

BEFORE THE NEW MEXICO PUBLIC REGULATION COMMISSION

**IN THE MATTER OF SOUTHWESTERN)
PUBLIC SERVICE COMPANY'S)
APPLICATION FOR EXPEDITED: (1))
ISSUANCE OF A CERTIFICATE OF PUBLIC)
CONVENIENCE AND NECESSITY)
AUTHORIZING CONSTRUCTION AND)
OPERATION OF A 345 KV TRANSMISSION)
LINE AND ASSOCIATED FACILITIES IN) CASE NO. 14-____-UT
EDDY AND LEA COUNTIES, NEW MEXICO;)
(2) APPROVAL OF THE LOCATION OF THE)
345 KV TRANSMISSION LINE; (3))
DETERMINATION OF RIGHT OF WAY)
WIDTH AND (4) AUTHORIZING ACCRUAL)
OF AN ALLOWANCE FOR FUNDS USED)
DURING CONSTRUCTION FOR THE)
TRANSMISSION LINE AND ASSOCIATED)
FACILITIES,)
SOUTHWESTERN PUBLIC SERVICE)
COMPANY,)
APPLICANT.)**

DIRECT TESTIMONY

of

JASON F. BRUNNER

on behalf of

SOUTHWESTERN PUBLIC SERVICE COMPANY

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GLOSSARY OF ACRONYMS AND DEFINED TERMS

Acronym/Defined Term	Meaning
kV	kilovolt
NESC	National Electric Safety Code
Proposed Project	345 kV transmission line and associated substation facility in Eddy and Lea Counties, New Mexico
ROW	right-of-way
SPS	Southwestern Public Service Company, a New Mexico corporation
Xcel Energy	Xcel Energy Inc.

LIST OF ATTACHMENTS

Attachment	Description
JFB-1	345 kV Transmission Structure Drawings

Case No. 14-____-UT
Direct Testimony
of
Jason F. Brunner

1 **I. WITNESS IDENTIFICATION AND QUALIFICATIONS**

2 **Q. Please state your name and business address.**

3 A. My name is Jason F. Brunner and my business address is 2913 Millennium Circle,
4 Billings, Montana 59102.

5 **Q. On whose behalf are you testifying?**

6 A. I am filing testimony on behalf of Southwestern Public Service Company, a New
7 Mexico corporation ("SPS") and wholly-owned subsidiary of Xcel Energy Inc.
8 ("Xcel Energy"). Xcel Energy is a registered holding company that owns several
9 electric and natural gas utility operating companies and a regulated natural gas
10 pipeline company.¹

11 **Q. By whom are you employed and in what position?**

12 A. I am employed by HDR Engineering, Inc. as a Project Manager of Transmission
13 Engineering Design.

14

¹ Xcel Energy is the parent company of four wholly-owned electric utility operating companies: Northern States Power Company, a Minnesota corporation; Northern States Power Company, a Wisconsin corporation; Public Service Company of Colorado, a Colorado corporation; and SPS. Xcel Energy's gas pipeline subsidiary is WestGas InterState, Inc.

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1 **Q. Please briefly outline your responsibilities as a Project Manager of**
2 **Transmission Engineering Design.**

3 A. I supervise the design and related activities that involve the construction and
4 maintenance of transmission lines in New Mexico, Texas, Washington, Colorado,
5 Idaho, North Dakota, South Dakota, Wisconsin, Minnesota, and Montana.

6 **Q. Describe your educational background.**

7 A. I received a Bachelor of Science degree in Electrical Engineering from Montana
8 State University in May 2000.

9 **Q. Please describe your professional experience.**

10 A. I began my employment with HDR Engineering, Inc. as a transmission design
11 engineer working on the design of new power lines operated at 345 kilovolt
12 ("kV") and below. In 2006, I became a Project Manager/Team Lead where I
13 supervised the design and coordination of new transmission and distribution lines.
14 From 2000 to 2006, I worked on the design of over 100 hundred projects
15 consisting of over 200 miles of transmission lines ranging from 69 kV to 345 kV.
16 Since becoming a Project Manager/Team Lead, I have led numerous transmission
17 line projects where I have been responsible for determining structure types,
18 required right-of-way widths, design criteria, etc. Since 2010, I have completed
19 two projects, each of approximately 40 miles, where I was the Project Manager

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Direct Testimony
of
Jason F. Brunner

1 and responsible for all aspects of the project including routing the transmission
2 line, right-of-way calculations and acquisition, environmental and permitting,
3 design of the transmission line, and construction support.

4 **Q. Do you hold any professional licenses?**

5 A. Yes, I am a registered professional engineer in the states of New Mexico, Texas,
6 Florida, Michigan, North Dakota, South Dakota, Minnesota, Wisconsin,
7 Washington, and Montana.

8

II. ASSIGNMENT

4

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Direct Testimony
of
Jason F. Brunner

1 **III. PROPOSED PROJECT AND RIGHT-OF-WAY REQUIREMENTS**

2 **Q. Please briefly describe the Proposed Project.**

3 A. The Proposed Project involves the construction and operation of a new 345 kV
4 transmission line and the Roadrunner Substation, which will be constructed to
5 accommodate a 345 kV transformer, but will initially be equipped and operate
6 with a 230 kV transformer. The proposed Roadrunner Substation will consist of
7 eight 230 kV circuit breakers, eleven 115 kV circuit breakers and one 252/290
8 MVA 230/115 kV transformer. The Roadrunner Substation will be built
9 approximately 22 miles northwest of Jal, New Mexico, near the intersection of
10 County Road 21 and State Highway 128. The 345 kV transmission line will
11 connect SPS's existing Potash Junction Substation, located 17 miles northeast of
12 Carlsbad, New Mexico, to the proposed Roadrunner Substation.

13 **Q. Has SPS determined the ROW required for the proposed 345 kV**
14 **transmission line?**

15 A. Yes. The proposed 345 kV transmission line will require a 150-foot ROW width,
16 75 feet on either side of the centerline in order to comply with specifications of
17 the National Electric Safety Code ("NESC"). Specifically, this ROW width must
18 be sufficient for the proposed transmission line which incorporates a basic phase
19 spacing of 27 feet for 345 kV design. The horizontal displacement of the 795

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1 kcmil ACSS bundled conductors due to a six-pound per square foot wind loading
2 on a 900-foot span, along with the applicable safety clearances will be contained
3 within the boundaries of this ROW easement. The proposed 150-foot ROW also
4 allows for flexibility during design and construction allowing spans to be longer
5 than 900 feet and phase spacing wider than 27 feet as necessary without violating
6 NESC requirements or the general safety of the public.

A. The 345 kV transmission line will utilize self-supporting steel structures installed on concrete foundations at corners and terminations of the transmission line. The remaining tangent (in-line) structures will typically be direct buried H-frame steel structures. If there are locations that require a narrower base to avoid existing oil-wells and terrain restrictions, single-pole steel structures may be installed. Typical structure configuration drawings are shown in Attachment JFB-1. The conductors will typically be 27 feet apart on both single-pole structures and H-frame structures. The conductors will be bundled 795 kcmil ACSS for the 345 kV transmission line. The new shield wires will be a combination of 3/8 inch extra high strength steel and optical ground wire.

A. The single circuit tangent structures (both H-frame and, if necessary, single-pole structures) will utilize steel arms to support the transmission line conductors. These structures will typically be spaced approximately 750 to 900 feet apart and will be fabricated of self-weathering steel. The total line length of the 345 kV

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of
Jason F. Brunner

1 transmission line will be approximately 40 miles and approximately 240 steel
2 tangent structures will be installed.

3 **Q. Please describe the corner and termination structures and how many will be**
4 **installed.**

5 A. The structures used at corners and terminations of the 345 kV transmission line
6 will be self-supporting steel 3-pole structures installed on concrete foundations as
7 shown in Attachment JFB-1. Approximately 21 of these structures will be used
8 along the route. The steel structures will be fabricated of self-weathering steel.

9 **Q. What is the construction timetable for the Proposed Project?**

10 A. Preliminary transmission line design began in January 2014 and is on going.
11 Material requests will be submitted beginning about halfway through the design
12 process (in mid to late 2014). All material should be available approximately nine
13 to twelve months after material requests are initiated. Construction should take
14 approximately seven months to complete. The expected in-service date of the
15 Proposed Project is October 2015.

Case No. 14- -UT

of

Jason F. Brunner

V. CONCLUSION

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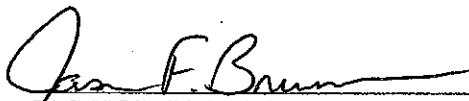
5

VERIFICATION

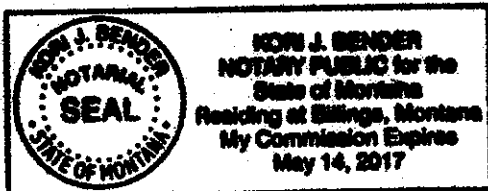
STATE OF MONTANA)
) ss.
COUNTY OF YELLOWSTONE)

Jason F. Brunner, first being sworn on his oath, states:

I am the witness identified in the preceding testimony. I have read the testimony and the accompanying attachments and am familiar with their contents. Based upon my personal knowledge, the facts stated in the direct testimony are true. In addition, in my judgment and based upon my professional experience, the opinions and conclusions stated in the testimony are true, valid, and accurate.


JASON F. BRUNNER

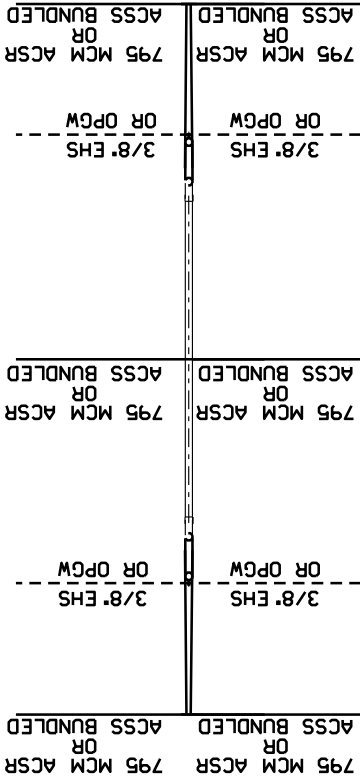
SUBSCRIBED AND SWORN TO before me this 15th day of April, 2014.




Notary Public, State of Montana
My Commission Expires: May 14, 2017

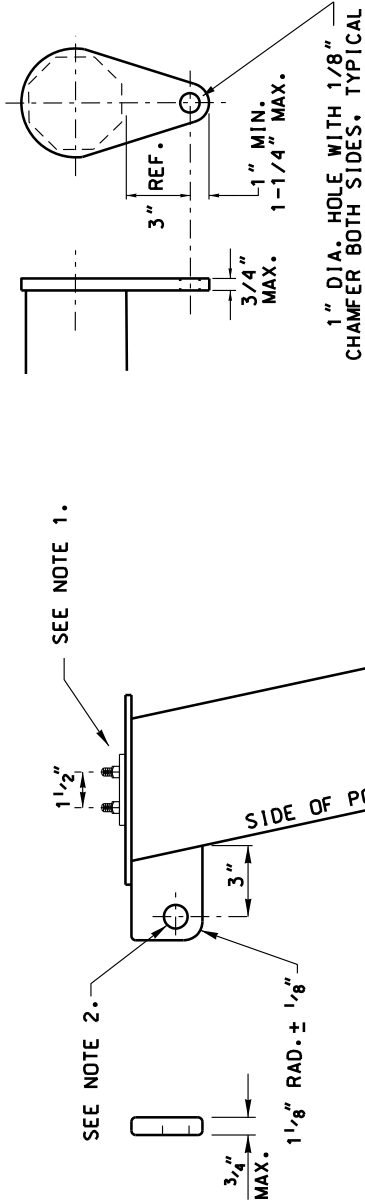
GENERAL NOTES

1. (2)1/2" ALL THREAD STUDS, 1-1/2" APART, 1" MINIMUM PROTRUSION. INSTALL 3" x 1-1/4" COVER PLATE WITH NUTS. FOR PAINTED POLES, PRIME, BUT DO NOT PAINT, AREA UNDER COVER PLATE. COVER PLATE SHALL BE INSTALLED WHEN WEATHERING STEEL IS SPECIFIED. SEE END PLATES A THROUGH D FOR STUD DETAILS.
2. 1" DIAMETER HOLE WITH 1/8" CHAMFER BOTH SIDES.
3. INSTALL STEP LUGS FROM 85' ABOVE BASE PLATE TO TOP OF POLE.
4. POLE HOLE DEPTH SHALL BE ACCURATE. WHEN HOLES DO NOT ALLOW STRUCTURE TO BE EVEN AND LEVEL, THE DEEP HOLE SHALL BE BACKFILLED AND THOROUGHLY TAMPED TO PROPER DEPTH.
5. POLE NUMBER SHALL BE INSTALLED ON EACH POLE AS REQUIRED.
6. SEE SHEET T-0-400 FOR GENERAL DETAILS.
7. SEE SHEET T-0-400A FOR ARM END PLATE DETAILS.
8. SUSPENSION INSULATORS TO BE 345kV POLYMER INSULATORS.
9. STRUCTURE DESIGN SHOWN IS FOR CONFIGURATION ONLY. ENGINEERING STRENGTH CALCULATIONS AND STRUCTURE DESIGN DETAILS MUST BE PERFORMED FOR EACH PROJECT.
10. BEARING PLATES TO BE MINIMUM 12" LARGER THAN POLE DIAMETER. PLATE THICKNESS IS TO BE 3/4".

