Exhibit 1

BLACK HILLS ENERGY

BEN FRENCH TO CAMBELL ST 69KV TRANSMISSION LINE

DRAWING LIST

DRAWING #	DRAWING DESCRIPTION
DL-01	DRAWING LIST
	ROUTE MAP
RM-01	ROUTE MAP
RM-02	ROUTE MAP
RM-03	ROUTE MAP
	PLAN AND PROFILE DRAWINGS
PP-01	STR BF SUB – STR 9
PP-02	STR 10 – STR E15-2
	STRUCTURE DETAILS
SD-01-1	TCHP-69UB
SD-02-1	SCRC-ST-M1
SD-03-1	TCIDE-69UB-1
SD-04-1	TCIDE-69UB-2
SD-05-1	SCHP
SD-06-1	SCDE-69
	ASSEMBLY DETAILS
AD-01-1	T-4A,B,S, T-4D(S), T-4C
AD-02-1	T-4F, T-4FD, T-4FC
AD-03-1	T-FDL, T-FSC-1, F-FSCS-M2, T-FSCS-M3
AD-04-1	T-SP(1)-B, T-BPB, T-PSB
AD-04-2	T-SP(1), T-BPD, T-PSD
AD-05-1	T-2S5B, 2S6B, T-2SPB2
AD-06-1	T-BDE6PB, TM-EXT-15, T-BDE6B
AD-06-2	T-BDE6PD, T-BDE6D
AD-07-1	TM-9ST, TM-9SD, TM-9SSJ, TM-9
AD-08-1	TD-1, TD-2
AD-09-1	TG-26, TA-P1, TGS-1(A), TM-GM
AD-10-1	TM-101 & TM-103, TP-A
AD-11-1	DPR-EHS, DPR-OPGW, DPR-336
AD-12-1	DPR-795
	DISTRIBUTION DETAILS
DD-01	308-ST-M1, 310-ST-M1

DRAWING #	DRAWING DESCRIPTION
	LOAD AND DESIGN DETAILS
LD-11-1	STR 6-1, DESIGN DETAILS
LD-11-2	STR 6-1, DESIGN DETAILS
LD-11-3	STR 6-1, LOAD TREES
LD-11-4	STR 6-1, LOAD TREES
	FOUNDATION DETAILS
FND-05-1	STR 6-1
	STAKING SHEETS
SS-01	STR BF SUB – STR 15-2
	PHASING DIAGRAM
PH-01	PHASING DIAGRAM
	SAG TABLES 336.4 KCMIL 26/7 ACSR "LINNET"
STC-01-1	STR 6-2 – STR 6, STR 15 – STR 15-2, FINAL
	SAG TABLES 795 KCMIL 45/7 ACSR "TERN"
STC-02-1	STR 6 – STR 15, INITIAL
	SAG TABLES AFL CC-55/443 "DNO-4748" OPGW
STF-01-1	STR 6-2 – STR 6, STR 15 – STR 15-2, FINAL
	SAG TABLES 3/8" 7 STRAND HS
STS-01-1	STR 6-2 – STR 6-1, FINAL
	MATERIAL LIST
ML-01	MATERIAL LIST

1	REVISION
DESCRIPTION: RECORD DRAWINGS	
NAME: DATE: REG. NO.:	
PROJECT #: 10114217	ISSUE DATE: 6/12/2020
PROJECT MANAGER: J. ELLSWORTH	
DESIGN ENGINEER: J. PANKRATZ	
DRAWN BY: Z. JANSEN	

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

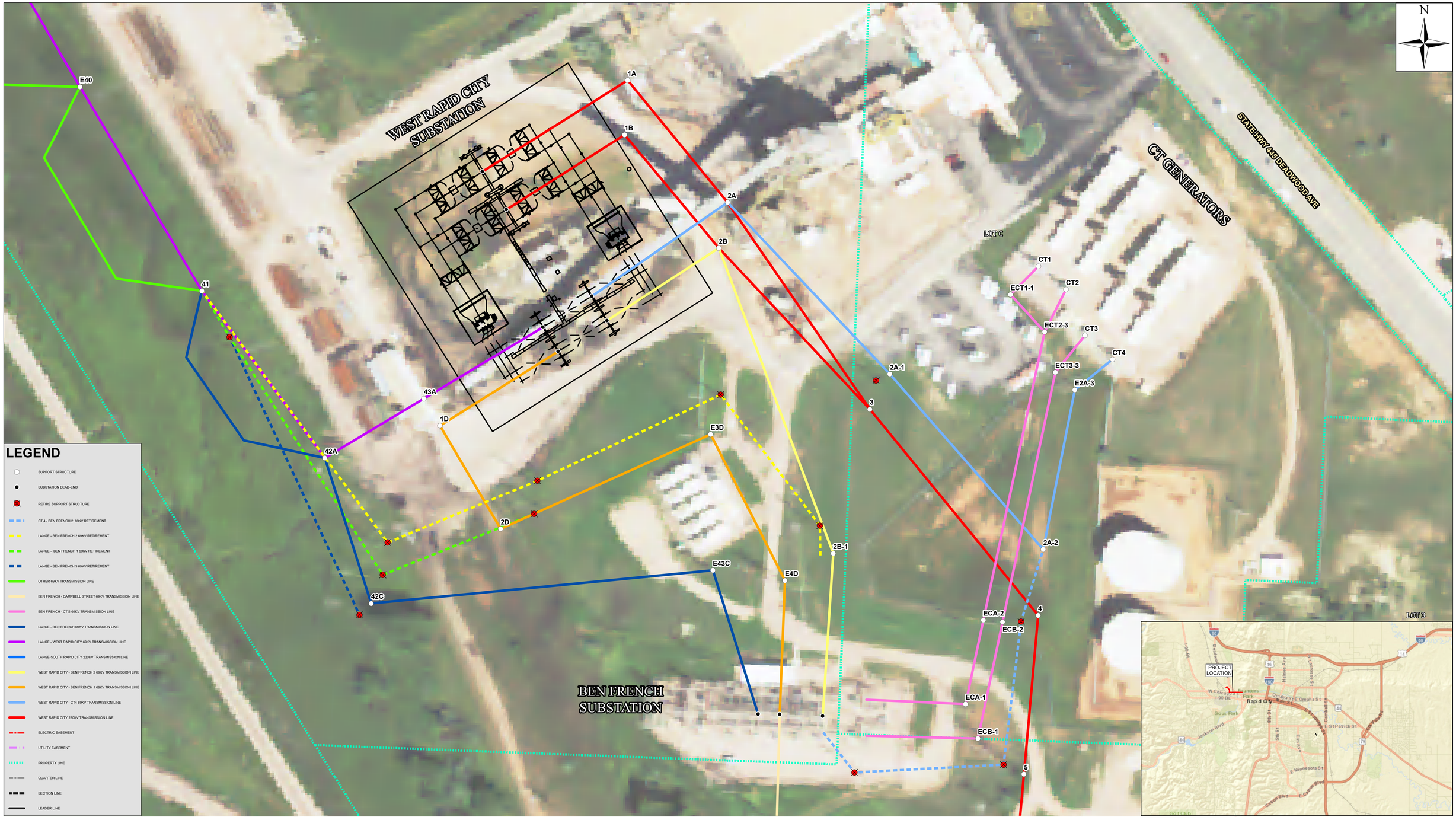
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

DRAWING LIST

0 1" 2"

FILENAME	BHE-DL-01-01.DWG
SCALE	NONE
SHEET	DL-01



LEGEND

- SUPPORT STRUCTURE
- SUBSTATION DEAD-END
- RETIRE SUPPORT STRUCTURE
- CT 4 - BEN FRENCH 2 69KV RETIREMENT
- LANGE - BEN FRENCH 2 69KV RETIREMENT
- LANGE - BEN FRENCH 1 69KV RETIREMENT
- LANGE - BEN FRENCH 3 69KV RETIREMENT
- OTHER 69KV TRANSMISSION LINE
- BEN FRENCH - CAMPBELL STREET 69KV TRANSMISSION LINE
- BEN FRENCH - CT'S 69KV TRANSMISSION LINE
- LANGE - BEN FRENCH 69KV TRANSMISSION LINE
- LANGE - WEST RAPID CITY 69KV TRANSMISSION LINE
- LANGE-SOUTH RAPID CITY 230KV TRANSMISSION LINE
- WEST RAPID CITY - BEN FRENCH 2 69KV TRANSMISSION LINE
- WEST RAPID CITY - BEN FRENCH 1 69KV TRANSMISSION LINE
- WEST RAPID CITY - CT4 69KV TRANSMISSION LINE
- WEST RAPID CITY 230KV TRANSMISSION LINE
- ELECTRIC EASEMENT
- UTILITY EASEMENT
- PROPERTY LINE
- QUARTER LINE
- SECTION LINE
- LEADER LINE

Black Hills Energy
Improving life with energy

HDR

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	09/11/2019	ISSUE FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CADD TECHNICIAN	Z. JANSEN
GIS TECHNICIAN	S.GRIFFIN
PROJECT NUMBER	10114217

BLACK HILLS POWER
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
69KV TERMINATIONS

ROUTE MAP

0 20 40 80 Feet

FILENAME: West Rapid City 69kV Terminations 22x34

SCALE: 1 inch = 50 feet

SHEET: RM-01



Black Hills Energy
Improving life with energy

HDR

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	09/11/2019	ISSUE FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CADD TECHNICIAN	Z. JANSEN
GIS TECHNICIAN	S.GRIFFIN
PROJECT NUMBER	10114217

BLACK HILLS POWER
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
69KV TERMINATIONS

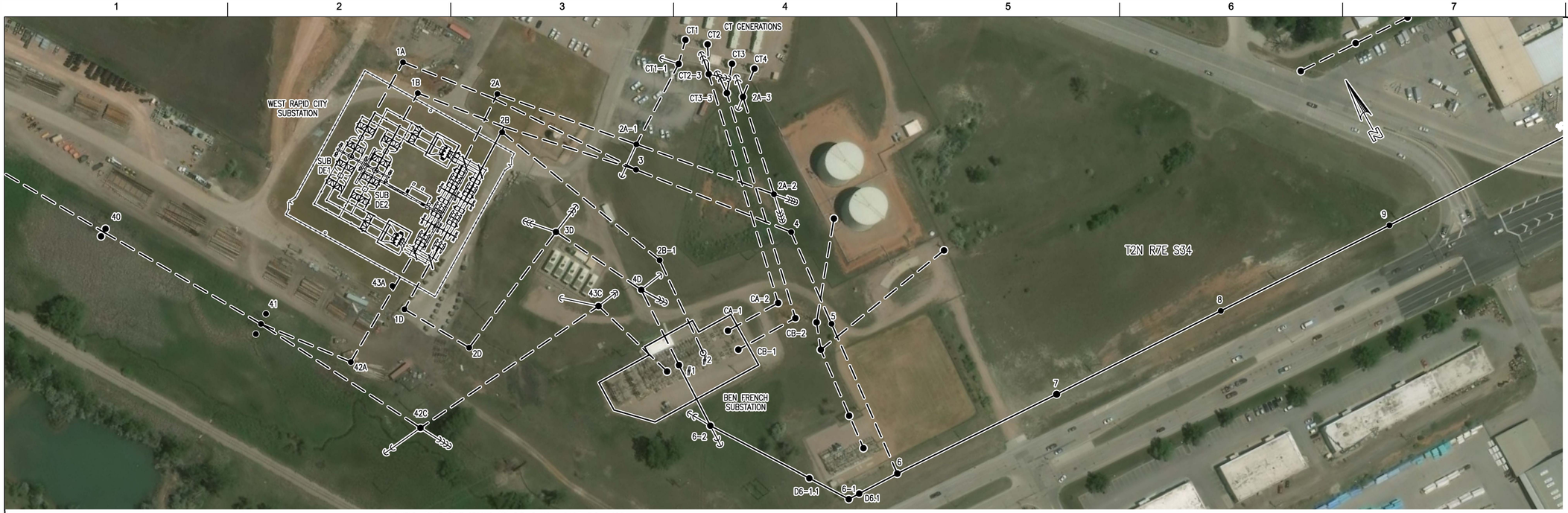
ROUTE MAP

0 20 40 80 Feet

FILENAME: West Rapid City 69KV Terminations 22x34

SCALE: 1 inch = 50 feet

SHEET: **RM-02**



PLAN NOTES:

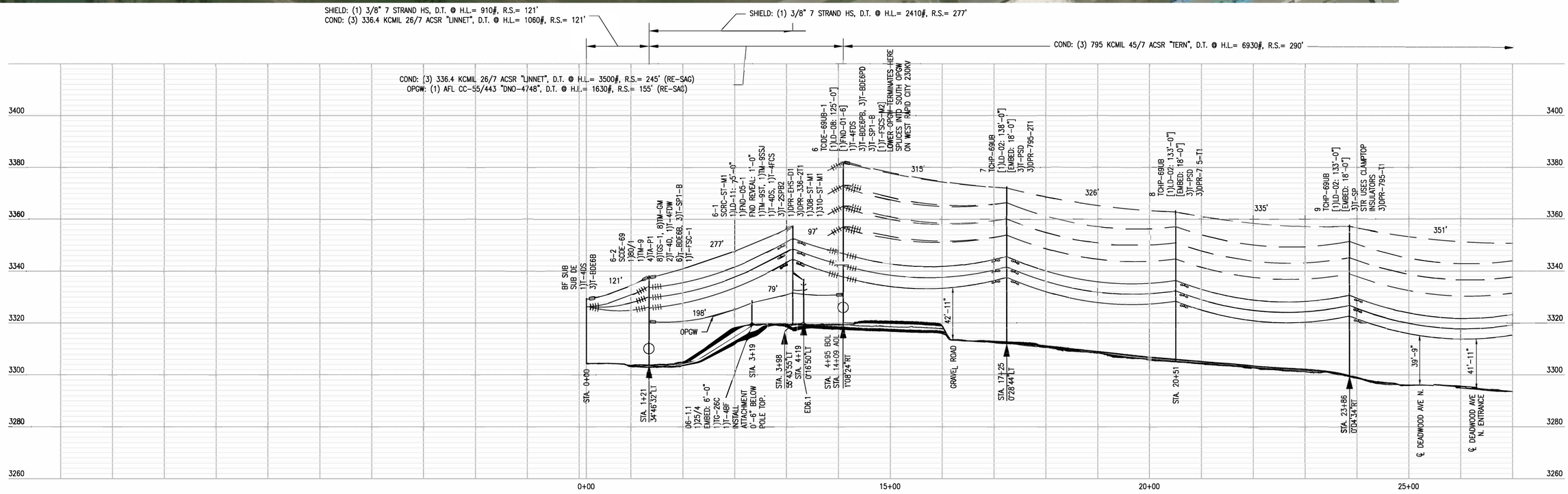
- STRUCTURE
- ALIGNMENT
- ALIGNMENT OF ANOTHER LINE

NOTES:

1. [XXX] – EXISTING ASSEMBLY
2. *XXX – RETIREMENT ASSEMBLY
3. T[XXX] – TRANSFER UNIT ASSEMBLY
4. SHIELD WIRE SHOWN AT 60°F (CREEP)
5. CONDUCTOR SHOWN AT 212°F (MAX SAG)

PROFILE NOTES:

- CONDUCTOR DAMPER
- SHIELD DAMPER
- OPGW SPLICE



ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
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PROJECT MANAGER	J. ELLSWORTH
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CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

PLAN AND PROFILE

0 1" 2"

FILENAME	BHE-PP-01-D-1.DWG
SCALE	H:1"=100' V:1"=20'
SHEET	PP-01



PLAN NOTES:

- STRUCTURE
- ALIGNMENT
- ALIGNMENT OF ANOTHER LINE

NOTES:

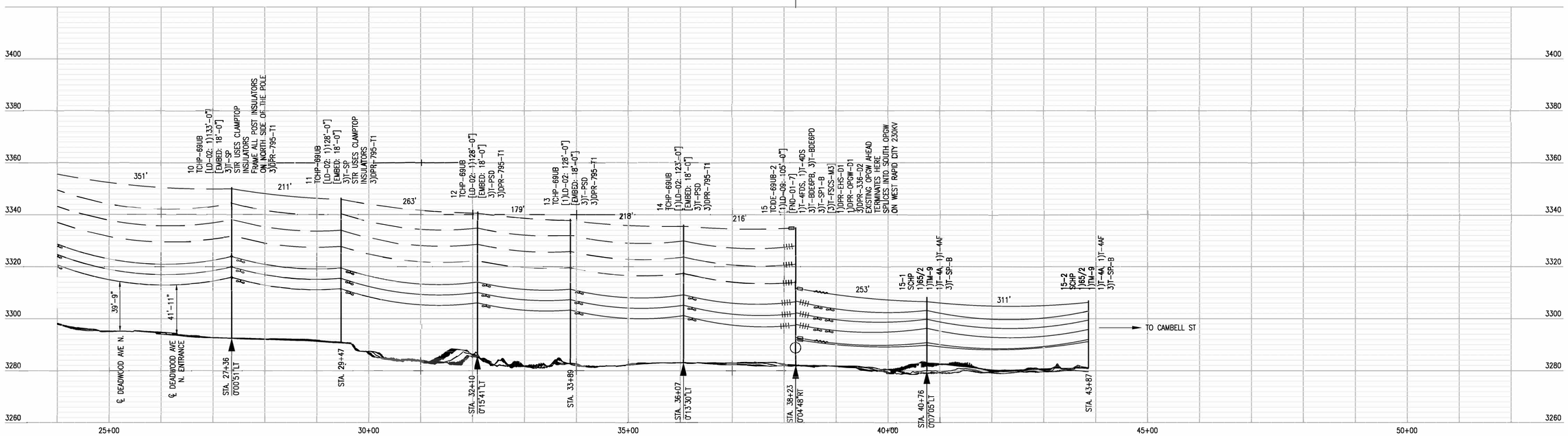
1. [XXX] – EXISTING ASSEMBLY
2. *XXX – RETIREMENT ASSEMBLY
3. T[XXX] – TRANSFER UNIT ASSEMBLY
4. SHIELD WIRE SHOWN AT 60°F (CREEP)
5. CONDUCTOR SHOWN AT 212°F (MAX SAG)

