

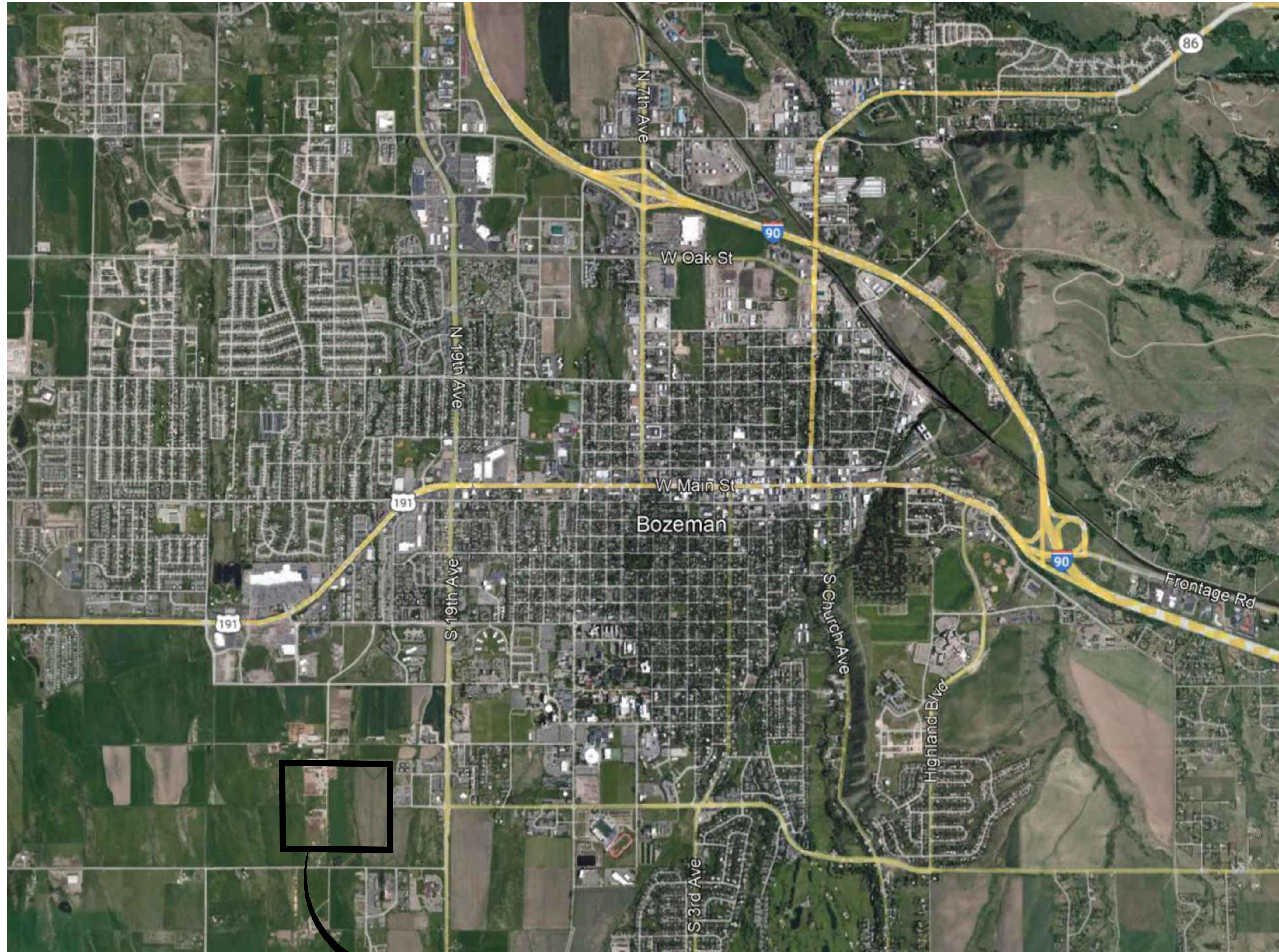


MONTANA STATE UNIVERSITY

BOZEMAN, MT

MAES - BART FARM AURORA TEST RANGE ELECTRICAL

PPA 22-0544



PROJECT LOCATION

SHEET INDEX

SHEET	TITLE
E-0	LEGEND
E-1	STAKING SHEET
E-2	SITE PLAN
E-3	SAG AND TENSION CHARTS
E-4	DETAILS
E-5	DETAILS
E-6	DETAILS

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CONSTRUCTION DOCUMENTS
MAES - BART FARM
AURORA TEST RANGE
ELECTRICAL



DRAWN BY: MWB

REVIEWED BY: MUS

REV.	DESCRIPTION	DATE

	LOW - VOLTAGE CIRCUIT BREAKER (CB). RATINGS AND NO. OF POLES AS SHOWN. WHEN SPECIFIC TYPE IS REQUIRED, X INDICATES TYPE. TYPES: MCCB - MOLDED CASE ICCB - INSULATED CASE LVP - LOW - VOLTAGE POWER MCP - MOTOR CIRCUIT PROTECTOR (RATING PER CONNECTED LOAD) SEPARATELY MOUNTED CIRCUIT BREAKER; SEE ELECTRICAL ONE - LINE DIAGRAM OR SCHEDULE FOR DESCRIPTION
	GROUND FAULT PROTECTION
	MEDIUM - VOLTAGE CIRCUIT BREAKER
	FUSE, SIZE, AND NUMBER OF FUSES AS NOTED
	FUSED CUTOUT, CURRENT RATING, FUSE SIZE, AND NUMBER OF POLES AS NOTED
	FUSIBLE SWITCH, CURRENT RATING, FUSE SIZE, AND QUANTITY AS NOTED
	NON-FUSED SWITCH, CURRENT RATING, AND NUMBER OF POLES AS NOTED
	DISCONNECT OR DRAWOUT CONNECTION
	MAGNETIC MOTOR STARTER AND SEPARATELY MOUNTED COMBINATION MAGNETIC MOTOR STARTER
	MOTOR CONTROLLER AND SEPARATELY MOUNTED MOTOR CONTROLLER WITH SHORT CIRCUIT PROTECTION AND DISCONNECT MOTOR STARTER AND CONTROLLER SUBSCRIPTS: A - MAGNETIC STARTER NEMA SIZE B - STARTER TYPE NONE - FULL VOLTAGE NON-REVERSING (FVNR) FVR - FULL VOLTAGE REVERSING 2S - TWO SPEED RVAT - REDUCED VOLTAGE AUTO TRANSFORMER C - CONTROL DIAGRAM OR CONTROLS SCHEDULE NUMBER (IF REQUIRED) D - CONTROLLER TYPE VFD - VARIABLE FREQUENCY DRIVE SS - SOLID STATE SEPARATELY MOUNTED COMBINATION MOTOR STARTER OR CONTROLLER; SEE ELECTRICAL ONE - LINE DIAGRAM OR SCHEDULE FOR DESCRIPTION
	THERMAL OVERLOAD ELEMENT
	THERMAL OVERLOAD RELAY CONTACT
	DISCONNECT OR SAFETY SWITCH, 30A, 3P, NON-FUSED UNLESS OTHERWISE NOTED
	MOTOR WITH DESIGN HORSEPOWER (WHEN INDICATED)
	GENERATOR
	TRANSFER SWITCH, CURRENT RATING, AND NUMBER OF POLES AS NOTED ATS - AUTOMATIC MTS - MANUAL
	TRANSFORMER (ONE-LINE)
	3-PHASE, 3-WIRE DELTA CONNECTION
	3-PHASE, 4-WIRE GROUNDED WYE CONNECTION
	EXISTING TRANSFORMER (PLAN VIEW)
	NEW TRANSFORMER (PLAN VIEW)
	3-PHASE TRANSFORMER (PLAN VIEW)
	DISTRIBUTION POLE: EXISTING / NEW (POLE MATERIAL, HEIGHT, AND CLASS AS SPECIFIED IN STAKING SHEETS.)

	SWITCHBOARD OR PANELBOARD; NAME, VOLTAGE, PHASE, NUMBER OF WIRES WHEN INDICATED
	NON-MOTOR LOAD WITH DESIGN KVA, KW, OR AMP
	CONTROL POWER TRANSFORMER (CPT)
	VOLTAGE TRANSFORMER (VT OR PT)
	CURRENT TRANSFORMER (CT)
	UTILITY WATT-HOUR METER PER UTILITY REQUIREMENTS
	DIGITAL METERING PACKAGE
	ELAPSED TIME METER
	GROUND
	LIGHTNING ARRESTER
	LOW VOLTAGE SURGE PROTECTIVE DEVICE
	ELECTRICAL CONNECTION
	NO ELECTRICAL CONNECTION
	SOLENOID VALVE
	CONTROL/RELAY COIL; X INDICATES TYPE, Y INDICATES LOOP NO. WHEN USED TYPES: CR - CONTROL RELAY DP - DEFINITE PURPOSE RELAY LC - LIGHTING CONTACTOR M - MOTOR STARTER PC - PHOTO CELL TC - TIME CLOCK TR - TIMING RELAY
	NORMALLY OPEN CONTACT (N.O.)
	NORMALLY CLOSED CONTACT (N.C.)
	NORMALLY OPEN TIME DELAY RELAY CONTACT WITH TIME DELAY ON CLOSING AFTER COIL IS ENERGIZED
	NORMALLY CLOSED TIME DELAY RELAY CONTACT WITH TIME DELAY ON OPENING AFTER COIL IS ENERGIZED
	NORMALLY OPEN TIME DELAY RELAY CONTACT WITH TIME DELAY ON OPENING AFTER COIL IS DE-ENERGIZED
	NORMALLY CLOSED TIME DELAY RELAY CONTACT WITH TIME DELAY ON CLOSING AFTER COIL IS DE-ENERGIZED
	NORMALLY OPEN TEMPERATURE SWITCH; CLOSE ON RISING TEMPERATURE
	NORMALLY CLOSED TEMPERATURE SWITCH; OPEN ON RISING TEMPERATURE
	NORMALLY OPEN FLOW SWITCH; CLOSE ON INCREASING FLOW
	NORMALLY CLOSED FLOW SWITCH; OPEN ON INCREASING FLOW
	NORMALLY OPEN LEVEL SWITCH; CLOSE ON RISING LEVEL
	NORMALLY CLOSED LEVEL SWITCH; OPEN ON RISING LEVEL
	NORMALLY OPEN PRESSURE SWITCH; CLOSE ON INCREASING PRESSURE
	NORMALLY CLOSED PRESSURE SWITCH; OPEN ON INCREASING PRESSURE
	NORMALLY OPEN LIMIT SWITCH; CLOSE ON REACHING LIMIT

