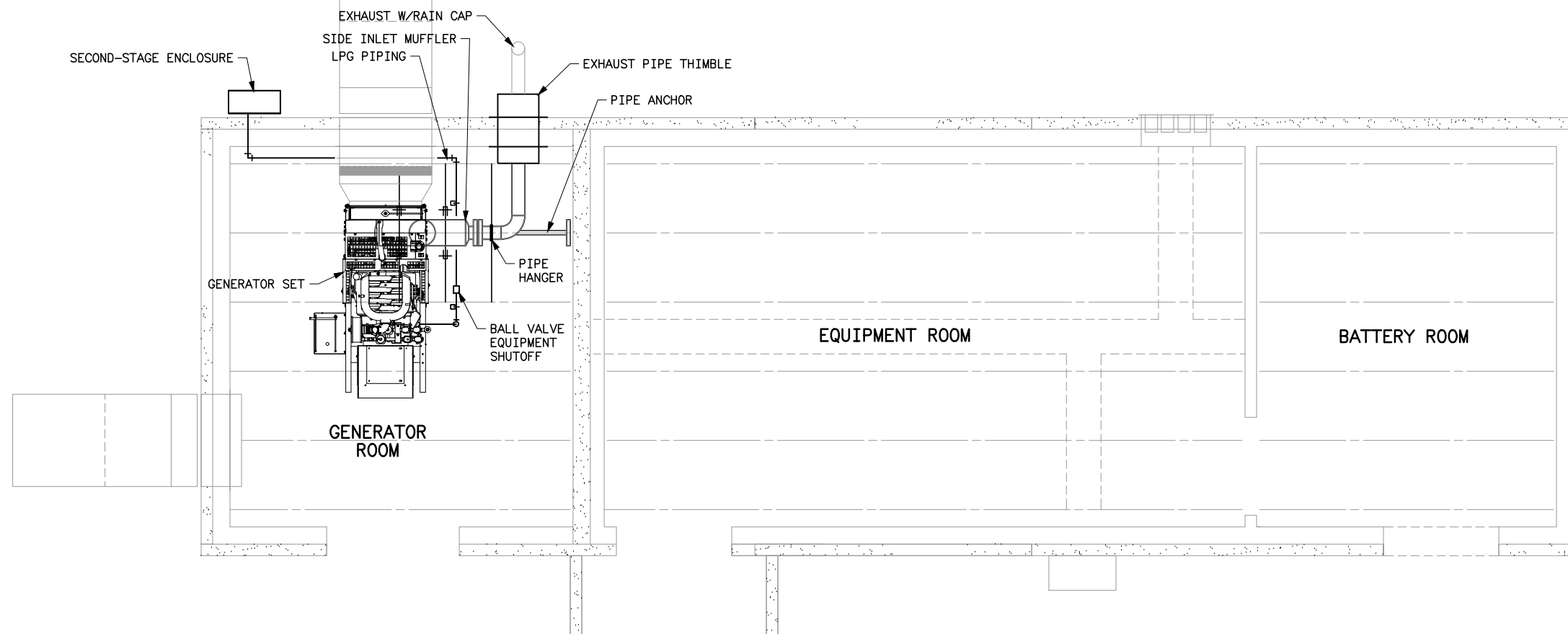
1. UNLESS OTHERWISE SPECIFIED, THE GENERATOR SET SHALL BE CSA CERTIFIED, UL 2200 LISTED AND INSTALLED PERMANENTLY WITHIN THE BUILDING STRUCTURE OR LOCATED PERMANENTLY OUTDOORS WITH A WEATHER PROTECTIVE ENCLOSURE.
2. FOR ENGINE AND FUEL SUPPLY REQUIREMENTS, REFERENCE THE LATEST EDITION OF NFPA 37, CHAPTER 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 MANUFACTURER'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 MANUFACTURER'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 R.V. PASCUA		APPROVED DOUG HANSON CIVIL ENGINEERING MANAGER
C/A/E	OCTOBER 19, 2016	31 3302

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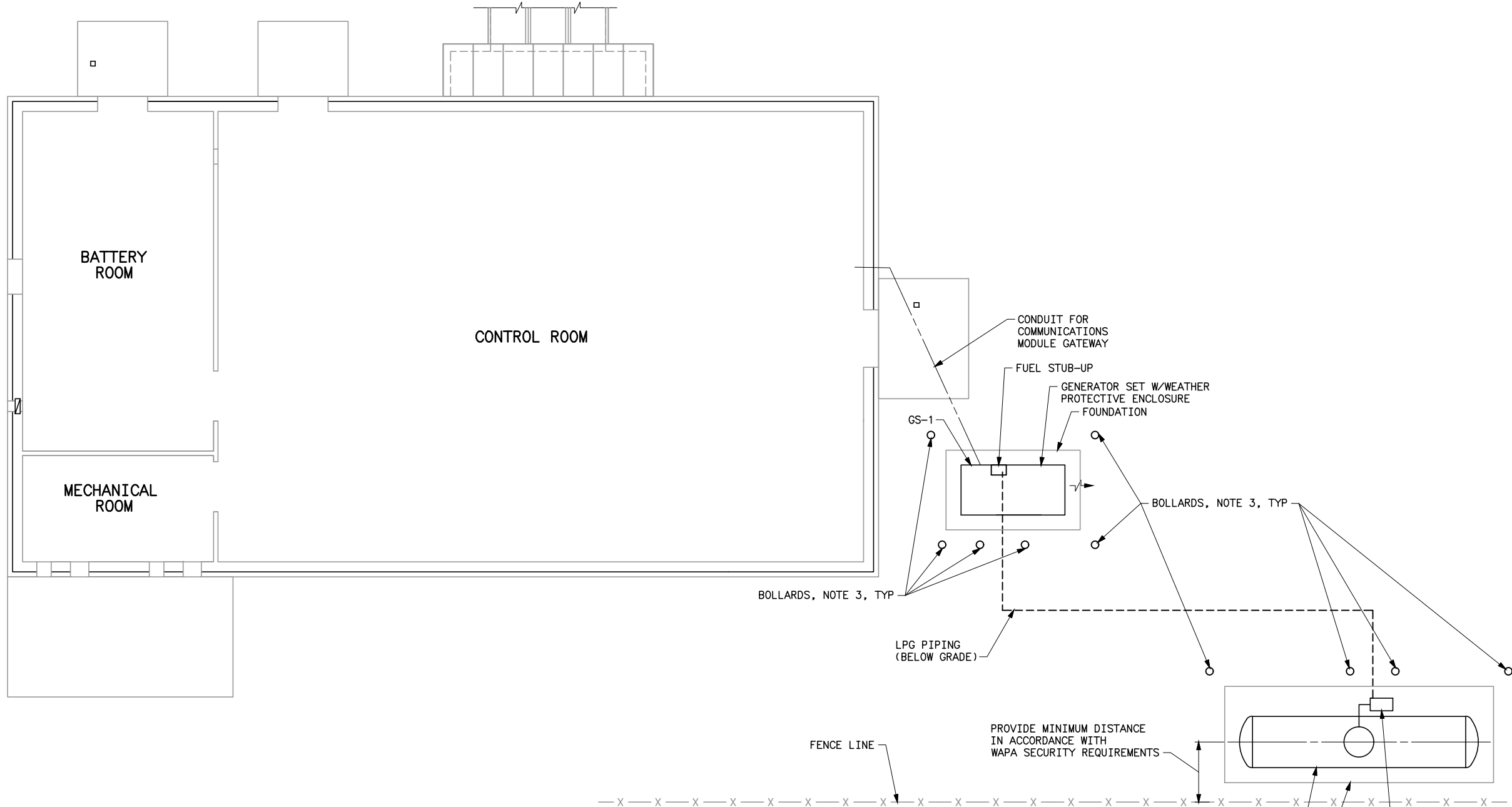


LPG DIAGRAM

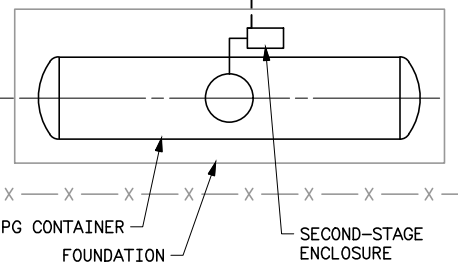
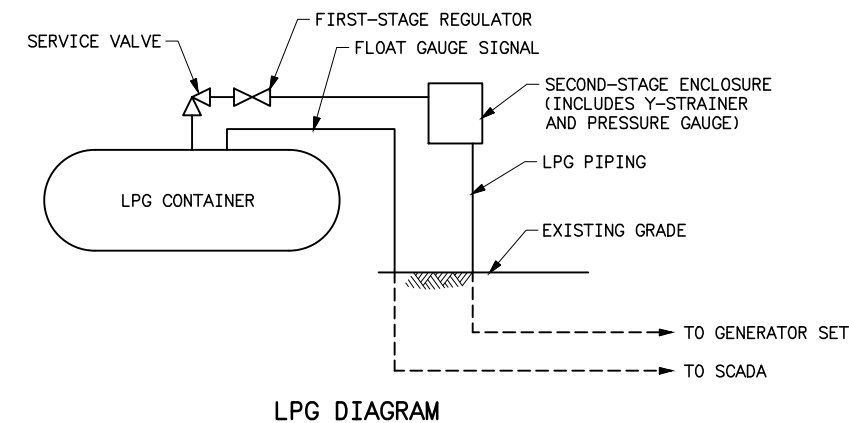
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO		
FACILITIES STANDARD TYPICAL INSTALLATION GENERATOR ROOM		
DESIGNED R. L. PASCUA	APPROVED DOUG HANSON CIVIL ENGINEERING MANAGER	
C.A.E. OCTOBER 19, 2016	31	3303

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XREF(S):



- 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.