PROFILE NOTES:

- CONDUCTOR DAMPER
- SHIELD DAMPER
- OPGW SPLICE

SHIELD: (1) 3/8" 7 STRAND HS, D.T. @ H.L.= 2770#, R.S.= 337'
COND: (3) 336.4 KCMIL 26/7 ACSR "LINNET", D.T. @ H.L.= 4035#, R.S.= 337'
OPGW: (1) AFL CC-55/443 "DNO-4748", D.T. @ H.L.= 2745#, R.S.= 285'
FIBER: (1) UNIDENTIFIED FIBER

COND: (3) 795 KCMIL 45/7 ACSR "TERN", D.T. @ H.L.= 6930#, R.S.= 290'



ISSUE	DATE	DESCRIPTION
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DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

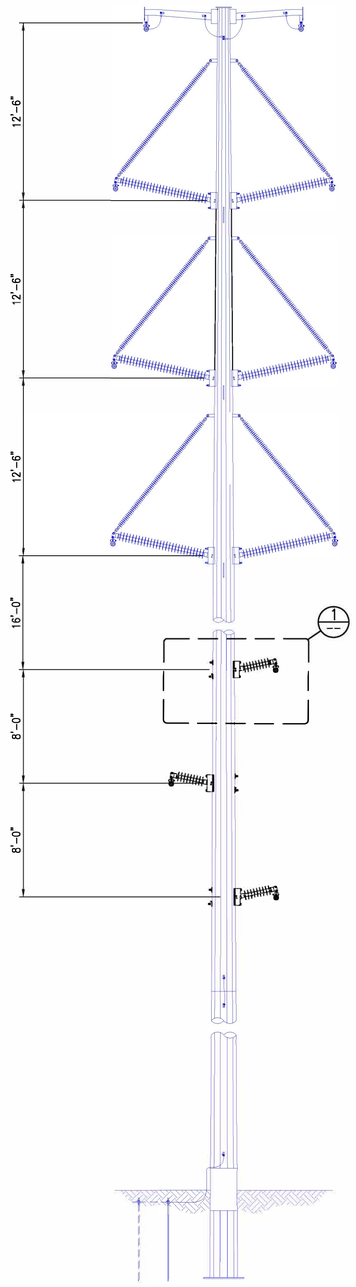
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

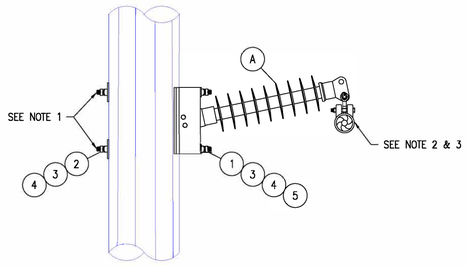
BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

PLAN AND PROFILE

0 1" 2"

FILENAME: BHE-PP-01-D-1.DWG
SCALE: H:1"=100' V:1"=20'
SHEET: PP-02





DETAIL 1
69KV INSULATOR
SCALE: N.T.S.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY.
1	N.S.	ROD, FULL THREADED, 7/8" X 120", ASTM A307 GRADE B	D17120	PORTLAND BOLT	13919-10'	3
2	N.S.	WASHER, SQUARE, 4" X 1/4", 15/16" HOLE	W322	HUGHES	SCW4-80	6
3	47-0242	NUT, SQUARE, 7/8"	N107	HUGHES	N80	12
4	22-7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	12
5	N.S.	WASHER, ROUND, 2" X 1/4", 15/16" HOLE	W410	HUGHES	RW2-80	6

TYPICAL ADDITIONAL ASSEMBLIES (CALLED OUT SEPARATELY)

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T-PSD	69KV HORIZONTAL POST	3

*SEE NOTE 6

NOTES:
1. ONE (1) STICK OF 7/8" X 10'-0" THREADED ROD PER INSULATOR ATTACHMENT. CUT TO LENGTH.
2. STRUCTURES 9, 10, AND 11 USE CLAMPTOP ASSEMBLY T-SP INSTEAD OF ASSEMBLY T-PSD.
3. FRAME ALL INSULATORS ON THE NORTH SIDE OF THE POLE ON STRUCTURE 10.
4. SEE LOAD AND DESIGN DRAWINGS FOR STEEL DESIGN DETAILS.
5. SEE STEEL POLE MANUFACTURING DRAWINGS FOR STEEL POLE DETAILS.
6. CONDUCTOR ASSEMBLIES ARE SEPARATE UNITS.
7. BLUE ASSEMBLIES ARE CALLED OUT IN THE WEST RAPID CITY 230KV TRANSMISSION LINE.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
TANGENT HORIZONTAL POST - 69KV UNDERBUILD

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: TCHP-69UB

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

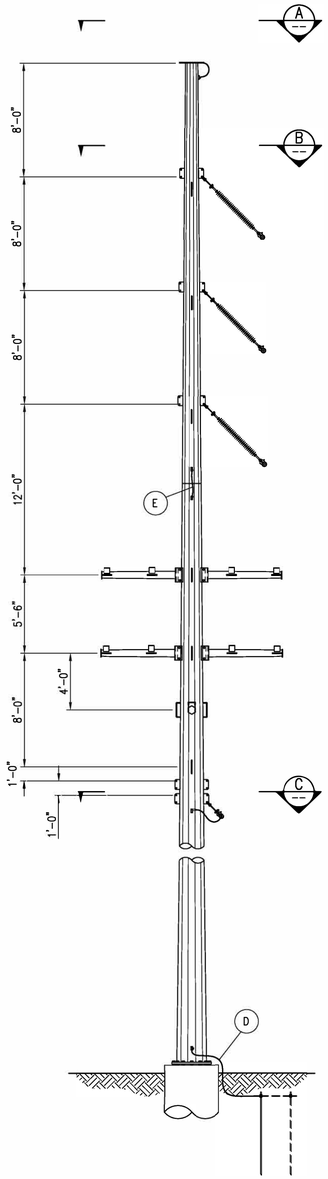
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

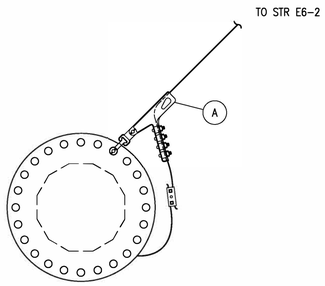
BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

STRUCTURE DETAILS
TANGENT HORIZONTAL POST
69KV UNDERBUILD
STR 7 - 14

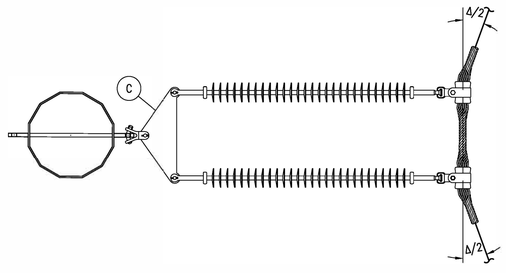
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FILENAME: BHE-SD-01-D-1.DWG
SCALE: 3/16"=1'-0"
SHEET: **SD-01-1**

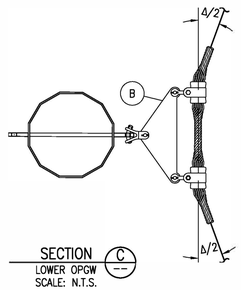




VIEW A
SHIELD
SCALE: N.T.S.



SECTION B
CONDUCTOR
SCALE: N.T.S.



SECTION C
LOWER OPGW
SCALE: N.T.S.

TYPICAL ADDITIONAL ASSEMBLIES (CALLED OUT SEPARATELY)			
ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T-4DS	OHSW DEADEND ASSEMBLY - STEEL POLE	1
B	T-4FCS	OPGW DOUBLE SUSPENSION ASSEMBLY - STEEL POLE	1
C	T-2SPD2	CONDUCTOR DOUBLE SUSPENSION ASSEMBLY	3
D	TM-9ST	GROUNDING ASSEMBLY	1
E	TM-9SSJ	STEEL POLE SLIP JOINT GROUNDING	1

NOTES:

1. POLE GROUNDS AND STATIC/CONDUCTOR ASSEMBLIES ARE CALLED OUT SEPARATELY.
2. SEE LOAD AND DESIGN DRAWINGS FOR STEEL DESIGN DETAILS.
3. SEE STEEL POLE MANUFACTURING DRAWINGS FOR STEEL POLE DETAILS.

SHEET TITLE
TRANSMISSION STRUCTURE
69kV RUNNING CORNER - STEEL POLE
W/ DISTRIBUTION UNDERBUILD

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: SCRC-ST-M1

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

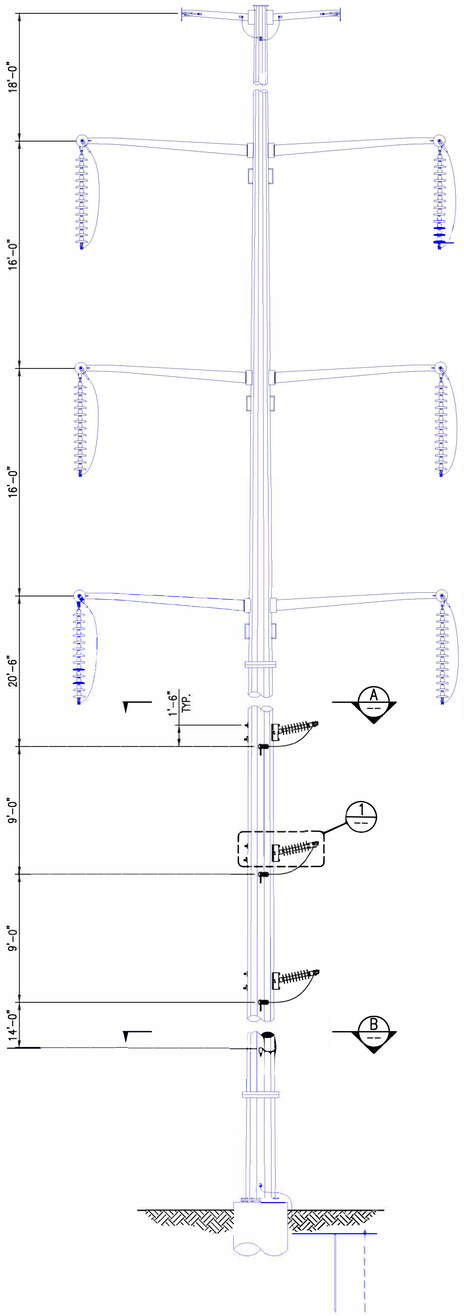
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

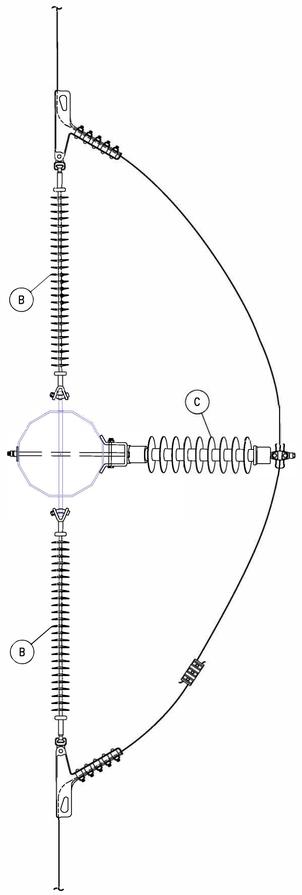
BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

STRUCTURE DETAILS
69KV RUNNING CORNER
STEEL POLE
STR 6-1

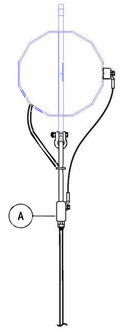
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SHEET: **SD-02-1**

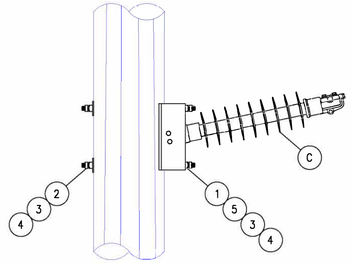




SECTION A
69KV CONDUCTORS
SCALE: N.T.S.



SECTION B
LOWER OPGW
SCALE: N.T.S.



DETAIL 1
JUMPER POST
SCALE: N.T.S.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY.
1	N.S.	ROD, FULL THREADED, 7/8" X 120", ASTM A307 GRADE B	D17120	PORTLAND BOLT	13919-10'	3
2	N.S.	WASHER, SQUARE, 4" X 1/4", 15/16" HOLE	W322	HUGHES	SCW4-80	6
3	47-0242	NUT, SQUARE, 7/8"	N107	HUGHES	N80	12
4	22-7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	12
5	N.S.	WASHER, ROUND, 2" X 1/4", 15/16" HOLE	W410	HUGHES	RW2-80	6

TYPICAL ADDITIONAL ASSEMBLIES (CALLED OUT SEPARATELY)

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T-4FDS	OPGW DEADEND ASSEMBLY - STEEL POLE	1
B	T-BDE6PD	CONDUCTOR DEADEND ASSEMBLY	6
C	T-SP1	69KV HORIZONTAL CLAMPTOP	3

*SEE NOTE 4

NOTES:
1. ONE (1) STICK OF 7/8" X 10'-0" THREADED ROD PER INSULATOR ATTACHMENT. CUT TO LENGTH.
2. SEE LOAD AND DESIGN DRAWINGS FOR STEEL DESIGN DETAILS.
3. SEE STEEL POLE MANUFACTURING DRAWINGS FOR STEEL POLE DETAILS.
4. CONDUCTOR ASSEMBLIES ARE SEPARATE UNITS.
5. BLUE ASSEMBLIES ARE CALLED OUT IN THE WEST RAPID CITY 230KV TRANSMISSION LINE.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
69KV INLINE DEADEND - 69KV UNDERBUILD

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: TCIDE-69UB-1

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

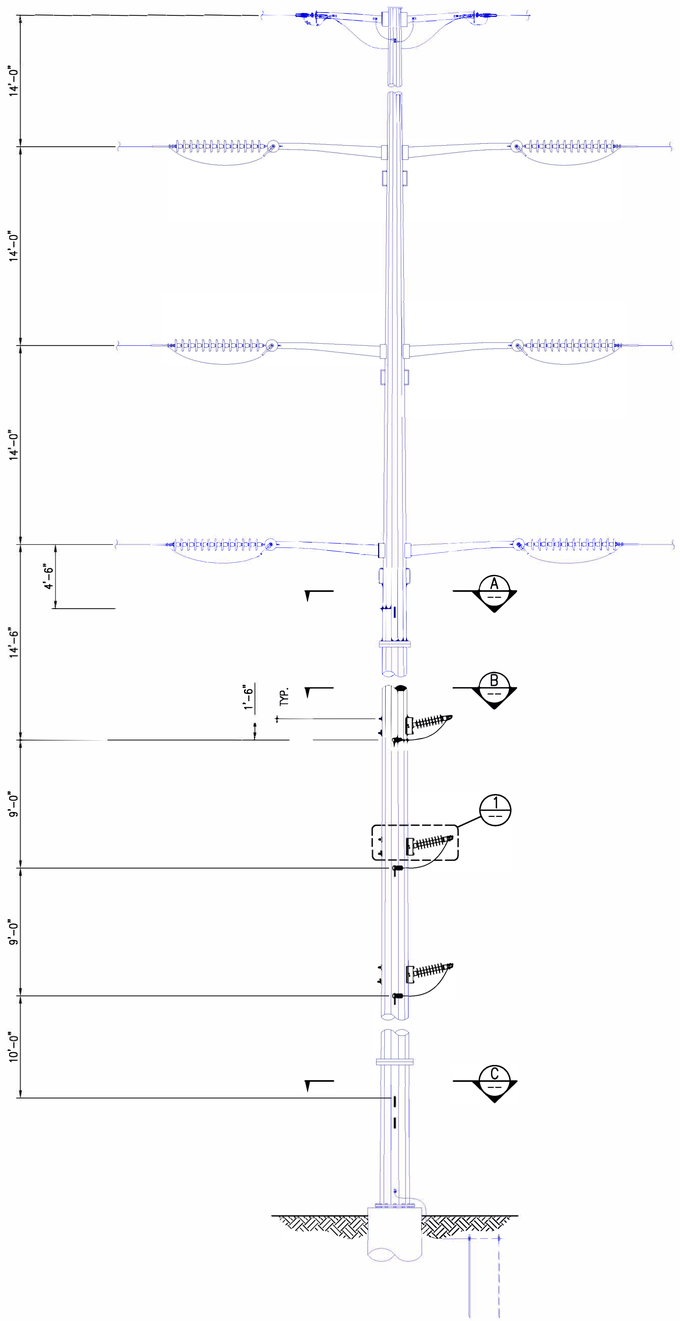
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

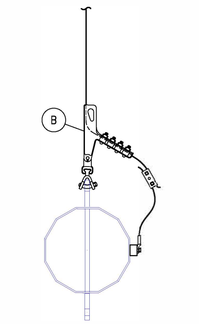
BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

STRUCTURE DETAILS
69KV INLINE DEADEND
69KV UNDERBUILD
STR 6

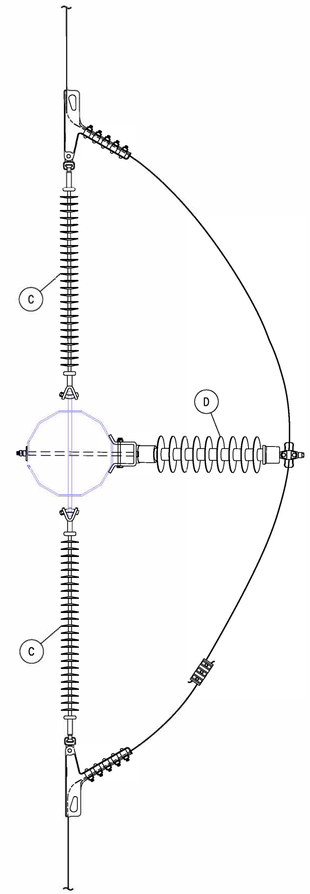
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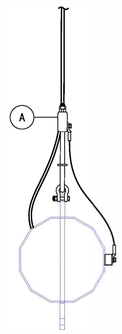
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SHEET: SD-03-1





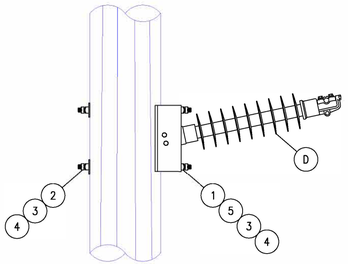
SECTION A
SHIELD
SCALE: N.T.S.