	NORMALLY CLOSED LIMIT SWITCH, OPEN ON REACHING LIMIT
	FIELD WIRING EXTERNAL TO CONTROL PANEL
	INTERLOCK; X INDICATES TYPE TYPES: E - ELECTRICAL M - MECHANICAL K - KEY
	3 POSITION SELECTOR SWITCH, MAINTAINED CONTACTS; UNLESS OTHERWISE NOTED, 2-POSITION SIMILAR
	NORMALLY OPEN PUSHBUTTON, MOMENTARY CONTACT UNLESS OTHERWISE NOTED
	NORMALLY CLOSED PUSHBUTTON, MOMENTARY CONTACT UNLESS OTHERWISE NOTED
	INDICATING LIGHT, X INDICATES LENS COLOR
	PUSH TO TEST INDICATING LIGHT, X INDICATES LENS COLOR LENS COLORS: R - RED Y - YELLOW G - GREEN W - WHITE B - BLUE A - AMBER
	TRANSFORMER
	SELECTOR SWITCH
	PUSHBUTTON
	INSTRUMENTATION/CONTROL DEVICE
	CONTROL PANEL INTEGRAL OR PROVIDED WITH ASSOCIATED EQUIPMENT
	CONTROL PANEL WITH DISCONNECT SWITCH INTEGRAL OR PROVIDED WITH ASSOCIATED EQUIPMENT
	JUNCTION OR PULL BOX
	PANELBOARD (250V TO 600V)
	PANELBOARD (LESS THAN 250V)
	ELECTRICAL EQUIPMENT ENCLOSURE: SWITCHBOARD, MOTOR CONTROL CENTER, CONTROL PANEL, OR OTHER EQUIPMENT AS INDICATED
	MOTION DETECTOR, PROVIDE POWER PACK AS NEEDED
	PHOTOCELL
	CEILING/PENDANT-MOUNTED LUMINAIRE - HID, COMPACT FLUORESCENT, OR INCANDESCENT
	WALL-MOUNTED LUMINAIRE - HID, COMPACT FLUORESCENT, OR INCANDESCENT
	CEILING/PENDANT-MOUNTED FLUORESCENT FIXTURE
	WALL-MOUNTED FLUORESCENT FIXTURE
	CEILING/PENDANT-MOUNTED FLUORESCENT FIXTURE NORMAL/EMERGENCY
	WALL-MOUNTED FLUORESCENT FIXTURE NORMAL/EMERGENCY
	EMERGENCY LIGHT FIXTURE, 2 ATTACHED HEADS AS SHOWN
	EMERGENCY LIGHT, REMOTE MOUNTED HEAD
	DOUBLE-FACED CEILING OR WALL-MOUNTED EXIT LIGHT; DIRECTIONAL ARROWS (IF REQUIRED) AS INDICATED ON PLANS
	SINGLE-FACED CEILING OR WALL-MOUNTED EXIT LIGHT; DIRECTIONAL ARROWS (IF REQUIRED) AS INDICATED ON PLANS
	AREA OR ROADWAY LIGHT - POLE-MOUNTED
	LIGHTING FIXTURE SUBSCRIPTS: X - INDICATES FIXTURE TYPE PER LIGHTING FIXTURE SCHEDULE Y - INDICATES CIRCUIT NUMBER FROM PANELBOARD Z - INDICATES CONTROLLING SWITCH (IF REQUIRED)
	MANUAL MOTOR STARTER

	TOGGLE SWITCH SUBSCRIPTS: X - INDICATES TYPE NONE - SINGLE POLE 3 - THREE-WAY 4 - FOUR-WAY HP - TOGGLE SWITCH, HORSEPOWER RATED K - KEY SWITCH TE - MANUAL MOTOR STARTER WITH THERMAL ELEMENT P - PILOT LIGHT L - LIGHTED HANDLE Y - SWITCH NAME/DESIGNATION
	SPECIAL-PURPOSE RECEPTACLE AS DEFINED ON PLANS
	PLUG-IN RECEPTACLE STRIP, QUANTITY AND SPACING OF RECEPTACLES AS NOTED OR SPECIFIED
	TELECOMMUNICATIONS OUTLET JUNCTION BOX
	QUAD-DUPLEX RECEPTACLE, TWO NEMA 5-20R UNDER COMMON COVER PLATE
	DUPLEX RECEPTACLE, NEMA 5-20R
	SIMPLEX RECEPTACLE, NEMA 5-20R SUBSCRIPTS: X - INDICATES TYPE GFCI - GROUND FAULT CIRCUIT INTERRUPTER Y - INDICATES CIRCUIT NUMBER FROM PANELBOARD
	CONDUIT TURNING UP
	CONDUIT TURNING DOWN
	HOME RUN TO PANEL, 2 #12, 1 #12G IN 3/4" UNLESS OTHERWISE NOTED
	HOME RUN WITH CONDUIT SEAL-OFF
	CIRCUIT RUN BETWEEN DEVICES EXPOSED IN NON-ARCHITECTURALLY FINISHED AREAS; CONCEALED IN ARCHITECTURALLY FINISHED AREAS. CONDUIT AND CONDUCTOR SIZES SHALL BE THE SAME AS THE HOMERUN FOR THE CIRCUIT.
	CIRCUIT RUN BETWEEN DEVICES CONCEALED IN NON-ARCHITECTURALLY FINISHED AREAS OR UNDER FLOOR SLAB. CONDUIT AND CONDUCTOR SIZES SHALL BE THE SAME AS THE HOMERUN FOR THE CIRCUIT.
	CIRCUIT HASH MARKS (WHEN INDICATED); LONG, SHORT, SINGLE DOT, AND DOUBLE DOT REPRESENT PHASE, NEUTRAL, EQUIPMENT GROUND, AND ISOLATED EQUIPMENT GROUND, RESPECTIVELY. #12 IN 3/4" CONDUIT UNLESS OTHERWISE INDICATED.
	CIRCUIT CONTINUATION
	CONDUIT STUBBED OUT AND CAPPED
	CONDUIT TAG OR CIRCUIT NUMBER - WIRE AND CONDUIT SIZE AS SPECIFIED IN CIRCUIT SCHEDULE ON THE SHEETS
	GROUND CABLE
	GROUND ROD
	FIRE ALARM ANNUNCIATOR
	FIRE ALARM CONTROL PANEL
	FIRE ALARM MANUAL PULL STATION
	FIRE ALARM CONTROL RELAY
	FIRE ALARM CONTACT, FLOW SWITCH
	FIRE ALARM CONTACT, TAMPER SWITCH
	FIRE ALARM CONTACT, PRESSURE SWITCH
	SMOKE AND DUCT DETECTOR SUBSCRIPT: I - IONIZATION TYPE P - PHOTOELECTRIC TYPE

	HEAT DETECTOR SUBSCRIPT: R/C - RATE COMPENSATION R/F - COMBINATION RATE OF RISE AND FIXED TEMP R - RATE OF RISE F - FIXED
	ALARM FLASHING LIGHT
	ALARM BELL AND FLASHING LIGHT COMBINATION UNIT
	ALARM HORN AND FLASHING LIGHT COMBINATION UNIT SUBSCRIPT: NONE - GENERAL ALARM DEVICE F - FIRE ALARM DEVICE
	ALARM BELL
	ALARM HORN
ABBREVIATIONS:	
A or AMP	AMPERES
AC	ALTERNATING CURRENT
AFF	ABOVE FINISHED FLOOR
ATS	AUTOMATIC TRANSFER SWITCH
C	CONDUIT
CB	CIRCUIT BREAKER
CKT	CIRCUIT
CU	COPPER
EF	EXHAUST FAN
ELEC	ELECTRIC
EMT	ELECTRICAL METALLIC TUBING
EXP	EXPLOSION PROOF
GFI	GROUND FAULT INTERRUPTER
GND	GROUND
HOA	HAND-OFF-AUTOMATIC
HP	HORSEPOWER
HVAC	HEATING, VENTILATING & AIR CONDITIONING
HZ	HERTZ
J-BOX	JUNCTION BOX
kw	KILOWATTS
kVA	KILOVOLT AMPERES
LFMC	LIQUIDTIGHT FLEXIBLE METAL CONDUIT
MAN	MANUAL
MCC	MOTOR CONTROL CENTER
MECH	MECHANICAL
MFR	MANUFACTURER
N	NEUTRAL
NC	NORMALLY CLOSED
NEC	NATIONAL ELECTRICAL CODE
NO	NORMALLY OPEN
#	NUMBER
PB	PUSHBUTTON
PH	PHASE
PNL	PANEL
PVC	POLYVINYL CHLORIDE CONDUIT
PWR	POWER
RECPT	RECEPTACLE
RGS	RIGID GALVANIZED STEEL
RETIRE	REMOVE
SV	SOLENOID VALVE
SW	SWITCH
SWBD	SWITCHBOARD
SWGR	SWITCHGEAR
T	THERMOSTAT
TD	TIME DELAY
TEL	TELEPHONE
UG	UNDERGROUND
UH	UNIT HEATER
V	VOLT
VA	VOLT AMPERES
VFD	VARIABLE FREQUENCY DRIVE
W	WATTS
WP	WEATHERPROOF
XFMR	TRANSFORMER
Y	WYE CONNECTED
Δ	DELTA CONNECTED
∅	PHASE
GENERAL NOTES:	
1. THIS IS A STANDARD ELECTRICAL SYMBOL SHEET, NOT ALL SYMBOLS MAY BE USED ON THIS PROJECT.	
2. SCREENING OR SHADING OF WORK IS USED TO INDICATE EXISTING COMPONENTS OR TO DE-EMPHASIZE PROPOSED IMPROVEMENTS TO HIGHLIGHT SELECTED TRADE WORK. REFER TO CONTEXT OF EACH SHEET FOR USAGE.	
3. REFERENCE OTHER LEGEND SHEETS FOR PROJECT-SPECIFIC EQUIPMENT SYMBOLS, EQUIPMENT ABBREVIATIONS, AND PIPING SYSTEM ABBREVIATIONS.	