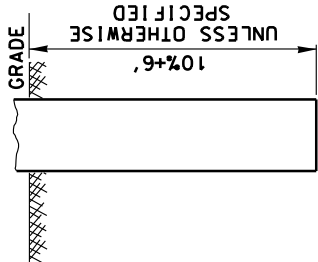


PLAN VIEW

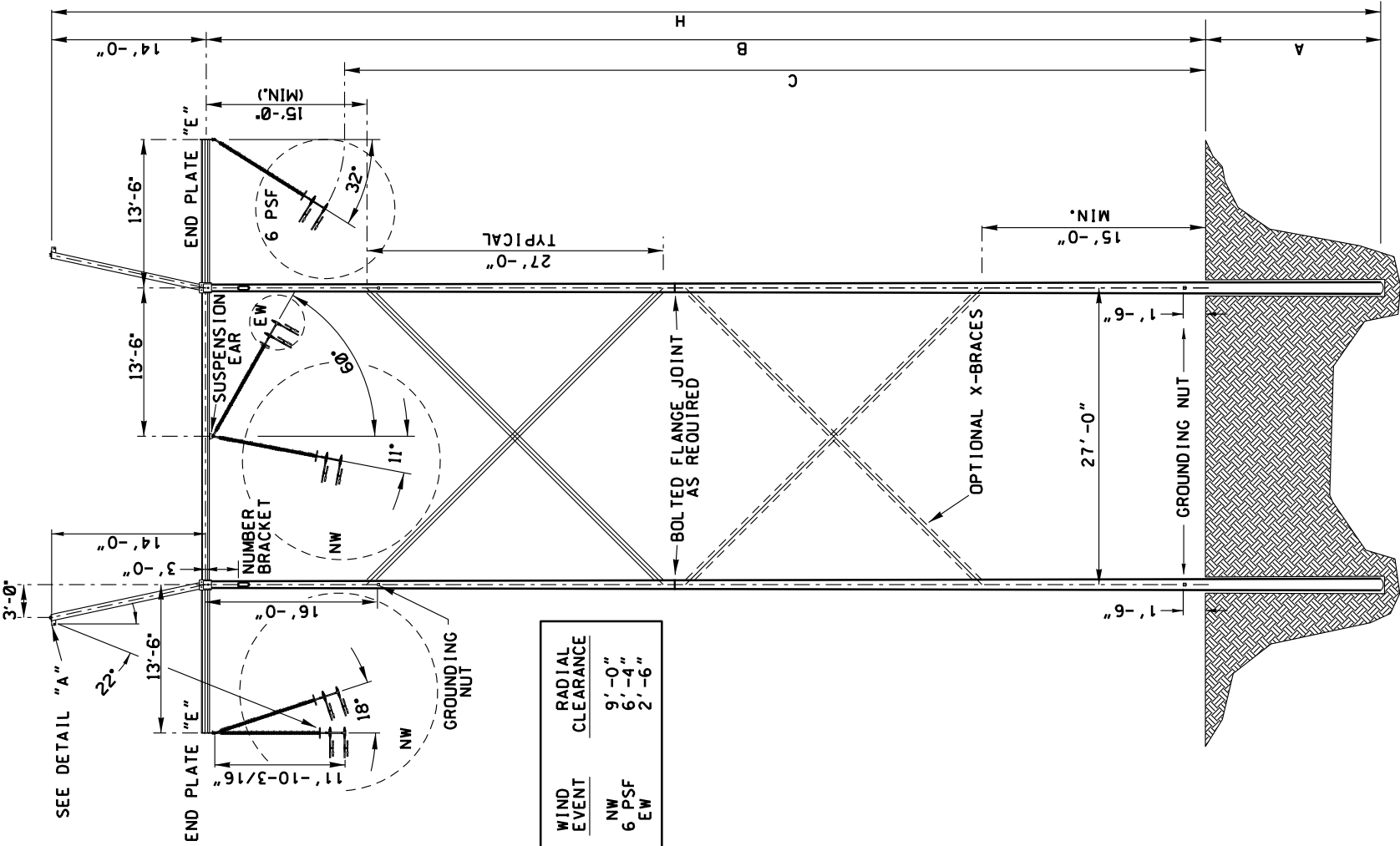
DIMENSIONS			
H	A	B	C
105'	16'6"	74'6"	62'0"
110'	17'0"	79'0"	66'6"
115'	17'6"	83'6"	71'0"
120'	18'0"	88'0"	75'6"
125'	18'6"	92'6"	80'0"
130'	19'0"	97'0"	84'6"
135'	19'6"	101'6"	89'0"
140'	20'0"	106'0"	93'6"
145'	20'6"	110'6"	98'0"
150'	21'0"	115'0"	102'6"



DETAIL "A"



DIRECT BURIAL DETAIL



ELEVATION VIEW

REV. 3. 01-09-13: GROUNDING NUT LOCATION			
REV. 2. 01-04-13: INSULATOR LENGTH, WIND CLEARANCE SWING ANGLES			
REV. 1. 05-31-12: DIM. TABLE, WIND CLEARANCE, CONDUCTORS, GROUNDING NUT			
THIS DRAWING IS THE PROPERTY OF XCEL ENERGY AMARILLO, TEXAS AND IS NOT TO BE REPRODUCED OR USED TO FURNISH ANY INFORMATION FOR THE MAKING OF DRAWINGS OR APPARATUS EXCEPT WHERE PROVIDED BY AGREEMENT WITH SAID COMPANY.			
DESCRIPTION			
345KV 0° - 2° STEEL TANGENT STRUCTURE			
APPROVED		CHECKED	
JCC: 09-07-10		07-19-11	
SCALE		ENGINEERING DEPT. TX	
NONE		T-O-519	
REV.		3	

DESIGN NOTES:

- 1. FOR TOWER AND FOOTING LOAD DATA SEE FORM IN PROJECT FILE.
- 2. STRUCTURE DESIGN SHOWN IS FOR CONFIGURATION ONLY. ENGINEERING STRENGTH CALCULATIONS AND STRUCTURE DESIGN DETAILS MUST BE PERFORMED FOR EACH PROJECT.
- 3. SUSPENSION INSULATORS ARE TO BE 345KV TOUGHENED GLASS INSULATORS.
- 4. INSTALL STEP LUGS FROM 85' ABOVE BASE PLATE TO TOP OF POLE.

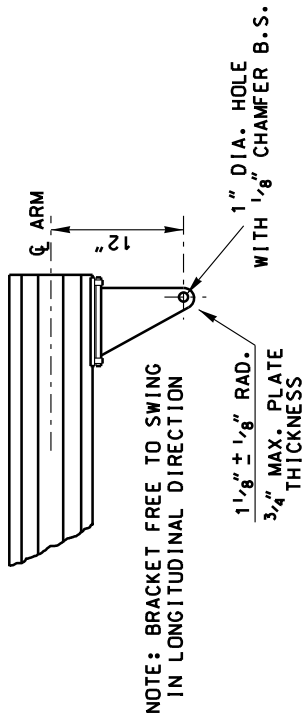
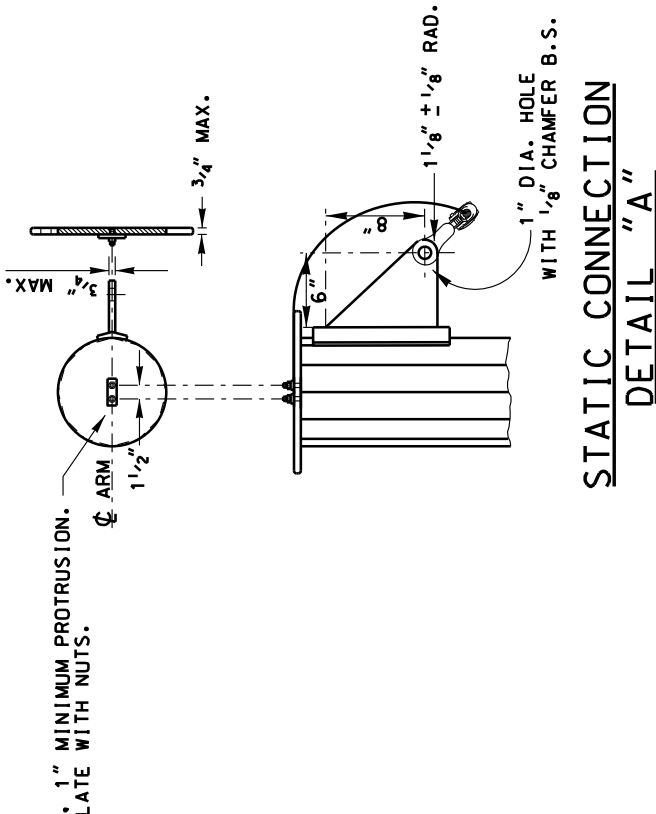
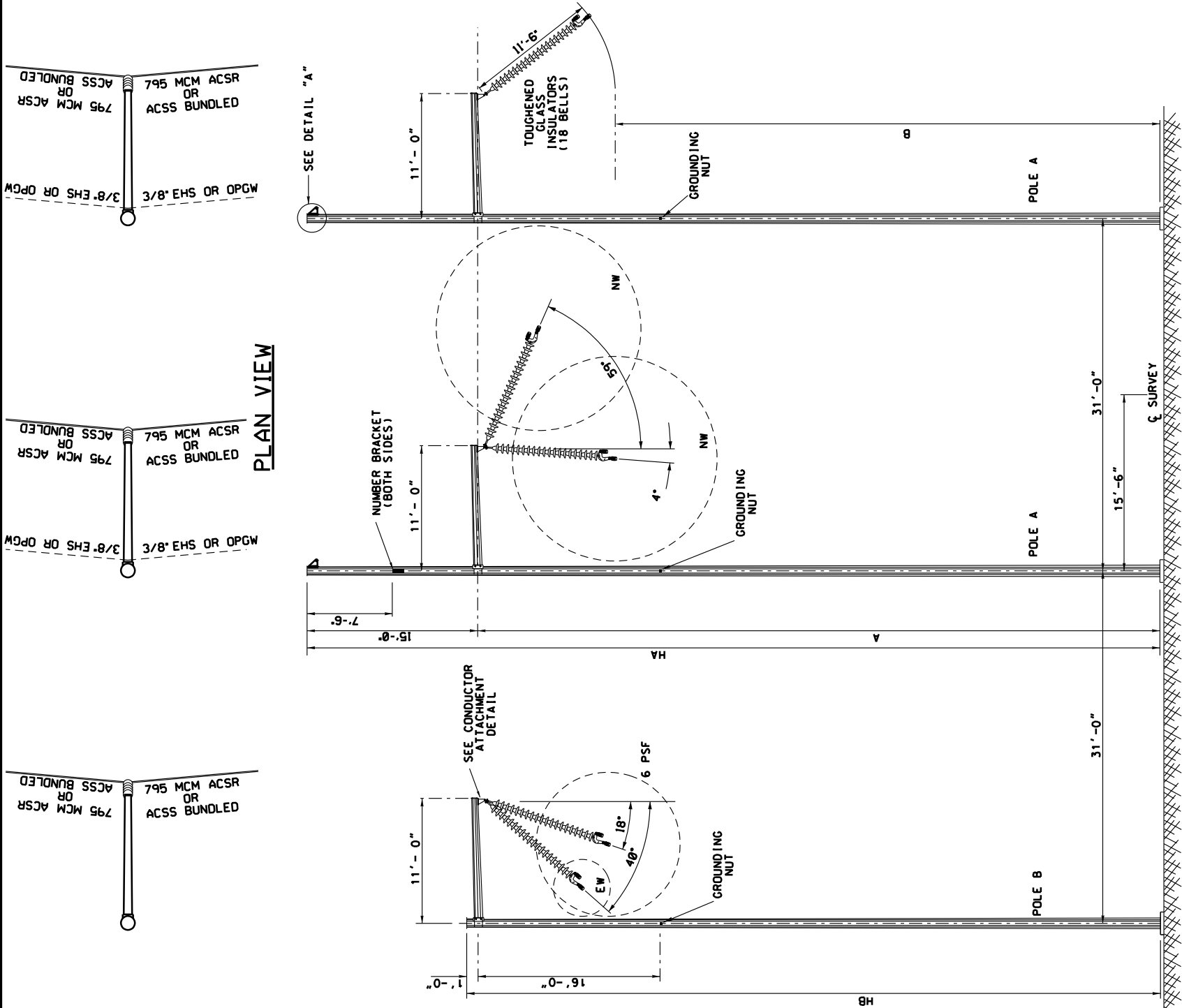
NOTES:

- 1. SEE SHEET T-O-400 FOR GENERAL DETAILS.
- 2. SEE SHEET T-O-400A FOR ARM END PLATE AND DEADEND EAR DETAILS.
- 3. SEE SHEET T-O-400C FOR ANCHOR BOLT CAGE DETAILS.