SECTION C
LOWER OPGW
SCALE: N.T.S.

SECTION B
69KV CONDUCTORS
SCALE: N.T.S.



DETAIL 1
JUMPER POST
SCALE: N.T.S.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY.
1	N.S.	ROD, FULL THREADED, 7/8" X 120", ASTM A307 GRADE B	D17120	PORTLAND BOLT	13919-10'	3
2	N.S.	WASHER, SQUARE, 4" X 1/4", 15/16" HOLE	W322	HUGHES	SCW4-80	6
3	47-0242	NUT, SQUARE, 7/8"	N107	HUGHES	N80	12
4	22-7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	12
5	N.S.	WASHER, ROUND, 2" X 1/4", 15/16" HOLE	W410	HUGHES	RW2-80	6

TYPICAL ADDITIONAL ASSEMBLIES (CALLED OUT SEPARATELY)

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T-4FDS	OPGW DEADEND ASSEMBLY - STEEL POLE	1
B	T-4DS	OHSW DEADEND ASSEMBLY - STEEL POLE	1
C	T-BDE6PD	CONDUCTOR DEADEND ASSEMBLY	6
D	T-SP1	69KV HORIZONTAL CLAMPTOP	3

*SEE NOTE 4

NOTES:
1. ONE (1) STICK OF 7/8" X 10'-0" THREADED ROD PER INSULATOR ATTACHMENT. CUT TO LENGTH.
2. SEE LOAD AND DESIGN DRAWINGS FOR STEEL DESIGN DETAILS.
3. SEE STEEL POLE MANUFACTURING DRAWINGS FOR STEEL POLE DETAILS.
4. CONDUCTOR ASSEMBLIES ARE SEPARATE UNITS.
5. BLUE ASSEMBLIES ARE CALLED OUT IN THE WEST RAPID CITY 230KV TRANSMISSION LINE.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
69KV INLINE DEADEND - 69KV UNDERBUILD

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: TCIDE-69UB-2

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

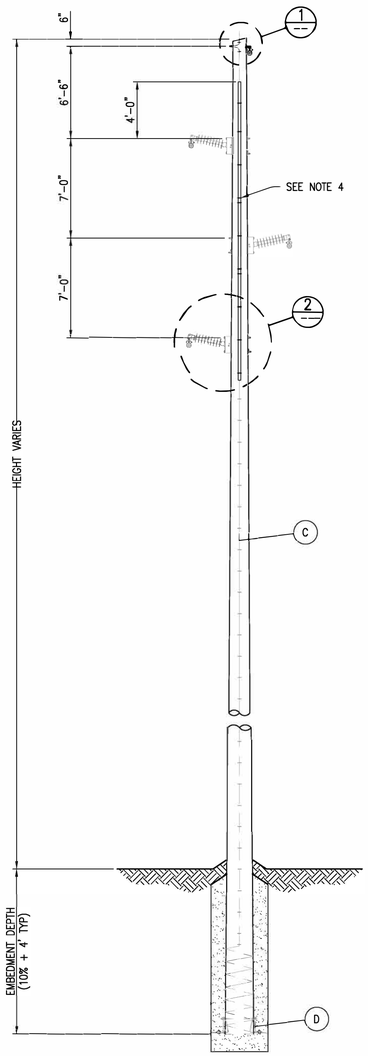
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

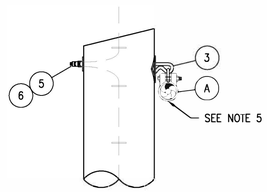
STRUCTURE DETAILS
69KV INLINE DEADEND
69KV UNDERBUILD
STR 15

0 1" 2"

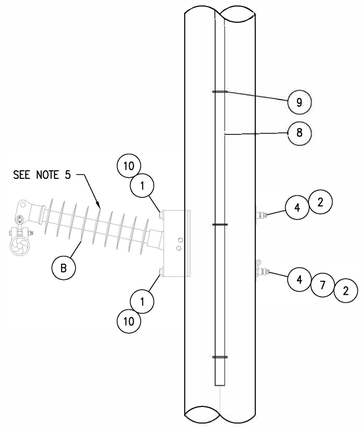
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SCALE: 3/16"=1'-0"
SHEET: SD-04-1



ELEVATION VIEW
SCALE: N.T.S.



DETAIL 1
SCALE: N.T.S.



DETAIL 2
SCALE: N.T.S.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	–	BOLT, MACHINE, 7/8" X REQ'D LENGTH	B270	HUGHES	–	6
1.1	20–7818	BOLT, MACHINE, 7/8" X 18"	B2718	HUGHES	B818–6	–
1.2	20–7820	BOLT, MACHINE, 7/8" X 20"	B2720	HUGHES	B820–6	–
1.3	20–7822	BOLT, MACHINE, 7/8" X 22"	B2722	HUGHES	B822–6	–
1.4	20–7824	BOLT, MACHINE, 7/8" X 24"	B2724	HUGHES	B824–6	–
2	22–7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	6
3	–	SHIELD WIRE SUPPORT, REQ'D LENGTH	F700	HUGHES	–	1
3.1	20–2412	SHIELD WIRE SUPPORT, 12" LENGTH	F700–2	HUGHES	2812.5–12–B1CL	–
3.2	20–2414	SHIELD WIRE SUPPORT, 14" LENGTH	F700–3	HUGHES	2812.5–14–B1CL	–
4	22–4425	WASHER, SQ. CURVED, 4" X 1/4", 15/16" HOLE	W504	HUGHES	SCW4–80	6
5	46–2726	CLIP, BONDING, FOR 5/8" DIA. BOLT, 5/16" MAX. WIRE	P205	HUGHES	2727.6	1
6	22–5800	NUT, SQUARE, 5/8"	N105	HUGHES	N60	1
7	N.S.	WASHER, SPRING, 15/16" HOLE	W207	HUGHES	2702.8	3
8	46–2503	MOULDING, GROUNDWIRE, 1–11/16" X 8'–0"	P300	HUGHES	2503.8	3
9	46–2504	MOULDING STAPLES, 1–3/4" X 3–1/2"	P400	HUBBELL	C2050222	15
10	N.S.	WASHER, ROUND, 2" X 1/4", 15/16" HOLE	W410	HUGHES	RW2–80	6

TYPICAL ADDITIONAL ASSEMBLIES (CALLED OUT SEPARATELY)

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T–4A	OHSW ATTACHMENT	1
B	T–PSD	69KV HORIZONTAL POST	3
C	TM–9	WOOD POLE GROUNDING ASSEMBLY	1
D	TP–A	POLE ANCHOR ASSEMBLY	1

TYPICAL BOLTS (QTY)*

ITEM NO.	POLE CLASS		
	2–1	H1–H2	H3–H4
1.1	4	2	–
1.2	2	2	2
1.3	–	2	2
1.4	–	–	2

*SEE NOTE 3

TYPICAL SHIELD WIRE SUPPORTS (QTY)*

ITEM NO.	POLE CLASS		
	2–1	H1–H2	H3–H4
3.1	1	–	–
3.2	–	1	1

*SEE NOTE 3

NOTES:

1. DRILLED HOLES SHALL BE 1/16" GREATER THAN THE SPECIFIED BOLT DIAMETER.
2. FIELD DRILLED HOLES SHALL BE THOROUGHLY TREATED.
3. BOLT LENGTHS AND STATIC WIRE SUPPORT LENGTHS ARE ESTIMATED BASED ON STANDARD CLASS DOUGLAS FIR POLE DIMENSIONS. ACTUAL POLE DIAMETERS MAY VARY.
4. WOOD MOULDING SHALL BE STAPLED TO THE POLE WITH (5) STAPLES PER 8'–0" MOULDING STICK. FIRST STAPLES 6" FROM BOTH ENDS.
5. STATIC/CONDUCTOR ASSEMBLIES ARE SEPARATE UNITS.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
69kV TANGENT POST

REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
SCHP

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

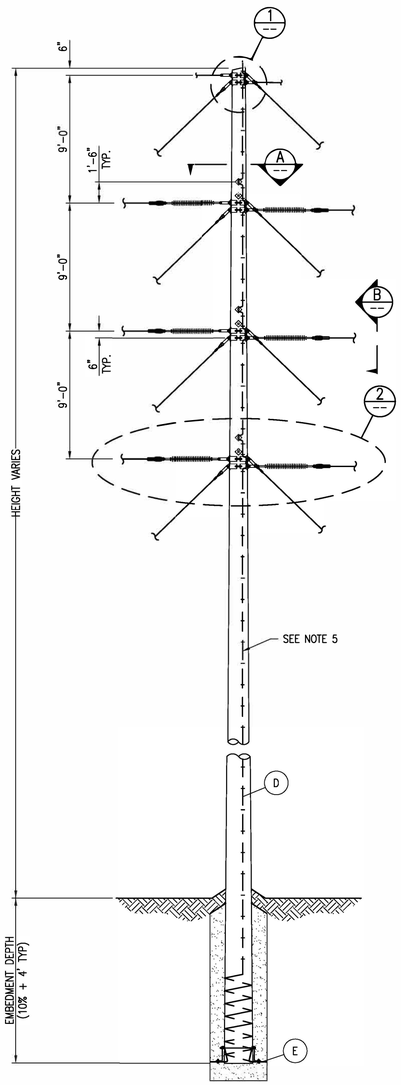
BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

STRUCTURE DETAILS
69KV TANGENT POST

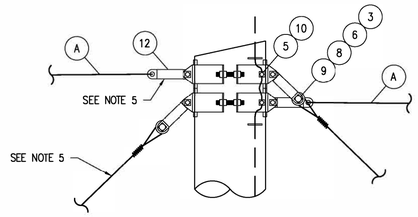
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SCALE 3/16"=1'–0"

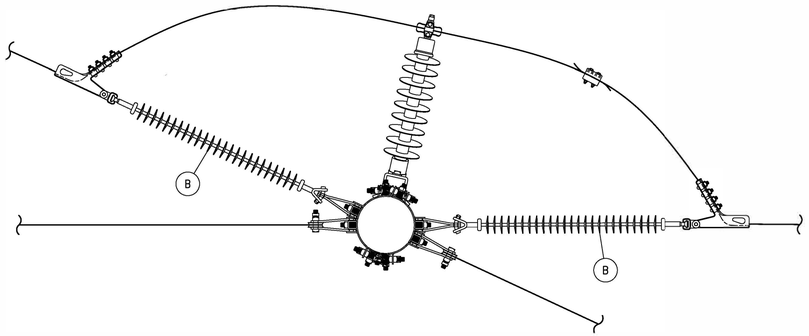
SHEET
SD-05-1



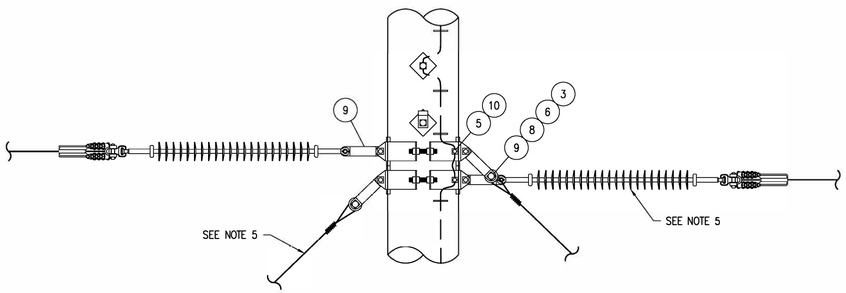
ELEVATION VIEW
SCALE: N.T.S.



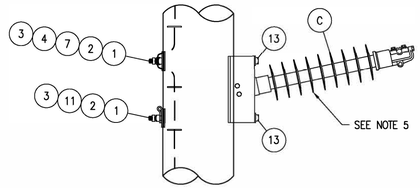
DETAIL 1
SHIELD ATTACHMENT
SCALE: N.T.S.



SECTION A
SCALE: N.T.S.



DETAIL 2
CONDUCTOR ATTACHMENT
SCALE: N.T.S.



VIEW B
JUMPER SUPPORT
SCALE: N.T.S.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY.
1	–	MACHINE BOLT, 7/8" X REQ'D LENGTH	B270	HUGHES	–	6
1.1	20–7818	MACHINE BOLT, 7/8" X 18"	B2718	HUGHES	B818–6	–
1.2	20–7820	MACHINE BOLT, 7/8" X 20"	B2720	HUGHES	B820–6	–
1.3	20–7822	MACHINE BOLT, 7/8" X 22"	B2722	HUGHES	B822–6	–
1.4	20–7824	MACHINE BOLT, 7/8" X 24"	B2724	HUGHES	B824–6	–
2	22–4425	WASHER, SQ. CURVED, 4" X 1/4", 15/16" HOLE	W504	HUGHES	SCW4–80	6
3	22–7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	14
4	47–0242	NUT, SQUARE, 7/8"	N107	HUGHES	N80	3
5	–	3108 POLE BANDS, HEAVY DUTY, REQ'D POLE DIAMETER	–	HUGHES	–	8
5.1	18–1116	3108 POLE BANDS, HEAVY DUTY, 7"–10" POLE	F110	HUGHES	3108.5	–
5.2	18–1117	3108 POLE BANDS, HEAVY DUTY, 9"–12" POLE	F111	HUGHES	3108.6	–
5.3	18–1118	3108 POLE BANDS, HEAVY DUTY, 11"–14" POLE	F112	HUGHES	3108.7	–
5.4	18–1119	3108 POLE BANDS, HEAVY DUTY, 13"–16" POLE	F113	HUGHES	3108.8	–
6	20–7803	BOLT, MACHINE, 7/8" X 3"	B273	HUGHES	B83–2	8
7	46–2728	CLIP, BONDING, FOR 7/8" DIA. BOLT, 5/16" MAX. WIRE	P207	HUGHES	2727.8	3
8	18–2808	GUY, ROLLER, 1 1/8" WR, 15/16" HOLE	G100	HUGHES	28082	8
9	14–3154	LINK, CONNECTING, 3/8" X 2" X 7 1/2", 15/16" HOLES, 38K LBS	F203	HUGHES	3154	28
10	46–2718	CLIP, BONDING, WITH 1/2" X 1 1/2" BOLT, 7/16" MAX. WIRE	P104	HUGHES	2718.55	8
11	N.S.	WASHER, SPRING, 15/16" HOLE	W207	HUGHES	2702.8	3
12	14–3152	LINK, CONNECTING, 1/4" X 2" X 7 1/2", 15/16" HOLES, 24K LBS	F201	HUGHES	3152	4
13	N.S.	WASHER, ROUND, 2" X 1/4", 15/16" HOLE	W410	HUGHES	RW2–80	6

TYPICAL ADDITIONAL ASSEMBLIES (CALLED OUT SEPARATELY)

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T–4DS	OHSW DEADEND ASSEMBLY	2
	T–4FDW	OPGW DEADEND ASSEMBLY	
B	T–BDE6PD	CONDUCTOR DEADEND ASSEMBLY – POLYMER	6
	T–BDE6D	CONDUCTOR DEADEND ASSEMBLY – BELLS	
C	T–SP1	CONDUCTOR JUMPER ASSEMBLY	3
D	TM–9	WOOD POLE GROUNDING ASSEMBLY	1
E	TP–A	POLE ANCHOR ASSEMBLY	1

TYPICAL BOLTS (QTY)*

ITEM NO.	POLE CLASS		
	2–1	H1–H2	H3–H4
1.1	4	–	–
1.2	2	4	–
1.3	–	2	4
1.4	–	–	2

*SEE NOTE 3

TYPICAL POLE BANDS (QTY)*

ITEM NO.	POLE CLASS		
	2–1	H1–H2	H3–H4
5.1	2	–	–
5.2	4	2	2
5.3	2	4	2
5.4	–	2	4

*SEE NOTE 3

NOTES:

1. DRILLED HOLES SHALL BE 1/16" GREATER THAN THE SPECIFIED BOLT DIAMETER.
2. FIELD DRILLED HOLES SHALL BE THOROUGHLY TREATED.
3. BOLT LENGTHS AND POLE BAND DIAMETERS ARE ESTIMATED BASED ON STANDARD CLASS DOUGLAS FIR POLE DIMENSIONS. ACTUAL POLE DIAMETERS MAY VARY.
4. BOND ALL HARDWARE TO POLE GROUND UNIT.
5. POLE GROUND, GUYS, ANCHORS, POLE ANCHORS, JUMPER SUPPORT, AND STATIC/CONDUCTOR ASSEMBLIES ARE SEPARATE UNITS.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
69kV SINGLE CIRCUIT DEADEND
LIGHT TO HEAVY ANGLE WITH POST

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: SCDE-69

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

STRUCTURE DETAILS
69KV SINGLE CIRCUIT DEADEND

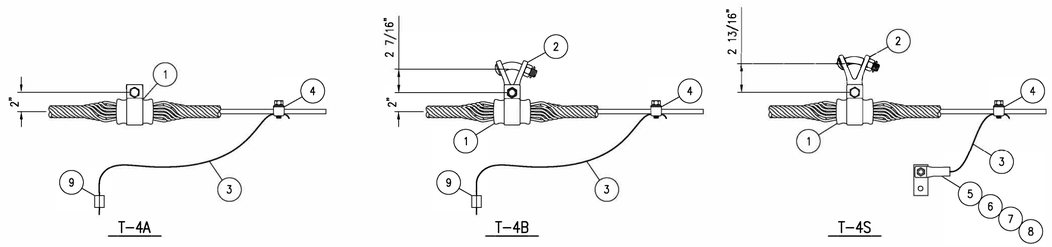
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FILENAME: BHE–SD–06–D–1.DWG
SCALE: 3/16"=1'–0"
SHEET: SD-06-1

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4A QTY	T-4B QTY	T-4S QTY
1	40-7104	AGS SUSPENSION ASSY, 15K, 3/8" EHS	K400	PREFORMED	AGS-7104	1	1	1
2	48-5207	Y-CLEVIS - EYE, 90, 20K	H901	ANDERSON	YCS-05-90		1	1
3	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			2'	2'	6'
4	46-6810	CLAMP, SINGLE BOLT, VISE TYPE, 3/8" EHS TO #2 STR CU	Q550	HUBBELL	GA9020GLSS	1	1	1
5	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012			1
6	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207			1
7	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS			1
8	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD			1
9	36-0002	GROUND CLAMP, #2 STRANDED TO #4 SOLID	Q501	HOMAC	CC24	1	1	

*MAX. LINE ANGLE = 30°



OHSW SUSPENSION
3/8" EHS 7 STRAND GALV.