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CONSTRUCTION DOCUMENTS

MAES - BART FARM AURORA TEST RANGE ELECTRICAL

**Morrison
Maierle**
engineers • surveyors • planners • scientists

DRAWN BY: MWB		
REVIEWED BY: MUS		
REV.	DESCRIPTION	DATE

MONTANA
MICHAEL BRAND
REGISTERED PROFESSIONAL ENGINEER
015022

22-0544

MMI# 0747.078

**SHEET TITLE
LEGEND**

**SHEET
E-0**

**DATE
03-15-2023**

COORDINATE TABLE

NORTHING	EASTING	DESCRIPTION
519026.55	1566467.80	P1
518879.36	1566464.77	P2
518698.79	1566460.66	P3
518517.43	1566456.96	P4
518506.25	1566527.96	S1

DESCRIPTION	ACTION	POLE HEIGHT - CLASS	BACK SPAN	CONDUCTOR LENGTH - SIZE TYPE	GUY	ANCHORING	GROUNDING	POLE TOP ASSEMBLY	SECONDARY	TRANSFORMER	COMMENT
POLE P1	EXISTING	40'-5	222		E1.1 E1.1	F2.8 F2.8	H1.1	C5.31 C5.31 A6.22G (LA)			EXISTING 40' CLASS 5 POLE WITH THREE-PHASE DEADEND POLE, THREE-PHASE TAP ACROSS ROAD, AND SINGLE-PHASE CONTINUING TO NEXT SPAN. TWO DOWN GUYS AND ANCHORS.
	RETIRE				E1.1	F2.8		A6.22G (LA)			RETIRE SINGLE-PHASE ASSEMBLY AND IN-LINE DOWN GUY. ABANDON ANCHOR.
	ADD							C6.21 (LA) A1.01			ADD POLE TOP INSULATOR AND IN-LINE INSULATORS TO EXISTING CROSSARM TO CONVERT TO THREE-PHASE DOUBLE DEAD-END ASSEMBLY.
POLE P2	EXISTING	40'-5	148	296 - #4 ACSR				A1.1			EXISTING 40'-5 POLE WITH SINGLE-PHASE IN-LINE ASSEMBLY.
	RETIRE	40'-5		296 - #4 ACSR				A1.1			RETIRE EXISTING POLE, SINGLE-PHASE ASSEMBLY, AND CONDUCTOR.
	ADD	40'-4		592 - #4 ACSR			H1.1	C1.12			ADD NEW 40' CLASS 4 POLE, THREE-PHASE IN-LINE POLE TOP ASSEMBLY, AND CONDUCTORS.
POLE P3	EXISTING	40'-5	180	360 - #4 ACSR	E1.1 E1.1	F2.8 F2.8	H1.1	A5.1 A5.1	UK1.1	G1.6	EXISTING SINGLE-PHASE DEAD-END POLE WITH 90° TAP ACROSS ROAD. SINGLE-PHASE TRANSFORMER WITH SECONDARY RISER ON STAND-OFF BRACKETS TO BUILDING.
	RETIRE	40'-5		360 - #4 ACSR	E1.1	F2.8		A5.1			RETIRE ENTIRE POLE. SAVE TRANSFORMER AND FUSE CUTOUT FOR RE-USE.
	ADD	40'-4		720 - #4 ACSR			H1.1	C1.12			INSTALL NEW 40' CLASS 4 POLE AND THREE-PHASE POLE TOP ASSEMBLY. RE-ATTACH 90° TAP ACROSS ROAD AND ASSOCIATED DOWN GUY USING NEW HARDWARE. HANG EXISTING TRANSFORMER AND FUSE CUTOUT ON NEW POLE. RE-INSTALL RISER AND SERVICE TO BUILDING. SEE SINGLE PHASE TAP GUIDE C5.11G, SHEET E-6.
POLE P4	EXISTING										
	RETIRE										
	ADD	40'-4	182	728 - #4 ACSR	E1.1	F2.8 (30 ft)	H1.1	C5.31	K1.2	G3.3 (3x50kVA)	ADD NEW 40' CLASS 4 POLE WITH THREE-PHASE DEADEND ASSEMBLY, THREE PHASE TRANSFORMER BANK (3 x 50kVA) AND SERVICE DROP ASSEMBLY. ADD TYPE 10T OR 10K FUSE TO MATCH MSU SYSTEM PROTECTION SCHEME.
POLE S1	ADD	30'-5	50	72 - #350 MCM AL QUAD			H1.1		K1.2		ADD NEW 30' CLASS 5 SERVICE POLE AND 350MCM THHN OR THHW OVERHEAD QUADRUPLX SERVICE CABLE, SLACK SPAN. INSTALL WEATHERHEAD, CONDUIT, AND CONDUCTOR TO THE CT CABINET. TERMINATE CONDUCTOR IN CT CABINET.

GENERAL NOTES

- LA - LESS CROSS ARM FOR EXISTING POLES WITH EXISTING CROSS ARMS.
- ALL CROSS ARMS TO BE 10' LENGTH. ALL DEAD END CROSS ARMS TO BE FIBERGLASS.



- GENERAL NOTES**
1. SEE STAKING SHEET FOR DETAILED COMMENTS, SHEET E-1.
 2. SEE SAG AND TENSION STRINGING CHART, SHEET E-3.
 3. SEE POLE ASSEMBLY DETAILS, SHEETS E-4 AND E-5.
- KEY NOTES**
- ① REMOVE EXISTING IN-LINE GUY.
 - ② INSTALL EXISTING DEAD-END ASSEMBLY AND ASSOCIATED DOWN GUY WITH NEW HARDWARE ON NEW 40' CLASS 4 POLE. RE-USE EXISTING TRANSFORMER AND FUSE CUTOUT. RE-INSTALL RISER AND SERVICE TO BUILDING.
 - ③ INSTALL NEW GUY AND ANCHOR ASSEMBLY AT 30' FROM NEW POLE.
 - ④ UNDERGROUND SERVICE CONDUCTOR, SEE DETAIL 1 SHEET E-5 AND ONE-LINE DIAGRAM & FEEDER SCHEDULE, DETAIL 1 SHEET E-6.
 - ⑤ NEW 208/120V 3-PHASE SECONDARY OVERHEAD QUADRUPLIX SERVICE CABLE. SEE ONE-LINE AND FEEDER SCHEDULE, DETAIL 1 SHEET E-6.
 - ⑥ INSTALL NEW 150kVA (3 x 50kVA) 12.47/7.2KV - 120/208V WYE, 3-PHASE TRANSFORMER BANK. INSTALL TYPE 10K OR 10T FUSE IN ACCORDANCE WITH MSU SYSTEM PROTECTION SCHEME.
 - ⑦ SERVICE ENTRANCE EQUIPMENT, SEE DETAIL 1, SHEET E-5.
 - ⑧ SEE SINGLE PHASE TAP GUIDE C.511G, SHEET E-6.

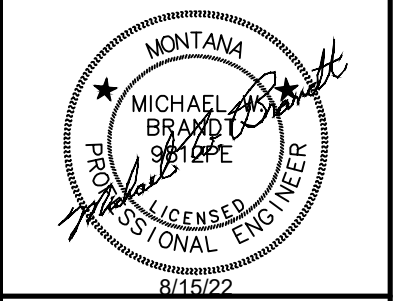


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CONSTRUCTION DOCUMENTS
MAES - BART FARM
AURORA TEST RANGE
ELECTRICAL



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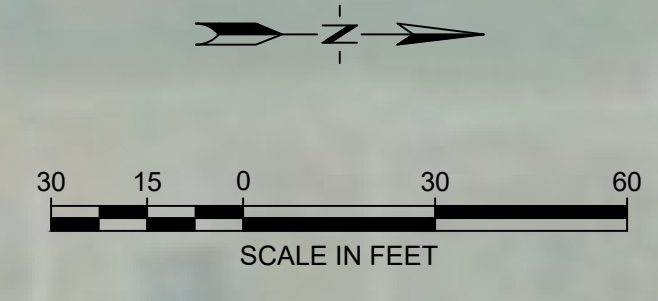
MMI# 0747.078

SHEET TITLE
 SITE PLAN

SHEET
 E-2

DATE
 03-15-2023

VERIFY SCALE!
 THESE PRINTS MAY BE REDUCED.
 LINE BELOW MEASURES ONE INCH
 ON ORIGINAL DRAWING.
 ───────────
 MODIFY SCALE ACCORDINGLY!