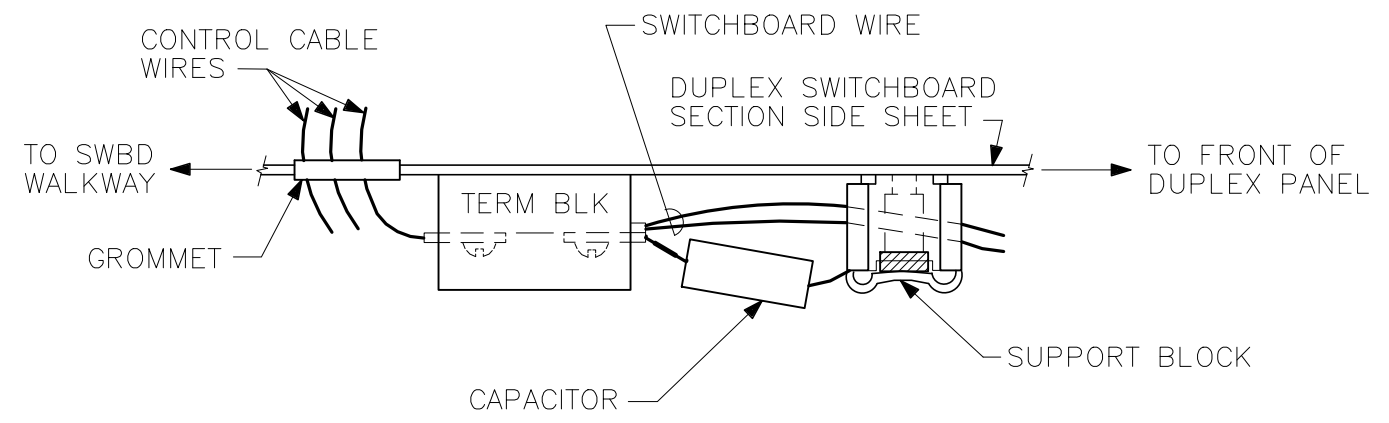
A	10-5-20 A7-JAS	REVISED TITLE BLOCK. NON-MECHANICAL REVISIONS. ADDED PIPE BOLLARDS.
	UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION HEADQUARTERS - LAKEWOOD, COLORADO	
FACILITIES STANDARD TYPICAL INSTALLATION MISCELLANEOUS DETAILS		
DESIGNED R.L. PASCUA		APPROVED DOUG HANSON CIVIL ENGINEERING MANAGER
DATE	OCTOBER 19, 2016	31 3304

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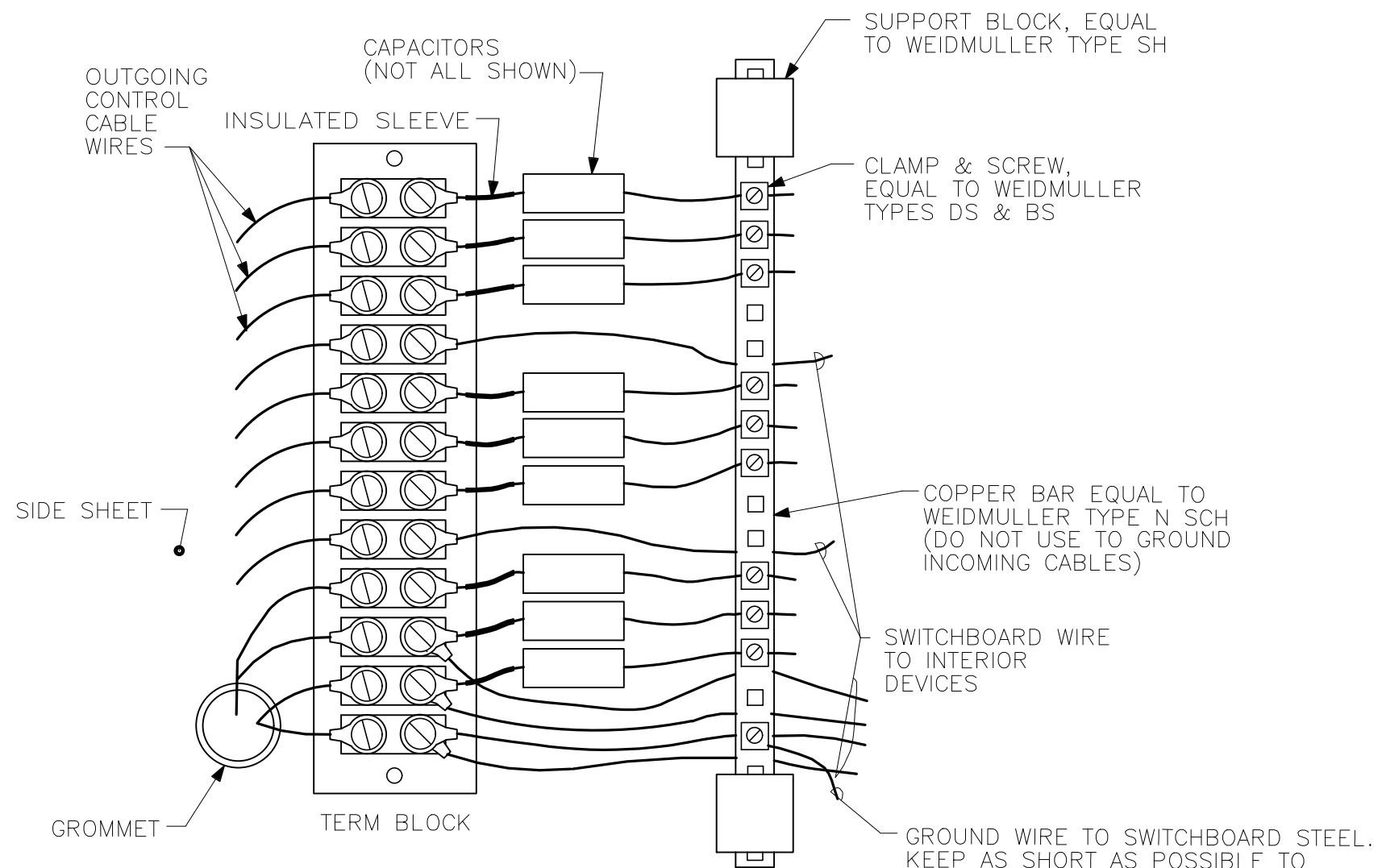
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SPECIFICATIONS

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.



TOP VIEW

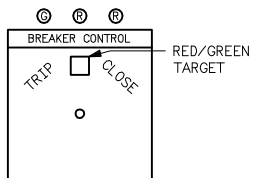


SIDE VIEW

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

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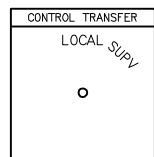
**BREAKER CONTROL
182CS***



CONTACTS	POSITIONS			
	TRIP	NAT	NAC	CLOSE
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	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

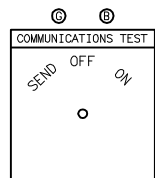
**CONTROL TRANSFER
43-182CS***



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

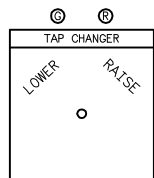
**COMMUNICATIONS TEST
BCCS***



CONTACTS	POSITIONS			
	SEND	OFF	ON	
1-1C	X			
2-2C	X			
3-3C	X			
4-4C	X	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
COMMUNICATION SYSTEM OK

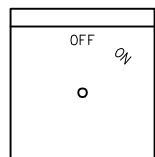
**RAISE/LOWER CONTROL
84-KV1ACS***



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

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

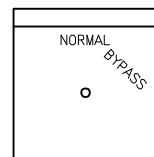
**DIFFERENTIAL CONTROL
87TB1CS***



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

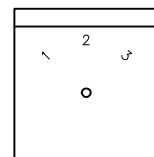
**BREAKER BYPASS CONTROL
182BCS***



CONTACTS	POSITIONS	
	NOR	BY
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	X	
20-20C	X	X	
21-21C	X	X	
22-22C	X	X	
23-23C	X	X	
24-24C	X	X	
25-25C		X	X
26-26C		X	X
27-27C		X	X
28-28C		X	X
29-29C		X	X
30-30C		X	X
31-31C		X	X
32-32C		X	X

BLACK, OVAL HANDLE
ALL POSITIONS MAINTAINED

SWITCH HANDLES

1. PISTOL GRIP HANDLES ARE USED FOR FUNCTIONS WHICH, WHEN INITIATED, CANNOT BE REVERSED OR STOPPED UNTIL COMPLETED.
2. ROUND OR KNURLED 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.

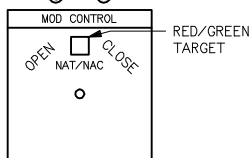
NOTES

1. THE TERMS "CUTOUT SWITCH" SHALL NOT BE USED.
 2. THE USE OF MINIATURE 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

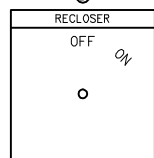
**MOD CONTROL
181CS***



CONTACTS	POSITIONS		
	OPEN	OFF	CLOSE
1-1C	X		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

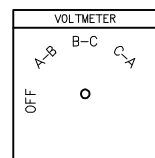
**RECLOSER CONTROL
79-182CS***



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

BLACK, OVAL HANDLE
ALL POSITIONS MAINTAINED

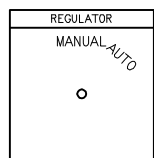
**VOLTMETER SELECT
VUIACS***



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

BLACK, KNURLED HANDLE
ALL POSITIONS MAINTAINED

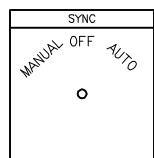
**REGULATOR CONTROL
90-KVIACS***



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

BLACK, OVAL HANDLE
ALL POSITIONS MAINTAINED

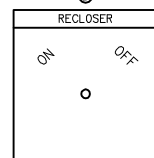
**SYNC
25-182CS***



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		X

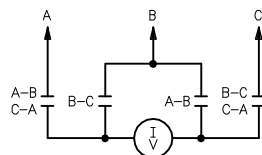
BLACK, OVAL HANDLE
REMOVABLE ONLY IN "OFF"
POSITION
ALL POSITIONS MAINTAINED

**RECLOSER CONTROL
79-182CS***



CONTACTS	POSITIONS	
	ON	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		DRAWINGS
	OFF	ON	
1-1T	X		5101
2-2T	X		5103
3-3T	X		
4-4T	X		

SBM

**DRAWING WHERE
DEVELOPMENT APPEARS**

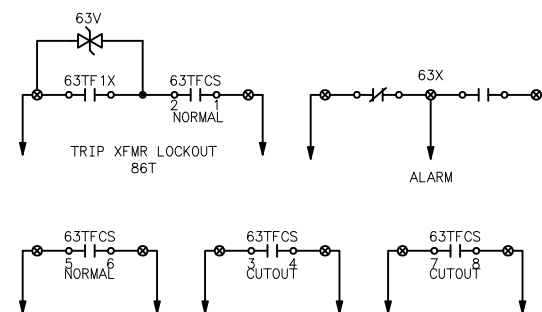
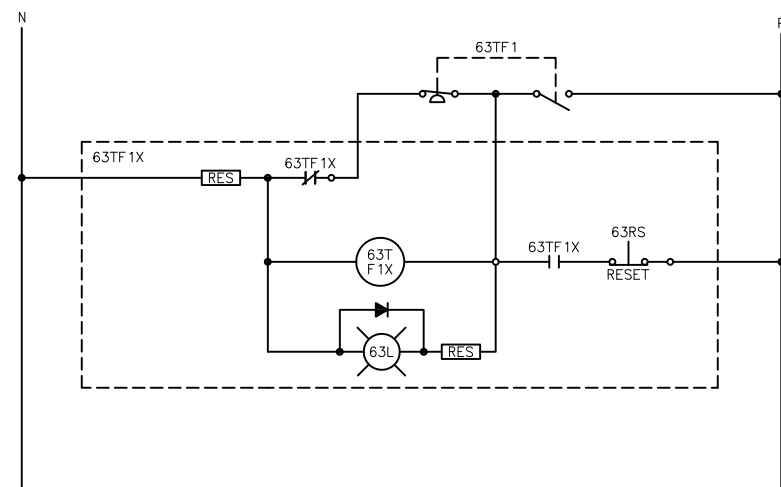
NOTE 4 (TYP)