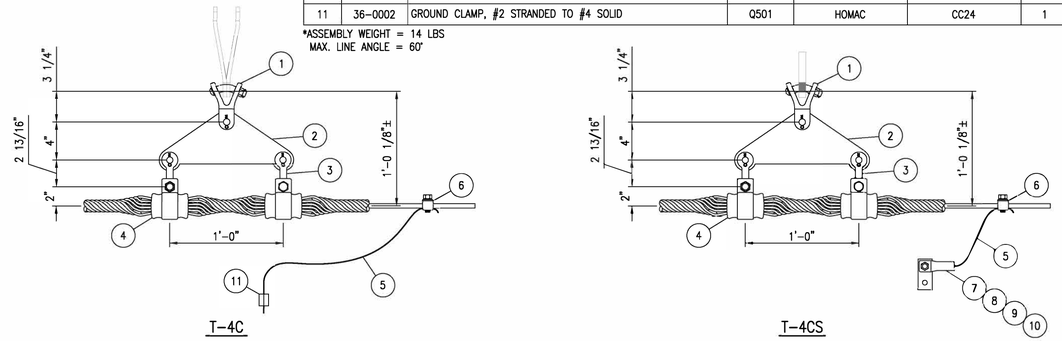
SHEET TITLE
TRANSMISSION ASSEMBLY
OHSW ATTACHMENT

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4A,B,S

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4C QTY	T-4CS QTY
1	48-5208	Y-CLEVIS, CLEVIS, 90, 3 1/4" LONG, 3/4" PIN, 30K	H801	HUBBELL	YCC3090	1	1
2	48-8510	AGS YOKE PLATE, 12" SPACING, 1/2" PLATE, 30K	H700	PREFORMED	YP-5907	1	1
3	48-5206	Y-CLEVIS, EYE, 20K	H900	ANDERSON	YCS-05	2	2
4	40-7804	AGS DOUBLE SUSPENSION ASSEMBLY, 15K, 3/8" EHS	K401	PREFORMED	AGS-7804	1	1
5	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			2'	6'
6	46-6810	CLAMP, SINGLE BOLT, VISE TYPE, 3/8" EHS TO #2 STR CU	Q550	HUBBELL	GA9020GLSS	1	1
7	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012		1
8	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207		1
9	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS		1
10	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD		1
11	36-0002	GROUND CLAMP, #2 STRANDED TO #4 SOLID	Q501	HOMAC	CC24	1	

*ASSEMBLY WEIGHT = 14 LBS
MAX. LINE ANGLE = 60°



OHSW DOUBLE SUSPENSION
3/8" EHS 7 STRAND GALV.

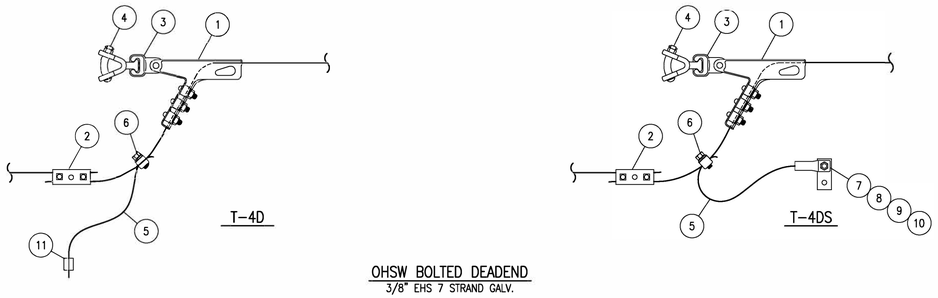
SHEET TITLE
TRANSMISSION ASSEMBLY
OHSW DOUBLE SUSPENSION

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4C

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4D QTY	T-4DS QTY
1	44-4053	STRAIN CLAMP, DE, 20K, 3/8" EHS	L300	HUBBELL	SWDE55N	1	1
2	18-5816	CLAMP, 3-BOLT, 6" LONG, 5/8" BOLT, 5/16" - 1/2" RANGE	Q100	MACLEAN	J931	1	1
3	N.S.	SOCKET EYE, 18K, 1/2" WIDTH, 11/16" HOLE, 2-1/16" LENGTH	H102	HUBBELL	SA04	1	1
4	48-3054	Y-CLEVIS BALL, 30K	H500	HUBBELL	YBC30	1	1
5	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			2'	6'
6	46-6810	CLAMP, SINGLE BOLT, VISE TYPE, 3/8" EHS TO #2 STR CU	Q550	HUBBELL	GA9020GLSS	1	1
7	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012		1
8	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207		1
9	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS		1
10	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD		1
11	36-0002	GROUND CLAMP, #2 STRANDED TO #4 SOLID	Q501	HOMAC	CC24	1	

*ONE ITEM (2) WILL BE REQUIRED FOR EVERY TWO ASSEMBLIES



OHSW BOLTED DEADEND
3/8" EHS 7 STRAND GALV.

SHEET TITLE
TRANSMISSION ASSEMBLY
OHSW DEADEND

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4D(S)

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
OHSW ASSEMBLIES

0 1" 2"

FILENAME BHE-AD-01-D-1.DWG
SCALE N.T.S.

SHEET
AD-01-1

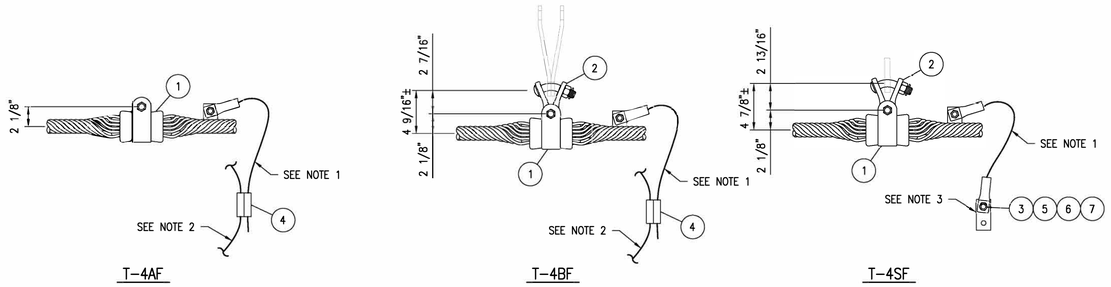
NOTES:

1. #4 STRANDED COPPER WITH CONNECTOR AND BOLTS. FURNISHED WITH ITEM 1.
2. WOOD POLE GROUND.
3. STEEL POLE NEMA PAD.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4AF QTY	T-4BF QTY	T-4SF QTY
1	N.S.	FIBERLIGN SUSPENSION ASSY, W/ GROUNDWIRE	J200	PREFORMED	4300104G	1	1	1
2	48-5207	Y-CLEVIS - EYE, 90, 20K	H901	ANDERSON	YCS-05-90		1	1
3	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012			1
4	N.S.	CONNECTOR, COMPRESSION #4 COPPER TO #4 COPPER	Q500	HOMAC	CC44	1	1	
5	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207			1
6	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS			1
7	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD			1

*MAX. LINE ANGLE = 30°



T-4AF T-4BF T-4SF

OPGW SUSPENSION
0.443" OPGW CABLE

SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW ATTACHMENT

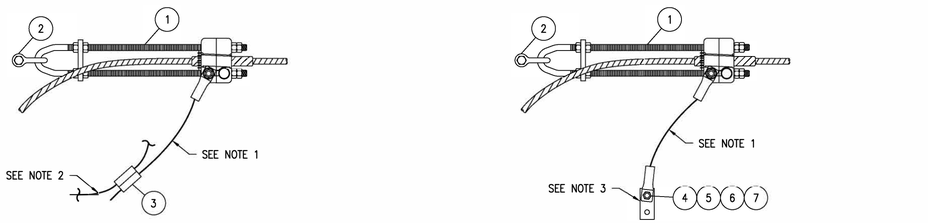
REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4F

NOTES:

1. #4 STRANDED COPPER WITH CONNECTOR AND BOLTS. FURNISHED WITH ITEM 1.
2. WOOD POLE GROUND.
3. STEEL POLE NEMA PAD.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4FDW QTY	T-4FDS QTY
1	N.S.	FIBER OPTIC DEADEND, 18" U-BOLT (48 FIBER), W/GROUNDWIRE	J300	PREFORMED	2801303G	1	1
2	N.S.	ANCHOR, SHACKLE, 3" LONG, 3/4" DIA., 7/8" DIA. PIN, 35K LBS	H602	HUGHES	2865-B3	1	1
3	N.S.	CONNECTOR, COMPRESSION #4 COPPER TO #4 COPPER	Q500	HOMAC	CC44	1	
4	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012		1
5	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207		1
6	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS		1
7	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD		1



T-4FDW T-4FDS

OPGW DEADEND
0.443" OPGW CABLE

SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW DEADEND

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4FD

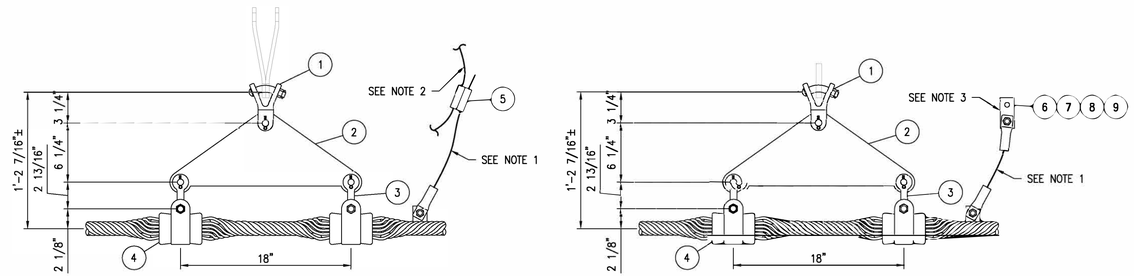
NOTES:

1. #4 STRANDED COPPER WITH CONNECTOR AND BOLTS. FURNISHED WITH ITEM 1.
2. WOOD POLE GROUND.
3. STEEL POLE NEMA PAD.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4FC QTY	T-4FCS QTY
1	48-5208	Y-CLEVIS, CLEVIS, 90, 3 1/4" LONG, 3/4" PIN, 30K	H801	HUBBELL	YCC3090	1	
2	48-8510	AGS YOKE PLATE, 18" SPACING, 1/2" PLATE, 30K	H702	HUGHES	AS2585-Z	1	1
3	48-5206	Y-CLEVIS, EYE, 20K	H900	ANDERSON	YCS-05	2	2
4	N.S.	FIBERLIGN DOUBLE SUSPENSION ASSY, W/ GROUNDWIRE	J201	PREFORMED	4300204G	1	1
5	N.S.	CONNECTOR, COMPRESSION #4 COPPER TO #4 COPPER	Q500	HOMAC	CC44	1	
6	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012		1
7	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207		1
8	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS		1
9	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD		1

*MAX. LINE ANGLE = 60°



T-4FC T-4FCS

OPGW DOUBLE SUSPENSION
0.433" OPGW CABLE

SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW DOUBLE SUSPENSION

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4FC

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
OPGW ASSEMBLIES

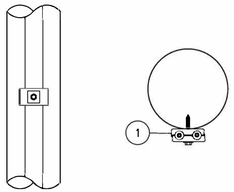
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SCALE N.T.S.
SHEET **AD-02-1**

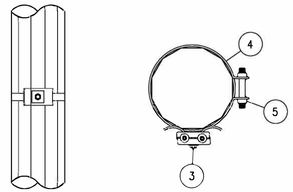
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-FDL-W QTY	T-FDL-S1 QTY	T-FDL-S2 QTY
1	N.S.	DOWNLEAD CUSHION KIT 0.443 OPGW W/ HARDWARE FOR WOOD POLE	J401	PREFORMED	8003041-H1	1	–	–
2	N.S.	DOWNLEAD CUSHION KIT, 0.443" OPGW W/ 1/2" -13 X 3" MOUNTING KIT	J403	PREFORMED	8003041-H3	–	–	1
3	N.S.	DOWNLEAD CUSHION KIT, 0.443" OPGW W/ BANDING BRACKET	J402	PREFORMED	8003041-B1	–	1	–
4	N.S.	BOLT-A-BAND, 3/4" X REQ'D LENGTH	J950	ALUMA-FORM	3/4-201-SSB-100	–	10'	–
5	N.S.	BUCKLE, BANDING, FOR 3/4" BANDING	J951	ALUMA-FORM	BAB-38	–	1	–

NOTES:

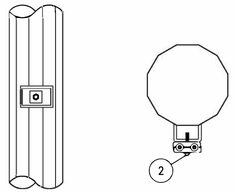
1. OPGW CONTINUOUS TO SPLICE BOX.
2. UNIT CONSISTS OF ONE DOWNLEAD CUSHION INSTALLED. SPECIFIC QUANTITY REQUIRED WILL VARY WITH STRUCTURE HEIGHT.



T-FDL-W
WOOD POLE



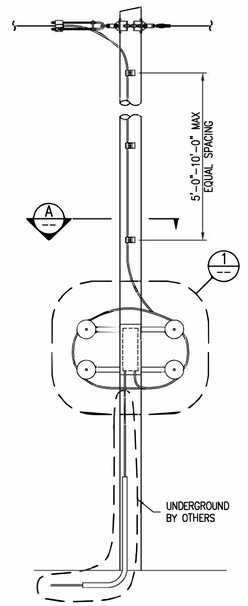
T-FDL-S1
STEEL POLE-BANDED



T-FDL-S2
STEEL POLE - BOLTED

SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW DOWNLEAD

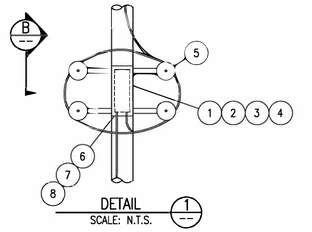
REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-FDL

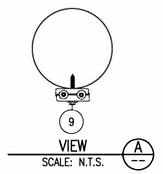


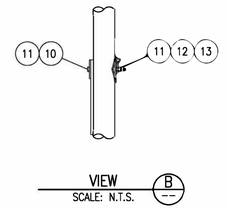
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	6" X 22" COYOTE CLOSURE KIT W/ 6 PORT END PLATE	J510	PREFORMED	8006659	1
2	N.S.	SPLICE TRAY KIT, 36 COUNT TRAY	J600	PREFORMED	80805514	2
3	N.S.	VERTICAL MOUNTING BRACKET KIT	J502	PREFORMED	8003472	1
4	N.S.	COYOTE DEFENDER FOR 6"X 22" CLOSURE	J511	PREFORMED	8003492	1
5	N.S.	VERTICAL CABLE STORAGE ASSEMBLY	J501	PREFORMED	8003569	1
6	N.S.	CLOSURE END PLATE GROMMETS, 7/8" PORT, 0.443" OPGW	J700	PREFORMED	8003597	1
7	N.S.	FUTURE CABLE PORT KIT, 7/8" PORT	J720	PREFORMED	8003371	3
8	N.S.	GROMMET PLUG, 3/4" PORT, QTY 2	J730	PREFORMED	80806037	1
9	N.S.	DOWNLEAD CUSHION KIT 0.443 OPGW W/ HARDWARE FOR WOOD POLE	J401	PREFORMED	8003041-H1	10
10	N.S.	BOLT, MACHINE, 5/8" X REQ'D LENGTH	B250	HUGHES	–	2
11	N.S.	WASHER, SQUARE, 2" X 1/4", 11/16"	W304	HUGHES	SW2-60	4
12	N.S.	WASHER, SPRING, 11/16" HOLE	W205	HUGHES	2702.6	2
13	N.S.	NUT, LOCK, MF TYPE, 5/8"	N405	HUGHES	MF60	2

NOTES:

1. SEE T-FDL FOR MORE DETAIL.
2. OPGW CONTINUOUS TO SPLICE BOX.
3. COIL 50 FEET OF OPGW AROUND COIL BRACKET ON DOWNLEAD.







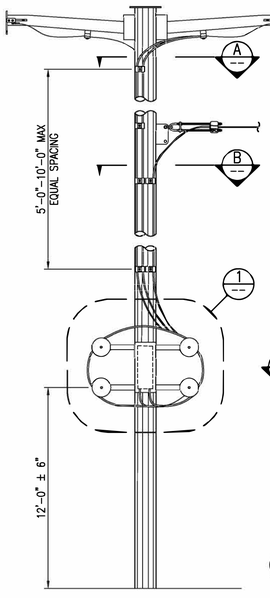
SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW SPLICE CASE - 1 OPGW
WOOD POLE