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ELECTRICAL

CONSTRUCTION DOCUMENTS

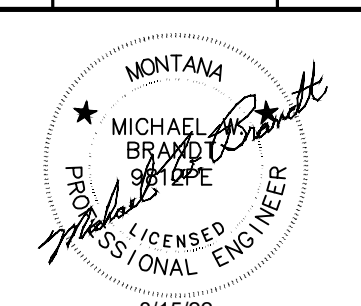


DRAWN BY: MWB

REVIEWED BY: -

REV. DESCRIPTION DATE

REV.	DESCRIPTION	DATE



22-0544

MMI# 0747.078

SHEET TITLE
SAG & TENSION
CHARTS

SHEET

E-3

DATE
03-15-2023

PHASE AND NEUTRAL CONDUCTOR
LOADING ZONE 1 - HEAVY
CONDUCTOR 4 ACSR (7/1)
RULING SPAN 172.134285316809

Temperature of F	0	10	20	30	40	50	60	70	80	90
Initial Tension	667.508	630.448	583.298	541.263	504.252	461.637	424.8	382.317	342.198	303.423
Span Length										
140	0.25'	0.26'	0.28'	0.30'	0.33'	0.36'	0.39'	0.43'	0.48'	0.54'
150	0.28'	0.30'	0.32'	0.35'	0.37'	0.41'	0.44'	0.49'	0.55'	0.62'
160	0.32'	0.34'	0.37'	0.40'	0.43'	0.46'	0.50'	0.56'	0.63'	0.71'
170	0.36'	0.38'	0.41'	0.45'	0.48'	0.52'	0.57'	0.63'	0.71'	0.80'
172.134285316	0.37'	0.39'	0.43'	0.46'	0.49'	0.54'	0.58'	0.65'	0.73'	0.82'
180	0.41'	0.43'	0.47'	0.50'	0.54'	0.59'	0.64'	0.71'	0.79'	0.89'
190	0.45'	0.48'	0.52'	0.56'	0.60'	0.65'	0.71'	0.79'	0.88'	1.00'
200	0.50'	0.53'	0.57'	0.62'	0.66'	0.73'	0.79'	0.88'	0.98'	1.10'
210	0.55'	0.59'	0.63'	0.68'	0.73'	0.80'	0.87'	0.97'	1.08'	1.22'

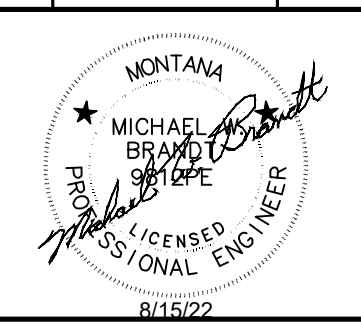
MAES - BART FARM
AURORA LINE EXTENSION

CONSTRUCTION DOCUMENTS

DRAWN BY: MWB

REVIEWED BY: -

REV.	DESCRIPTION	DATE



22-0544

MMI# 0747.078

SHEET TITLE
DETAILS

SHEET
E-4

DATE
03-15-2023

NOTE: When connecting to existing bolt end, use eye nut "aa" and locknut "ek" instead of eyebolt subassembly "o-d-ek".

ITEM	MATERIAL	ASSEMBLY: A5		
		QTY	QTY	QTY
d	Washer, square, 3", curved	2	2	2
k	Insulator, suspension, 4 1/4"	2	2	2
p	Bolt, eye, 5/8" x req'd length	2	3	2
o	Connectors, as req'd			
aa	Nut, eye		1	
av	Jumper's, as req'd			
ba	Shackle, anchor		1	1
ek	Locknuts	2	3	2
eu	Link, extension, insulated			
(du)	(Link, extension) - (optional)			(1)

DESIGN PARAMETERS:		SINGLE DEADENDS	
PERMITTED UNBALANCED CONDUCTOR TENSION:	See Table A (Exhibit 2)	APRIL 2005	1 - PHASE PRIMARY
		RUS	12.47/7.2 kV
			A5.1, A5.2, A5.3 (A5), (A5-2)

ITEM	MATERIAL	ASSEMBLY: A1				ASSEMBLY NUMBERS	
		QTY	QTY	QTY	QTY	NEW	(OLD)
a	Insulator, pin type (12.47/7.2 kV)	1	1	1	1	A1.01	(M5-2)
b	Pin, pole top, 20"	1	1	1	1	A1.01P	(M5-18)
c	Bolt, machine, 5/8" x req'd length	2	2			A1.011P	(M5-5)
d	Washer, square, 2 1/4"	2	2	1		A1.011L	(M5-7)
f	Pin, crossarm steel, 5/8" x 10 3/4"			1	1	A1.01	(M5-2)
ea	Insulator, post type (12.47/7.2 kV)					A1.011P	(M5-7)
eb	Bracket, pole top					A1.011L	(M5-7)
ek	Locknuts	2	2				

DESIGN PARAMETERS:		SINGLE SUPPORT-PRIMARY	
A1.01:	See TABLE I	APRIL 2005	1 - PHASE PRIMARY
A1.01P:	See TABLE II	RUS	12.47/7.2 kV
A1.011:	See TABLE II		A1.01, A1.01P
A1.011P:	See TABLE II		A1.011, A1.011P
A1.011L:	See TABLE III		A1.011L

ITEM	QTY	MATERIAL	DESIGN PARAMETERS:	
			APRIL 2005	1 - PHASE PRIMARY
1	1	A6.21 Primary Assembly	RUS	12.47/7.2 kV
1	1	A2.021 Primary Assembly		A6.22G
1	1	N2.21 Neutral Assembly		
p		Connectors, as req'd		
av		Jumpers, as req'd		

DESIGN PARAMETERS:		DOUBLE DEADEND GUIDE (FEED THROUGH ON CROSSARMS)	
PERMITTED UNBALANCED CONDUCTOR TENSION:	See Table A (Exhibit 2)	APRIL 2005	1 - PHASE PRIMARY
MAXIMUM LINE ANGLE = 5° (See Dwg. A6-21)		RUS	12.47/7.2 kV

ITEM	QTY	MATERIAL	DESIGN PARAMETERS:	
			APRIL 2005	3 - PHASE PRIMARY
d	1	Washer, square, 3", curved	RUS	C5.21, C5.31
d	10	Washer, square, 2 1/4"		(C7), (C7-1)
g	2	Crossarm, 3 5/8" x 4 5/8" x 10'-0"		
i	4	Bolt, carriage, 3/8" x 4 1/2"		
j	2	Screw, lag, 1/2" x 4"		
k	6	Insulator, suspension, 4 1/4"		
n	3	Bolt, double arming, 5/8" x req'd length		
oa	1	Bolt, eye, 5/8" x req'd length		
oo	3	Nut, eye, 5/8"		
cu	4	Brace, 28"		
ek	18	Locknuts		

DESIGN PARAMETERS:		SINGLE DEADEND ON CROSSARMS	
PERMITTED UNBALANCED CONDUCTOR TENSION:	See Table A (Exhibit 2)	APRIL 2005	3 - PHASE PRIMARY
MAXIMUM LINE ANGLE = 5° (See Dwg. A6-21)		RUS	12.47/7.2 kV

NOTE: The high-voltage neutral of the transformer bank must be connected to the primary neutral.

VOLTAGE POTENTIALS-SECONDARY	
PHASES	VOLTAGE
a-b	208 VOLTS (480)
b-c	208 VOLTS (480)
a-c	208 VOLTS (480)
a-N	120 VOLTS (277)
b-N	120 VOLTS (277)
c-N	120 VOLTS (277)

4 Wire-Wye Secondary 120/208 Volt (277/480)

NOTE: The primary and secondary neutrals must be firmly tied together and grounded or else excessive secondary voltages may develop.

DESIGN PARAMETERS:		TRANSFORMER/METER CONNECTION GUIDE GROUND-WYE - GROUND-WYE FOR 120/208 VOLT POWER LOADS	
APRIL 2005	3 - PHASE PRIMARY	RUS	G3.3G
RUS	12.47/7.2 kV		

ITEM	QTY	MATERIAL	DESIGN PARAMETERS:	
			APRIL 2005	3 - PHASE PRIMARY
d	2	Washer, square, 2 1/4"	RUS	G3.3
g	1	Crossarm, 3 5/8" x 4 5/8" x 10'-0"		(G312-)
i	2	Bolt, carriage, 3/8" x 4 1/2"		
j	1	Screw, lag, 1/2" x 4", as req'd		
n	1	Bolt, dble arm, 5/8" x req'd length		
p		Connectors, as req'd		
ae	3	Arrester, surge, (9 kV)		

DESIGN PARAMETERS:		THREE-PHASE TRANSFORMER BANK GROUND-WYE PRIMARY GROUND-WYE, 4 WIRE SECONDARY	
APRIL 2005	3 - PHASE PRIMARY	RUS	G3.3
RUS	12.47/7.2 kV		(G312-)