DRAWING	DEVELOPMENT
BREAKER OR MOD DC SCHEMATIC	182CS 181CS 25-182CS 79-182CS
CONTROL TRANSFER DC SCHEMATIC	43-182CS
LINE RELAYING DC SCHEMATIC	BCCS 21-1CS
VOLTAGE TRANSFORMER AC SCHEMATIC	VUIACS
TRANSFORMER DC CONTROL SCHEMATIC	84-KV1ACS 90-KVIACS
DIFFERENTIAL DC SCHEMATIC	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 KIM DAM		APPROVED W.A. JACOBY SUBSTATION CONTROL DESIGN MANAGER
A/E	OCTOBER 10, 1983	31 4003

EXPLANATION

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

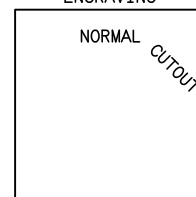


NOTES

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

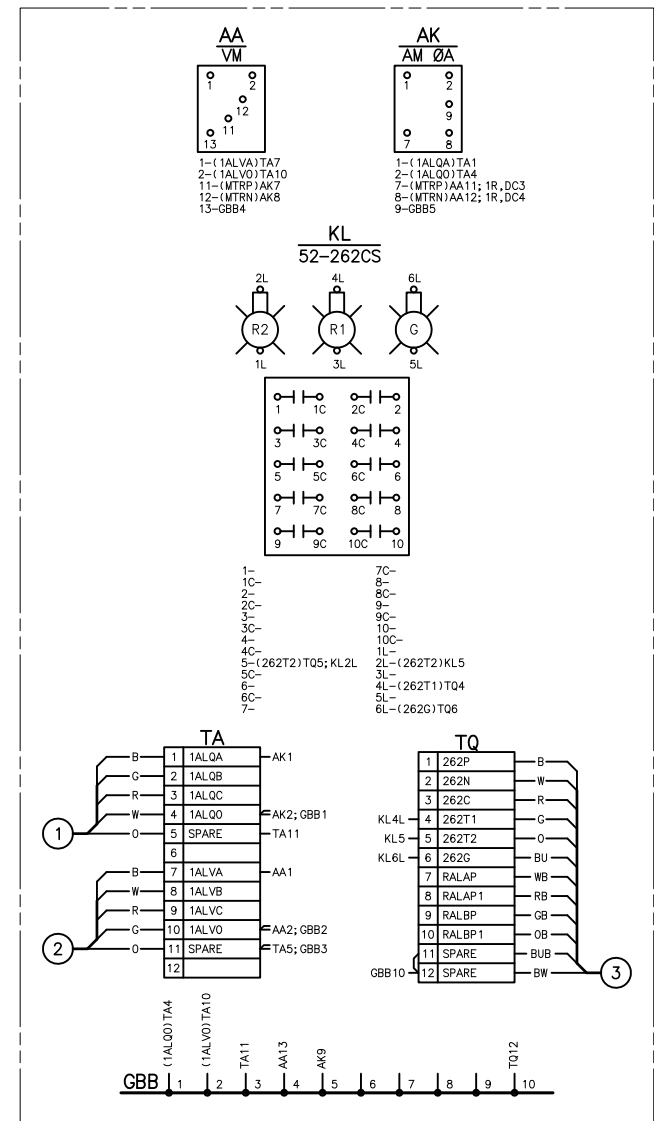


CONTROL SWITCH
DEVELOPMENT

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

DUPLEX SWITCHBOARD - CHA
PANEL 1F (REAR VIEW)



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

DATE	MAY 10, 1979	31	4005
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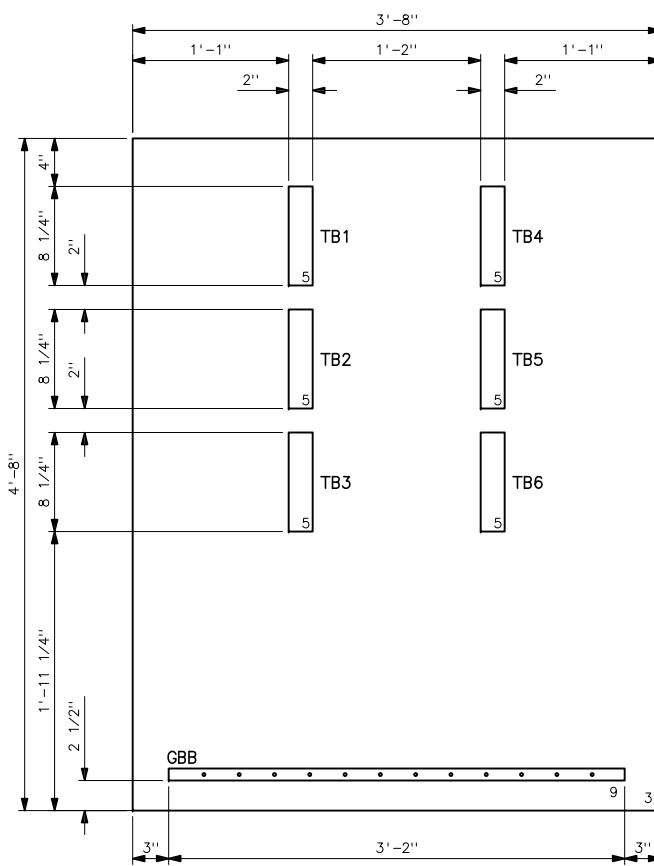
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COLOR SCHEME FOR MIMIC BUSES		
VOLTAGE	COLOR	APPROXIMATE COLOR NO. FEDERAL STANDARD 595
GROUND BUS	WHITE	17875
480 VOLT	BRIGHT BLUE	15123
2.4 KILOVOLT	DARK BLUE	15045
4.16 KILOVOLT	LIGHT GREEN	14533
6.9 KILOVOLT	BRIGHT GREEN	14187
11.5 KILOVOLT	BLUE GREEN	14325
11.95 KILOVOLT	BLUE GREEN	14325
12.47 KILOVOLT	DARK GREEN	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

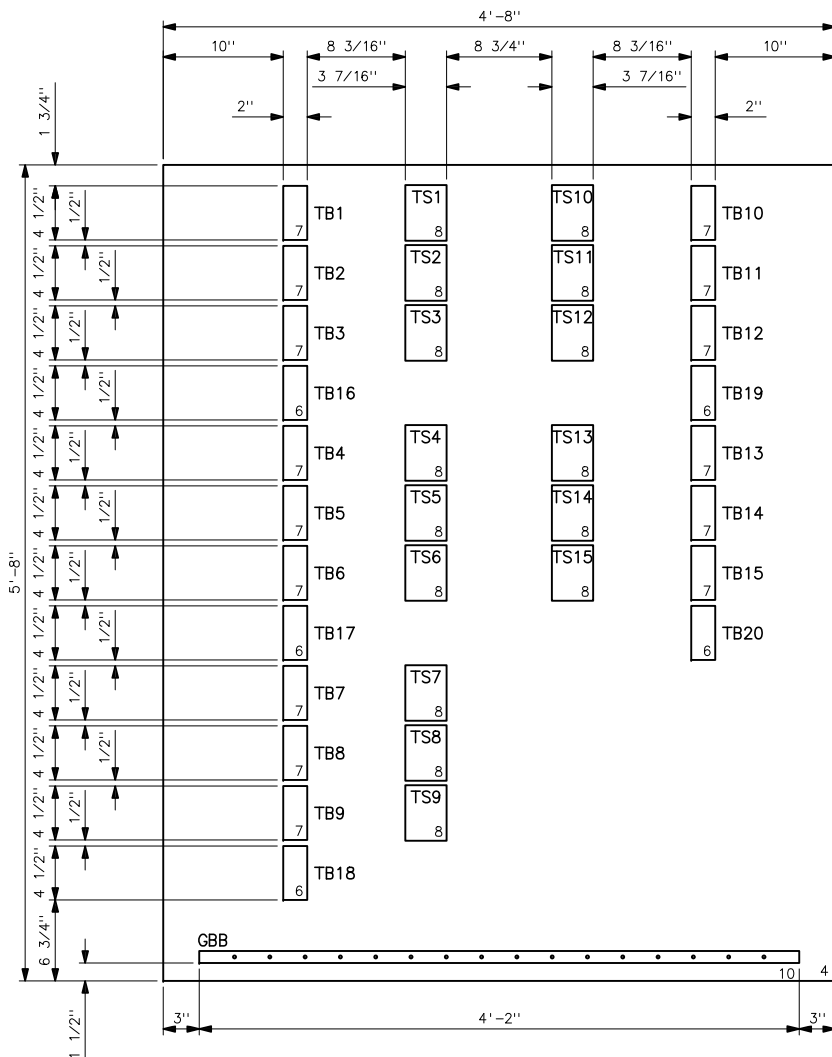
* EXCEPT IN GLOSS FINISH

Mar 22, 2006 - 2:31pm Plot test By: See la S: \Engineering\Standard Drawings\3\3\3\4086.dwg Last Saved By: palmer IMAGES:

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

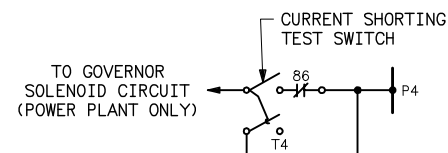
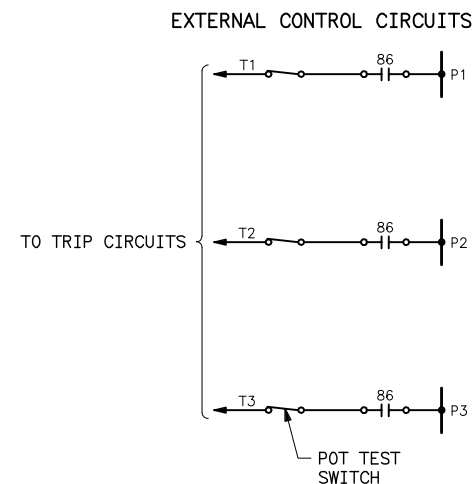
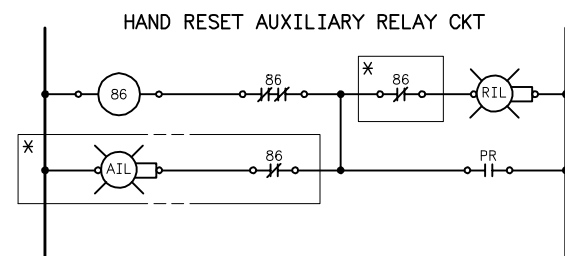
- NOTES**
1. PROVIDE GASKETED CONDUIT HUBS AT THE BOTTOM OF ENCLOSURE AS REQUIRED FOR CONTROL CABLE ENTRY.
 2. THE CONTRACTOR SHALL TERMINATE CONTROL CABLES AT TERMINAL BLOCKS AND PERFORM WIRING BETWEEN TERMINAL BLOCKS AND TEST SWITCHES PER DRAWING(S) TO BE FURNISHED BY GOVERNMENT AT A LATER DATE. STRANDED 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.
A	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
A	MARCH 9, 1993	31 4018