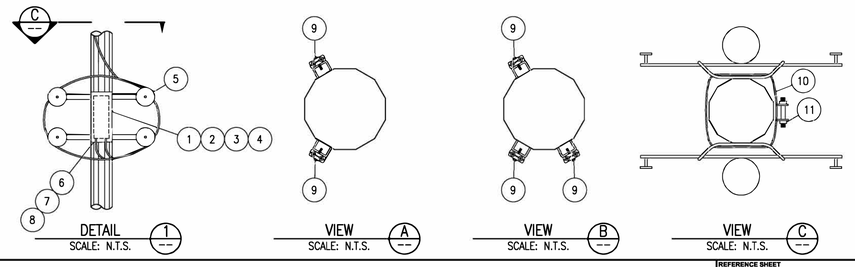
REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-FSC-1

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	6" X 22" COYOTE CLOSURE KIT W/ 6 PORT END PLATE	J510	PREFORMED	8006659	2
2	N.S.	SPLICE TRAY KIT, 36 COUNT TRAY	J600	PREFORMED	80805514	6
3	N.S.	VERTICAL MOUNTING BRACKET KIT	J502	PREFORMED	8003472	2
4	N.S.	COYOTE DEFENDER FOR 6"X 22" CLOSURE	J511	PREFORMED	8003492	2
5	N.S.	VERTICAL CABLE STORAGE ASSEMBLY	J501	PREFORMED	8003569	2
6	N.S.	CLOSURE END PLATE GROMMETS, 7/8" PORT, 0.443" OPGW	J700	PREFORMED	8003597	5
7	N.S.	FUTURE CABLE PORT KIT, 7/8" PORT	J720	PREFORMED	8003371	3
8	N.S.	GROMMET PLUG, 3/4" PORT, QTY 2	J730	PREFORMED	80806037	2
9	N.S.	DOWNLEAD CUSHION KIT, 0.443 OPGW W/ 1/2"-13 X 3" MOUNTING KIT	J403	PREFORMED	8003041-H3	40
10	N.S.	BOLT-A-BAND, 3/4" X REQ'D LENGTH	J950	ALUMA-FORM	3/4-201-SSB-100	60'
11	N.S.	BUCKLE, BANDING, FOR 3/4" BANDING	J951	ALUMA-FORM	BAB-38	2

NOTES:

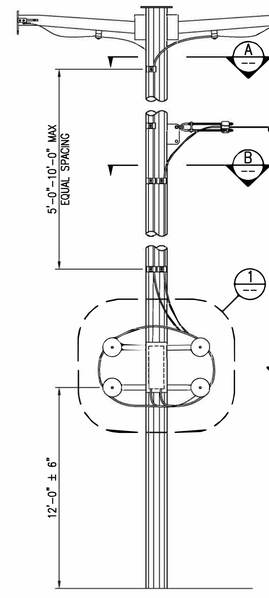
1. OPGW CONTINUOUS TO SPLICE BOX.
2. COIL 50 FEET OF OPGW AROUND COIL BRACKET ON DOWNLEAD.

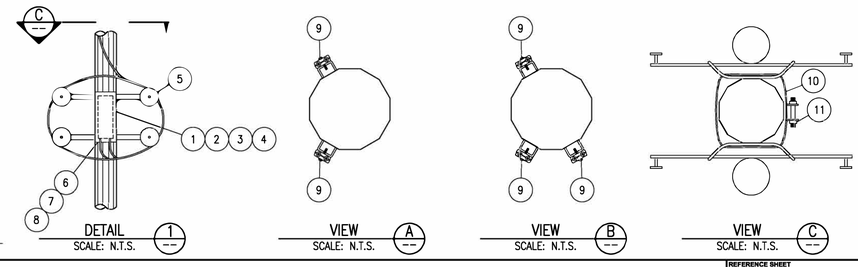




SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW SPLICE CASE - STEEL POLE
DOUBLE CIRCUIT - TWO SPLICE CASES

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-FSCS-M2





SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW SPLICE CASE - STEEL POLE
DOUBLE CIRCUIT - TWO SPLICE CASES

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-FSCS-M3

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
OPGW SPLICE DETAILS

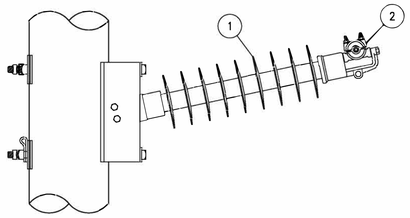
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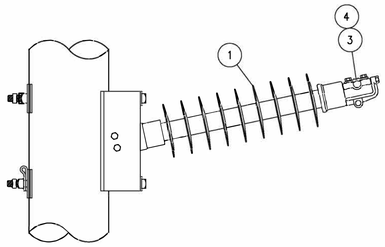
SHEET
AD-03-1

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-SP-B QTY	T-SP1-B QTY
1	N.S.	INSULATOR, HORIZONTAL POST, CLAMPTOP, 69KV	I250	HUBBELL	P250043S1020	1	1
2	N.S.	AGS SUPPORT ASSEMBLY, 336.4 KCMIL 26/7 ACSR "LINNET"	K351	PREFORMED	AGS-5212	1	–
3	N.S.	CLAMP, TRUNNION, 336.4 KCMIL 26/7 ACSR "LINNET", 2,800 LBS	K301	HUBBELL	TSC106	–	1
4	N.S.	INHIBITOR, RUST (NO-OX-ID), 1 PT CAN, GRADE "A"	O102	SANCHEM INC	NO-OX-ID "A" SPECIAL	–	0.06



CONDUCTOR SUPPORT T-SP-B
336.4 ACSR – 26/7 "LINNET"



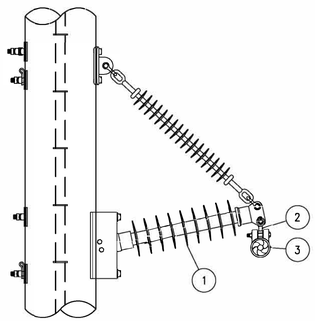
JUMPER SUPPORT T-SP1-B
336.4 ACSR – 26/7 "LINNET"

SHEET TITLE
TRANSMISSION ASSEMBLY
69kV HORIZONTAL CLAMPTOP
336.4 ACSR - 26/7 "LINNET"

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-SP(1)-B

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	INSULATOR, HORIZONTAL BRACED POST ASSEMBLY, 69KV	I200	HUBBELL	BLP043G1200	1
2	3053	Y-CLEVIS, EYE, 90, 40K	H902	HUBBELL	YCS-06-90-40	1
3	40-5112	AGS SUPSENSION ASSEMBLY, 25K, 336.4 ACSR – 26/7 "LINNET"	K504	PREFORMED	AGS-5112	1



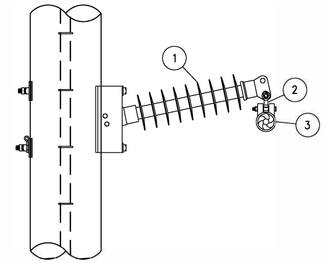
69kV BRACED POST ASSEMBLY
336.4 ACSR – 26/7 "LINNET"

SHEET TITLE
TRANSMISSION ASSEMBLY
69kV BRACED POST ASSEMBLY
336.4 ACSR - 26/7 "LINNET"

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-BPB

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	INSULATOR, HORIZONTAL POST, DROP TONGUE, 69KV	I220	HUBBELL	P250043S0020	1
2	48-5207	Y-CLEVIS, EYE, 90, 20K	H901	HUBBELL	YCS-05-90	1
3	40-5112	AGS SUPSENSION ASSEMBLY, 25K, 336.4 ACSR – 26/7 "LINNET"	K504	PREFORMED	AGS-5112	1



69kV HORIZONTAL POST
336.4 ACSR – 26/7 "LINNET"

SHEET TITLE
TRANSMISSION ASSEMBLY
69kV HORIZONTAL POST
336.4 ACSR - 26/7 "LINNET"

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-PSB

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

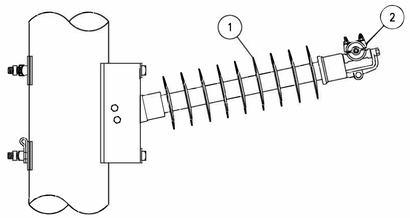
ASSEMBLY DETAILS
POST INSULATOR ASSEMBLIES
336.4 KCMIL 26/7 ACSR "LINNET"

0 1" 2"

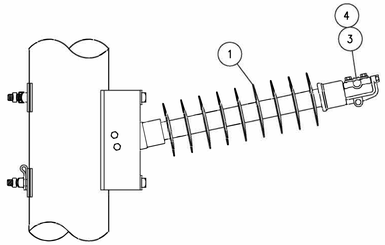
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SCALE N.T.S.

SHEET
AD-04-1

LIST OF MATERIALS							
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-SP QTY	T-SP1 QTY
1	N.S.	INSULATOR, HORIZONTAL POST, CLAMPTOP, 69KV	I250	HUBBELL	P250043S1020	1	1
2	N.S.	AGS SUPPORT ASSEMBLY, 795 KCMIL 45/7 ACSR "TERN"	K350	PREFORMED	AGS-5227	1	–
3	48-7020	CLAMP, TRUNNION, 795 KCMIL 45/7 ACSR "TERN", 2,800 LBS	K300	HUBBELL	TSC150	–	1
4	N.S.	INHIBITOR, RUST (NO-OX-ID), 1 PT CAN, GRADE "A"	O102	SANCHEM INC	NO-OX-ID "A" SPECIAL	–	0.06



CONDUCTOR SUPPORT T-SP
795 ACSR-45/7 "TERN"

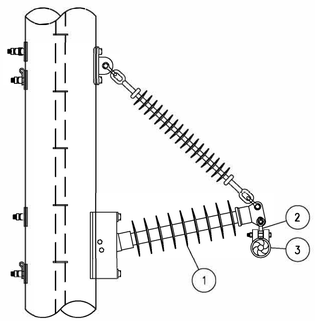


JUMPER SUPPORT T-SP1
795 ACSR-45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
69kV HORIZONTAL CLAMPTOP
795 ACSR - 45/7 "TERN"

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-SP(1)

LIST OF MATERIALS						
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	INSULATOR, HORIZONTAL BRACED POST ASSEMBLY, 69KV	I200	HUBBELL	BLP043G1200	1
2	48-3053	Y-CLEVIS, EYE, 90, 40K	H902	HUBBELL	YCS-06-90-40	1
3	40-5114	AGS SUPSENSION ASSEMBLY, 25K, 795 ACSR-45/7 "TERN"	K500	PREFORMED	AGS-5128	1

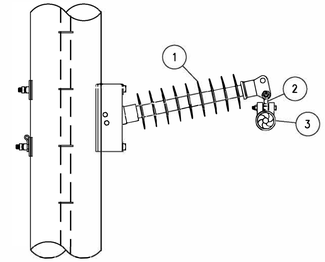


69kV BRACED POST ASSEMBLY
795 ACSR-45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
69kV BRACED POST ASSEMBLY
795 ACSR - 45/7 "TERN"

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-BPD

LIST OF MATERIALS						
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	INSULATOR, HORIZONTAL POST, DROP TONGUE, 69KV	I220	HUBBELL	P250043S0020	1
2	48-3053	Y-CLEVIS, EYE, 90, 40K	H902	HUBBELL	YCS-06-90-40	1
3	40-5114	AGS SUPSENSION ASSEMBLY, 25K, 795 ACSR-45/7 "TERN"	K500	PREFORMED	AGS-5128	1



69kV HORIZONTAL POST
795 ACSR-45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
69kV HORIZONTAL POST
795 ACSR - 45/7 "TERN"

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-PSD

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
POST INSULATOR ASSEMBLIES
795 KCMIL 45/7 ACSR "TERN"

0 1" 2"

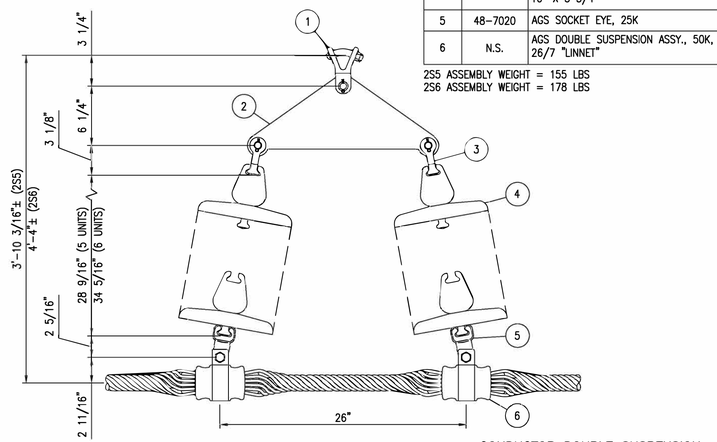
FILENAME BHE-AD-04-D-2.DWG
SCALE N.T.S.

SHEET
AD-04-2

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-2S5B QTY	T-2S6B QTY
1	48-5208	Y-CLEVIS, CLEVIS, 90°, 3 1/4" LONG, 3/4" PIN, 30K	H801	HUBBELL	YCC3090	1	1
2	N.S.	AGS YOKE PLATE, 18" SPACING, 5/8" PLATE, 40K	H701	PREFORMED	YP-5908	1	1
3	48-3055	BALL CLEVIS, 30K	H550	HUBBELL	BC30	2	2
4	40-0027	GLASS INSULATOR, 22K LB, M&E, ANSI CL 52-3, 10" X 5 3/4"	I100	SEDIVER	N100/146	10	12
5	48-7020	AGS SOCKET EYE, 25K	H100	PREFORMED	SE-5154	2	2
6	N.S.	AGS DOUBLE SUSPENSION ASSY., 50K, 336.4 ACSR 26/7 "LINNET"	K505	PREFORMED	AGS-5813	1	1

2S5 ASSEMBLY WEIGHT = 155 LBS
2S6 ASSEMBLY WEIGHT = 178 LBS



CONDUCTOR DOUBLE SUSPENSION
336.4 ACSR – 26/7 "LINNET"
MAX. LINE ANGLE = 60°

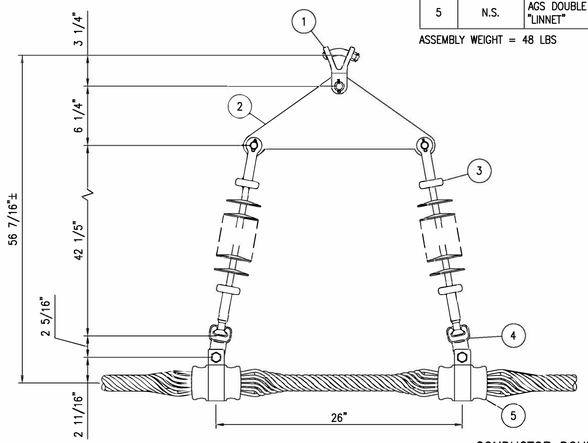
SHEET TITLE
TRANSMISSION ASSEMBLY
CONDUCTOR DOUBLE SUSPENSION
PORCELAIN

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-2S5B,2S6B

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48-5208	Y-CLEVIS, CELVIS, 90°, 30K	H801	HUBBELL	YCC3090	1
2	N.S.	AGS YOKE PLATE, 18" SPACING, 5/8" PLATE, 40K	H701	PREFORMED	YP-5908	1
3	48-6925	INSULATOR, SUSPENSION, Y-CLEVIS BALL, 42.2" LENGTH, 25K	I111	MACLEAN	S14080031MXAL019	2
4	48-7020	AGS SOCKET EYE, 25K	H100	PREFORMED	SE-5154	2
5	N.S.	AGS DOUBLE SUSPENSION ASSY., 50K, 336.4 ACSR 26/7 "LINNET"	K505	PREFORMED	AGS-5813	1

ASSEMBLY WEIGHT = 48 LBS



CONDUCTOR DOUBLE SUSPENSION
336.4 ACSR – 26/7 "LINNET"
MAX. LINE ANGLE = 60°

SHEET TITLE
TRANSMISSION ASSEMBLY
CONDUCTOR DOUBLE SUSPENSION
POLYMER

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-2SPB2

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
RUNNING ANGLE
SUSPENSION INSULATOR ASSEMBLIES
336.4 KCMIL 26/7 ACSR "LINNET"

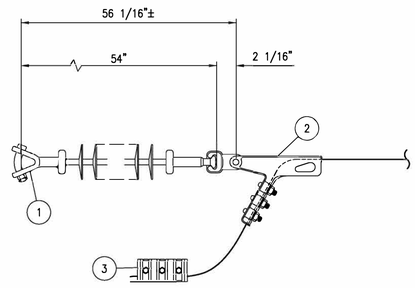
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FILENAME BHE-AD-05-D-1.DWG
SCALE N.T.S.