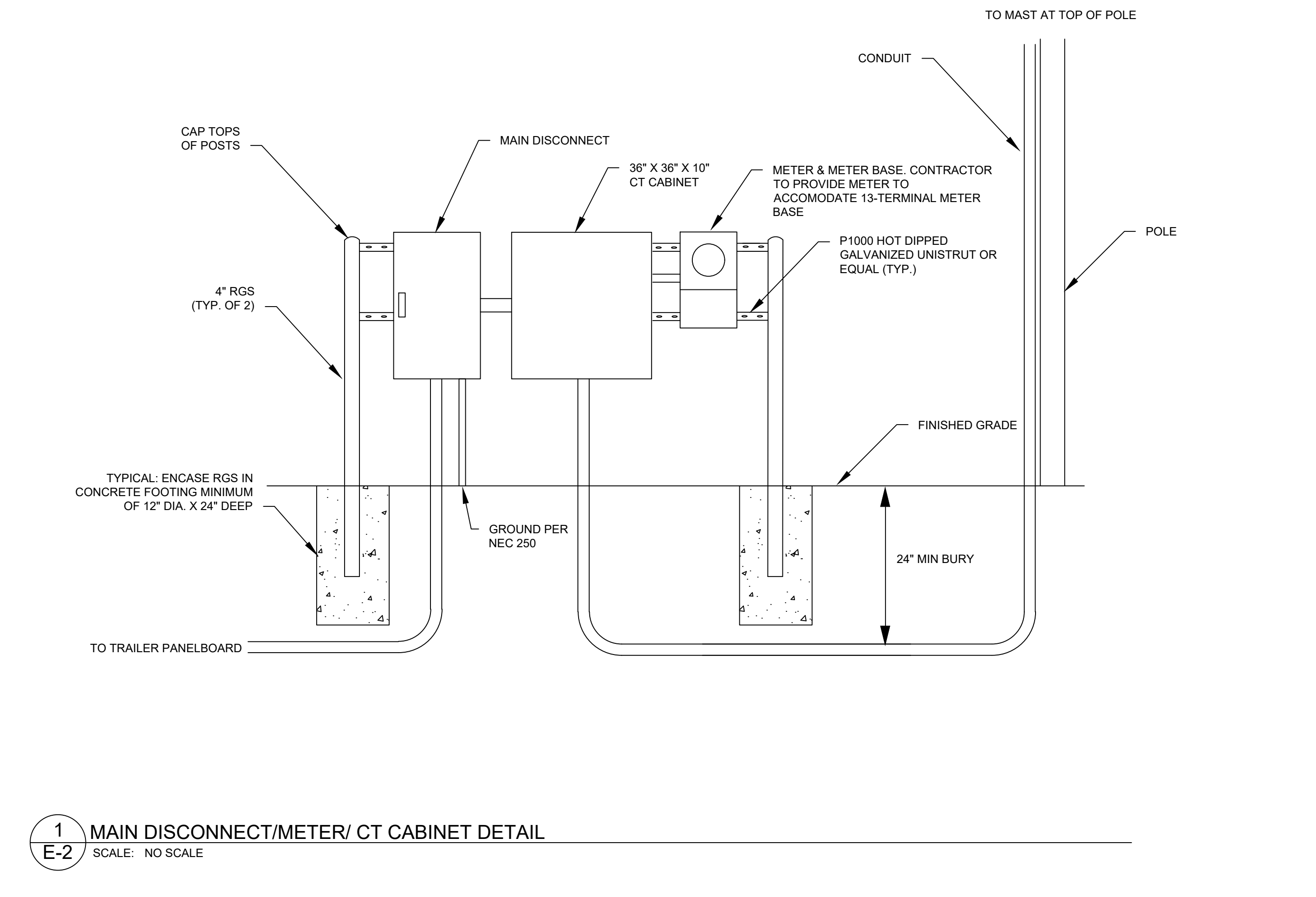
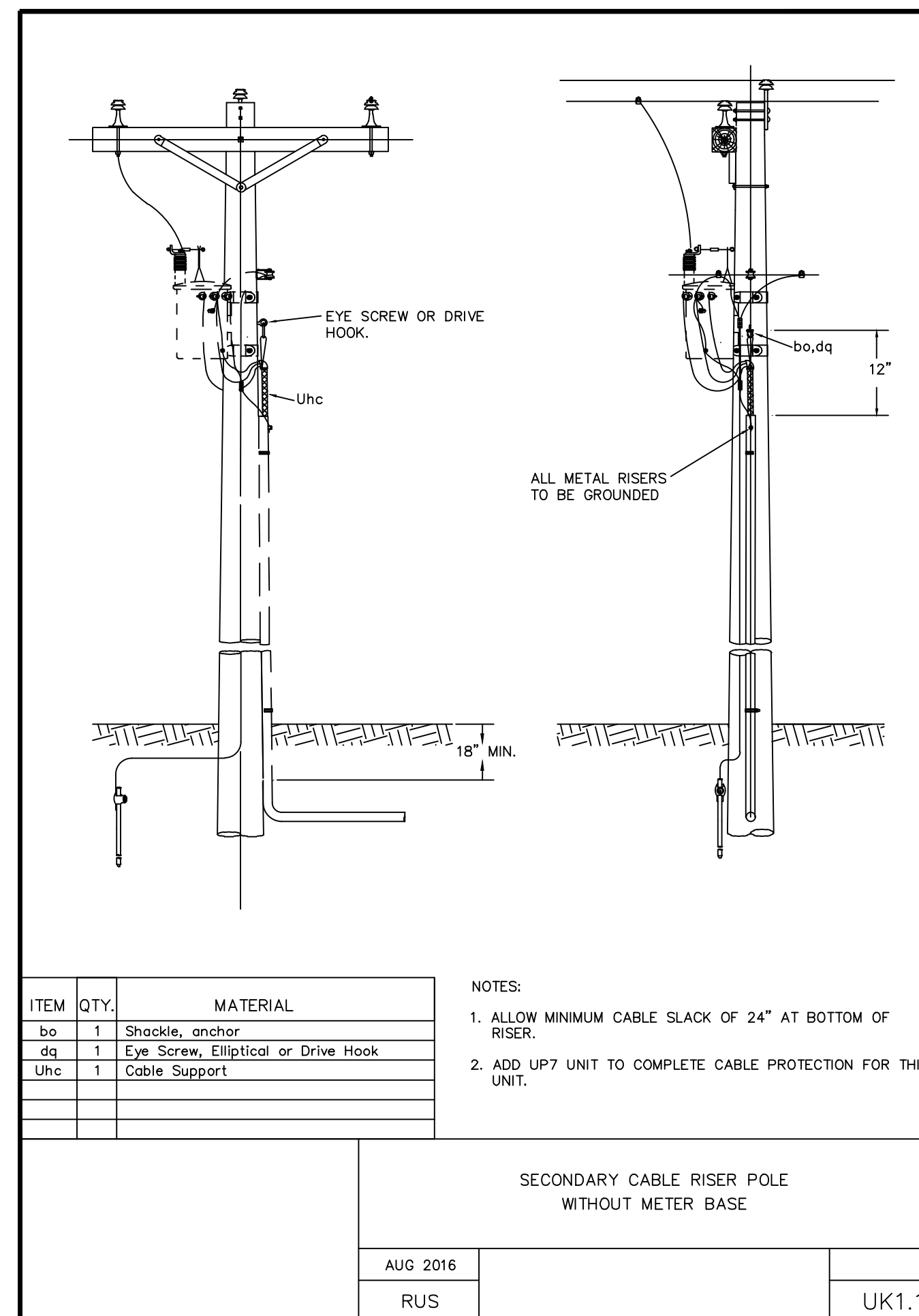
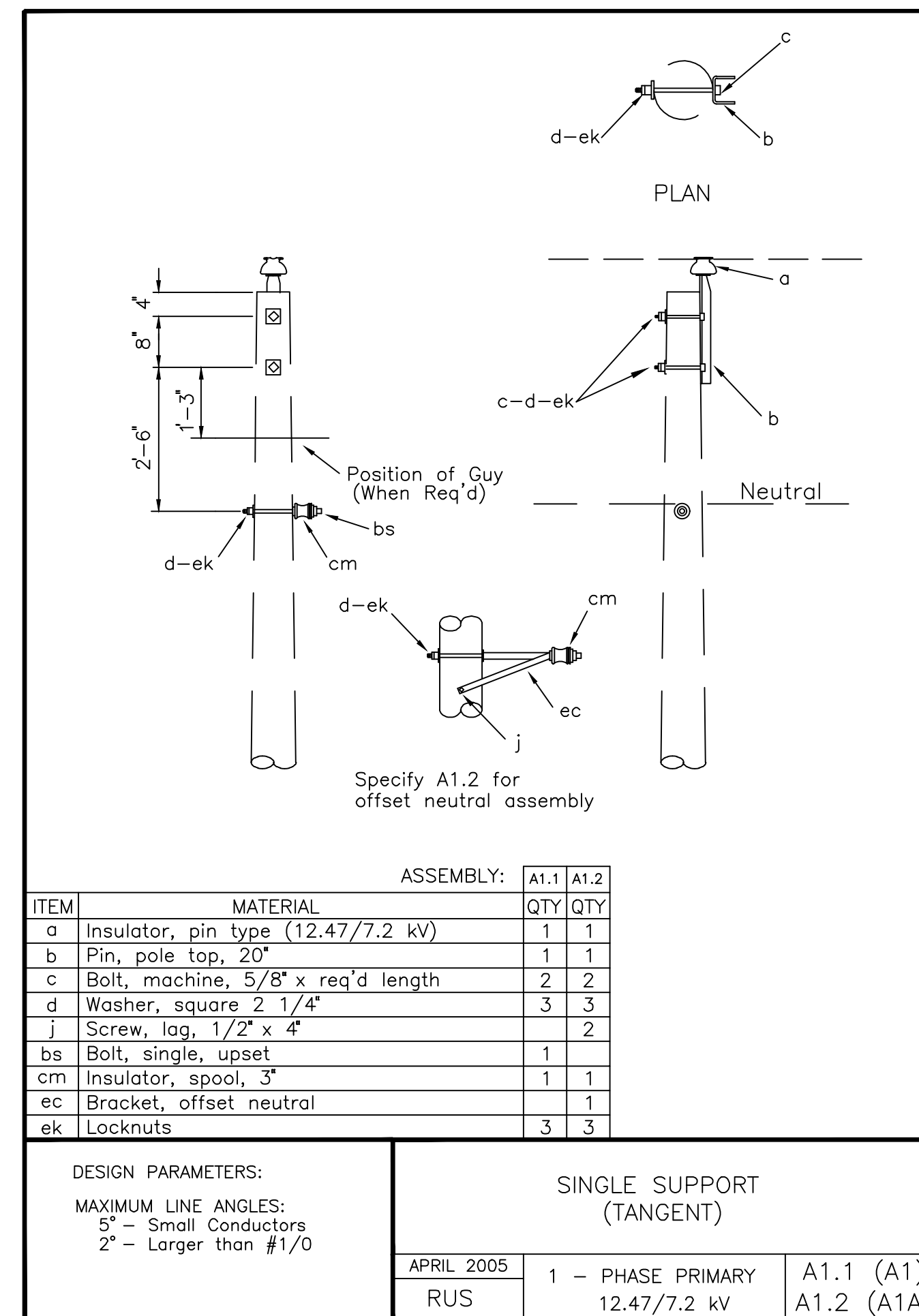
ITEM	QTY	MATERIAL	DESIGN PARAMETERS:	
			APRIL 2005 <th>12.47/7.2 kV</th>	12.47/7.2 kV
c	4	Bolt, machine, 5/8" x req'd length	RUS	G1.6
d	4	Washer, square, 2 1/4"		
p		Connectors, as req'd		
af	1	Arrester, surge (9 kV)		
an	1	Cutout, dist. open (15 kV)		
ao	1	Transformer, 12.47 kv, conventional		