(2)1/2" ALL THREAD STUDS, 1 1/2" APART, 1" MINIMUM PROTRUSION. INSTALL 3" x 1 1/4" DISPOSABLE COVER PLATE WITH NUTS.

WIND EVENT	RADIAL CLEARANCE
NW 6 PSF	9'-0"
EW	6'-4"
	2'-6"

DIMENSIONS			
HA	HB	A	B
75'	61'-0"	60'-0"	48'-0"
80'	66'-0"	65'-0"	53'-0"
85'	71'-0"	70'-0"	58'-0"
90'	76'-0"	75'-0"	63'-0"
95'	81'-0"	80'-0"	68'-0"
100'	86'-0"	85'-0"	73'-0"
105'	91'-0"	90'-0"	78'-0"
110'	96'-0"	95'-0"	83'-0"
115'	101'-0"	100'-0"	88'-0"
120'	106'-0"	105'-0"	93'-0"
125'	111'-0"	110'-0"	98'-0"
130'	116'-0"	115'-0"	103'-0"
135'	121'-0"	120'-0"	108'-0"
140'	126'-0"	125'-0"	113'-0"
145'	131'-0"	130'-0"	118'-0"
150'	136'-0"	135'-0"	123'-0"
155'	141'-0"	140'-0"	128'-0"
160'	146'-0"	145'-0"	133'-0"
165'	151'-0"	150'-0"	138'-0"
170'	156'-0"	155'-0"	143'-0"



CONDUCTOR ATTACHMENT

REV. 3, 02-05-13: SWING CLEARANCE, GLASS INSULATOR DIMENSION			
REV. 2, 01-04-13: SWING CLEARANCE, GLASS INSULATORS, DIM. TABLE			
REVISIONS REV. 1, 03-15-12: SWING CLEARANCE, DIMENSION TABLE, MISC.			
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DESCRIPTION			
345KV 3 POLE STEEL 4°-10° ANGLE STR.			
APPROVED	DRAWN	DATE	CHECKED
CUM4, 12-20-99	JDC/BCK	6-17-98	JGC, 12-20-99
SCALE		ENGINEERING DEPT. TX	
NONE		T-O-442	
REV.			3

DESIGN NOTES:

- 1. FOR TOWER AND FOOTING LOAD DATA SEE FORM IN PROJECT FILE.
- 2. STRUCTURE DESIGN SHOWN IS FOR CONFIGURATION ONLY. ENGINEERING STRENGTH CALCULATIONS AND STRUCTURE DESIGN DETAILS MUST BE PERFORMED FOR EACH PROJECT.
- 3. SUSPENSION INSULATORS ARE TO BE 345KV TOUGHENED GLASS INSULATORS.
- 4. INSTALL STEP LUGS FROM 85’ ABOVE BASE PLATE TO TOP OF POLE.

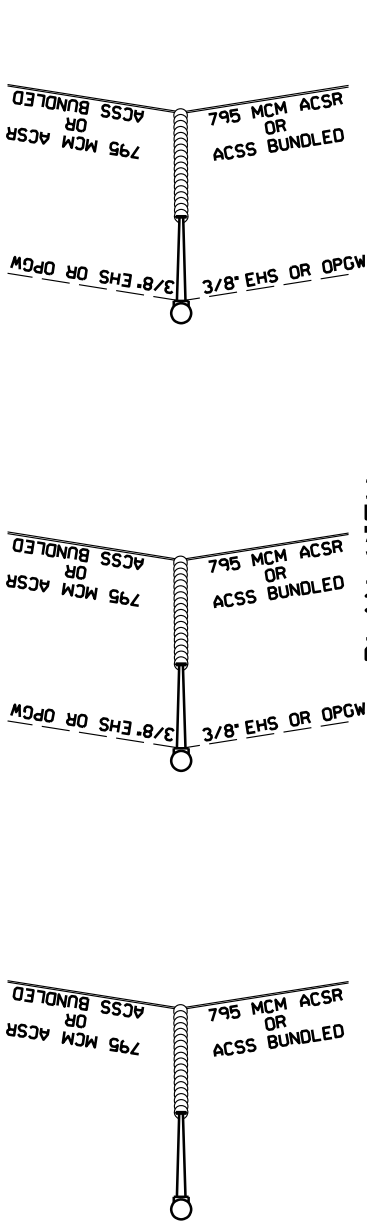
NOTES:

- 1. SEE SHEET T-O-400 FOR GENERAL DETAILS.
- 2. SEE SHEET T-O-400A FOR ARM END PLATE AND DEADEND EAR DETAILS.
- 3. SEE SHEET T-O-400C FOR ANCHOR BOLT CAGE DETAILS.

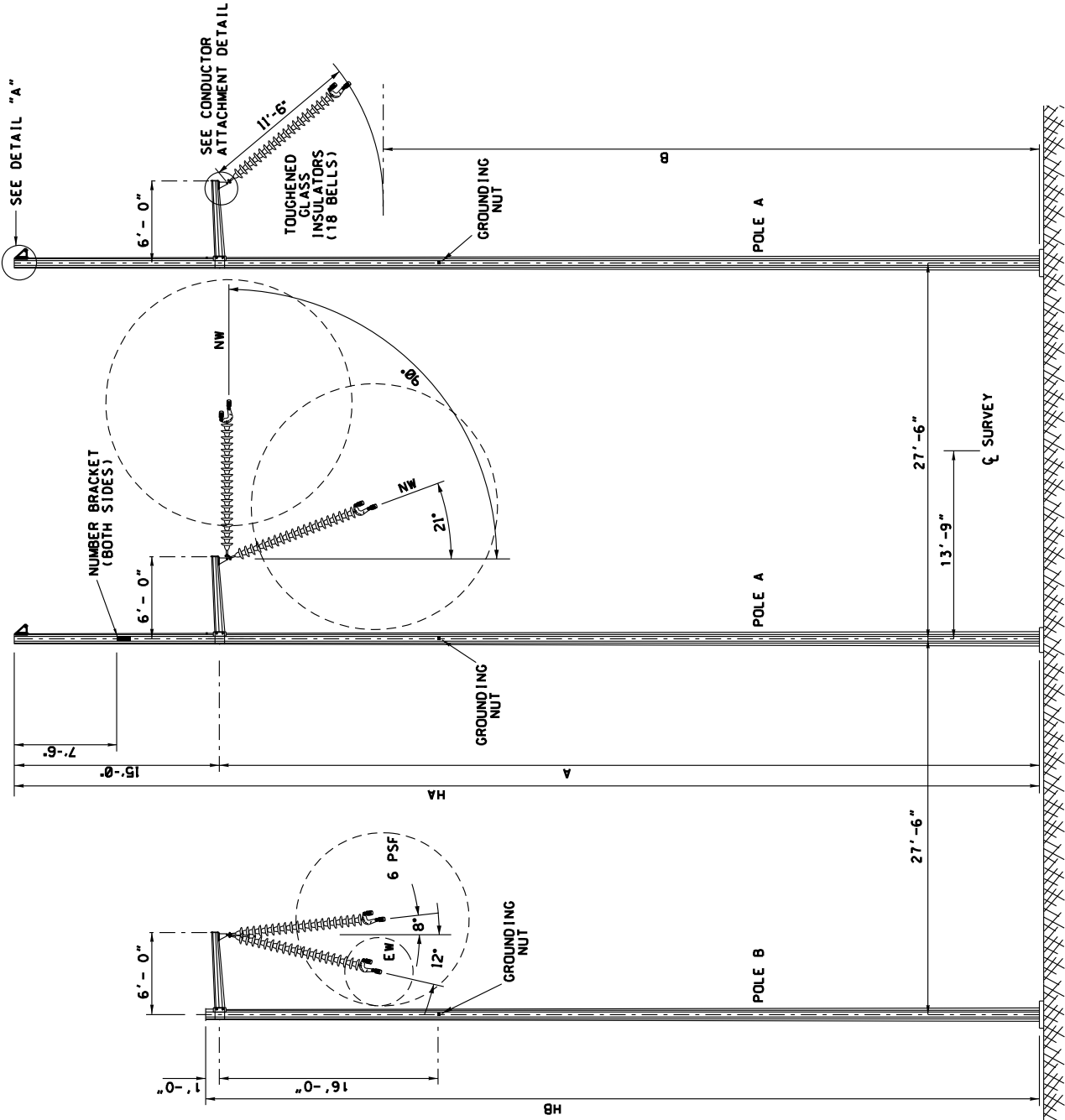
(2)1 1/2" ALL THREAD STUDS, 1 1/2" APART, 1" MINIMUM PROTRUSION. INSTALL 3" x 1 1/4" DISPOSABLE COVER PLATE WITH NUTS.

WIND EVENT	RADIAL CLEARANCE
NW 6 PSF	9'-0"
EW 6 PSF	6'-4"
	2'-6"

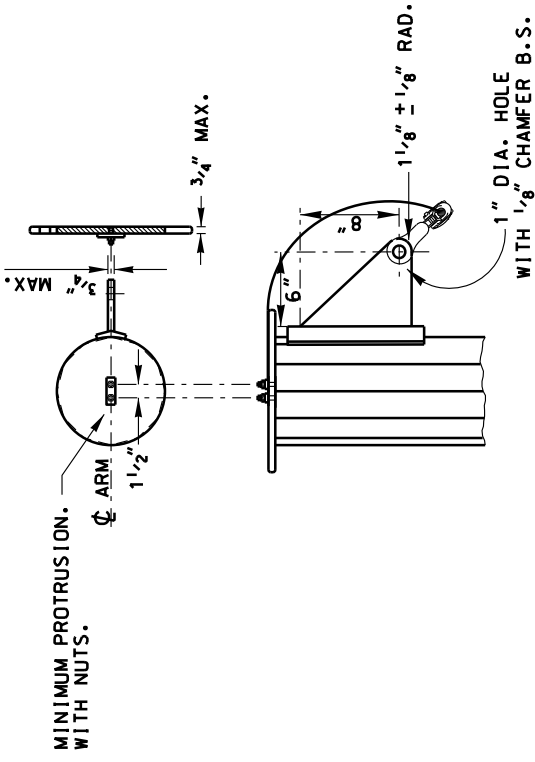
DIMENSIONS			
HA	HB	A	B
75'	61'0"	60'0"	48'0"
80'	66'0"	65'0"	53'0"
85'	71'0"	70'0"	58'0"
90'	76'0"	75'0"	63'0"
95'	81'0"	80'0"	68'0"
100'	86'0"	85'0"	73'0"
105'	91'0"	90'0"	78'0"
110'	96'0"	95'0"	83'0"
115'	101'0"	100'0"	88'0"
120'	106'0"	105'0"	93'0"
125'	111'0"	110'0"	98'0"
130'	116'0"	115'0"	103'0"
135'	121'0"	120'0"	108'0"
140'	126'0"	125'0"	113'0"
145'	131'0"	130'0"	118'0"
150'	136'0"	135'0"	123'0"
155'	141'0"	140'0"	128'0"
160'	146'0"	145'0"	133'0"
165'	151'0"	150'0"	138'0"
170'	156'0"	155'0"	143'0"