SHEET
AD-05-1

LIST OF MATERIALS						
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48-6927	INSULATOR, DEADEND, Y-CLEVIS BALL, 54" LENGTH, 25K	I300	MACLEAN	S14080042MXAL027	1
2	42-0087	STRAIN CLAMP, DEADEND W/ SOCKET-EYE, 30K, 0.50 - 1.20 RANGE	L100	HUBBELL	SD98S	1
3	42-0482	PARALLEL GROOVE CONNECTOR, 0.743 - 1.152 RANGE	Q600	AFL	482.2P	1

*ONE ITEM (3) WILL BE REQUIRED FOR EVERY TWO ASSEMBLIES



CONDUCTOR BOLTED DEADEND
336.4 ACSR - 26/7 "LINNET"

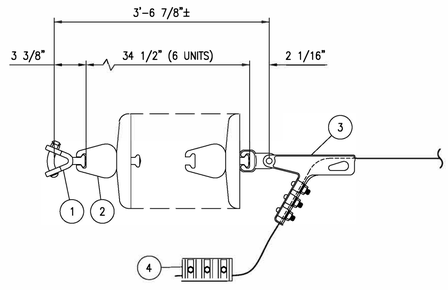
SHEET TITLE
TRANSMISSION ASSEMBLY
CONDUCTOR BOLTED DEADEND
POLYMER

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-BDE6PB

LIST OF MATERIALS						
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48-3054	Y-CLEVIS, BALL, 30K	H500	HUBBELL	YBC30	1
2	N.S.	GLASS INSULATOR, 30K LB, M&E, ANSI CL 52-5, 10" X 5 3/4"	I102	SEDIVER	N14/146	6
3	42-0087	STRAIN CLAMP, DEADEND W/ SOCKET-EYE, 30K, 0.50 - 1.20 RANGE	L100	HUBBELL	SD98S	1
4	42-0482	PARALLEL GROOVE CONNECTOR, 0.743 - 1.152 RANGE	Q600	AFL	482.2P	1

*ONE ITEM (4) WILL BE REQUIRED FOR EVERY TWO ASSEMBLIES

ASSEMBLY WEIGHT = 75 LBS

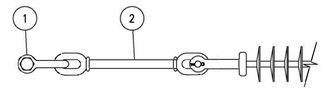


CONDUCTOR BOLTED DEADEND
336.4 ACSR - 26/7 "LINNET"

SHEET TITLE
TRANSMISSION ASSEMBLY
CONDUCTOR BOLTED DEADEND

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-BDE6B

LIST OF MATERIALS						
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	ANCHOR SHACKLE, 3.5" LONG, 7/8" DIA, 3/4" PIN, 60K LBS	H603	HUBBELL	AS50BNK	1
2	N.S.	HOT LINK EXTENSION, CHAIN EYE - CHAIN EYE, 15" LONG, 30K LBS	H400	HUBBELL	H003015	1



TM-EXT-15
15" EXTENSION LINK

SHEET TITLE
TRANSMISSION ASSEMBLY
15" EXTENSION LINK

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TM-EXT-15

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
DEADEND INSULATOR ASSEMBLIES
336.4 KCMIL 26/7 ACSR "LINNET"

0 1" 2"

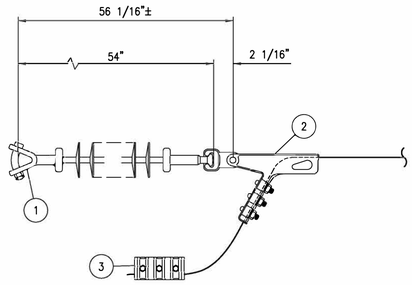
FILENAME BHE-AD-06-D-1.DWG
SCALE N.T.S.

SHEET **AD-06-1**

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48–6927	INSULATOR, DEADEND, Y–CLEVIS BALL, 54" LENGTH, 25K	I300	MACLEAN	S14080042MXAL027	1
2	42–1120	STRAIN CLAMP, DEADEND W/ SOCKET–EYE, 30K, 0.50 – 1.20 RANGE	L101	HUBBELL	SD112S	1
3	42–0483	PARALLEL GROOVE CONNECTOR, 0.743 – 1.152 RANGE	Q601	AFL	483.3P	1

*ONE ITEM (3) WILL BE REQUIRED FOR EVERY TWO ASSEMBLIES



CONDUCTOR BOLTED DEADEND
795 ACSR–45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
CONDUCTOR BOLTED DEADEND
POLYMER

REFERENCE SHEET
1 OF 1

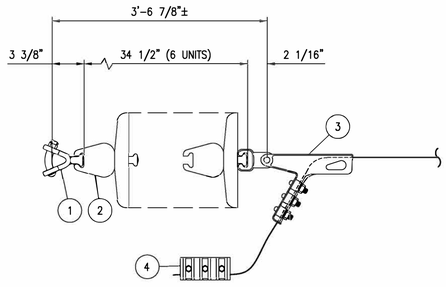
EXHIBIT NUMBER
T-BDE6PD

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48–3054	Y–CLEVIS, BALL, 30K	H500	HUBBELL	YBC30	1
2	N.S.	GLASS INSULATOR, 30K LB, M&E, ANSI CL 52–5, 10" X 5 3/4"	I102	SEDIVER	N14/146	6
3	42–1120	STRAIN CLAMP, DEADEND W/ SOCKET–EYE, 30K, 0.50 – 1.20 RANGE	L101	HUBBELL	SD112S	1
4	42–0483	PARALLEL GROOVE CONNECTOR, 0.743 – 1.152 RANGE	Q601	AFL	483.3P	1

*ONE ITEM (4) WILL BE REQUIRED FOR EVERY TWO ASSEMBLIES

ASSEMBLY WEIGHT = 75 LBS



CONDUCTOR BOLTED DEADEND
795 ACSR–45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
CONDUCTOR BOLTED DEADEND

REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
T-BDE6D

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
DEADEND INSULATOR ASSEMBLIES
795 KCMIL 45/7 ACSR "TERN"

0 1" 2"

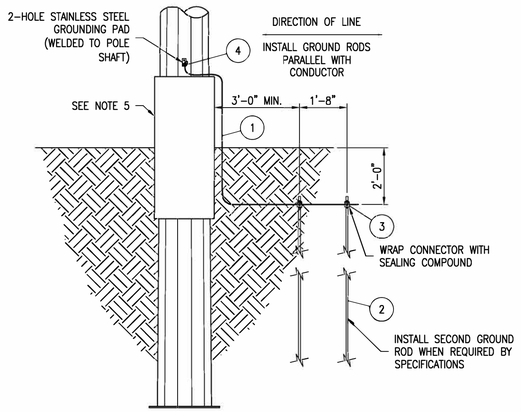
FILENAME BHE–AD–06–D–2.DWG

SCALE N.T.S.

SHEET **AD-06-2**

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			10'
2	46-0588	ROD, GROUND, 5/8" X 8'-0", COPPERCLAD	P500	GALVAN	6260G13	1
3	46-0058	CLAMP, GROUND ROD, 0.128 TO 0.460 RANGE, 5/8" ROD	P701	CHANCE	C2030344	1
4	N.S.	CLAMP, VISE TYPE, LIGHTNING ARRESTOR GROUND, #2 STRANDED	P820	HUBBELL	GC207	1



STEEL POLE GROUNDING DETAIL
SCALE: N.T.S.

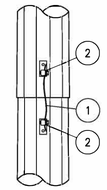
SPECIFICATIONS FOR DRIVEN GROUND ROD INSTALLATION:

1. INSTALL 8'-0" OF GROUND ROD AND TEST THE RESISTANCE LEVEL. WHEN RESISTANCE IS 25Ω OR LESS, NO ADDITIONAL STEPS ARE NEEDED.
2. IF RESISTANCE IS 25Ω OR GREATER, INSTALL AN ADDITIONAL 8'-0" OF GROUND ROD AS SHOWN:
   - TEST RESISTANCE WITH 1ST ROD CONNECTED TO 2ND ROD WITH #2 CU FOR COMBINED PARALLEL RESISTANCE VALUE. RECORD RESISTANCE VALUE.
3. AFTER DRIVING TWO (2) GROUND RODS AS NOTED ABOVE AND THE COMBINED RESISTANCE IS 25Ω OR GREATER, THE ELECTRICAL ENGINEERING DEPARTMENT SHOULD BE CONSULTED FOR FURTHER ACTION.
4. BOND STATIC WIRE TO POLE GROUND, USE FARGO CONNECTOR (ITEM #5).
5. GROUNDING THE SAME FOR STEEL POLE ON CONCRETE PIER FOUNDATIONS.

SHEET TITLE: **TRANSMISSION ASSEMBLY STEEL POLE GROUNDING**
REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: TM-9ST

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			4'
2	N.S.	CLAMP, VISE TYPE, LIGHTNING ARRESTOR GROUND, #2 STRANDED	P820	HUBBELL	GC207	2

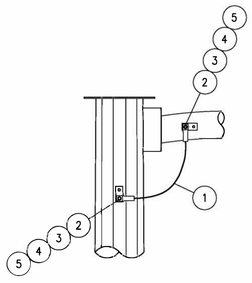


TM-9SSJ
SLIP JOINT
SCALE: N.T.S.

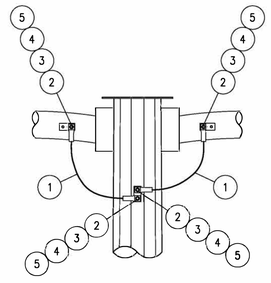
SHEET TITLE: **TRANSMISSION ASSEMBLY STEEL POLE SLIP JOINT GROUNDING**
REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: TM-9SSJ

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	9SD-1	9SD-2
1	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			5'	10'
2	N.S.	COMPRESSION TERMINAL, COPPER, #6 – 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012	2	4
3	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207	2	4
4	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS	2	4
5	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD	2	4



TM-9SD-1
SINGLE DAVIT GROUNDING
SCALE: N.T.S.

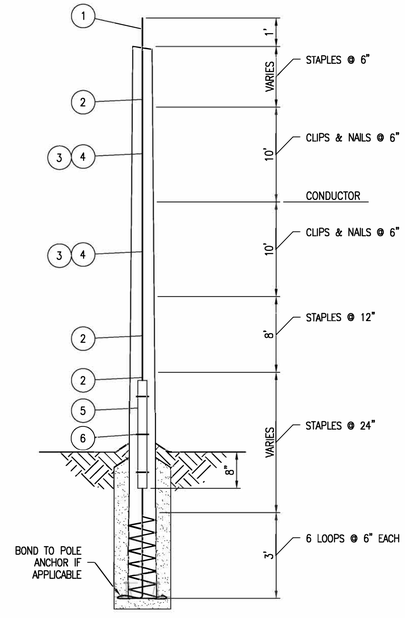


TM-9SD-2
DOUBLE DAVIT GROUNDING
SCALE: N.T.S.

SHEET TITLE: **TRANSMISSION ASSEMBLY STEEL POLE DAVIT ARM GROUNDING**
REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: TM-9SD

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	36-4000	GROUNDWIRE, #4CU SD, 40% CONDUCTIVITY	C901			125'
2	46-7494	STAPLE, CUT (SLASH) 1 1/2" X 3/8" CU-COATED, BARBED	P600	MACLEAN	J7682	50
3	46-7460	NAIL, 10D, CU-COATED	P150	MACLEAN	J7260	40
4	46-2729	CLIP, CU-COATED	P151	KEARNEY	5730-1	40
5	46-2503	WOOD MOULDING, 1-11/16" X 8'	P300	HUGHES	2503.8	1
6	46-2504	MOULDING STAPLES, 1-3/4" X 3-1/2"	P400	HUBBELL	C2050222	3



NOTES:

1. BOND ALL POLE HARDWARE TO POLE GROUND. USE BONDING CLIP.
2. ON 230/69kV CONSTRUCTION, BOND ALL 69kV HARDWARE.
3. GROUND WIRE SHALL BE INSTALLED FOR THE FULL LENGTH OF EACH POLE, ACROSS THE BOTTOM, AND BACK UP IN WRAP TURNS AS SHOWN. STAPLE THE WRAPS AT EACH INTERSECTION OF THE DOWNLEAD, AND EVERY 12" FOR THE LENGTH OF THE WRAPS.
4. THIS UNIT INCLUDES THE MEASURE AND RECORDING OF EACH POLE'S FOOTING RESISTANCE, AFTER POLE SETTING IS COMPLETED AND BEFORE INSTALLING THE OHSW.
5. FOR FOOTING RESISTANCES GREATER THAN 15 OHMS, GROUNDING CONNECTIONS SHALL BE USED TO BOND TOGETHER THE GROUND WIRES OF EACH POLE AND GUY ANCHORS IF APPLICABLE.
6. IF THE FOOTING RESISTANCE READS GREATER THAN 15 OHMS AFTER INSTALLATION PROCEDURES PER NOTE 5, CONTRACTOR SHALL NOTIFY THE ENGINEER FOR FURTHER GROUNDING INSTRUCTIONS.
7. BOND STATIC WIRE TO POLE GROUND, USE FARGO CONNECTOR. (ITEM #5)
8. SEE INDIVIDUAL STRUCTURE DRAWINGS FOR REMAINING DIMENSIONS.

SHEET TITLE: **TRANSMISSION ASSEMBLY WOOD POLE GROUNDING**
REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: TM-9

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

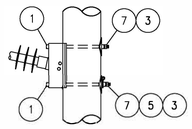
ASSEMBLY DETAILS
GROUNDING ASSEMBLIES

0 1" 2"
FILENAME: BHE-AD-07-D-1.DWG
SCALE: N.T.S.
SHEET: AD-07-1

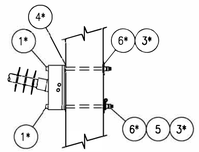
LIST OF MATERIAL

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	1A	1B	1C	1D
1	N.S.	BOLT, MACHINE, 7/8" X REQ'D LENGTH	B270			2	2*	2	–
2	N.S.	ROD, FULL THREADED, 7/8" X REQ'D LENGTH, W/ 4 NUTS	D170			–	–	–	2
3	22–7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	2	2*	2	4
4	N.S.	POLE SHIM, GAIN BASE TO FLAT	V400	N/A	N/A	–	1*	–	–
5	N.S.	WASHER, SPRING, 15/16" HOLE	W207	HUGHES	2702.8	1	1	–	–
6	N.S.	WASHER, SQUARE, 4" X 1/4", 15/16" HOLE	W322	HUGHES	SW4–80	–	2*	2	2
7	22–4425	WASHER, SQ. CURVED, 4" X 1/4", 15/16" HOLE	W504	HUGHES	SCW4–80	2	–	–	–

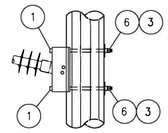
(*) DENOTES MATERIAL SUPPLIED BY LAMINATED POLE MANUFACTURER



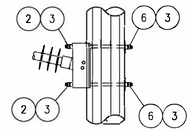
TD–1A
ROUND WOOD POLE ASSEMBLY
SCALE: N.T.S.



TD–1B
LAMINATED POLE ASSEMBLY
SCALE: N.T.S.



TD–1C
STEEL POLE ASSEMBLY
SCALE: N.T.S.



TD–1D
LARGE STEEL POLE ASSEMBLY
SCALE: N.T.S.

NOTES:

1. STRENGTH LIMITATIONS OF 7/8" BOLTS.
   - A. SINGLE SHEAR THROUGH THREADS 17,270 LBS.
   - B. SINGLE SHEAR THROUGH SHAFT 24,350 LBS.
   - C. MINIMUM TENSILE STRENGTH 25,400 LBS.

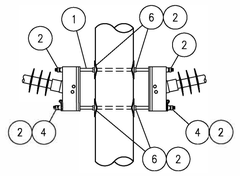
SHEET TITLE
TRANSMISSION ASSEMBLY
SINGLE INSULATOR BASE TO POLE ASSEMBLY

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: TD-1

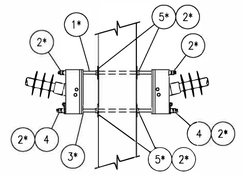
LIST OF MATERIAL

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	2A	2B	2C
1	N.S.	ROD, FULL THREADED, 7/8" X REQ'D LENGTH, W/ 4 NUTS	D170			2	2*	2
2	22–7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	8	8*	8
3	N.S.	POLE SHIM, GAIN BASE TO FLAT	V400	N/A	N/A	–	2*	–
4	N.S.	WASHER, SPRING, 15/16" HOLE	W207	HUGHES	2702.8	2	2	–
5	N.S.	WASHER, SQUARE, 4" X 1/4", 15/16" HOLE	W322	HUGHES	SW4–80	–	4*	4
6	22–4425	WASHER, SQ. CURVED, 4" X 1/4", 15/16" HOLE	W504	HUGHES	SCW4–80	4	–	–

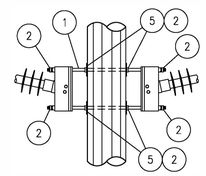
(*) DENOTES MATERIAL SUPPLIED BY LAMINATED POLE MANUFACTURER



TD–2A
ROUND WOOD POLE ASSEMBLY
SCALE: N.T.S.



TD–2B
LAMINATED POLE ASSEMBLY
SCALE: N.T.S.



TD–2C
STEEL POLE ASSEMBLY
SCALE: N.T.S.

NOTES:

1. STRENGTH LIMITATIONS OF 7/8" BOLTS.
   - A. SINGLE SHEAR THROUGH THREADS 17,270 LBS.
   - B. SINGLE SHEAR THROUGH SHAFT 24,350 LBS.
   - C. MINIMUM TENSILE STRENGTH 25,400 LBS.