DESIGN PARAMETERS:		SINGLE-PHASE, CONVENTIONAL TRANSFORMER (DEADEND POLE)	
APRIL 2005	12.47/7.2 kV	RUS	G1.6

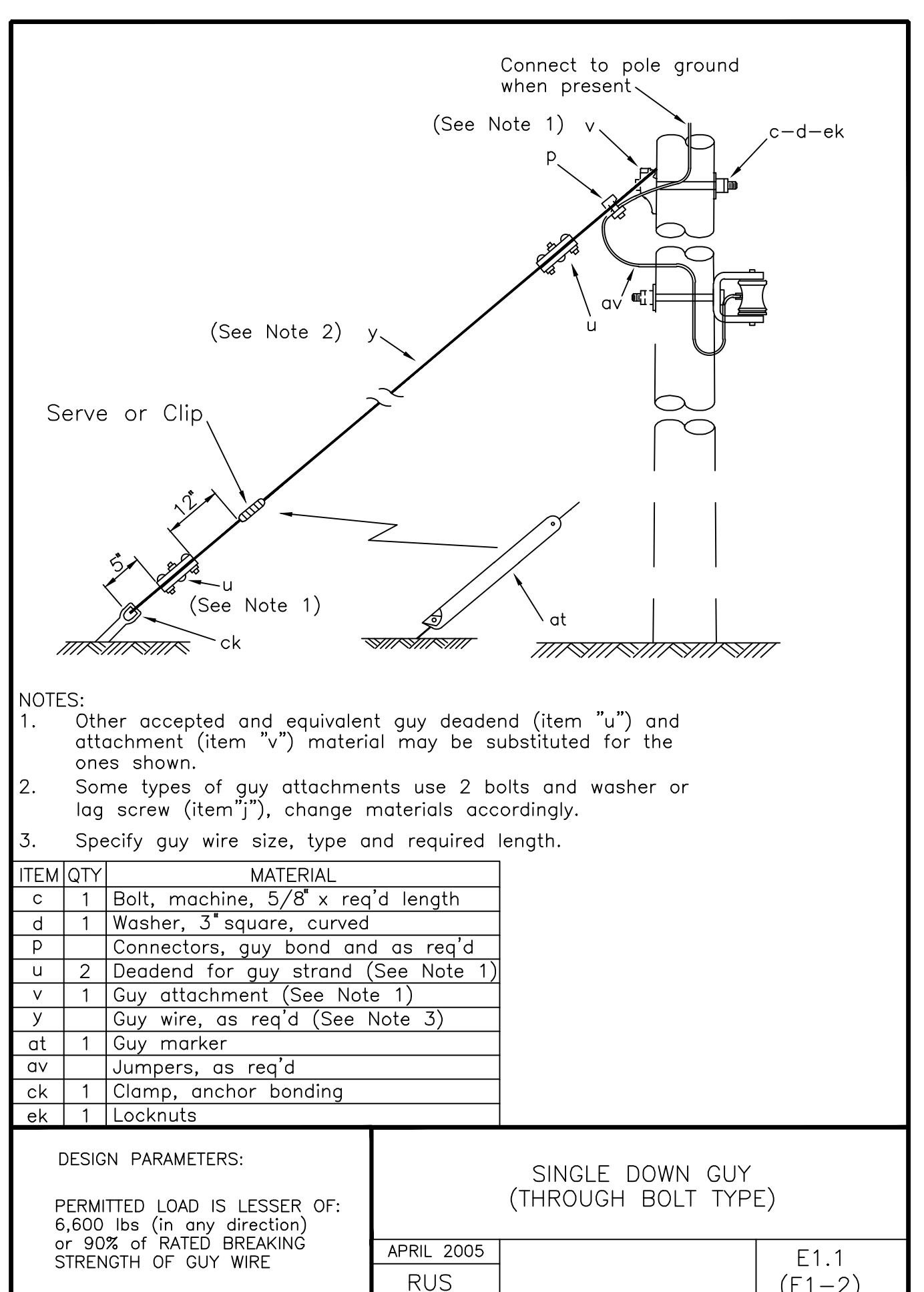
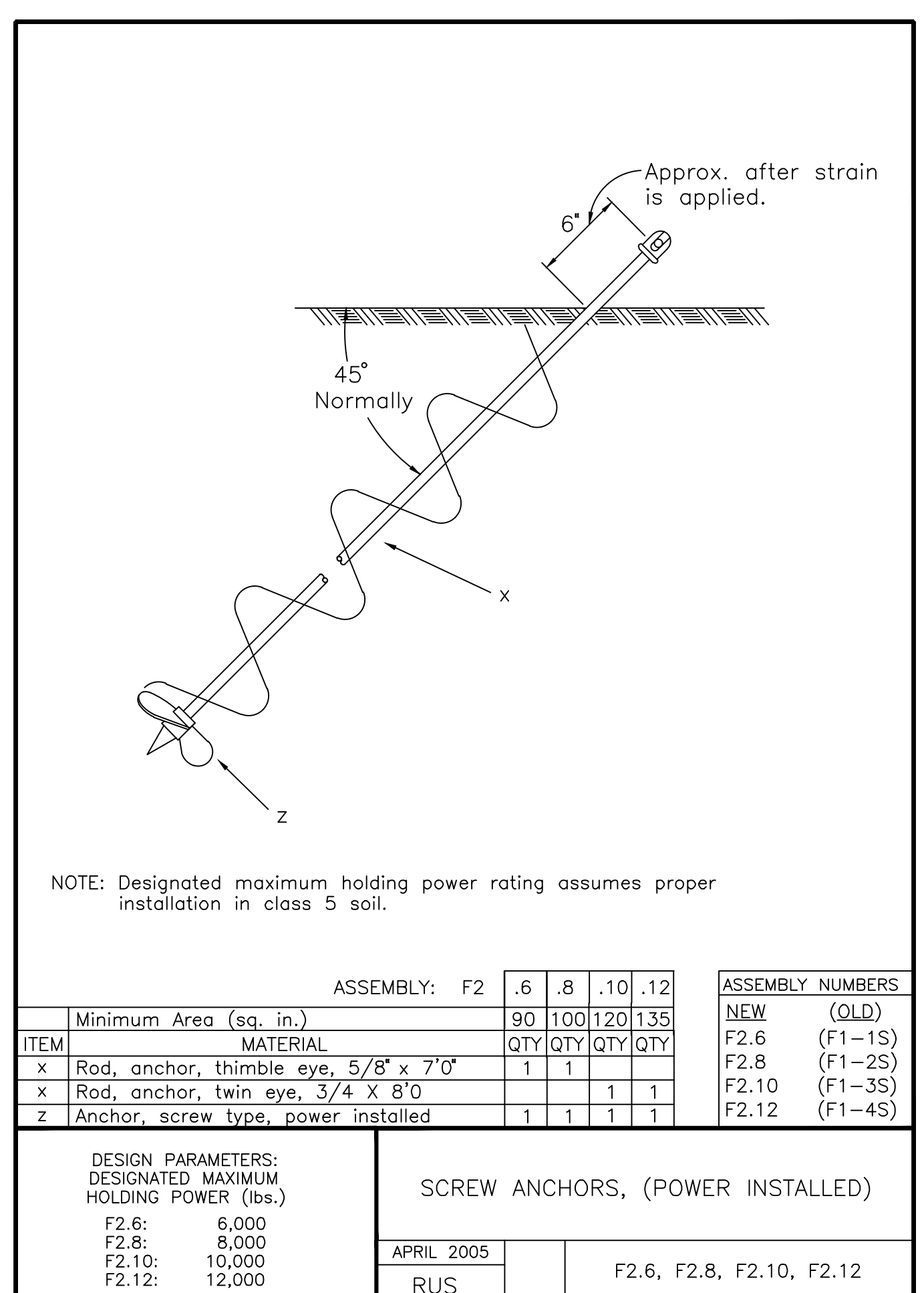
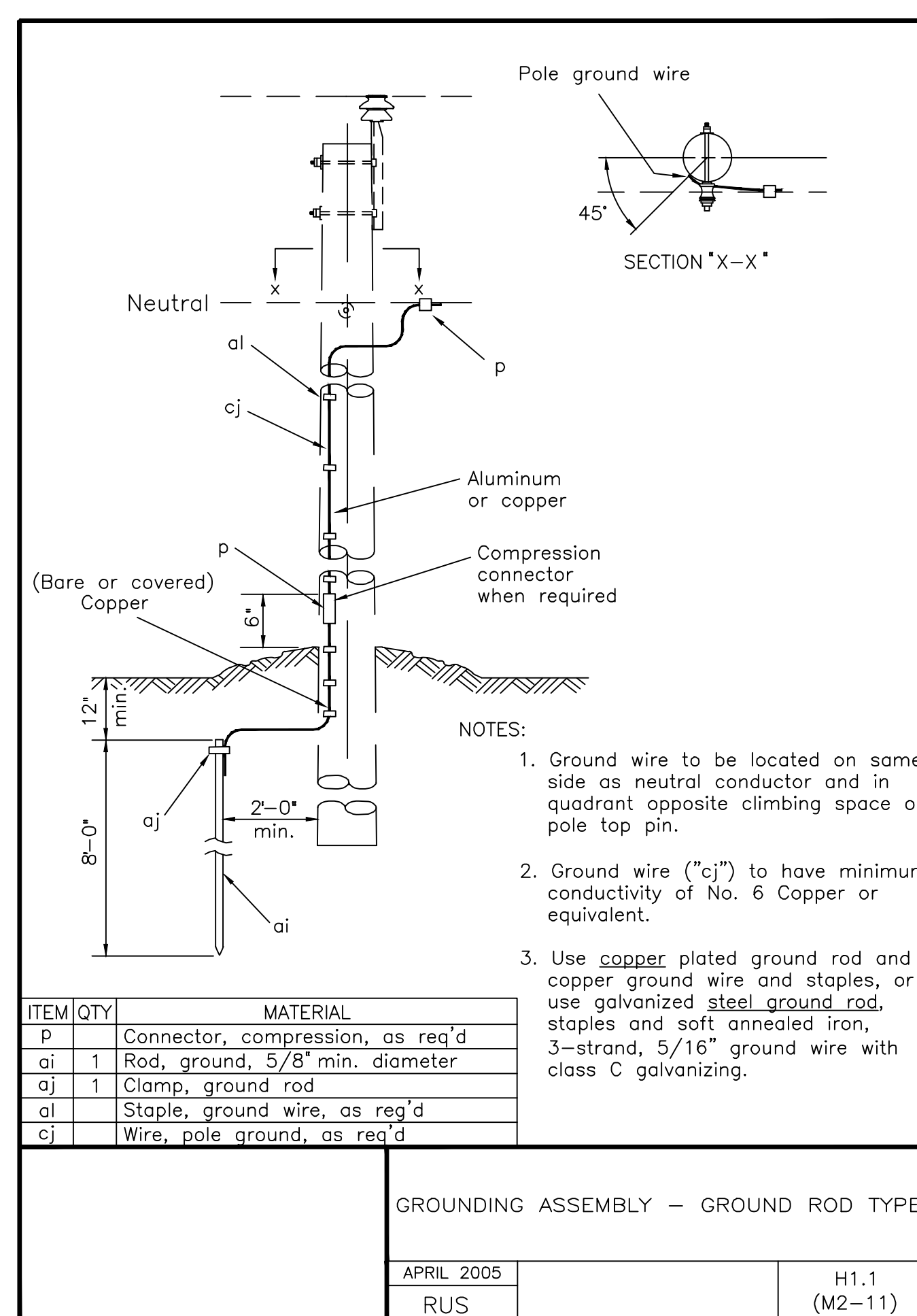
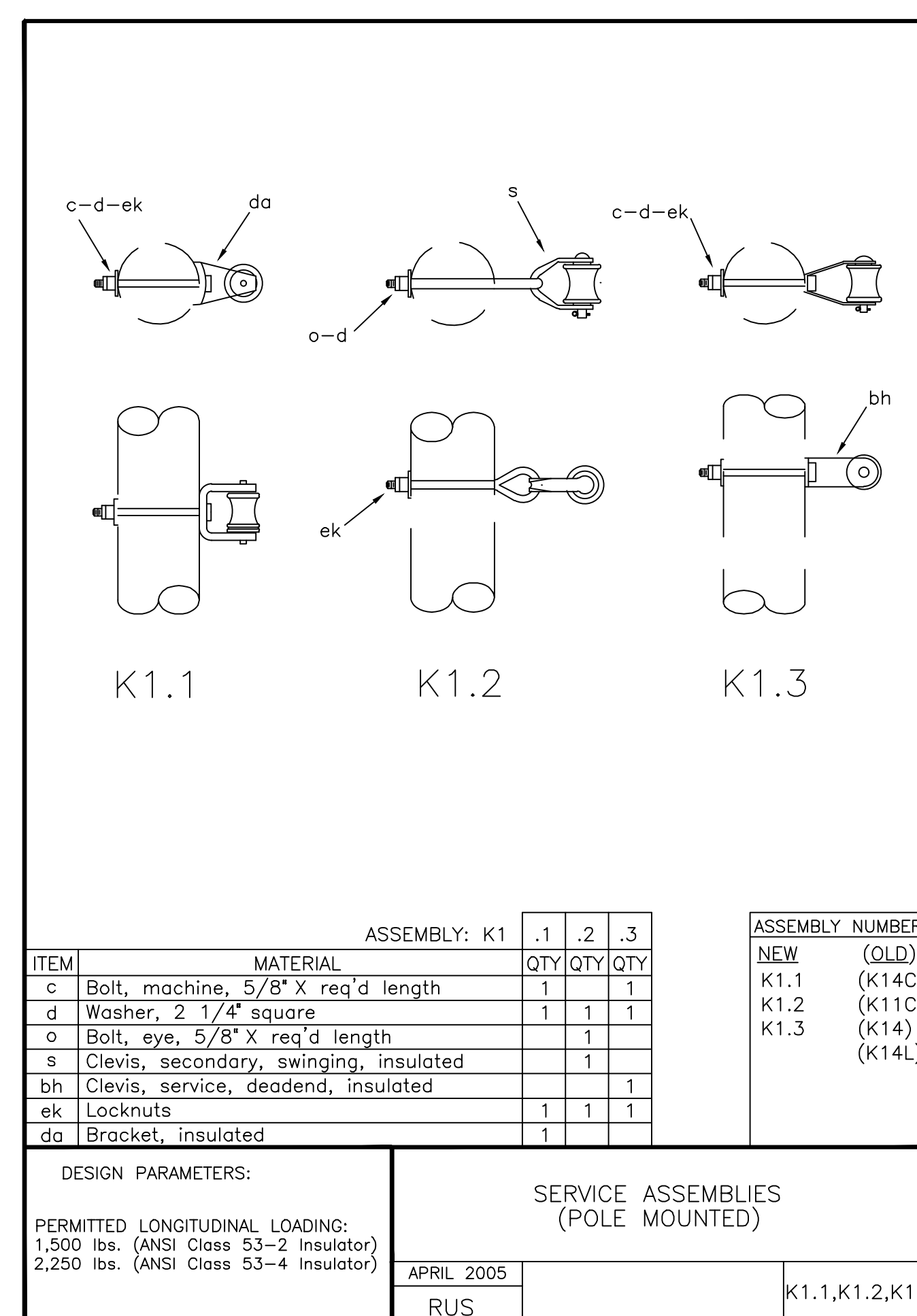
ITEM	QTY	MATERIAL	DESIGN PARAMETERS:	
			APRIL 2005	3 - PHASE PRIMARY
a	1	Insulator, pin type, (12.47/7.2 kV)	RUS	C1.11 (C1)
b	3	Pin, pole top, 20"		C1.12 (C1A)
c	1	Bolt, machine, 5/8" x req'd length		
d	3	Washer, square, 2 1/4"		
f	2	Pin, crossarm steel, 5/8" x 10 3/4"		
g	7	Crossarm, 3 5/8" x 4 5/8" x 10'-0"		
i	2	Bolt, carriage, 3/8" x 4 1/2"		
j	3	Screw, lag, 1/2" x 4"		
bs	1	Bolt, single, upset		
cm	1	Insulator, spool, 3"		
cu	1	Brace, 28"		
ec	2	Bracket, offset neutral		
ek	1	Locknuts		