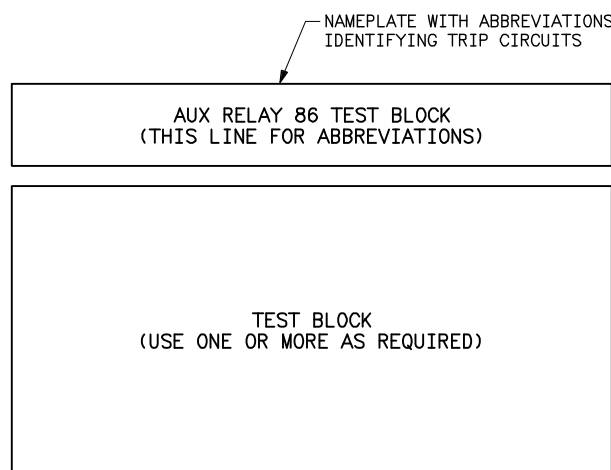
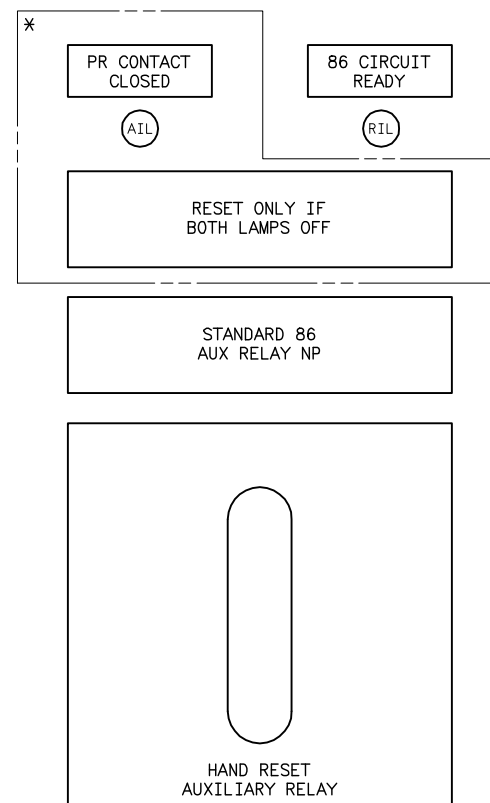
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EXPLANATION

* _ _ _ _ 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

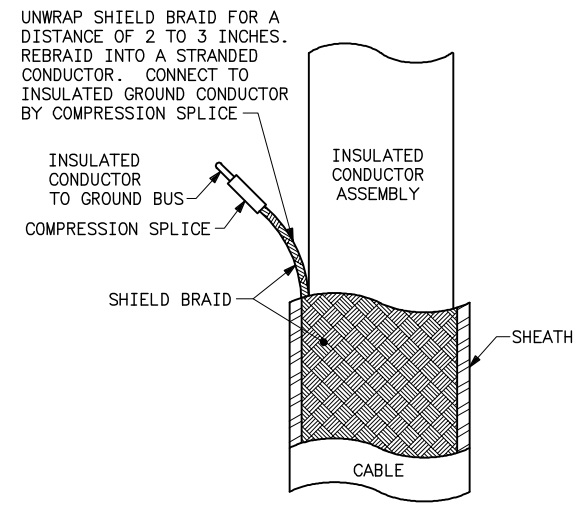
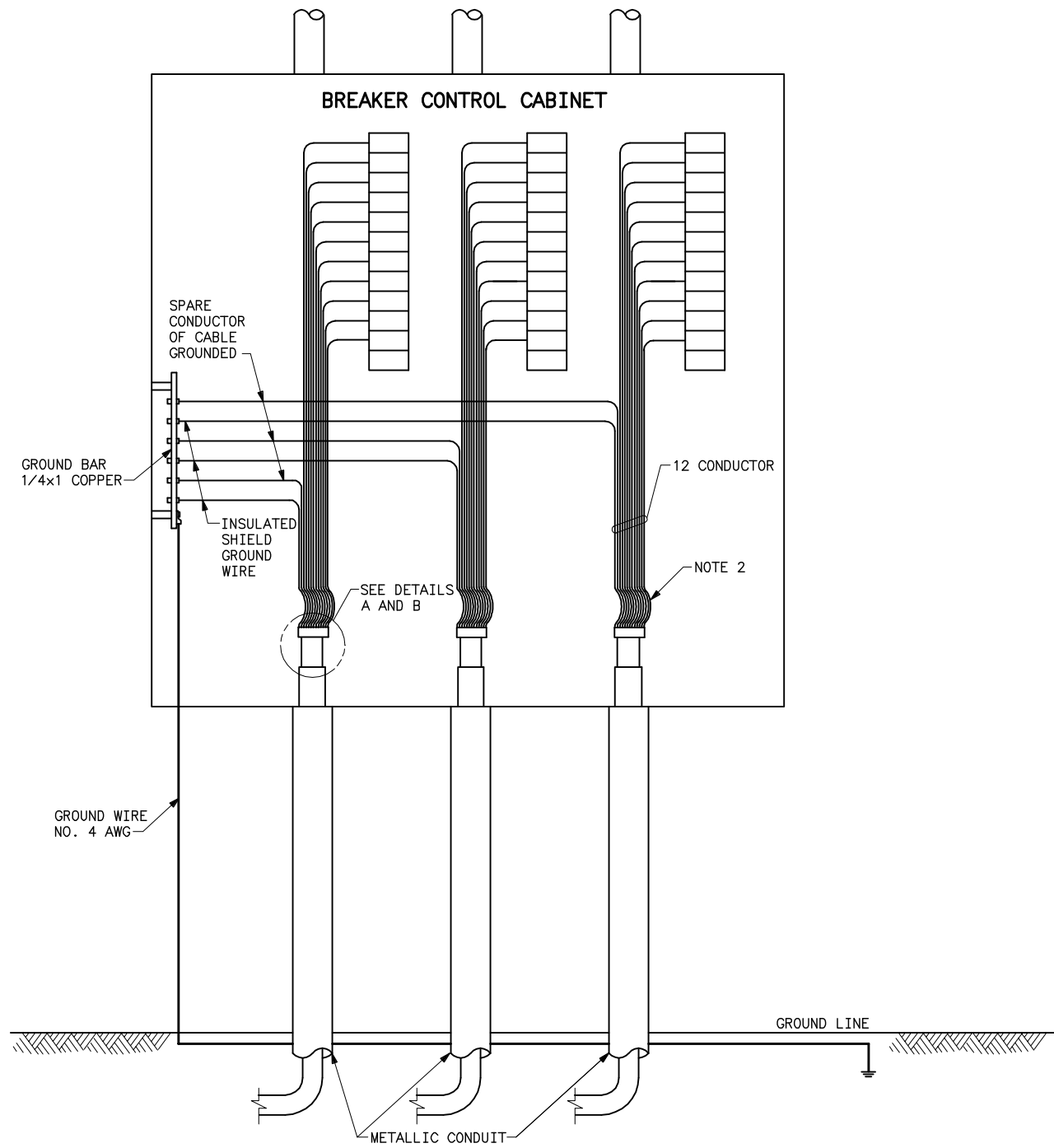


DESIRED LOCATION OF LAMPS AND NAMEPLATES

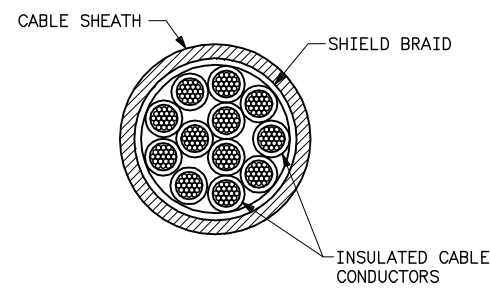


Mar 22, 2006 - 2:30pm Plot test By: See la S: \Engineering\Standard Drawings\3\3\3\5103.dwg Last Saved By: palmer IMAGES:

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.S.B.R. _____		APPROVED JOHN W. WORK CHIEF, SUBSTATION CONTROL BRANCH
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

Mar 22, 2006 - 2:34pm Plot test By: See la S: \Engineering\Standard Drawings\31\31_6000e.dwg Last Saved By: palmer IMAGES:

NEMA IDENTIFICATION COLOR CODE FOR CONTROL CABLES

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

NOTES

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

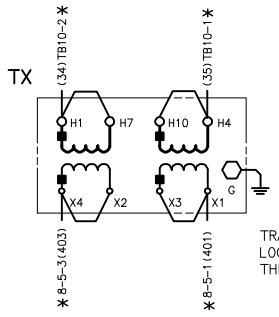
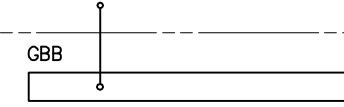
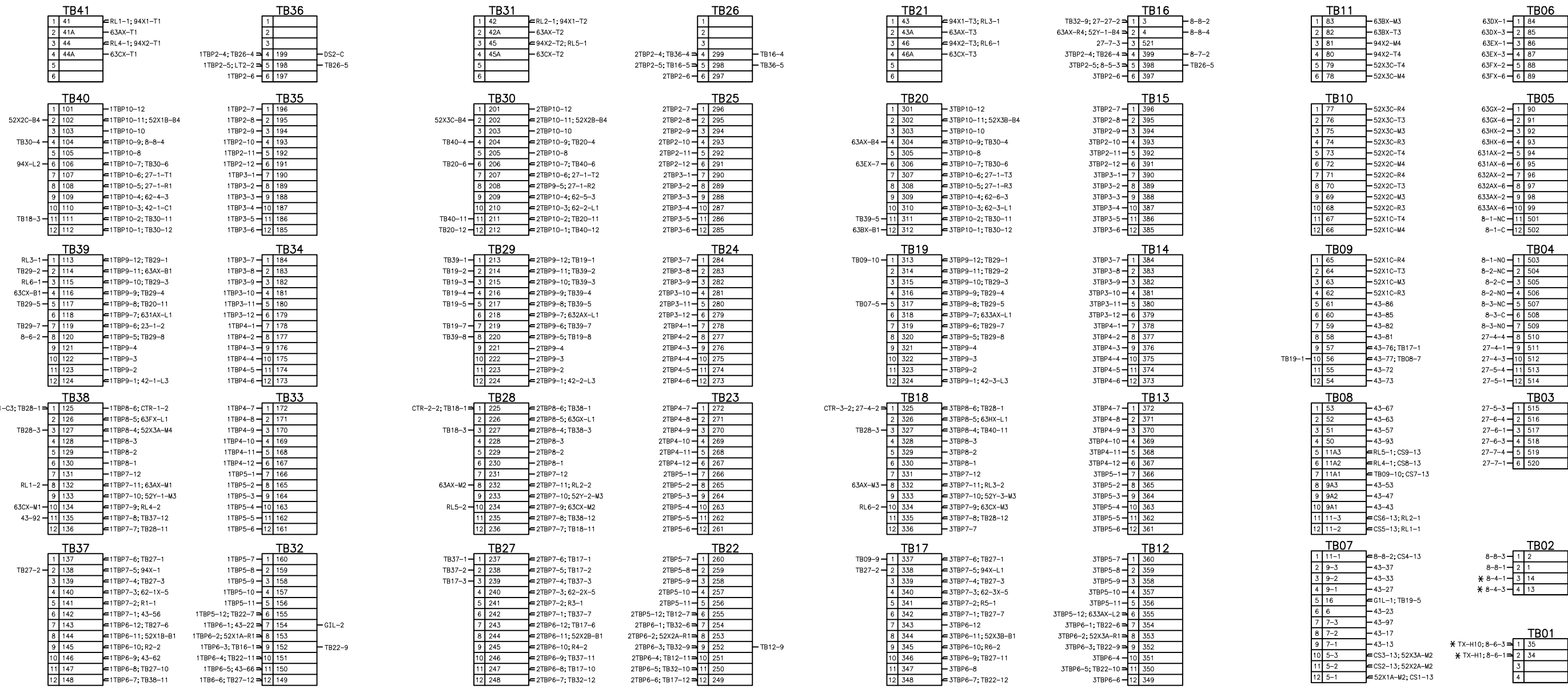
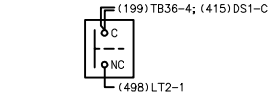
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A	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.
	SUPERSEDES DWG NO. 31-1076	
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS CONTROL CABLE COLOR CODE IDENTIFICATION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