SHEET TITLE
TRANSMISSION ASSEMBLY
DOUBLE INSULATOR BASE TO POLE ASSEMBLY

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: TD-2

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

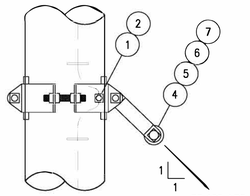
ASSEMBLY DETAILS
INSULATOR BASE TO POLE ASSEMBLIES

0 1" 2"

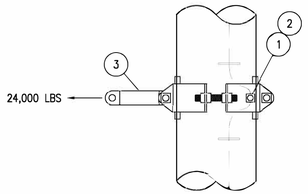
FILENAME: BHE–AD–08–D–1.DWG
SCALE: N.T.S.
SHEET: **AD-08-1**

LIST OF MATERIALS

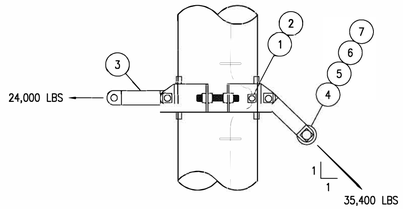
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	TG-26B QTY	TG-26C QTY	TG-26D QTY	TG-26E QTY
1	N.S.	POLE BAND ASSY. HEAVY DUTY, REQ'D POLE DIAMETER	–	HUGHES	–	1	1	1	1
1.1	18-1116	POLE BANDS, HEAVY DUTY, 7"-10" POLE	F110	HUGHES	3108.5	–	–	–	–
1.2	18-1117	POLE BANDS, HEAVY DUTY, 9"-12" POLE	F111	HUGHES	3108.6	–	–	–	–
1.3	18-1118	POLE BANDS, HEAVY DUTY, 11"-14" POLE	F112	HUGHES	3108.7	–	–	–	–
1.4	18-1119	POLE BANDS, HEAVY DUTY, 13"-16" POLE	F113	HUGHES	3108.8	–	–	–	–
2	46-2718	CLIP, BONDING, WITH 1/2" X 1 1/2" BOLT, 7/16" MAX. WIRE	P104	HUGHES	2718.55	1	1	1	1
3	14-3152	LINK, CONNECTING, 1/4" X 2" X 7 1/2", 15/16" HOLES, 24K LBS	F201	HUGHES	3152	–	2	2	–
4	14-3154	LINK, CONNECTING, 3/8" X 2" X 7 1/2", 15/16" HOLES, 38K LBS	F203	HUGHES	3154	2	–	2	4
5	18-2808	GUY, ROLLER, 1 1/8" WR, 15/16" HOLE	G100	HUGHES	28082	1	–	1	2
6	20-7803	MACHINE BOLT, 7/8" X 3"	B273	HUGHES	B83-2	1	–	1	2
7	22-7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	1	–	1	2



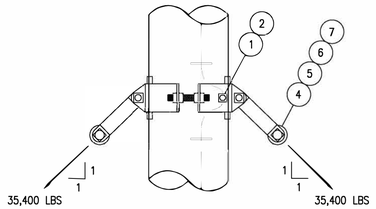
TG-26B



TG-26C



TG-26D



TG-26E

NOTES:

1. THE INDICATED LOADS ARE DESIGN MAXIMUMS.
2. FOR GUY SLOPES MORE THAN 1V TO 1H, THE MAXIMUM VERTICAL CAPACITY SHOULD NOT EXCEED 25,000 LBS.
3. WHEN TWO GUY ATTACHMENTS ARE NEEDED. THE ADDITIONAL POLE BAND SHALL BE 6' BELOW THE FIRST ONE.

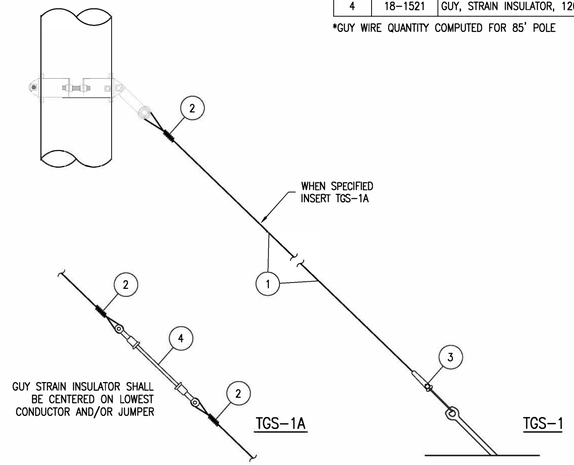
SHEET TITLE
TRANSMISSION ASSEMBLY
POLE BAND ASSEMBLIES

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TG-26

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	TGS-1 QTY	TGS-1A QTY
1	18-7167	WIRE, GALVANIZED, 7 STEEL STRAND, 7/16" EHS	C801	–	–	110'	110'
2	18-7168	GUY DEADEND GRIP, FOR 7/16" EHS	G601	PREFORMED	GDE-1108	1	3
3	18-0716	GUY, STRANDVISE, 7/16" EHS, SHORT BAIL	G902	MACLEAN	5203	1	1
4	18-1521	GUY, STRAIN INSULATOR, 120" LONG, 21K LBS, ROLLER, ROLLER	G200	HUGHES	CF694-120R2	–	1

*GUY WIRE QUANTITY COMPUTED FOR 85' POLE



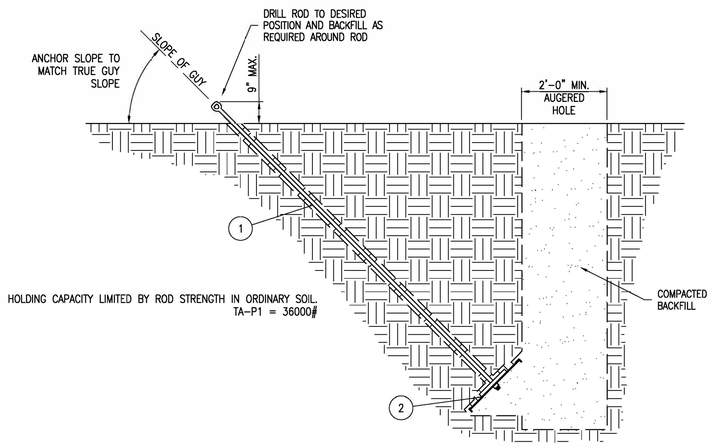
TGS-1A TGS-1

SHEET TITLE
TRANSMISSION ASSEMBLY
SINGLE GUY ASSEMBLIES
7/16" EHS

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TGS-1(A)

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	TA-P1 QTY
1	18-1102	ROD, ANCHOR, TWIN EYE 1" X 10', 36K	A100	MACLEAN	J7540	1
2	18-1024	ANCHOR, CROSS-PLATE TYPE, 400 IN BEARING AREA, 1" ROD	A200	MACLEAN	J3524	1

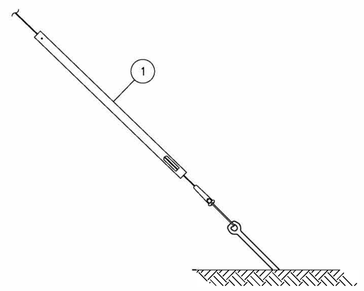


SHEET TITLE
TRANSMISSION ASSEMBLY
PLATE ANCHOR
AUGERED

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TA-P1

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	GUY, GUARD, 2" X 8'-0", FULL ROUND, YELLOW	G400	MACLEAN	J1493Y	1



GUY MARKER

SHEET TITLE
TRANSMISSION ASSEMBLY
GUY MARKER

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TM-GM

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

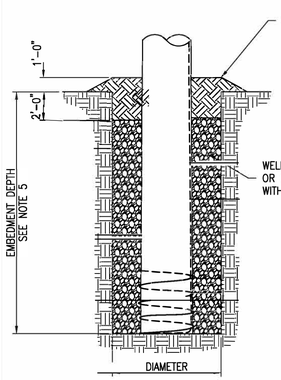
ASSEMBLY DETAILS
GUY AND ANCHOR ASSEMBLIES

0 1" 2"

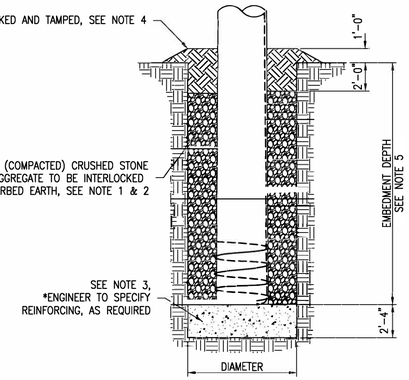
FILENAME BHE-AD-09-D-1.DWG
SCALE N.T.S.
SHEET **AD-09-1**

POLE STABILITY FOUNDATION					
IMPORTED GRANULAR BACKFILL					
POLE HT.–CL.	EMBEDMENT DEPTH (FT)	DIAMETER (FT)	POLE WIDTH (IN)	POLE WEIGHT (LB)	APPROX. QTY. CUBIC YDS. (10% + 4 FT)
60–1	10	4.0*	18.0	–	3.2
70–1	11	4.0*	18.9	–	3.6
80–H1	12	4.0*	20.9	–	3.8
90–H2	13	4.0*	23.2	–	4.0
100–H2	14	4.0*	24.0	–	4.2

(*) HOLE DIAMTER AS NEEDED TO TAMP ALL THE WAY AROUND THE POLE.



TM–101
IMPORTED BACKFILL
SCALE: N.T.S.



TM–103
IMPORTED BACKFILL AND BEARING REINFORCEMENT
SCALE: N.T.S.

GRADATION FOR IMPORTED GRANULAR BACKFILL	
SIZE OF GRAVEL OR CRUSHED STONE	SIZE OF MESH (IN)
100% BY WEIGHT TO PASS 1" SCREEN	1.00
60%–90% BY WEIGHT TO PASS 1/2" SCREEN	0.500
40%–60% BY WEIGHT TO PASS NO. 4 SCREEN	0.187
25%–50% BY WEIGHT TO PASS NO. 8 SCREEN	0.0937
20%–40% BY WEIGHT TO PASS NO. 16 SCREEN	0.0469
15%–30% BY WEIGHT TO PASS NO. 40 SCREEN	0.0165

IMPORTANT

EACH POLE SHALL BE BACKFILLED FROM BOTTOM TO TOP BY ONE LABORER SHOVELING FILL AND TWO OTHERS USING PNEUMATIC TAMPERS.

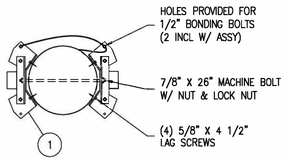
NOTES:

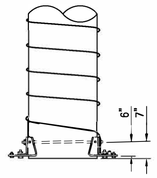
1. GRADATION FOR IMPORTED BACKFILL IS SHOWN IN THE TABLE. THE AGGREGATE SHALL BE WELL MIXED IN A STOCK PILE, AND PNEUMATICALLY PLACED AND TAMPED IN 6–INCH LIFTS.
2. THE SPECIFICATION FOR AGGREGATE GIVEN IN THE TABLE IS MINIMUM. IN AREAS WHERE SMALLER FINES ARE AVAILABLE AT COMPARABLE COST, IT IS RECOMMENDED THAT THE ENGINEER SPECIFY SMALLER FINES.
3. CONCRETE SHALL BE 2000 PSI HIGH EARLY STRENGTH CONCRETE. IT SHALL BE DEPOSITED IN A MANNER WHICH WILL PREVENT SEGREGATION OF THE AGGREGATE AND CEMENT. CARE SHOULD BE TAKEN TO AVOID GETTING DIRT MIXED WITH THE CONCRETE. THE POLE SHALL NOT BE SET UNTIL THE CONCRETE BEARING BASE HAS ATTAINED SUFFICIENT STRENGTH TO SUPPORT THE POLE. DURING THE PLACEMENT OF POLE, AVOID BUMPING CONCRETE BASE.
4. WELL TAMPED NATIVE BACKFILL SHOULD BE PLACED AROUND THE POLE AS SHOWN.
5. SEE STRUCTURE DRAWINGS FOR EMBEDMENT DEPTHS.

SHEET TITLE
TRANSMISSION ASSEMBLY
POLE STABILITY FOUNDATION

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TM-101 & TM-103

LIST OF MATERIALS						
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	18–1895	ANCHOR ASSEMBLY WITH BOLTS; PAIR	F300	HUGHES	A–1895–2	1





SHEET TITLE
TRANSMISSION ASSEMBLY
POLE ANCHOR ASSEMBLY

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TP-A

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

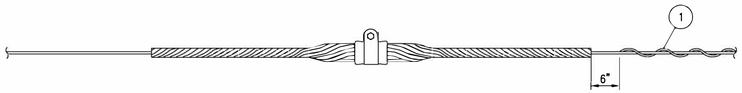
BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
POLE STABILITY ASSEMBLIES

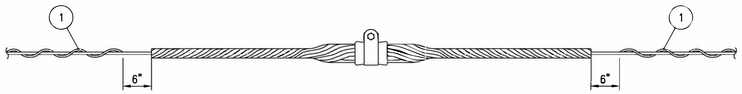
0 1" 2"

FILENAME BHE–AD–10–D–1.DWG
SCALE N.T.S.
SHEET **AD-10-1**

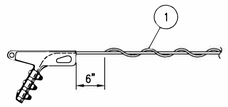
LIST OF MATERIALS								
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T1 QTY	2T1 QTY	D1 QTY
1	N.S.	SPIRAL VIBRATION DAMPER, 0.327" – 0.461" RANGE	S110	PREFORMED	5050104	1	2	1



DPR–EHS–T1



DPR–EHS–2T1



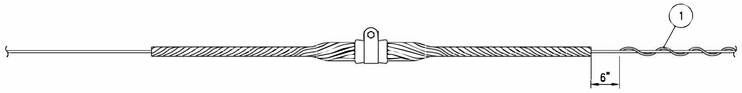
DPR–EHS–D1

SHEET TITLE
TRANSMISSION ASSEMBLY
DAMPER - 3/8" EHS

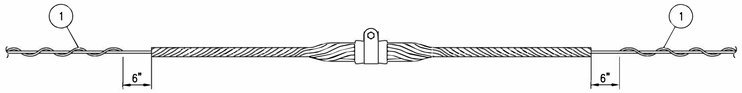
REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
DPR-EHS

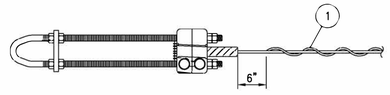
LIST OF MATERIALS								
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T1 QTY	2T1 QTY	D1 QTY
1	N.S.	SPIRAL VIBRATION DAMPER, 0.327" – 0.461" RANGE	S110	PREFORMED	5050104	1	2	1



DPR–OPGW–T1



DPR–OPGW–2T1



DPR–OPGW–D1

SHEET TITLE
TRANSMISSION ASSEMBLY
DAMPER - OPGW

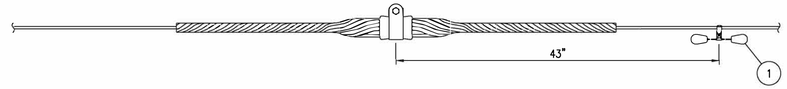
REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
DPR-OPGW

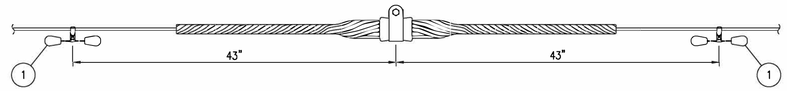
LIST OF MATERIALS								
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T1 QTY	2T1 QTY	D1 QTY	D2 QTY
1	N.S.	DAMPER, DOGBONE, 336 ACSR	S152	HUBBELL	60705–11	1	2	1	2

NOTES:

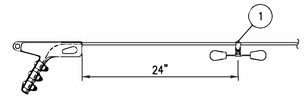
1. FIRST DAMPER AT SUSPENSION SPAN ENDS SHALL BE LOCATED FROM CENTER OF DAMPER CLAMP TO THE SUSPENSION SUPPORT PER REFERENCED DIMENSION.
2. THE ORIENTATION OF THE WEIGHTS ALONG THE CONDUCTOR IS OPTIONAL. (I.E. WHETHER THE LARGE WEIGHT IS TOWARD THE TOWER OR TOWARD THE SPAN. ORIENT THE DAMPER FOR EASY ACCESS TO THE BOLT AND TO OBTAIN VISUAL ASSURANCE OF POSITIVE CONDUCTOR SEATING.
3. FOLLOW MANUFACTURER'S INSTALLATION INSTRUCTIONS IN DELIVERY BOX.
4. SEE SAG TABLES FOR INSTALLATION DIRECTION ON THE LINE.



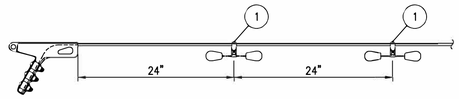
DPR–336–T1



DPR–336–2T1



DPR–336–D1



DPR–336–D2

SHEET TITLE
TRANSMISSION ASSEMBLY
DAMPER - 336 ACSR

REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
DPR-336

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
DAMPER ASSEMBLIES

0 1" 2"

FILENAME BHE–AD–11–D–1.DWG
SCALE N.T.S.

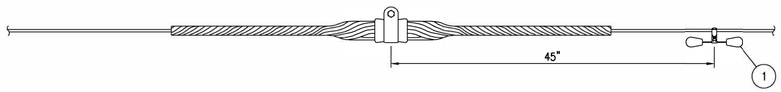
SHEET
AD-11-1

LIST OF MATERIALS

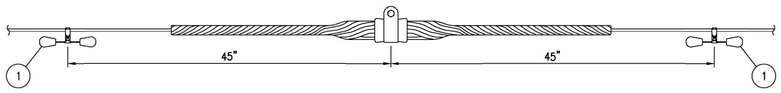
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T1 QTY	2T1 QTY	D1 QTY	D2 QTY
1	N.S.	DAMPER, DOGBONE, 795 ACSR	S150	HUBBELL	60710-12	1	2	1	2

NOTES:

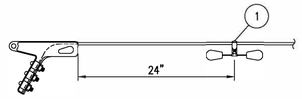
1. FIRST DAMPER AT SUSPENSION SPAN ENDS SHALL BE LOCATED FROM CENTER OF DAMPER CLAMP TO THE SUSPENSION SUPPORT PER REFERENCED DIMENSION.
2. THE ORIENTATION OF THE WEIGHTS ALONG THE CONDUCTOR IS OPTIONAL. (I.E. WHETHER THE LARGE WEIGHT IS TOWARD THE TOWER OR TOWARD THE SPAN. ORIENT THE DAMPER FOR EASY ACCESS TO THE BOLT AND TO OBTAIN VISUAL ASSURANCE OF POSITIVE CONDUCTOR SEATING.
3. FOLLOW MANUFACTURER'S INSTALLATION INSTRUCTIONS IN DELIVERY BOX.
4. SEE SAG TABLES FOR INSTALLATION DIRECTION ON THE LINE.