DESIGN PARAMETERS:		SINGLE SUPPORT ON CROSSARM (TANGENT)	
MAXIMUM LINE ANGLES: 5° - Small Conductors 2° - Larger than #1/0		APRIL 2005	3 - PHASE PRIMARY
		RUS	12.47/7.2 kV

GENERAL NOTES
1. SEE STAKING SHEET E-1 FOR LOCATION OF EACH DETAIL USED.

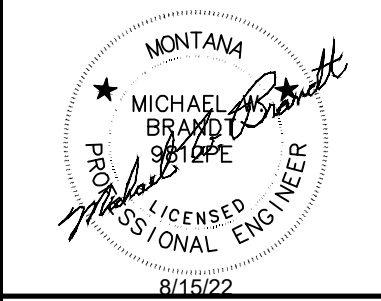


1 MAIN DISCONNECT/METER/ CT CABINET DETAIL
E-2 SCALE: NO SCALE



GENERAL NOTES
1. SEE STAKING SHEET E-1 FOR LOCATION OF EACH DETAIL USED.

REV.	DESCRIPTION	DATE



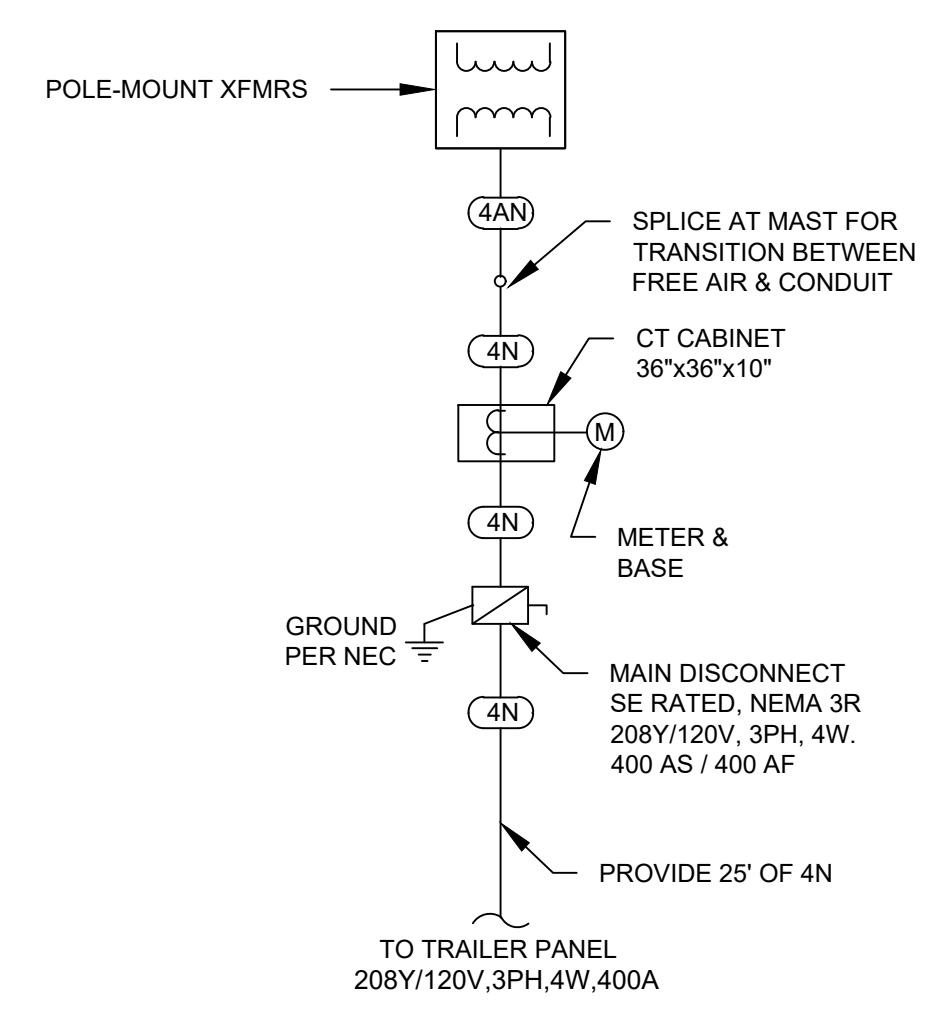
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MMI# 0747.078