LT2

LT1-2(418); TB36-5(198) LIGHT (498) DS2-NC

DS2

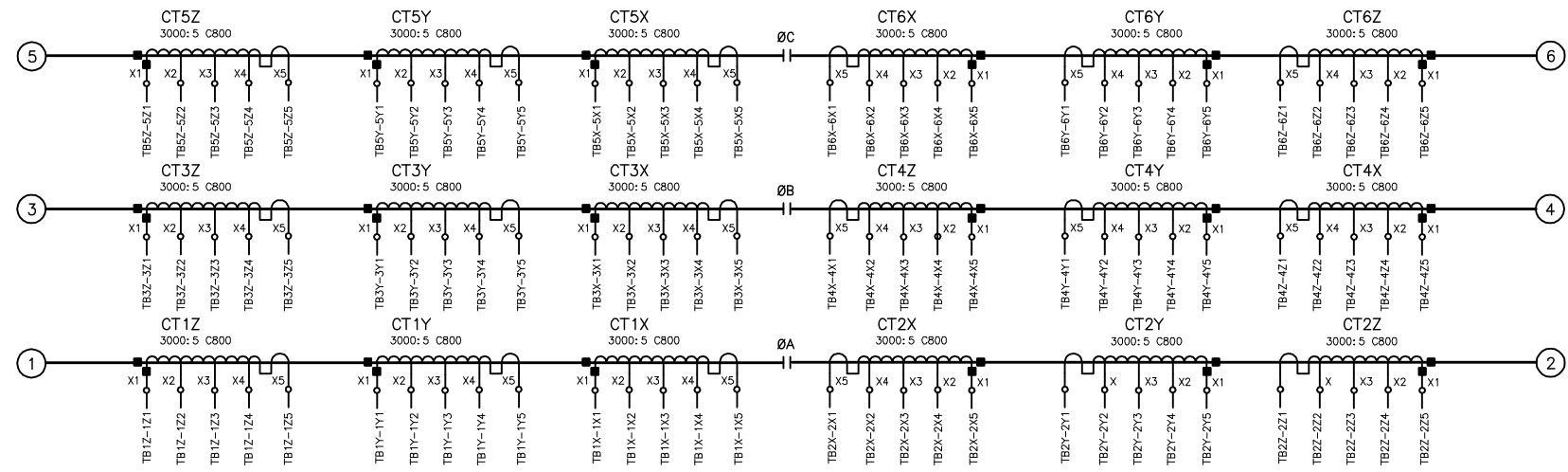


TRANSFORMER IS LOCATED OUTSIDE OF THE CONTROL CABINET

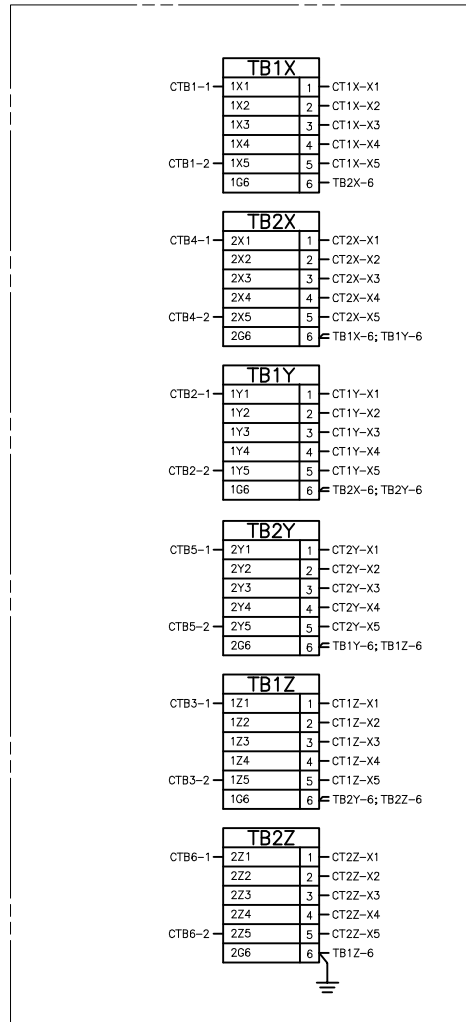
EXPLANATION

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

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

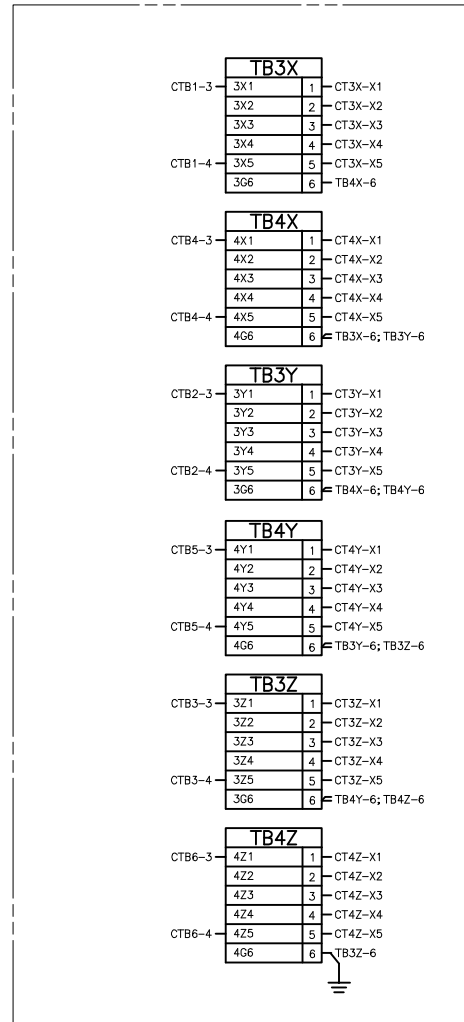


HOUSING-POLE 1



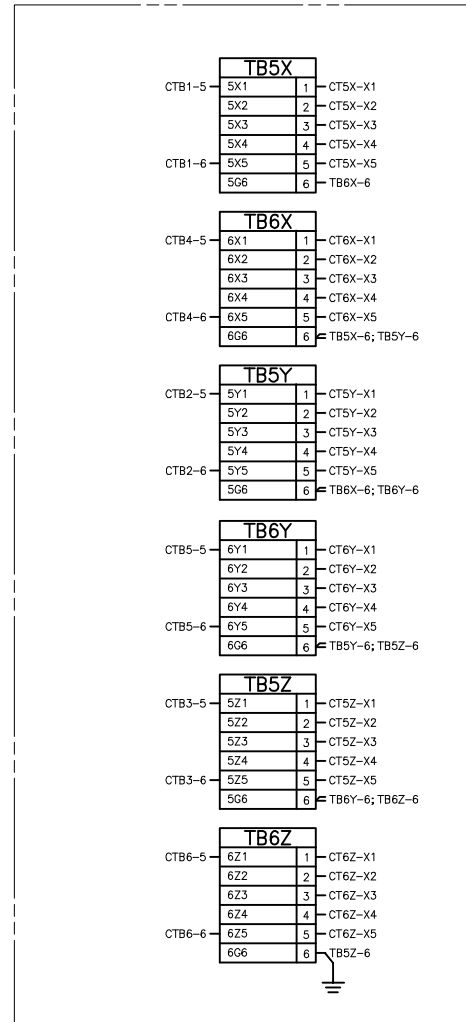
LEFT SIDE WALL

HOUSING-POLE 2



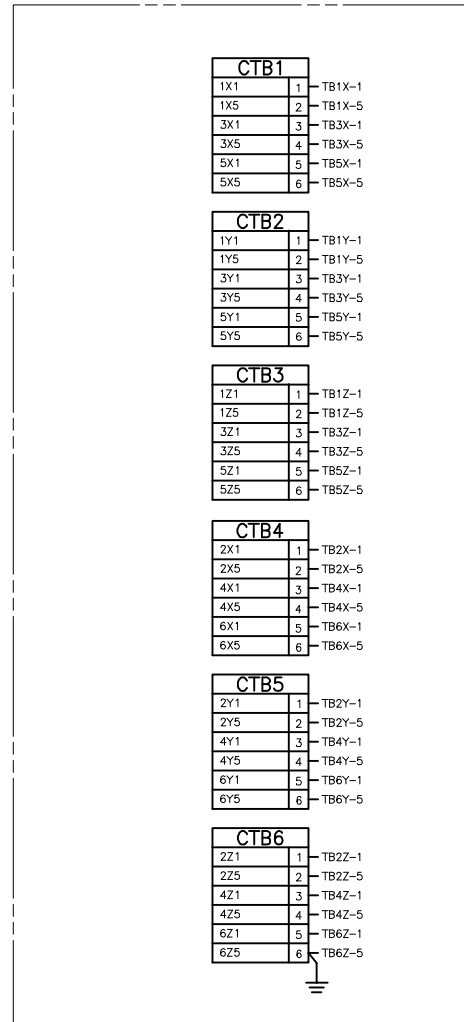
LEFT SIDE WALL

HOUSING-POLE 3



LEFT SIDE WALL

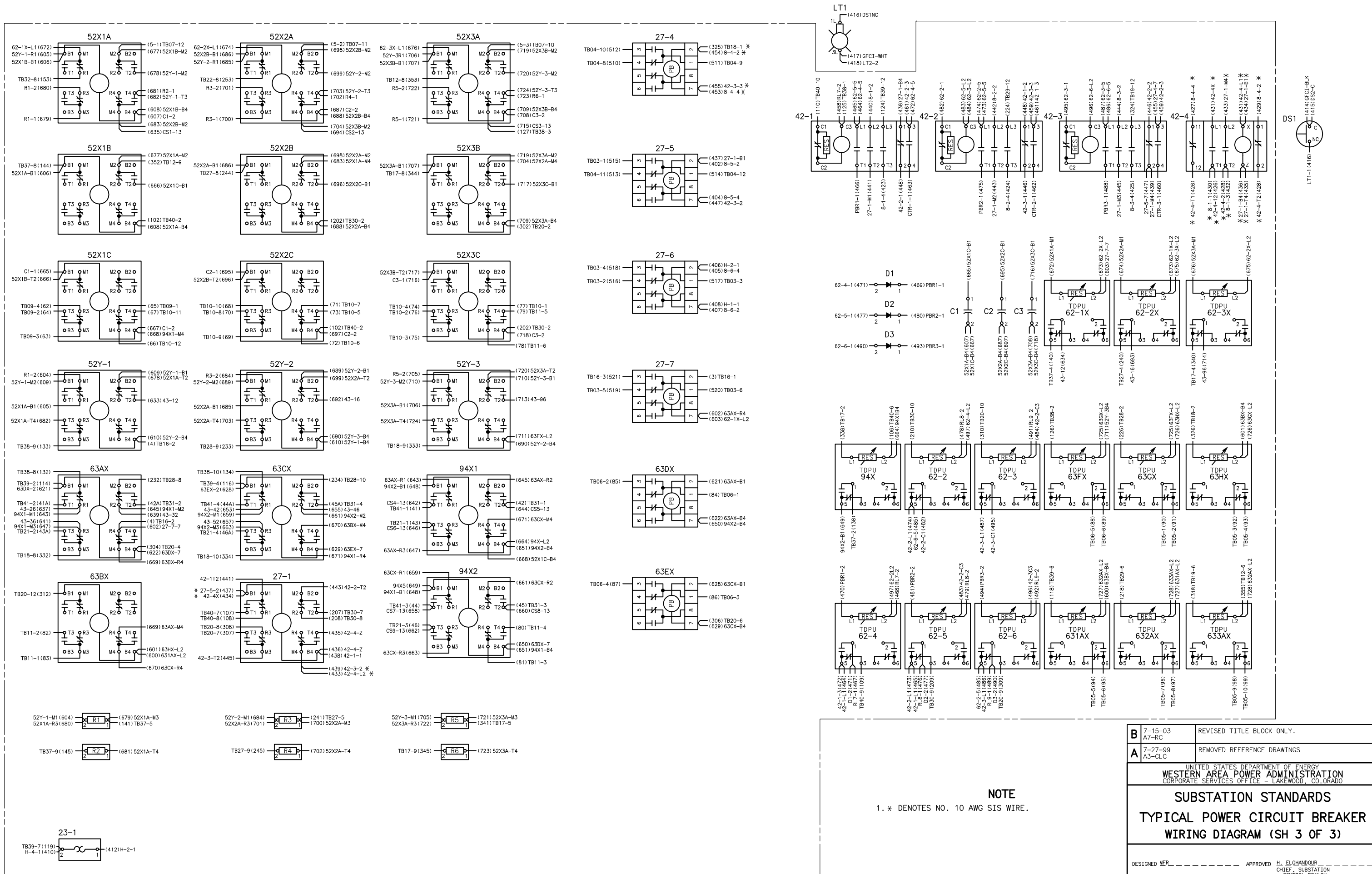
RIGHT SIDE WALL



RIGHT SIDE WALL

B	7-15-03	REVISED TITLE BLOCK ONLY.
	A7-RC	
A	7-27-99	REMOVED REFERENCE DRAWINGS
	A3-CLC	
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	MER	APPROVED H. ELGHANDOUR
		CHIEF, SUBSTATION CONTROL BRANCH
A	JULY 13, 1994	31 6012

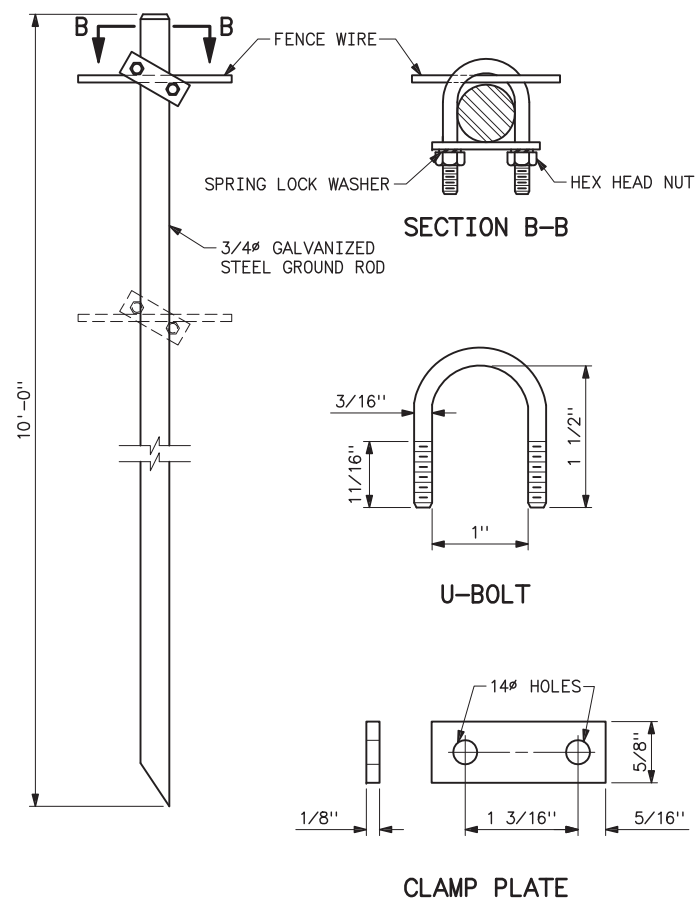
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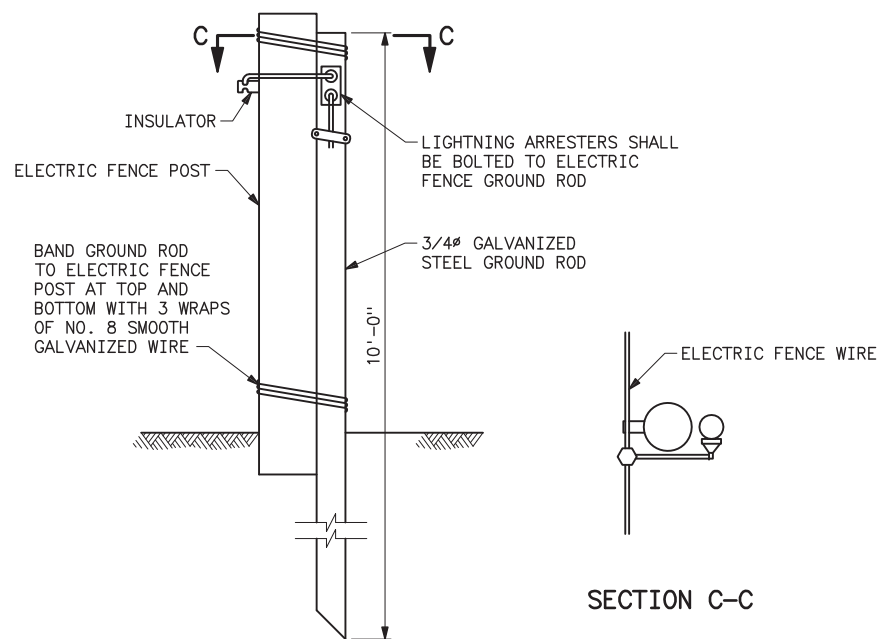
FRONT VIEW OF CONTROL CABINET FRONT PANEL

NOTE
 1. * DENOTES NO. 10 AWG SIS WIRE.

B	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.