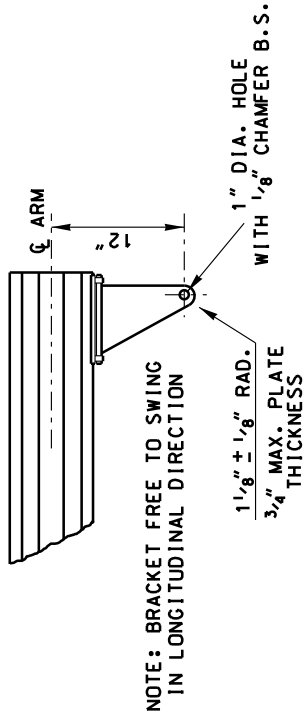
PLAN VIEW



ELEVATION VIEW



STATIC CONNECTION
DETAIL "A"



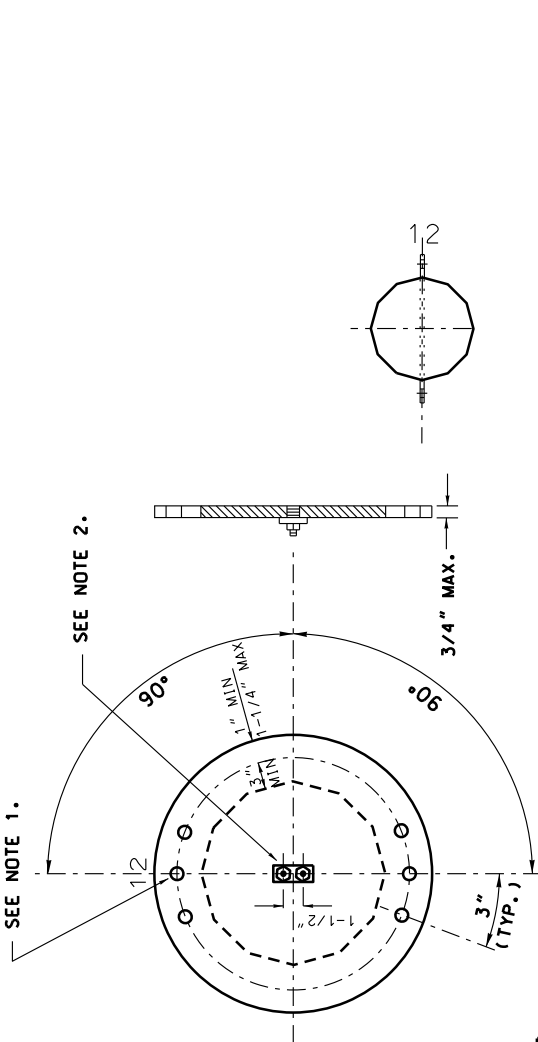
NOTE: BRACKET FREE TO SWING
IN LONGITUDINAL DIRECTION

CONDUCTOR ATTACHMENT

REV. 3, 02-05-13: SWING ANGLES, GLASS INSULATOR DIMENSION			
REV. 2, 01-04-13: SWING ANGLES, GLASS INSULATORS, DIM. TABLE			
REV. 1, 03-09-12: SWING CLEARANCE, DIM. TABLE, MISC.			
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DESCRIPTION			
345KV 3 POLE STEEL 10°-18° ANGLE STR.			
APPROVED	DRAWN	DATE	CHECKED
CJM; 12-20-99	JDC/BCK	07-07-98	JGC; 12-01-99
SCALE		ENGINEERING DEPT. TX	
NONE		T-O-443	
REV.			3

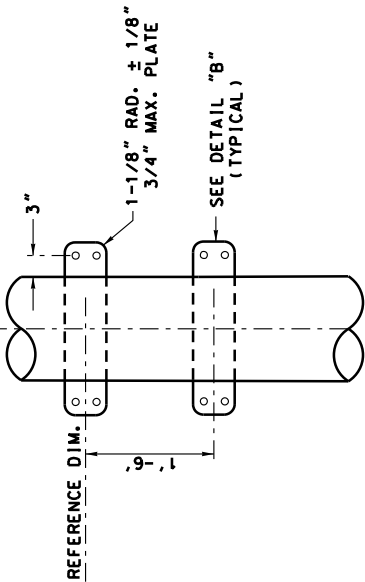
GENERAL NOTES

1. 1" DIAMETER HOLE WITH 1/8" CHAMFER BOTH SIDES, TYPICAL.
2. (2)1/2" ALL THREAD STUDS, 1-1/2" APART, 1" MINIMUM PROTRUSION. INSTALL 3" x 1-1/4" COVER PLATE WITH NUTS. FOR PAINTED POLES, PRIME, BUT DO NOT PAINT AREA UNDER COVER PLATE. COVER PLATE SHALL BE INSTALLED WHEN WEATHERING STEEL IS SPECIFIED.
3. INSTALL STEP LUGS FROM 85' ABOVE BASE PLATE TO TOP OF POLE.
4. POLE NUMBER SHALL BE INSTALLED ON EACH POLE AS REQUIRED.
5. SEE SHEET T-0-400 FOR GENERAL DETAILS.
6. SEE SHEET T-0-400A FOR END PLATE DETAILS.
7. SEE SHEET T-0-400C FOR ANCHOR BOLT CASE DETAILS.
8. STRAIN INSULATORS ARE TO BE 345kv TOUGHENED GLASS INSULATORS.
9. STRUCTURE DESIGN SHOWN IS FOR CONFIGURATION ONLY. ENGINEERING STRENGTH CALCULATIONS AND STRUCTURE DESIGN DETAILS MUST BE PERFORMED FOR EACH PROJECT.



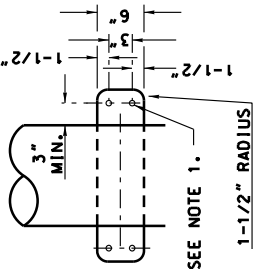
POLE TOP DETAIL

DIMENSIONS		
HA	HB	A
75'	62'0"	49'0"
80'	67'0"	54'0"
85'	72'0"	59'0"
90'	77'0"	64'0"
95'	72'0"	69'0"
100'	87'0"	74'0"
105'	92'0"	79'0"
110'	97'0"	84'0"
115'	102'0"	89'0"
120'	107'0"	94'0"
125'	112'0"	99'0"
130'	117'0"	104'0"
135'	122'0"	109'0"
140'	127'0"	114'0"
145'	132'0"	119'0"
150'	137'0"	124'0"
155'	142'0"	129'0"
160'	147'0"	134'0"
165'	152'0"	139'0"
170'	157'0"	144'0"

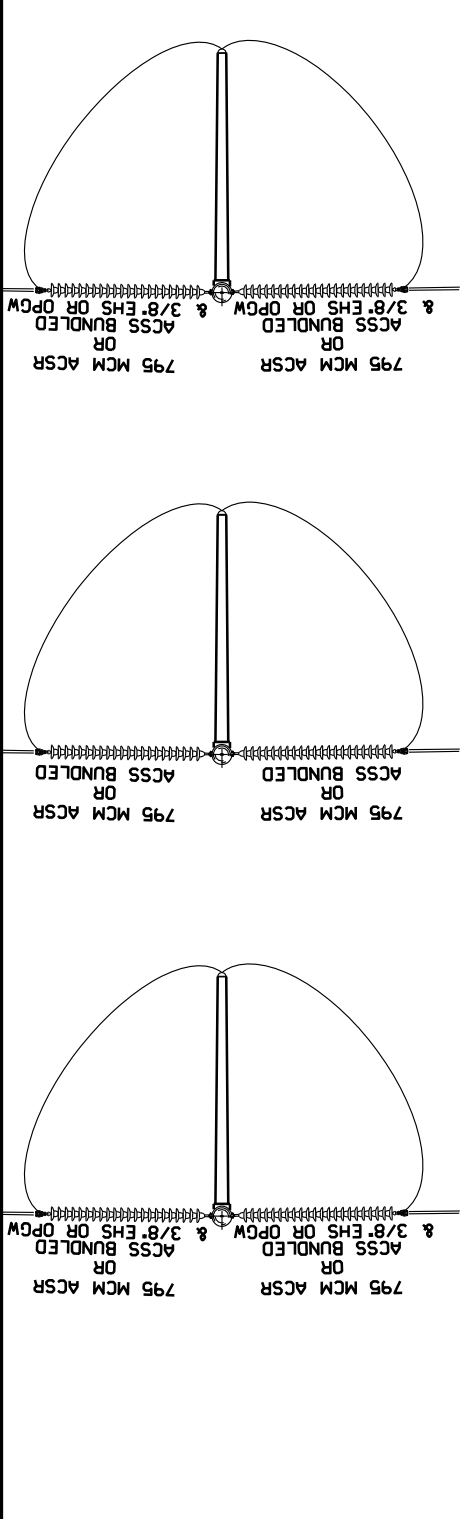


DETAIL "A"

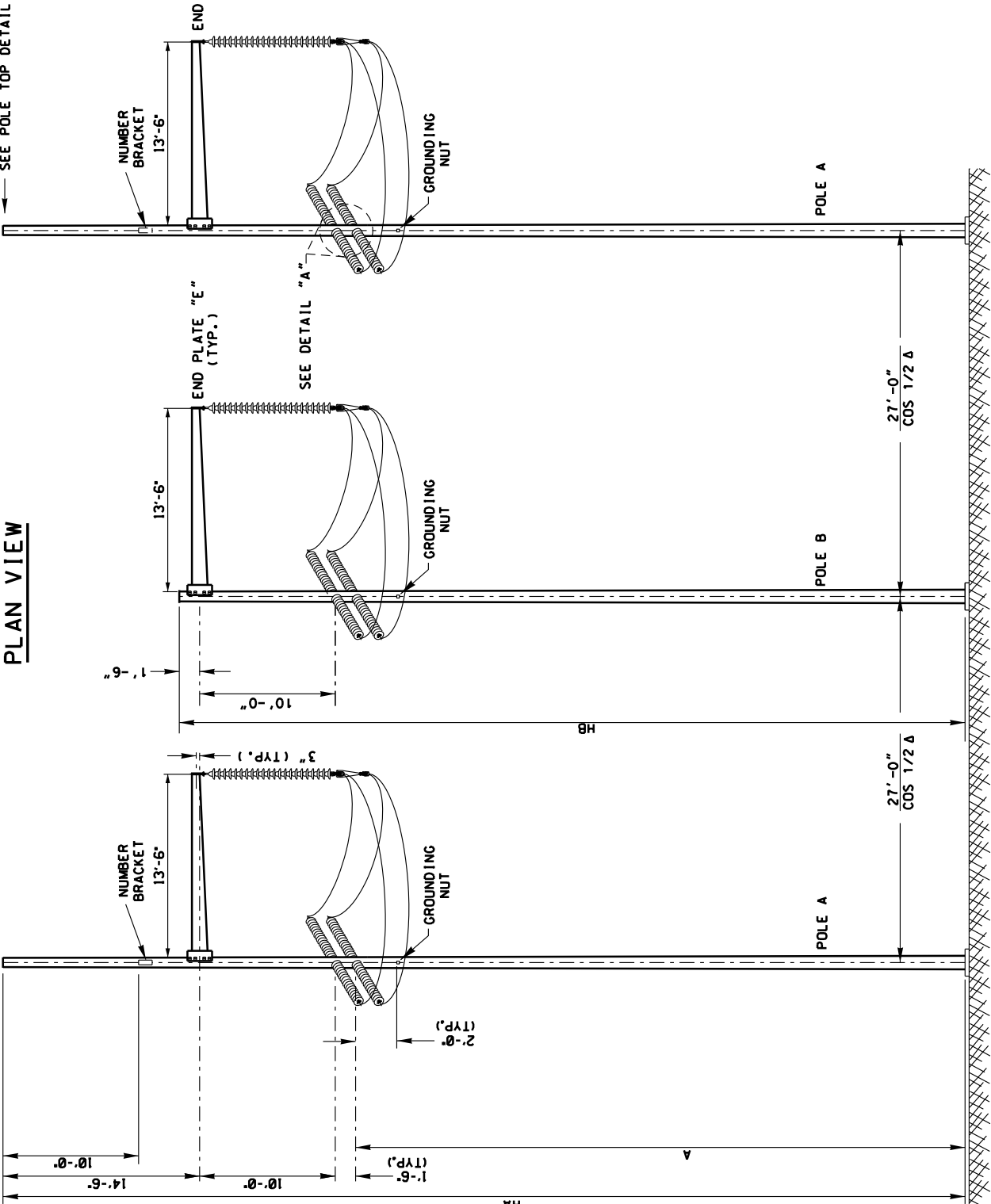
CONDUCTOR ATTACHMENT &
INSULATOR ATTACHMENT BRACKET



DETAIL "B"