SHEET TITLE
DETAILS

SHEET
E-6

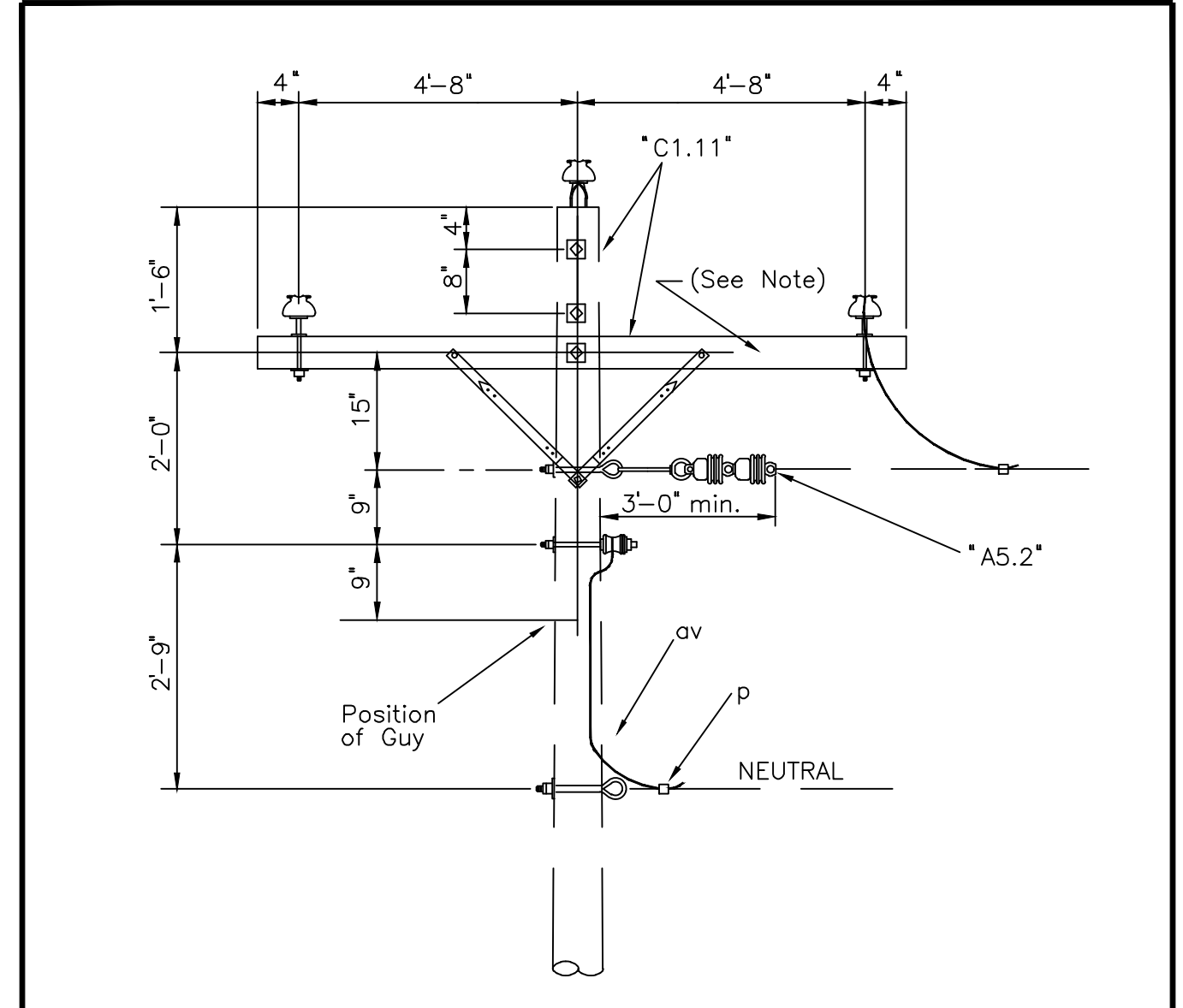
DATE
03-15-2023



1 SECONDARY ONE LINE DIAGRAM
E-2 SCALE: NO SCALE

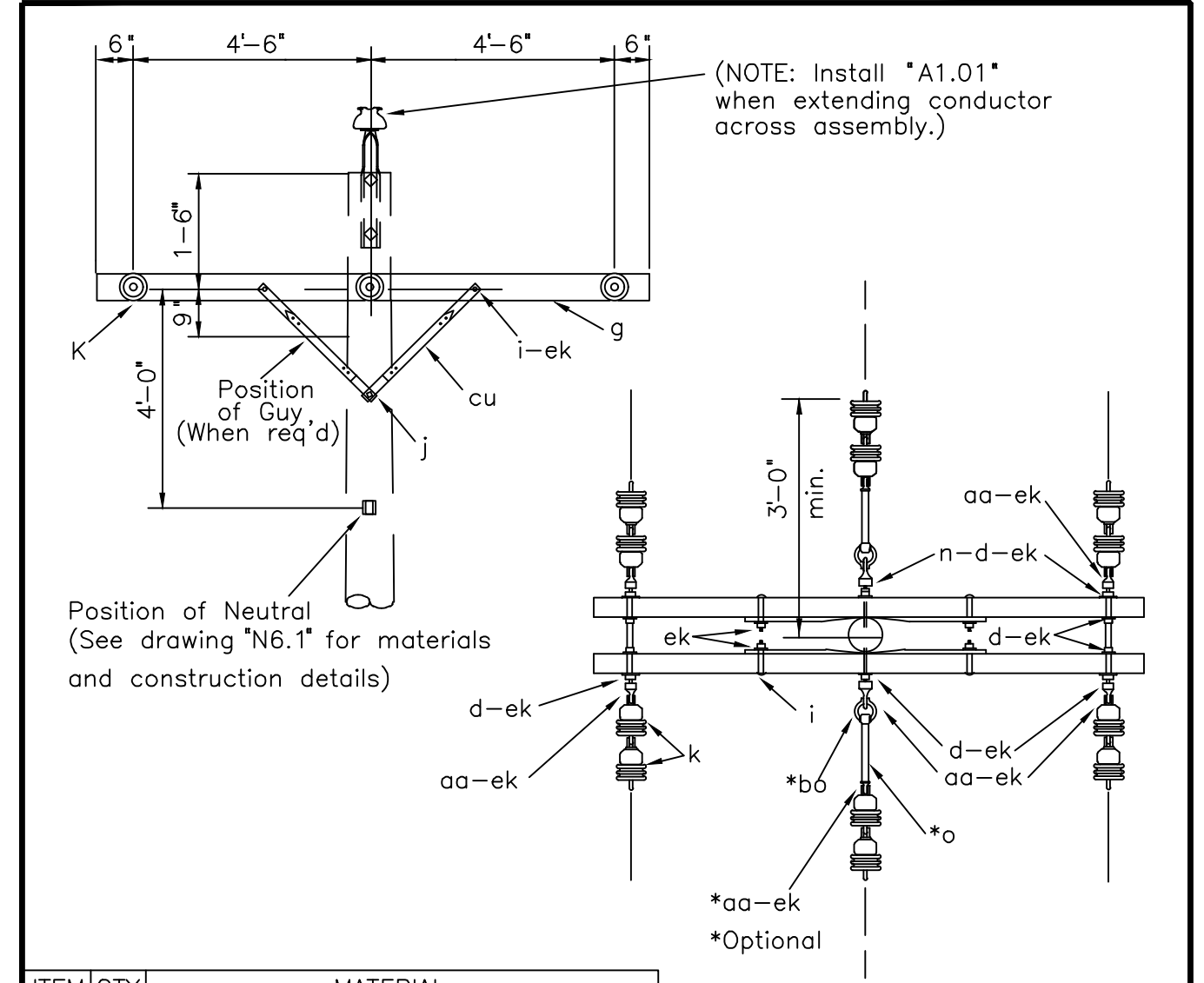
FEEDER NUMBER	AMPS	WIRE QTY PER CONDUIT	SETS IN PARALLEL	75 DEG COPPER		GROUND AWG
				CONDUIT	PHASE QTY AND AWG	
4N	400	4W	1	4"	3#500	1#3

FEEDER NUMBER	AMPS	WIRE QTY	SETS IN PARALLEL	75 DEG ALUMINUM		GROUND AWG
				CONDUIT	PHASE QTY AND AWG	
4AN	400	4W	1	N/A	3#350	1#3



ITEM	QTY	MATERIAL
1	1	"C1.11" Primary Assembly
1	1	"A5.2" Primary Assembly
p		Connectors, as req'd
av		Jumpers, as req'd

DESIGN PARAMETERS:	SINGLE PHASE TAP GUIDE		
PERMITTED LONGITUDINAL LOAD = 5,000 lbs./Conductor	APRIL 2005	3 - PHASE PRIMARY	C5.11G
	RUS	12.47/7.2 kV	



ITEM	QTY	MATERIAL
d	2	Washer, square, 3", curved
d	10	Washer, square, 2 1/4"
g	2	Crossarm, 3 5/8" x 4 5/8" x 10'-0"
i	4	Bolt, carriage, 3/8" x 4 1/2"
j	2	Screw, lag, 1/2" x 4"
k	12	Insulator, suspension, 4 1/4"
n	4	Bolt, double arming, 5/8" x req'd length
o	2	Bolt, eye, 5/8" x req'd length
p		Connectors, as req'd
aa	8	Nut, eye, 5/8"
av		Jumpers, as req'd
bo	2	Shackle, anchor
cu	4	Brace, 28"
ek	26	Locknuts

DESIGN PARAMETERS:	DOUBLE DEADEND ON CROSSARMS		
PERMITTED UNBALANCED CONDUCTOR TENSION: See Table A (Exhibit 2)	APRIL 2005	3 - PHASE PRIMARY	C6.21 (CB)
MAXIMUM LINE ANGLE = 5° (See Note 2)	RUS	12.47/7.2 kV	C6.31