A	7-27-99 A3-CLC	REMOVED REFERENCE DRAWINGS
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
SUBSTATION STANDARDS TYPICAL POWER CIRCUIT BREAKER WIRING DIAGRAM (SH 3 OF 3)		
DESIGNED MER	APPROVED H. ELGHANDOUR	CHIEF, SUBSTATION CONTROL BRANCH
A	JULY 13, 1994	31 6013



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.

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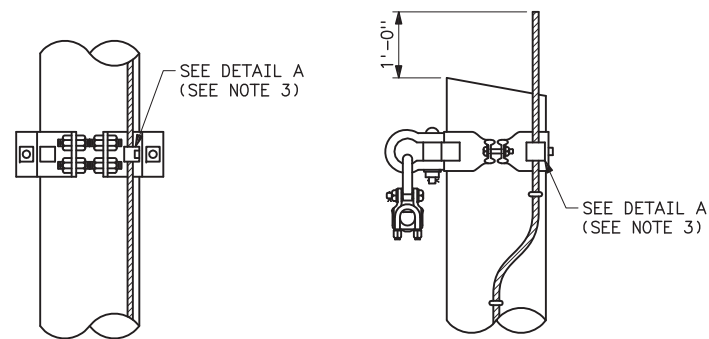
C	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.
B	7-13-99 A3-RMC	REDRAWN.
SUPERSEDES DWG NO. E40-D-5017		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
TRANSMISSION LINE STANDARDS TRANSMISSION LINES FENCE GROUNDING HARDWARE		
DESIGNED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

MATERIALS LIST

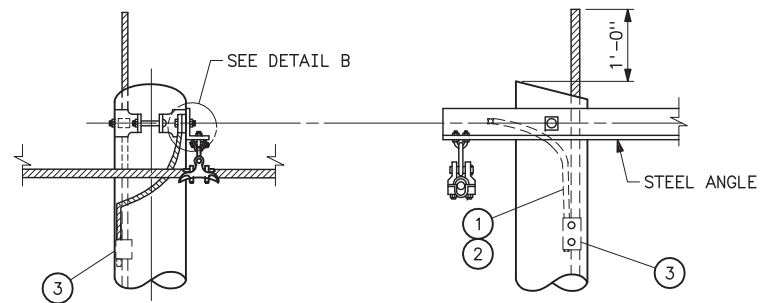
ITEM NO.	DESCRIPTION
1	NO.2 AWG, 30% CONDUCTIVITY, COPPER CLAD WIRE
2	GALVANIZED 2-INCH BARBED STAPLES
3	CLAMP, PARALLEL GROOVE, 2-BOLT COPPER ALLOY
4	POLE BOTTOM PLATE (BLACKBURN NO. GP 110 OR EQUAL) ATTACHED TO POLE
5	GROUNDING CLIP ASSEMBLY (INCLUDES BONDING CLIP, CARRIAGE BOLT, NUT, AND LOCKNUT)
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