PLAN VIEW

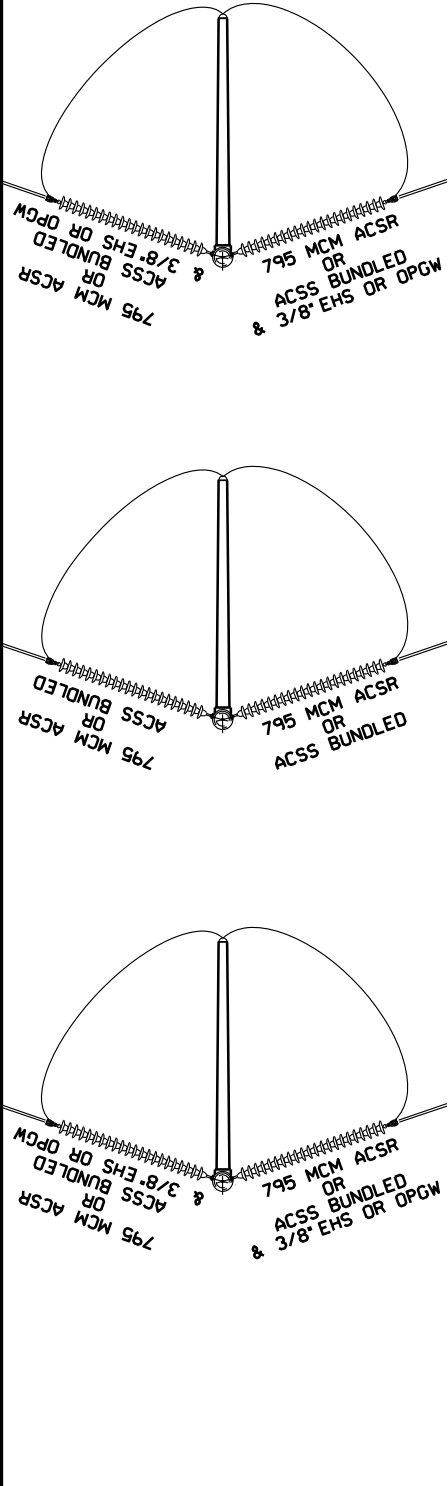


ELEVATION VIEW

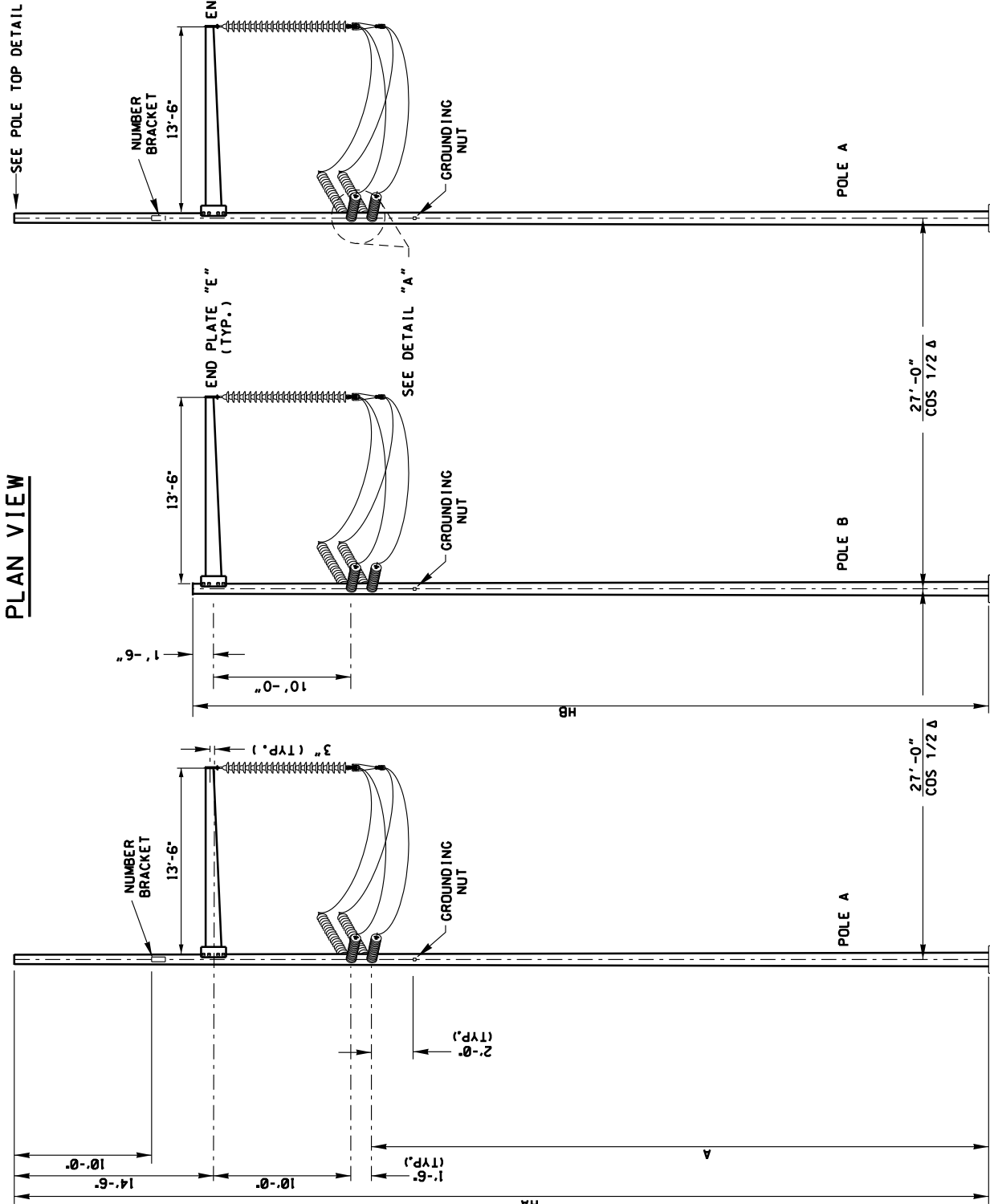
REV. 3. 07-13-12: POLE TOP DET.: SUSP. INSULATORS: ARM LENGTH			
REV. 2. 05-31-12: REVISE BUNDLE YONE			
REVISIONS			
REV. 1. 03-29-12: DIM. TABLE. DAVIT ARMS. ALL DETAILS			
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DESCRIPTION			
345KV 3-POLE STEEL 0°-2° DE STRUCTURE			
APPROVED		CHECKED	
JCC		ALB/BCK	
SCALE		DATE	
NONE		03-03-98	
ENGINEERING DEPT. TX		T-0-451	
REV.		3	

GENERAL NOTES

1. 1" DIAMETER HOLE WITH 1/8" CHAMFER BOTH SIDES, TYPICAL.
2. (2) 1/2" ALL THREAD STUDS, 1-1/2" APART, 1" MINIMUM PROTRUSION. INSTALL 3" x 1-1/4" COVER PLATE WITH NUTS. FOR PAINTED POLES, PRIME, BUT DO NOT PAINT AREA UNDER COVER PLATE. COVER PLATE SHALL BE INSTALLED WHEN WEATHERING STEEL IS SPECIFIED.
3. INSTALL STEP LUGS FROM 85' ABOVE BASE PLATE TO TOP OF POLE.
4. POLE NUMBER SHALL BE INSTALLED ON EACH POLE AS REQUIRED.
5. SEE SHEET T-0-400 FOR GENERAL DETAILS.
6. SEE SHEET T-0-400A FOR END PLATE DETAILS.
7. SEE SHEET T-0-400C FOR ANCHOR BOLT CAGE DETAILS.
8. SEE SHEET T-0-400D FOR FIBER OPTIC SPLICE DETAILS.
9. STRAIN INSULATORS ARE TO BE 345kv TOUGHENED GLASS INSULATORS. SUSPENSION INSULATORS ARE TO BE 345kv TOUGHENED GLASS INSULATORS.
10. STRUCTURE DESIGN SHOWN IS FOR CONFIGURATION ONLY. ENGINEERING STRENGTH CALCULATIONS AND STRUCTURE DESIGN DETAILS MUST BE PERFORMED FOR EACH PROJECT.

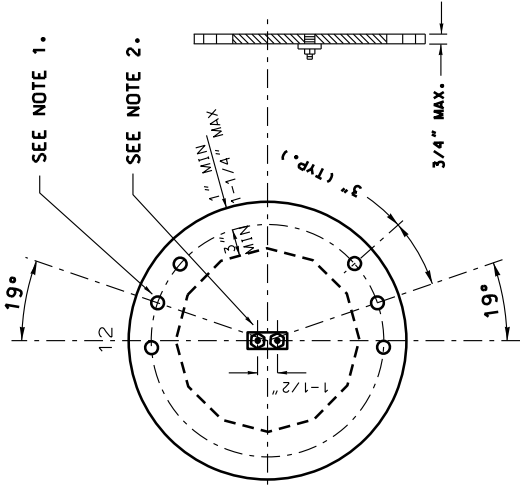


PLAN VIEW

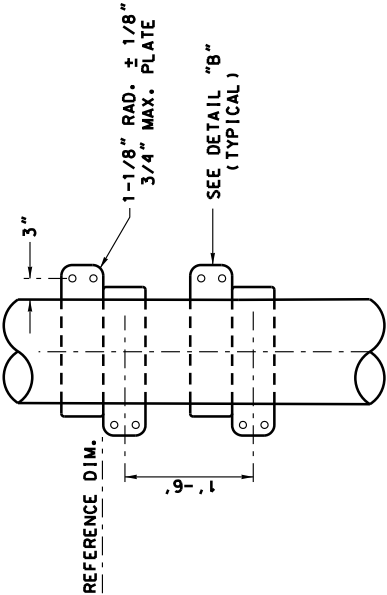


ELEVATION VIEW

DIMENSIONS		
HA	HB	A
75'	62'0"	49'0"
80'	67'0"	54'0"
85'	72'0"	59'0"
90'	77'0"	64'0"
95'	82'0"	69'0"
100'	87'0"	74'0"
105'	92'0"	79'0"
110'	97'0"	84'0"
115'	102'0"	89'0"
120'	107'0"	94'0"
125'	112'0"	99'0"
130'	117'0"	104'0"
135'	122'0"	109'0"
140'	127'0"	114'0"
145'	132'0"	119'0"
150'	137'0"	124'0"
155'	142'0"	129'0"
160'	147'0"	134'0"
165'	152'0"	139'0"
170'	157'0"	144'0"

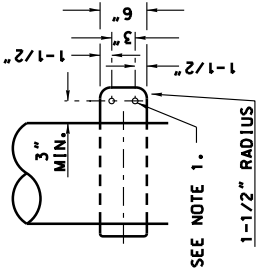


POLE TOP DETAIL



DETAIL "A"

CONDUCTOR ATTACHMENT &
INSULATOR ATTACHMENT BRACKET



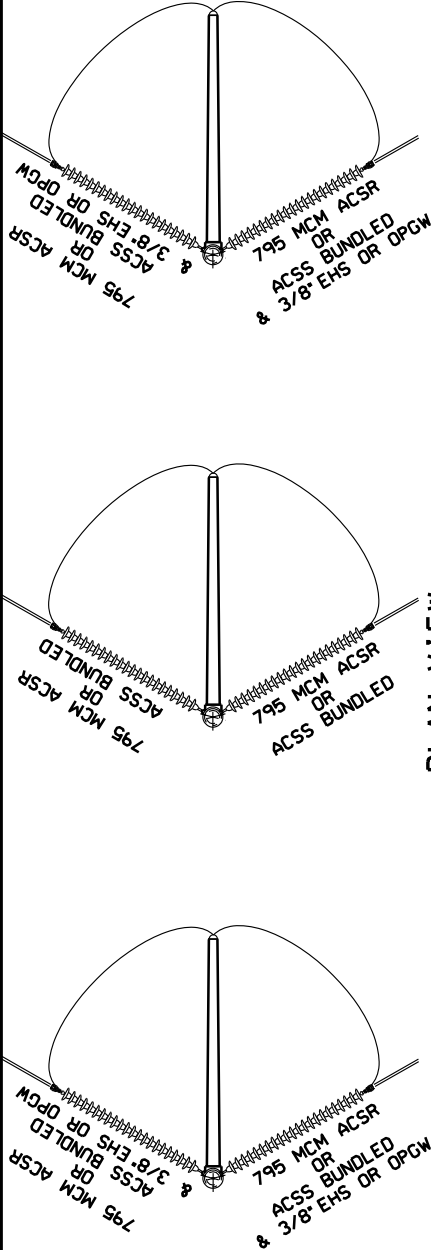
DETAIL "B"

REVISIONS

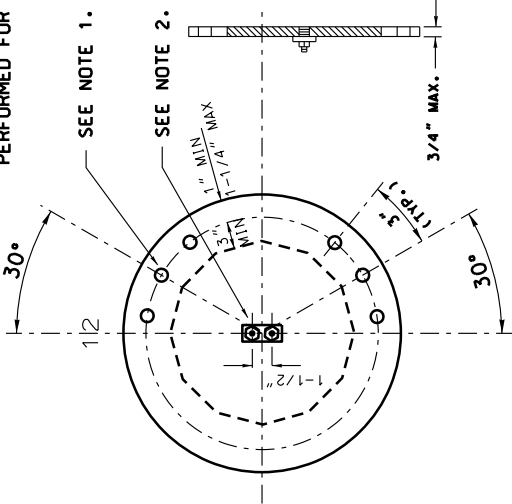
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DESCRIPTION		
345KV 3 POLE STEEL 30°-45° ANGLE - FIBER SPLICE		
	DRAWN BOK	DATE 08-08-12
APPROVED JCC:	SCALE NONE	CHECKED T-30-442
ENGINEERING DEPT. TX		REV.

GENERAL NOTES

1. 1" DIAMETER HOLE WITH 1/8" CHAMFER BOTH SIDES, TYPICAL.
2. (2)1/2" ALL THREAD STUDS, 1-1/2" APART, 1" MINIMUM PROTRUSION, INSTALL 3" x 1-1/4" COVER PLATE WITH NUTS. FOR PAINTED POLES, PRIME, BUT DO NOT PAINT AREA UNDER COVER PLATE. COVER PLATE SHALL BE INSTALLED WHEN WEATHERING STEEL IS SPECIFIED.
3. INSTALL STEP LUGS FROM 85' ABOVE BASE PLATE TO TOP OF POLE.
4. POLE NUMBER SHALL BE INSTALLED ON EACH POLE AS REQUIRED.
5. SEE SHEET T-0-400 FOR GENERAL DETAILS.
6. SEE SHEET T-0-400A FOR END PLATE DETAILS.
7. SEE SHEET T-0-400C FOR ANCHOR BOLT CAGE DETAILS.
8. SEE SHEET T-0-400D FOR FIBER OPTIC SPLICE DETAILS.
9. STRAIN INSULATORS ARE TO BE 345kV TOUGHENED GLASS INSULATORS. SUSPENSION INSULATORS ARE TO BE 345kV TOUGHENED GLASS INSULATORS.
10. STRUCTURE CALCULATIONS AND STRUCTURE DESIGN DETAILS MUST BE PERFORMED FOR EACH PROJECT.

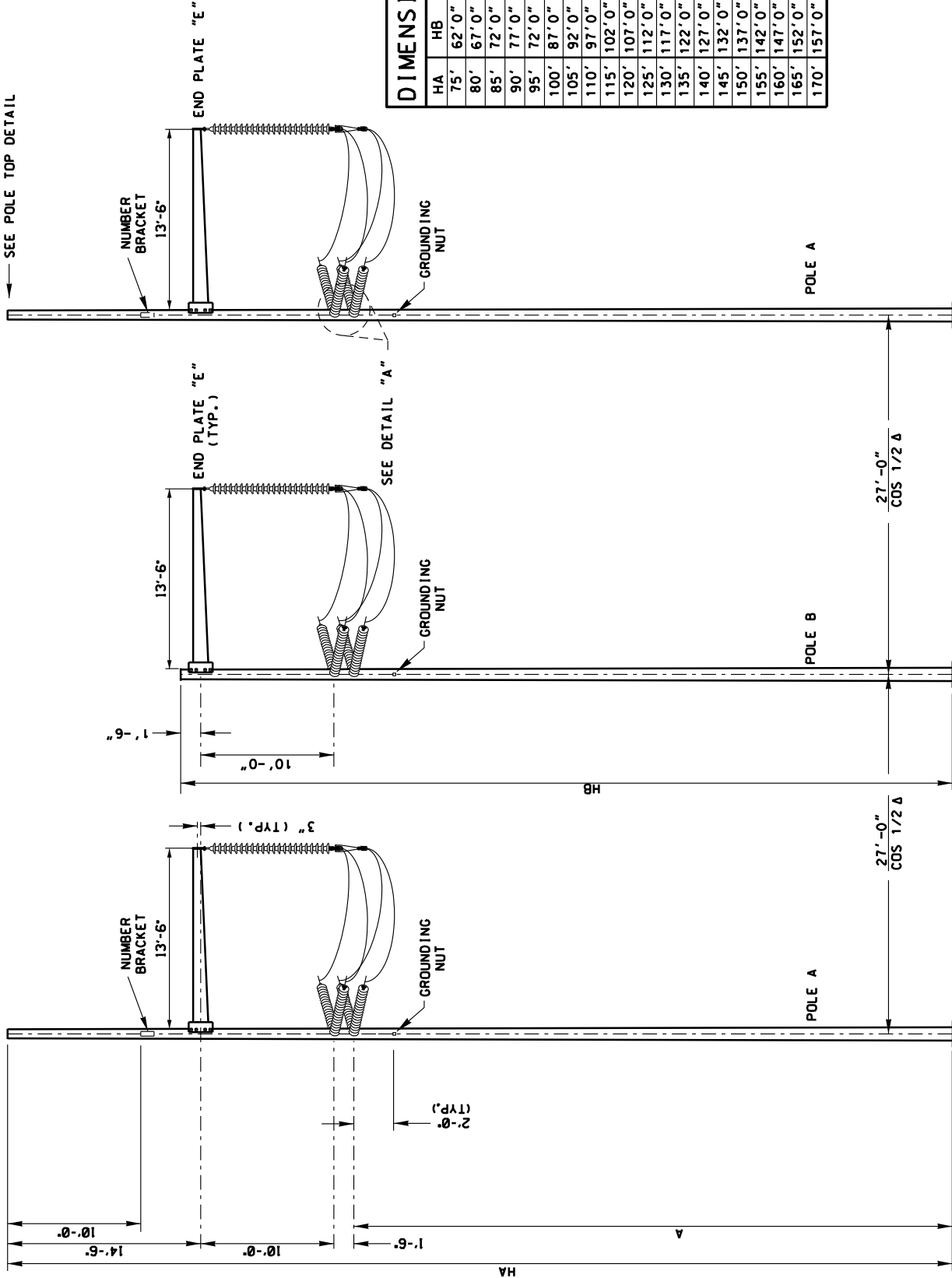


PLAN VIEW

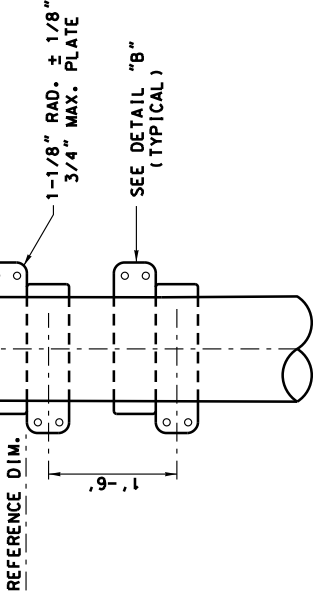


POLE TOP DETAIL

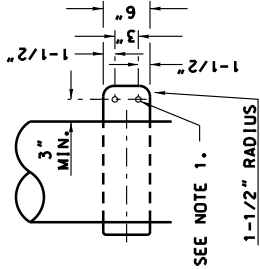
DIMENSIONS		
HA	HB	A
75'	62'0"	49'0"
80'	67'0"	54'0"
85'	72'0"	59'0"
90'	77'0"	64'0"
95'	72'0"	69'0"
100'	87'0"	74'0"
105'	92'0"	79'0"
110'	97'0"	84'0"
115'	102'0"	89'0"
120'	107'0"	94'0"
125'	112'0"	99'0"
130'	117'0"	104'0"
135'	122'0"	109'0"
140'	127'0"	114'0"
145'	132'0"	119'0"
150'	137'0"	124'0"
155'	142'0"	129'0"
160'	147'0"	134'0"
165'	152'0"	139'0"
170'	157'0"	144'0"



ELEVATION VIEW



DETAIL "A"
CONDUCTOR ATTACHMENT &
INSULATOR ATTACHMENT BRACKET



DETAIL "B"

REVISIONS

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DESCRIPTION		
345KV 3-POLE STEEL 45°-75° ANGLE - FIBER SPLICE		
	DRAWN BOK	DATE 08-08-12
APPROVED JGC:	SCALE NONE	CHECKED T-30-443
	ENGINEERING DEPT. TX	REV.

GENERAL NOTES

- 1. 1" DIAMETER HOLE WITH 1/8" CHAMFER BOTH SIDES, TYPICAL.
- 2. (2)1/2" ALL THREAD STUDS, 1-1/2" APART, 1" MINIMUM PROTRUSION. INSTALL 3" x 1-1/4" COVER PLATE WITH NUTS. FOR PAINTED POLES, PRIME, BUT DO NOT PAINT AREA UNDER COVER PLATE. COVER PLATE SHALL BE INSTALLED WHEN WEATHERING STEEL IS SPECIFIED.
- 3. INSTALL STEP LUGS FROM 85' ABOVE BASE PLATE TO TOP OF POLE.
- 4. POLE NUMBER SHALL BE INSTALLED ON EACH POLE AS REQUIRED.
- 5. SEE SHEET T-0-400 FOR GENERAL DETAILS.
- 6. SEE SHEET T-0-400A FOR END PLATE DETAILS.
- 7. SEE SHEET T-0-400C FOR ANCHOR BOLT CAGE DETAILS.
- 8. SEE SHEET T-0-400D FOR FIBER OPTIC SPLICE DETAILS.
- 9. STRAIN INSULATORS ARE TO BE 345KV TOUGHENED GLASS INSULATORS. SUSPENSION INSULATORS ARE TO BE 345KV TOUGHENED GLASS INSULATORS.
- 10. STRUCTURE DESIGN SHOWN IS FOR CONFIGURATION ONLY. ENGINEERING STRENGTH CALCULATIONS AND STRUCTURE DESIGN DETAILS MUST BE PERFORMED FOR EACH PROJECT.

SEE NOTE 1.
SEE NOTE 2.

SEE POLE TOP DETAIL

POLE TOP DETAIL

DETAIL "A"

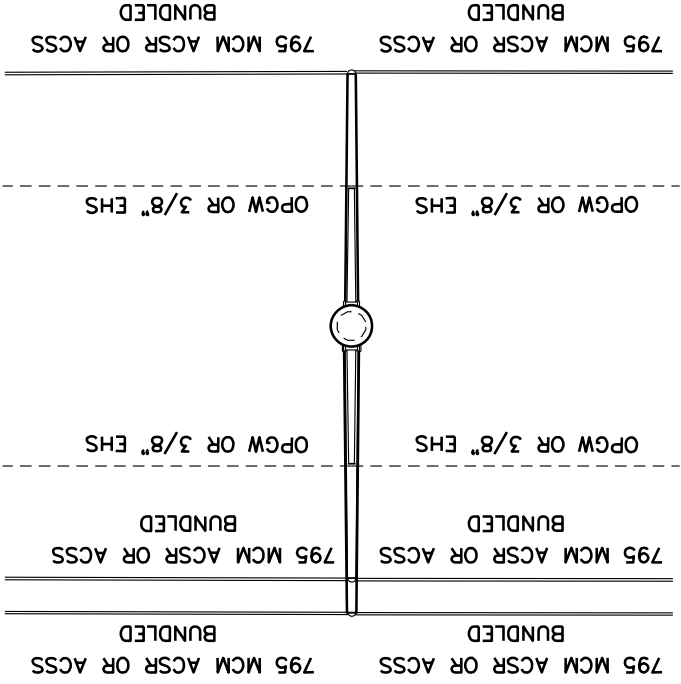
CONDUCTOR ATTACHMENT &
INSULATOR ATTACHMENT BRACKET

DETAIL "B"