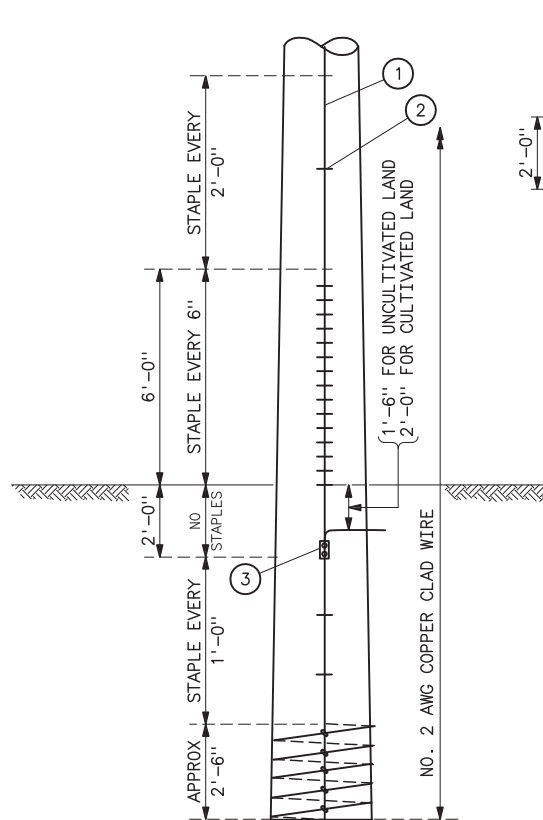
1. INSTALL GROUND WIRE AS INDICATED ON INDIVIDUAL STRUCTURE DRAWINGS.
2. PARALLEL GROOVE CLAMP, BONDING CLIP AND JUMPER FOR BONDING TO CROSSARM IS REQUIRED FOR 230KV STRUCTURES ONLY.
3. USE ONE GROUNDING CLIP ASSEMBLY PER POLE BAND.
4. UNDERGROUND POLE-TO-POLE GROUND WIRE TIE IS REQUIRED FOR ALL STRUCTURES 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.



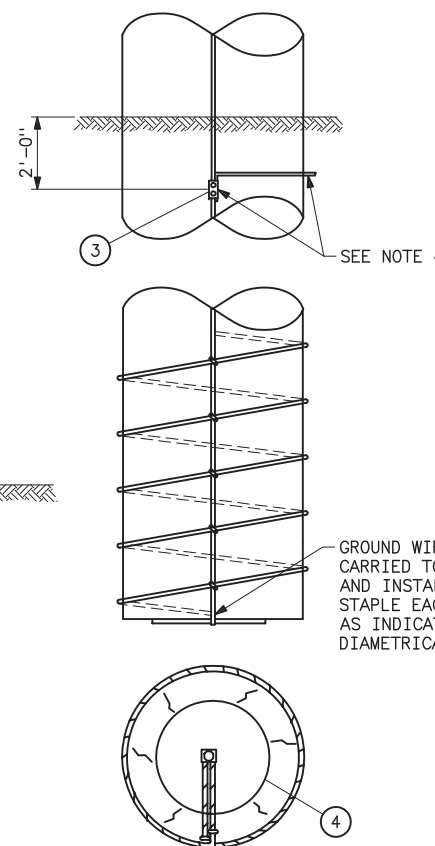
POLE BAND BONDING



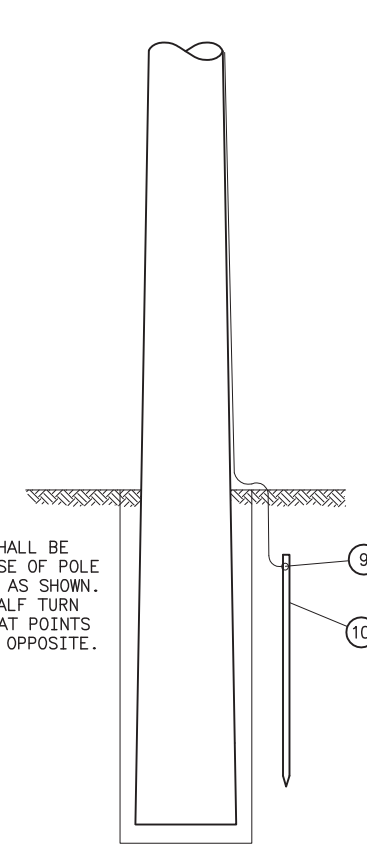
STEEL ANGLE BONDING



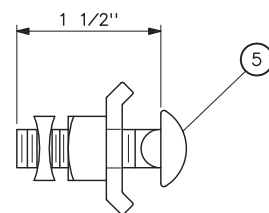
GROUND WIRE ATTACHMENT DETAILS



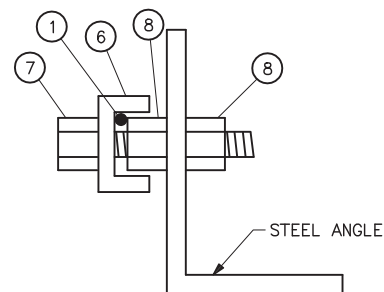
POLE BUTT WRAPPING DETAIL



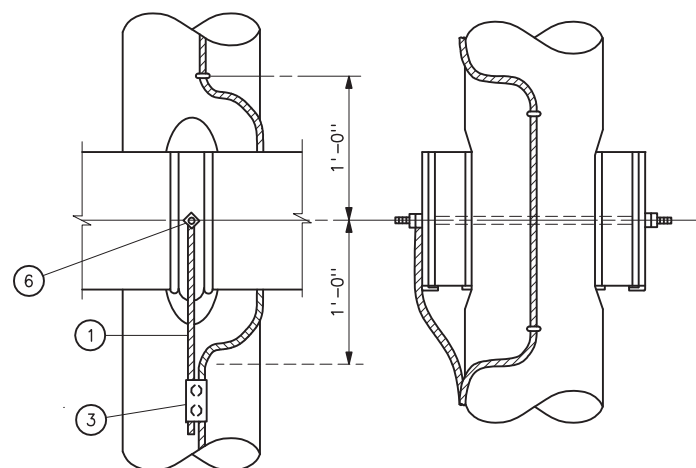
GROUND ROD DETAIL
SEE NOTE 5



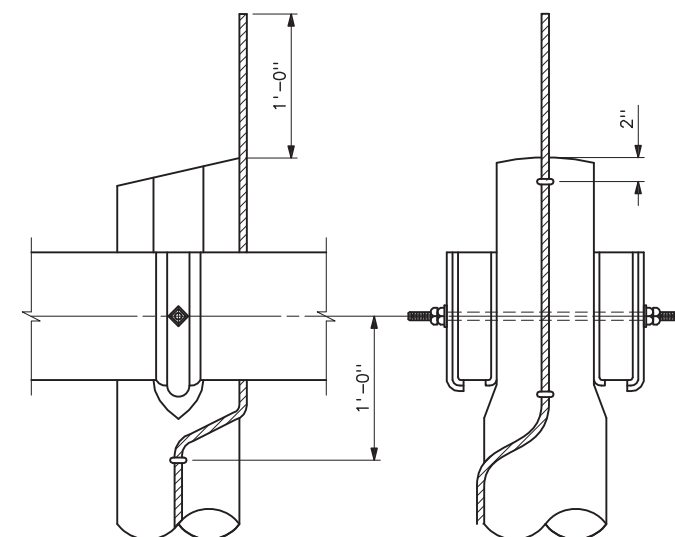
DETAIL A
GROUNDING CLIP ASSEMBLY
(SEE NOTE 3)



DETAIL B
BONDING CLIP ASSEMBLY

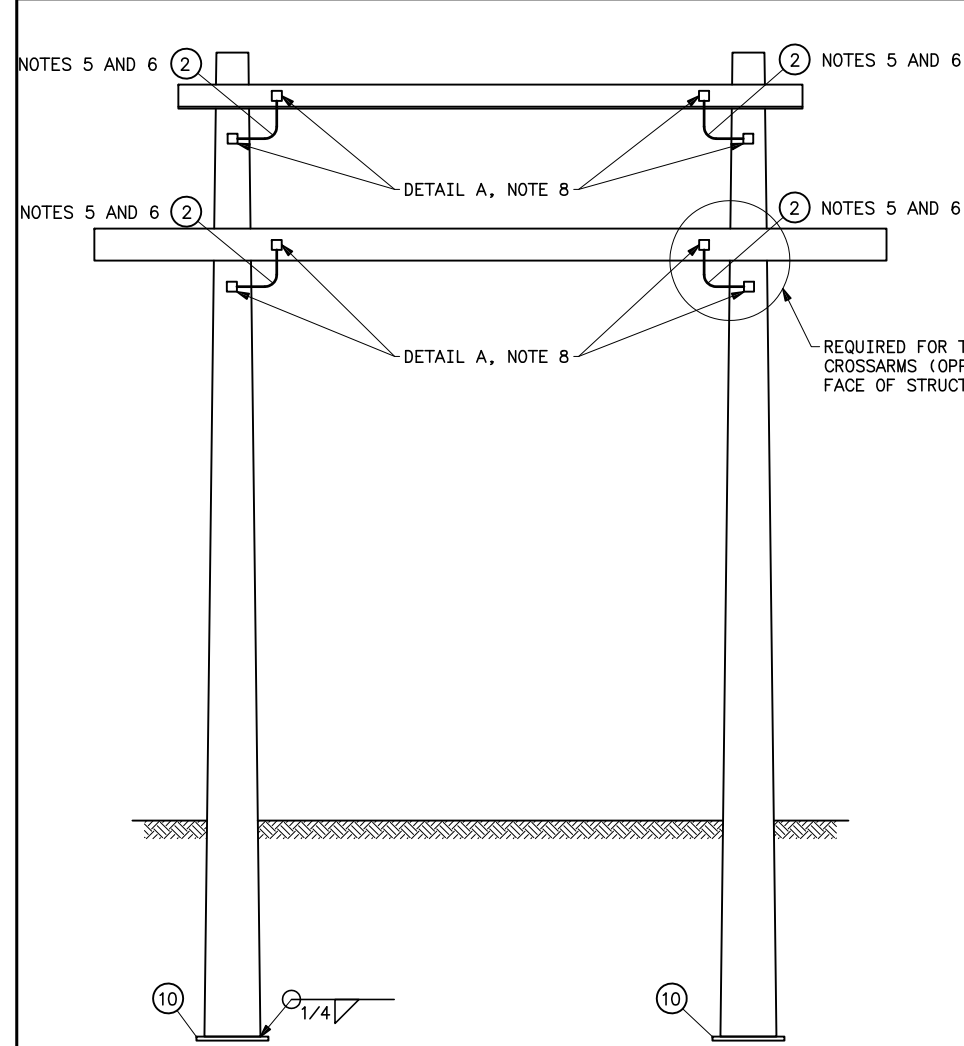


CROSSARM DETAIL AND BONDING
FOR STRUCTURE WITH OGW
(SEE NOTE 2)