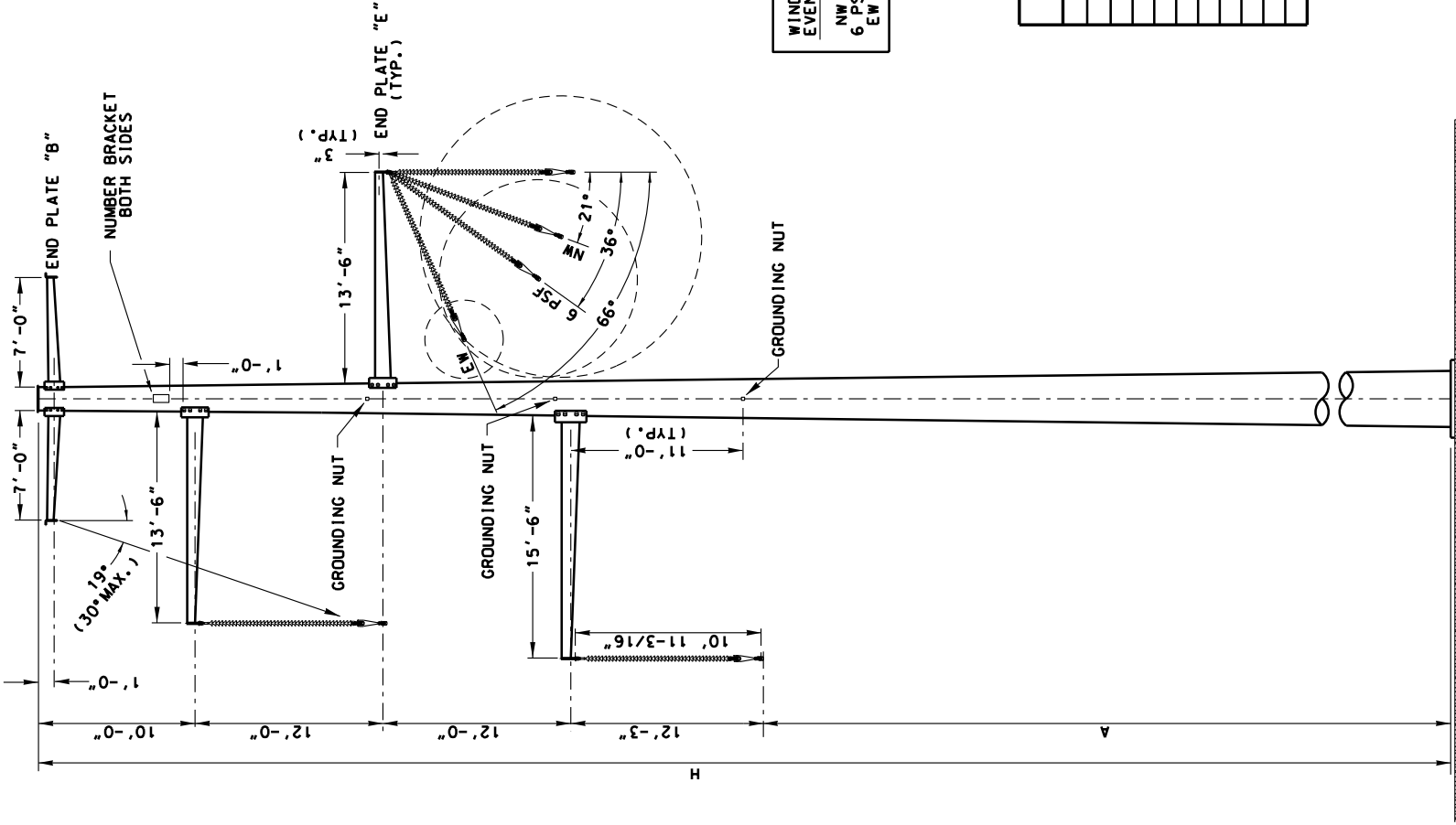
DIMENSIONS		
HA	HB	A
75'	62'0"	49'0"
80'	67'0"	54'0"
85'	72'0"	59'0"
90'	77'0"	64'0"
95'	72'0"	69'0"
100'	87'0"	74'0"
105'	92'0"	79'0"
110'	97'0"	84'0"
115'	102'0"	89'0"
120'	107'0"	94'0"
125'	112'0"	99'0"
130'	117'0"	104'0"
135'	122'0"	109'0"
140'	127'0"	114'0"
145'	132'0"	119'0"
150'	137'0"	124'0"
155'	142'0"	129'0"
160'	147'0"	134'0"
165'	152'0"	139'0"
170'	157'0"	144'0"

ELEVATION VIEW

REVISIONS			XCEL ENERGY AMARILLO, TEXAS		
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345KV 3-POLE STEEL ANGLE 75°-100° ANGLE - FIBER SPLICE			DRAWN BOK		
XcelEnergy			DATE 08-08-12		
APPROVED			CHECKED		
JGC:			SCALE NONE		
			ENGINEERING DEPT. TX		
			REV. T-30-444		



PLAN VIEW



ELEVATION VIEW

GENERAL NOTES

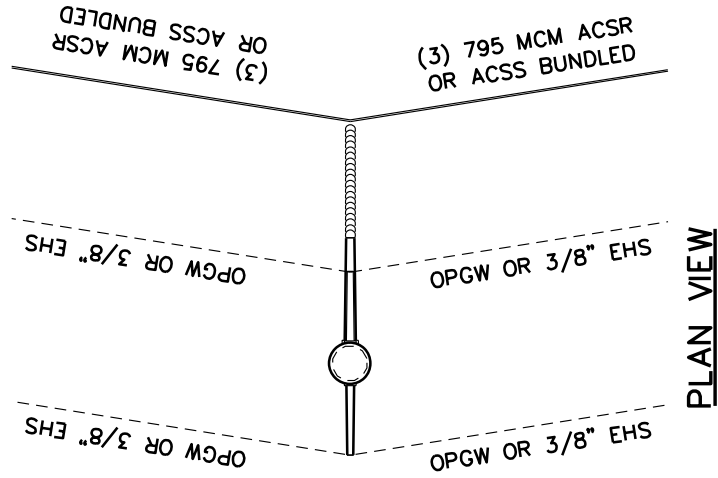
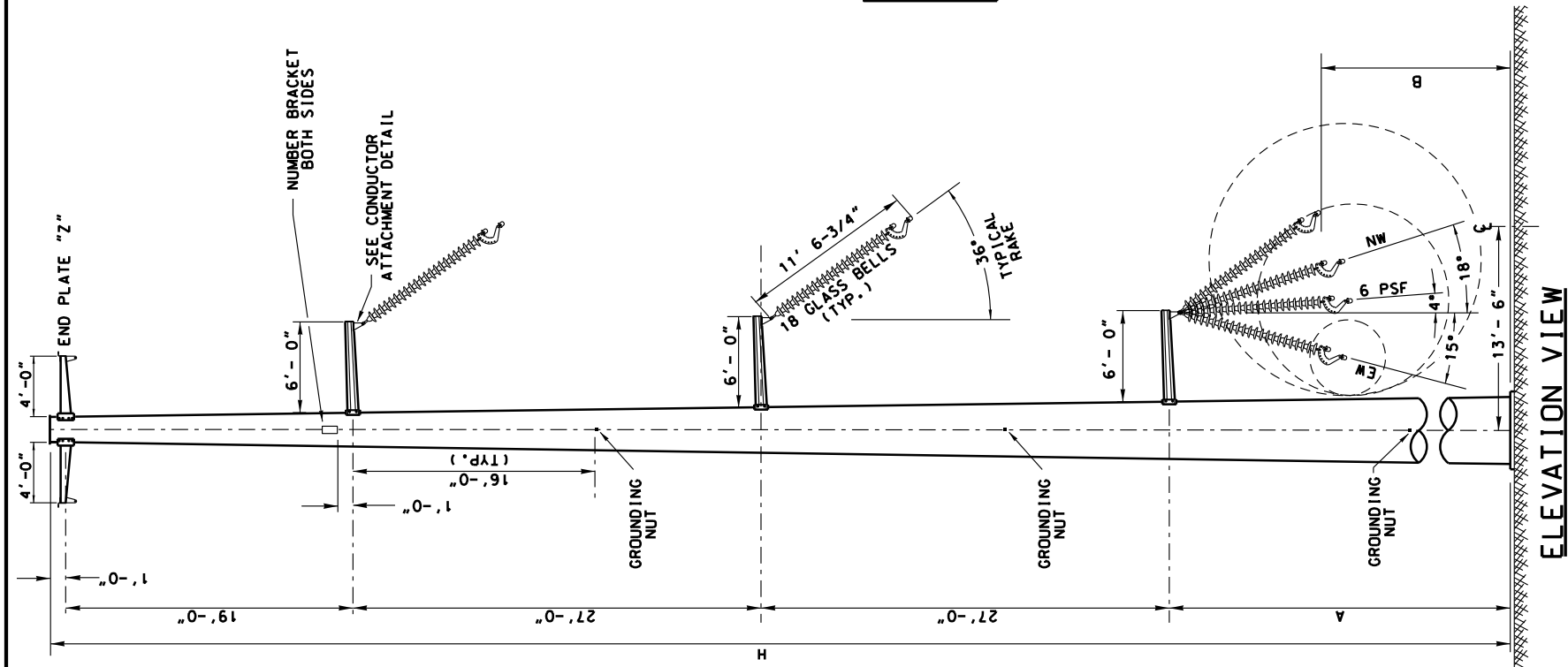
1. 1" DIAMETER HOLE WITH 1/8" CHAMFER BOTH SIDES, TYPICAL.
2. (2)1/2" ALL THREAD STUDS, 1-1/2" APART, 1" MINIMUM PROTRUSION. INSTALL 3" x 1-1/4" COVER PLATE WITH NUTS. FOR PAINTED POLES, PRIME, BUT DO NOT PAINT AREA UNDER COVER PLATE. COVER PLATE SHALL BE INSTALLED WHEN WEATHERING STEEL IS SPECIFIED.
3. INSTALL STEP LUGS FROM 85' ABOVE BASE PLATE TO TOP OF POLE.
4. POLE NUMBER SHALL BE INSTALLED ON EACH POLE AS REQUIRED.
5. SEE SHEET T-0-400A FOR GENERAL DETAILS.
6. SEE SHEET T-0-400A FOR ARM END PLATE AND DEADEND EAR DETAILS.
7. SEE SHEET T-0-400C FOR ANCHOR BOLT CAGE DETAILS.
8. SUSPENSION INSULATORS ARE TO BE 345kV POLYMER INSULATORS.
9. STRUCTURE DESIGN SHOWN IS FOR CONFIGURATION ONLY. ENGINEERING STRENGTH CALCULATIONS AND STRUCTURE DESIGN DETAILS MUST BE PERFORMED FOR EACH PROJECT.

WIND EVENT	RADIAL CLEARANCE
NW	9'-0"
6 PSF	6'-4"
EW	2'-6"

DIM.	
H	A
120'	73'-3"
125'	78'-3"
130'	83'-3"
135'	88'-3"
140'	93'-3"
145'	98'-3"
150'	103'-3"
155'	108'-3"
160'	113'-3"
165'	118'-3"

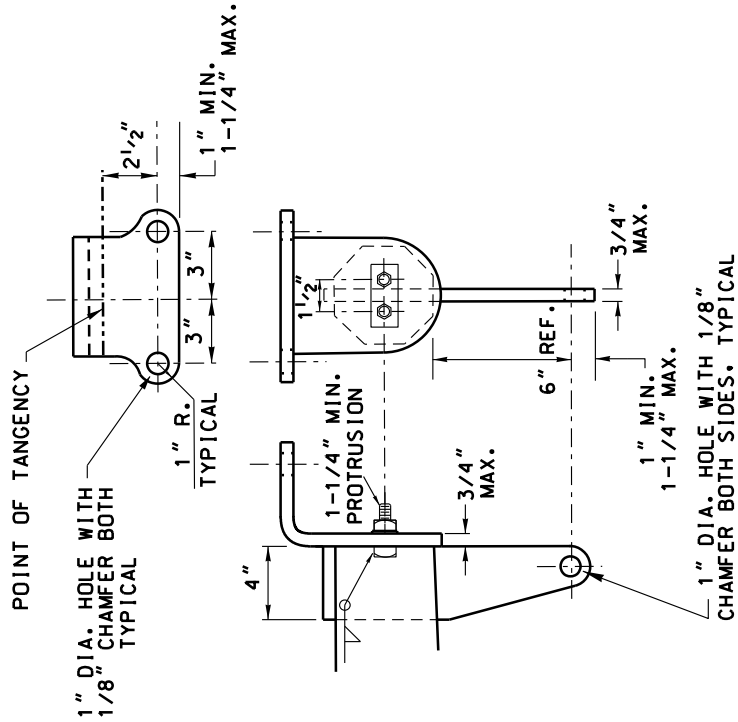
DESIGNED BY: PATTERSON & DEWAR ENGINEERS, INC. - TX FIRM 7149

REVISIONS			
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DESCRIPTION			
345KV SINGLE POLE STEEL TANGENT 0°-2°			
	DRAWN P&D-BCK	DATE 01-23-13	CHECKED
APPROVED JCC	SCALE NONE	ENGINEERING DEPT. TX T-30-451	REV. 0



WIND EVENT	RADIAL CLEARANCE
NW	9' - 0"
6 PSF	6' - 4"
EW	2' - 6"

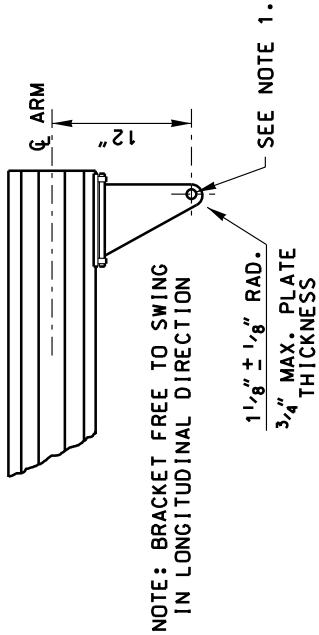
D I M E N S I O N S		
H	A	B
120'	46'-0"	35'-9"
125'	51'-0"	40'-9"
130'	56'-0"	45'-9"
135'	61'-0"	50'-9"
140'	66'-0"	55'-9"
145'	71'-0"	60'-9"
150'	76'-0"	65'-9"
155'	81'-0"	70'-9"
160'	86'-0"	75'-9"
165'	91'-0"	80'-9"



END PLATE "Z"

GENERAL NOTES

1. 1" DIAMETER HOLE WITH 1/8" CHAMFER BOTH SIDES, TYPICAL.
2. 231/2" ALL THREAD STUDS, 1-1/2" APART, 1" MINIMUM PROTRUSION, INSTALL 3" x 1-1/4" COVER PLATE WITH NUTS, FOR PAINTED POLES, PRIME, BUT DO NOT PAINT AREA UNDER COVER PLATE. COVER PLATE SHALL BE INSTALLED WHEN WEATHERING STEEL IS SPECIFIED.
3. INSTALL STEP LUGS FROM 85" ABOVE BASE PLATE TO TOP OF POLE.
4. POLE NUMBER SHALL BE INSTALLED ON EACH POLE AS REQUIRED.
5. SEE SHEET T-0-400 FOR GENERAL DETAILS.
6. SEE SHEET T-0-400A FOR ARM END PLATE AND DEADEND EAR DETAILS.
7. SEE SHEET T-0-400C FOR ANCHOR BOLT CAGE DETAILS.
8. SUSPENSION INSULATORS ARE TO BE 345KV TOUGHENED GLASS INSULATORS.
9. STRUCTURE DESIGN SHOWN IS FOR CONFIGURATION ONLY. ENGINEERING STRENGTH CALCULATIONS AND STRUCTURE DESIGN DETAILS MUST BE PERFORMED FOR EACH PROJECT.



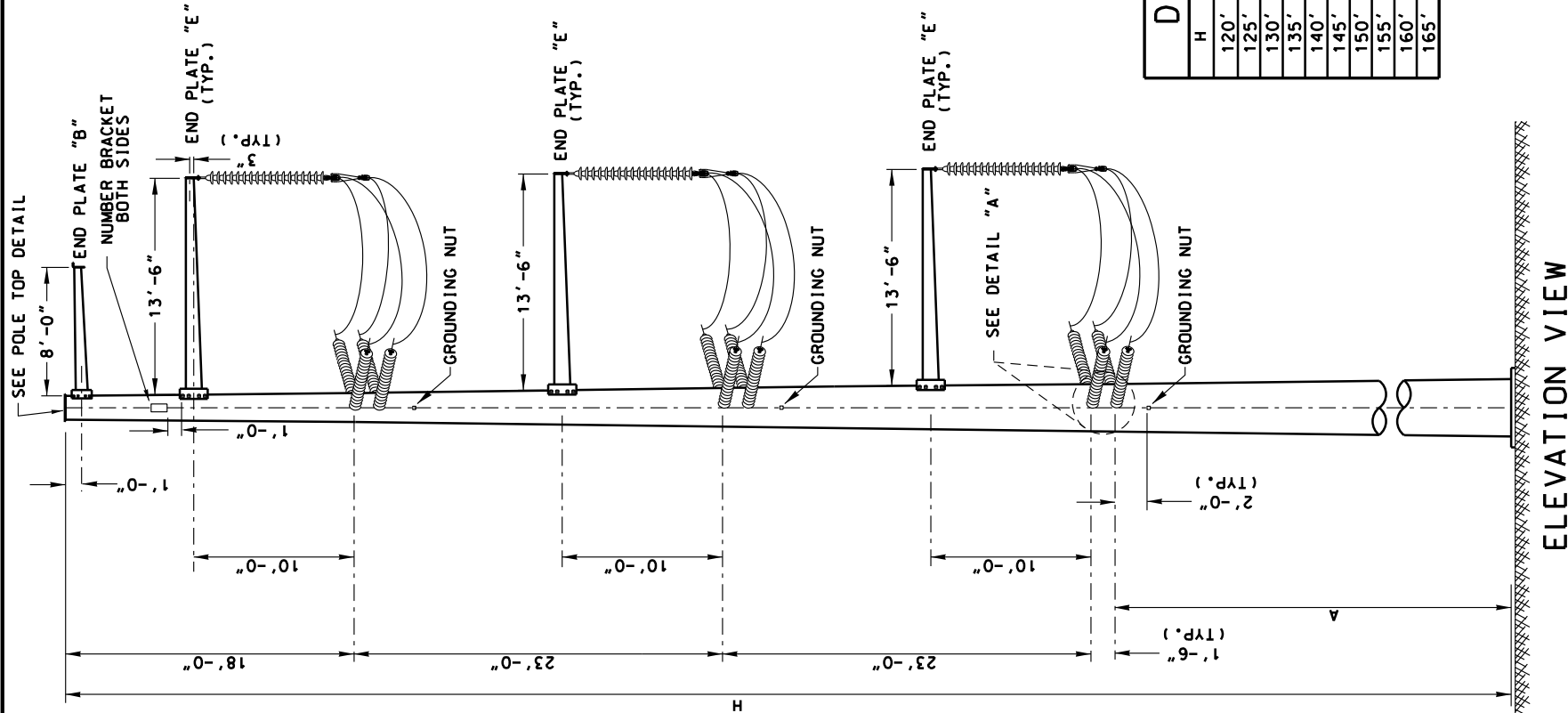
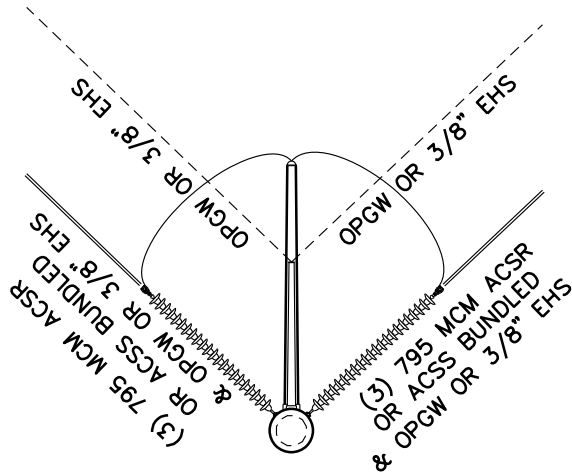
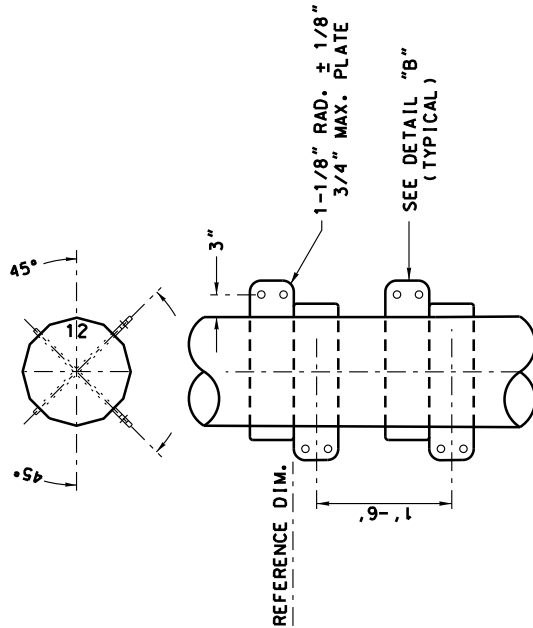
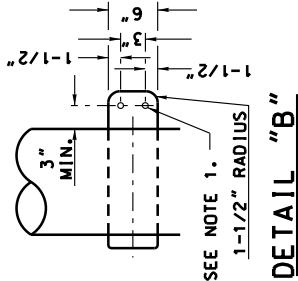
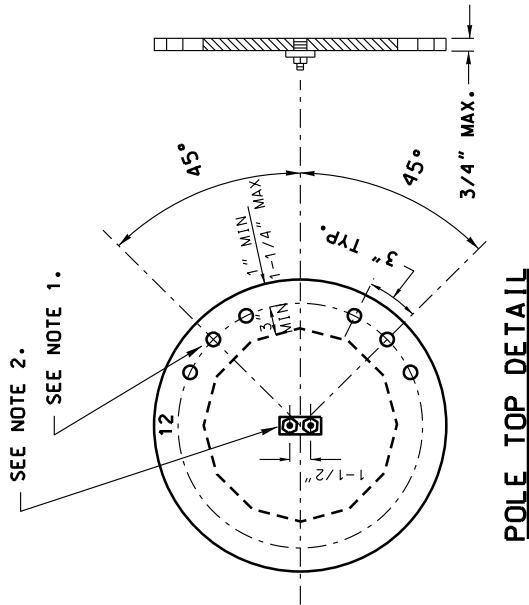
CONDUCTOR ATTACHMENT

DESIGNED BY: PATTERSON & DEWAR ENGINEERS, INC. - TX FIRM 7149
REVISIONS

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Xcel Energy AMARILLO, TEXAS			
DESCRIPTION			
345KV SINGLE POLE RUNNING ANGLE 6°-16°			
		DRAWN P&O-BOK	DATE 01-23-13
APPROVED JCC -----		SCALE NONE	ENGINEERING DEPT. TX T-30-452
REV.			0

GENERAL NOTES

1. 1" DIAMETER HOLE WITH 1/8" CHAMFER BOTH SIDES, TYPICAL.
2. (21) 2" ALL THREAD STUDS, 1-1/2" NUTS, 1" MINIMUM PROTRUSION, INSTALL 3" x 1-1/4" COVER PLATE WITH APPTS. FOR PAINTED POLES, PRIME, BUT DO NOT PAINT AREA UNDER COVER PLATE. COVER PLATE SHALL BE INSTALLED WHEN WEATHERING STEEL IS SPECIFIED.
3. INSTALL STEP LUGS FROM 85" ABOVE BASE PLATE TO TOP OF POLE.
4. POLE NUMBER SHALL BE INSTALLED ON EACH POLE AS REQUIRED.
5. SEE SHEET T-0-4000 FOR GENERAL DETAILS.
6. SEE SHEET T-0-400A FOR ARM END PLATE AND DEADEND EAR DETAILS.
7. SEE SHEET T-0-400C FOR ANCHOR BOLT CASE DETAILS.
8. SEE SHEET T-0-400D FOR FIBER OPTIC SPLICE DETAILS.
9. STRAIN INSULATORS AND SUSPENSION INSULATORS ARE TO BE 345kV TOUGHENED GLASS INSULATORS.
10. STRUCTURE DESIGN SHOWN IS FOR CONFIGURATION ONLY. ENGINEERING STRENGTH CALCULATIONS AND STRUCTURE DESIGN DETAILS MUST BE PERFORMED FOR EACH PROJECT.



DIM.		
	H	A
	120'	54'-6"
	125'	59'-6"
	130'	64'-6"
	135'	69'-6"
	140'	74'-6"
	145'	79'-6"
	150'	84'-6"
	155'	89'-6"
	160'	94'-6"
	165'	99'-6"

DETAIL "A"
CONDUCTOR ATTACHMENT &
INSULATOR ATTACHMENT BRACKET

DESIGNED BY: PATTERSON & DEWAR ENGINEERS, INC. - TX FIRM 7149

REVISIONS	
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DESCRIPTION 345KV SINGLE POLE DEADEND (75°-100°)-F IBER SPLICE	
	DRAWN P&D-BCK
DATE 01-23-13	CHECKED
APPROVED JCC -----	SCALE NONE
ENGINEERING DEPT. 1X T-30-456	REV. 0