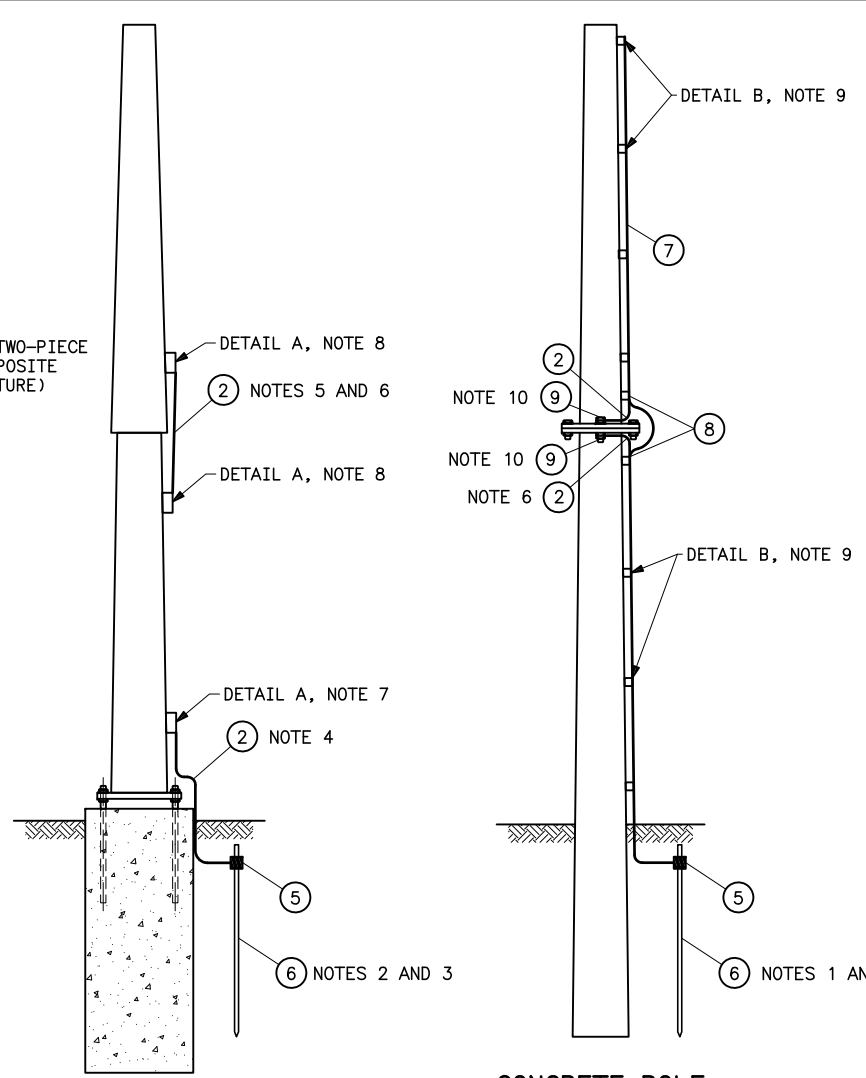


CROSSARM DETAIL AND BONDING
FOR STRUCTURE WITHOUT OGW

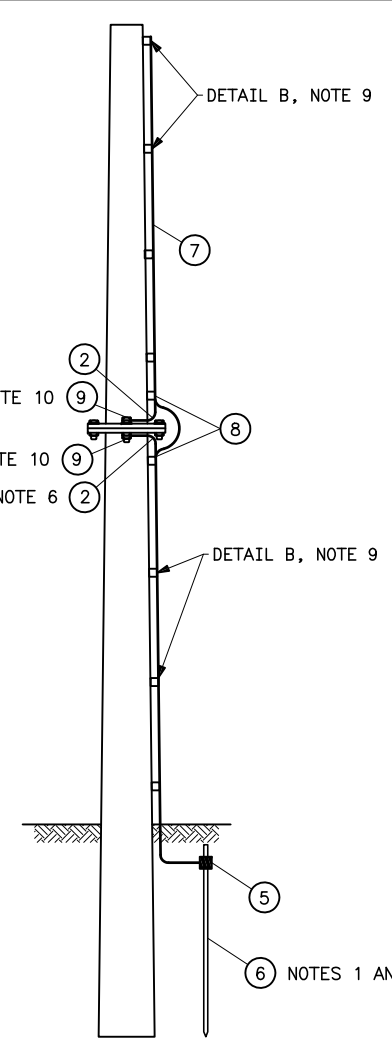
C	7-15-03 A7-RC	REVISED TITLE BLOCK ONLY.
B	5-18-95 A2-RMC	REDRAWN.
SUPERSEDES DWG NO. 40-D-4978		
UNITED STATES DEPARTMENT OF ENERGY WESTERN AREA POWER ADMINISTRATION CORPORATE SERVICES OFFICE - LAKEWOOD, COLORADO		
TRANSMISSION LINE STANDARDS WOOD POLE STRUCTURES GROUNDING DETAILS		
DESIGNED SRR	APPROVED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



WEATHERING STEEL H-FRAME
NATIVE BACKFILL
NOTE 13



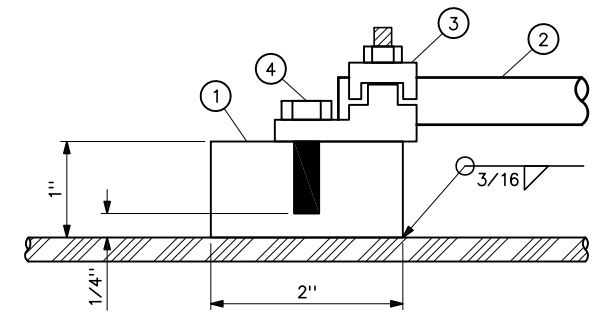
WEATHERING STEEL POLE
CONCRETE FOUNDATION OR CONCRETE BACKFILL
NOTE 13



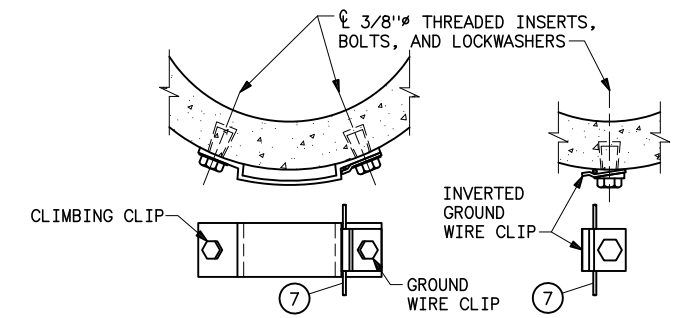
CONCRETE POLE
NATIVE BACKFILL

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

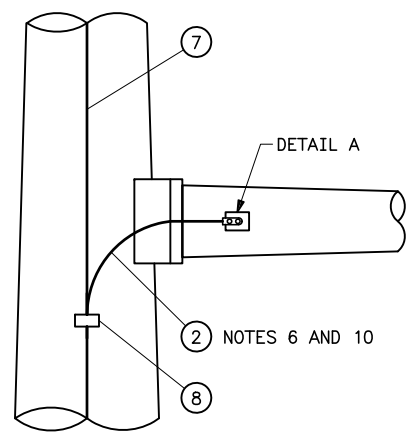
- NOTES**
- GROUND RODS ARE REQUIRED FOR ALL CONCRETE POLES.
 - GROUND RODS ARE REQUIRED FOR ALL WEATHERING STEEL POLES WITH CONCRETE FOUNDATIONS OR CONCRETE BACKFILL.
 - PLACE TOP OF GROUND ROD A MINIMUM OF 6" BELOW GROUND LINE.
 - PIGTAIL JUMPERS ARE REQUIRED BETWEEN POLE SHAFTS AND GROUND RODS ON 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.



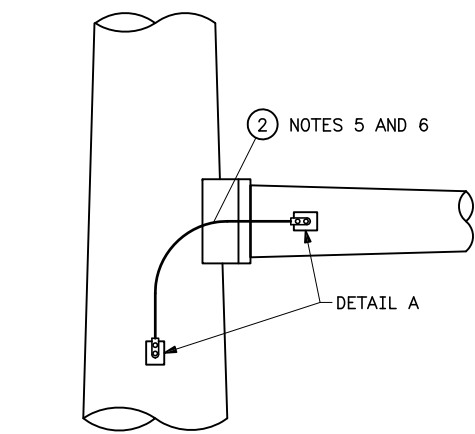
DETAIL A
GROUND PLATE DETAIL
NOTE 12



DETAIL B
CONCRETE POLE
GROUND WIRE CLIP ATTACHMENTS
NOTE 9

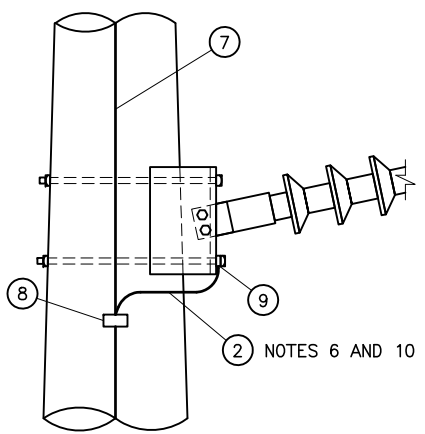


CONCRETE POLE

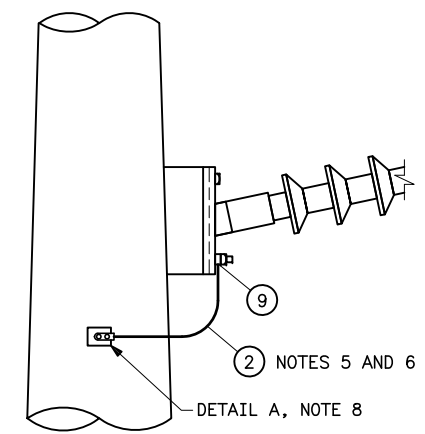


WEATHERING STEEL POLE

DAVIT ARM GROUNDING

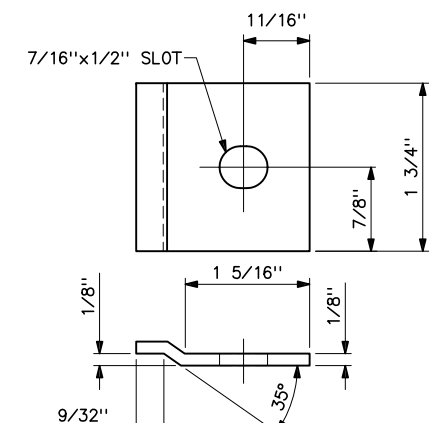


CONCRETE POLE



WEATHERING STEEL POLE

POST INSULATOR GROUNDING



GROUND WIRE CLIP
CONCRETE POLE

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

APRIL 20, 1984	41	1015
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Plotted By: lampan Sep 16, 2009- 3:47pm
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