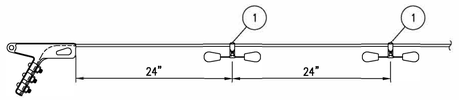
DPR-795-T1



DPR-795-2T1



DPR-795-D1



DPR-795-D2

SHEET TITLE
TRANSMISSION ASSEMBLY
DAMPER - 795 ACSR

REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
DPR-795

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
DAMPER ASSEMBLIES

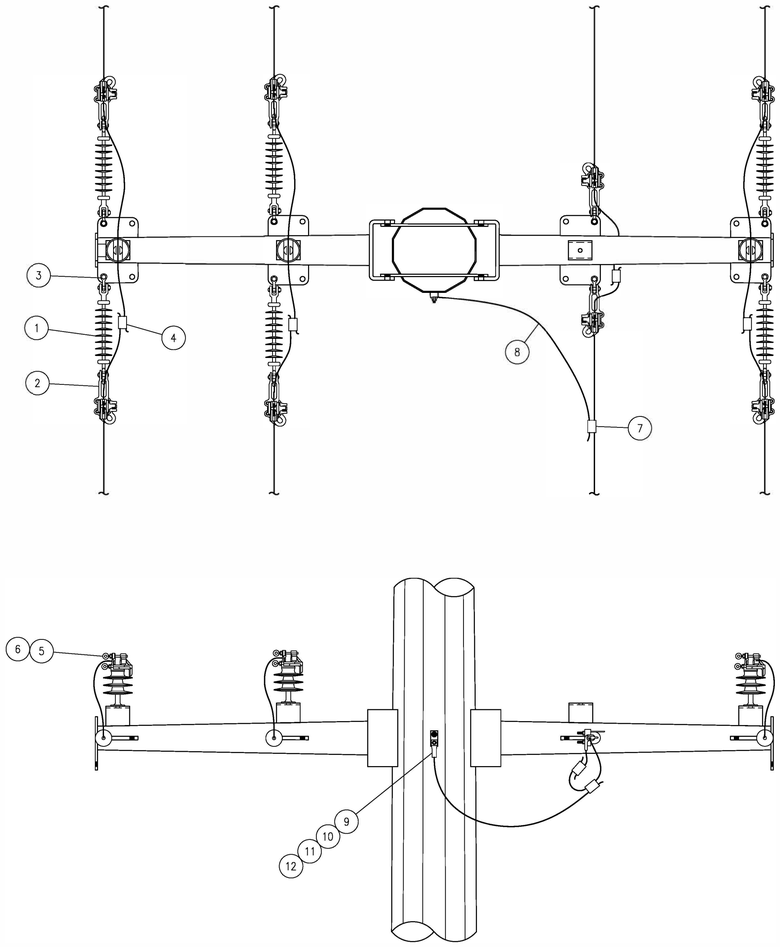
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FILENAME BHE-AD-12-D-1.DWG
SCALE N.T.S.

SHEET
AD-12-1

308-ST-M1 LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY.
1	48-3512	INSULATOR, SUSP., DE, POLYMER, CLEVIS EYE, 25KV	I601	HUBBELL	4010350215	6
2	N.S.	DEADEND CLAMP, STRAIGHT LINE SPRING LOADED, #4 TO 556.5 ACSR	L600	HUBBELL	AS0D8581N	8
3	N.S.	ANCHOR, SHACKLE, 2 1/2" LONG, 5/8" DIA., 3/4" DIA. PIN, 25K LBS	H601	HUGHES	2865-B2	8
4	42-0482	PARALLEL GROOVE CONNECTOR, 3/0 ACSR TO 397 ACSR	Q600	ALCOA	482.2	4
5	48-0049	HENDRIX CLAMPTOP INSULATOR, 1.75" MAX CONDUCTOR, 25KV	I650	HENDRIX	HPI-25VTM-01	3
6	24-5857	PIN, STEEL CROSSARM, SHORT SHANK, 1" DIAMETER THREADS	E800	HUBBELL	886P	3
7	N.S.	CONNECTOR, PARALLEL GROOVE, #1-336.4 ACSR TO #8 SOL-2/0 STR. CU	Q553	HUBBELL	LC52AXB	1
8	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902	SOUTHWIRE		5'
9	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012	1
10	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207	1
11	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS	1
12	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD	1

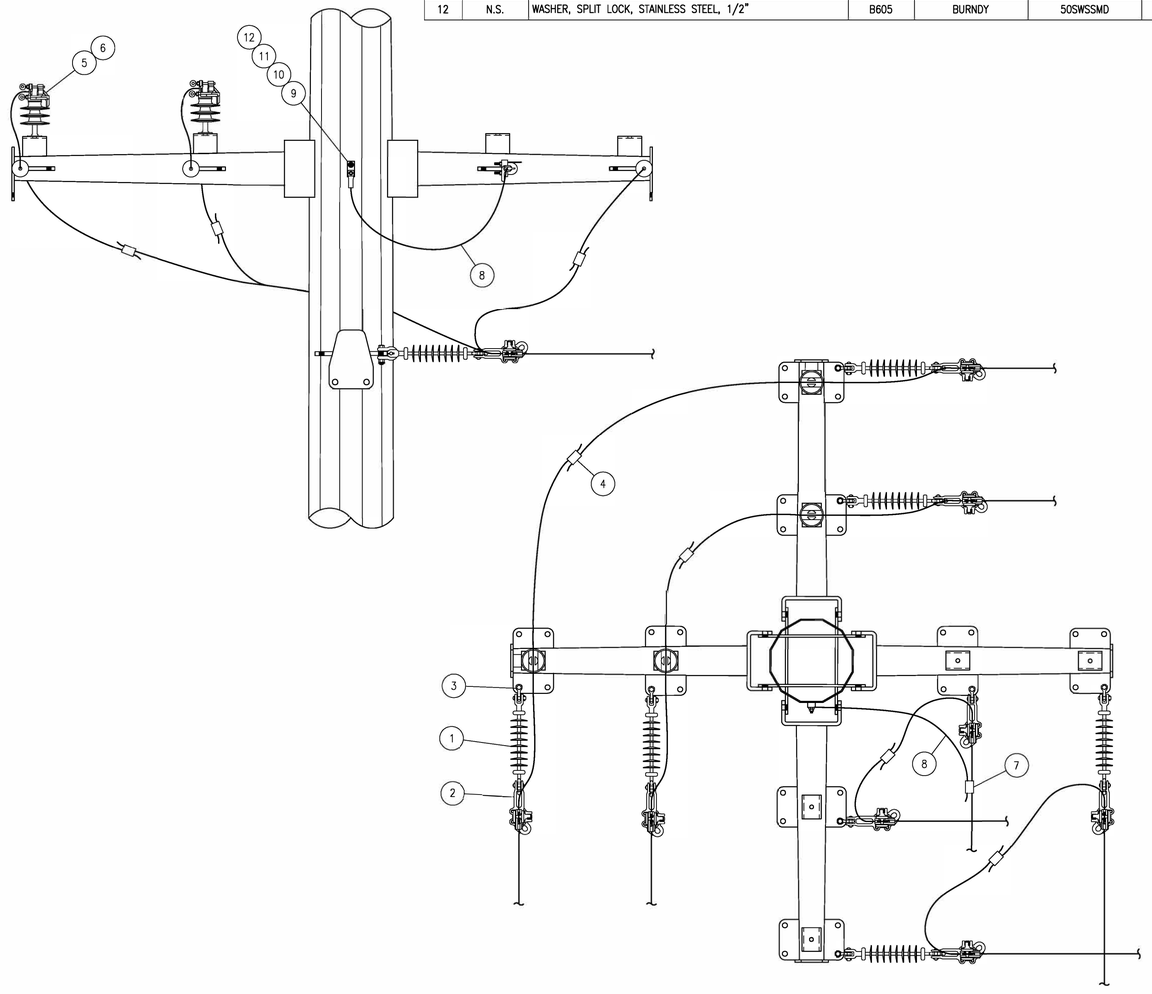


SHEET TITLE
DISTRIBUTION ASSEMBLY
IN-LINE DEADEND ON DAVIT ARMS
24.9 KV

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
308-ST-M1

310-ST-M1 LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY.
1	48-3512	INSULATOR, SUSP., DE, POLYMER, CLEVIS EYE, 25KV	I601	HUBBELL	4010350215	6
2	N.S.	DEADEND CLAMP, STRAIGHT LINE SPRING LOADED, #4 TO 556.5 ACSR	L600	HUBBELL	AS0D8581N	8
3	N.S.	ANCHOR, SHACKLE, 2 1/2" LONG, 5/8" DIA., 3/4" DIA. PIN, 25K LBS	H601	HUGHES	2865-B2	8
4	42-0482	PARALLEL GROOVE CONNECTOR, 3/0 ACSR TO 397 ACSR	Q600	ALCOA	482.2	4
5	48-0049	HENDRIX CLAMPTOP INSULATOR, 1.75" MAX CONDUCTOR, 25KV	I650	HENDRIX	HPI-25VTM-01	4
6	24-5857	PIN, STEEL CROSSARM, SHORT SHANK, 1" DIAMETER THREADS	E800	HUBBELL	886P	4
7	N.S.	CONNECTOR, PARALLEL GROOVE, #1-336.4 ACSR TO #8 SOL-2/0 STR. CU	Q553	HUBBELL	LC52AXB	1
8	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902	SOUTHWIRE		5'
9	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012	1
10	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207	1
11	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS	1
12	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD	1



SHEET TITLE
DISTRIBUTION ASSEMBLY
BUCKARM DEADEND ON DAVIT ARMS
24.9 KV

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
310-ST-M1

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

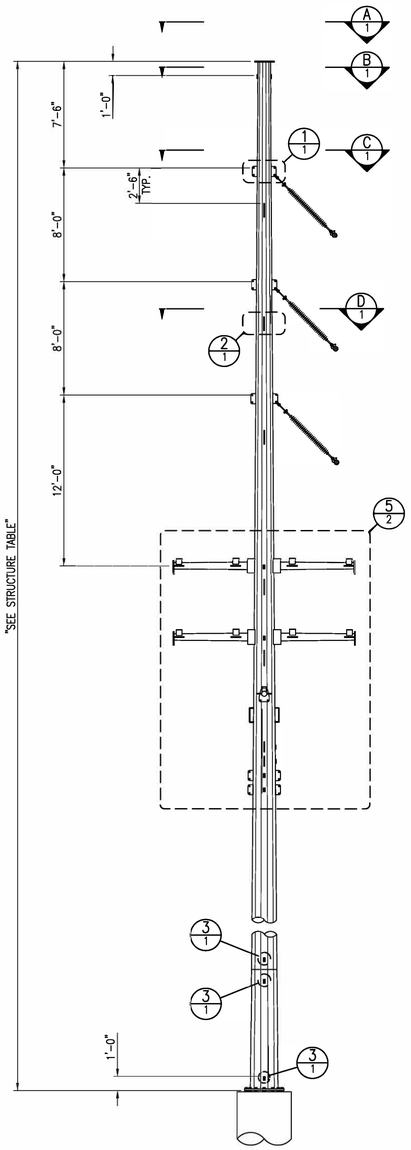
BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

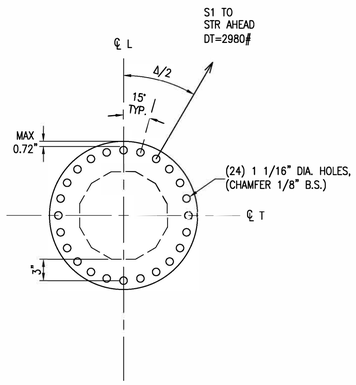
DISTRIBUTION DETAIL

0 1" 2"

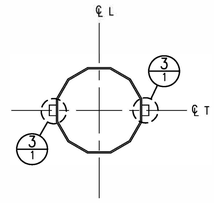
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SCALE 3/16"=1'-0"

SHEET **DD-01**

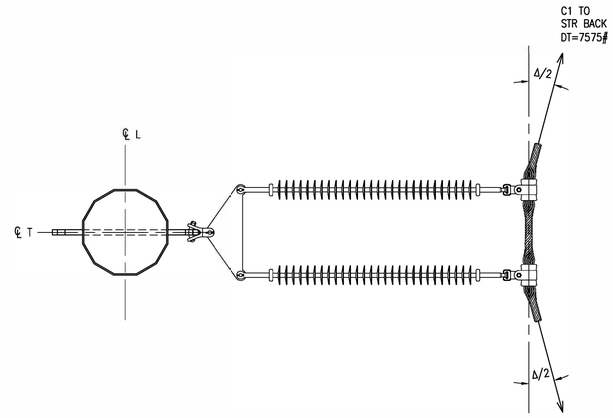




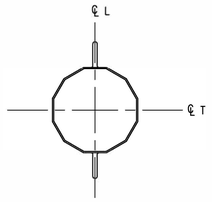
VIEW
SHIELD ORIENTATION
SCALE: N.T.S.
A 1



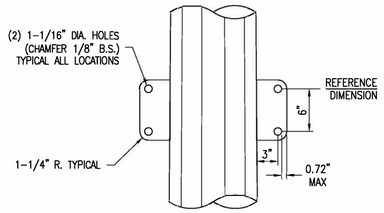
SECTION
SHIELD NEMA PAD ORIENTATION
SCALE: N.T.S.
B 1



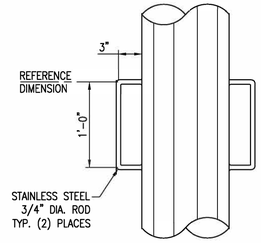
SECTION
CONDUCTOR ORIENTATION
SCALE: N.T.S.
C 1



SECTION
GROUND LOOP ORIENTATION
SCALE: N.T.S.
D 1



DETAIL
POLE VANGS
SCALE: N.T.S.
1 1



DETAIL
GROUNDING LOOP
SCALE: N.T.S.
2 1

GENERAL NOTES

MAXIMUM SHIELD WIRE VANG THICKNESS = 3/4"
MAXIMUM CONDUCTOR VANG THICKNESS = 1"
MAXIMUM DISTRIBUTION VANG THICKNESS = 3/4"
LOAD TREE VALUES ARE ULTIMATE, INCLUDE OVERLOAD FACTORS, AND ARE SHOWN IN POUNDS.

DESIGN CRITERIA

(S1) SHIELD WIRE IS 3/8" 7 STRAND STEEL EHS, MAXIMUM TENSION AT NESC HEAVY LOADING: 2980# R.S.= 400'
(C1) CONDUCTOR IS 795 KCMIL 45/7 ACSR "TERN" MAXIMUM TENSION AT NESC HEAVY LOADING: 7575# R.S.= 400'
(D1) DISTRIBUTION IS 336.4 KCMIL 26/7 ACSR "LINNET" MAXIMUM TENSION AT NESC HEAVY LOADING: 4550# R.S.= 300'
(D2) DISTRIBUTION IS 336.4 KCMIL 26/7 ACSR "LINNET" MAXIMUM TENSION AT NESC HEAVY LOADING: 800# R.S.= 50'
(N1) NEUTRAL IS 336.4 KCMIL 26/7 ACSR "LINNET" MAXIMUM TENSION AT NESC HEAVY LOADING: 4550# R.S.= 300'
(N2) NEUTRAL IS 336.4 KCMIL 26/7 ACSR "LINNET" MAXIMUM TENSION AT NESC HEAVY LOADING: 800# R.S.= 50'
(O1) OPGW IS AFL CC-55/443 "DNO-4748" OPGW, MAXIMUM TENSION AT NESC HEAVY LOADING: 2000# R.S.= 400'

HEIGHT OF STR.: SEE STRUCTURE TABLE
DESIGN MAXIMUM ANGLE (Δ): 60°00'00"

TRANSMISSION
WIND SPAN: 400'
WEIGHT SPAN: 800' AT NESC HEAVY LOADING

DISTRIBUTION
WIND SPAN: 300'
WEIGHT SPAN: 600' AT NESC HEAVY LOADING

DISTRIBUTION TAP
WIND SPAN: 25'
WEIGHT SPAN: 100' AT NESC HEAVY LOADING

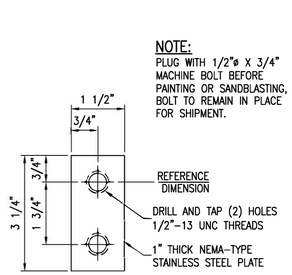
SPECIFICATIONS

1. POLES TO BE DESIGNED PER SECTION 33 71 16.23 TUBULAR STEEL POLES SPECIFICATIONS.
2. ALL STEEL TO BE WEATHERING STEEL.
3. POLES TO HAVE EITHER SLIP JOINTS OR BOLTED FLANGE TYPE SPLICES, WHICHEVER IS MORE COST EFFECTIVE.
   A. IF SLIP JOINTS ARE USED, INSTALL GROUND PADS (DETAIL 3) ABOVE AND BELOW THE SLIP JOINT.
4. STRUCTURES SHALL BE DESIGNED ASSUMING DRILLED PIER TYPE FOUNDATION.
5. THE CIRCLED LOADINGS SHOWN IN LOAD TREES CONVEY THE ADDITIONAL VERTICAL LOAD THAT WILL BE APPLIED TO THE STRUCTURE BY LINE PERSONNEL DURING CONSTRUCTION AND MAINTENANCE OPERATIONS.
   A. IT IS REQUIRED THAT ALL CONDUCTOR ATTACHMENT SUPPORTS BE DESIGNED TO MEET THIS REQUIREMENT. HOWEVER, AS THE LOADING WILL BE APPLIED TO ONLY ONE PHASE AT ANY GIVEN TIME, THE SHAFT MAY BE DESIGNED FOR ITS APPLICATION AT A SINGLE CONTROLLING PHASE LOCATION TO BE DETERMINED BY THE STEEL MANUFACTURER.

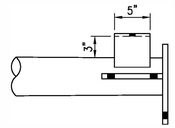
DEFLECTION

SEE TUBULAR STEEL POLE SPECIFICATION FOR DEFLECTION OF THE SHAFT UNDER LOAD CASE V.

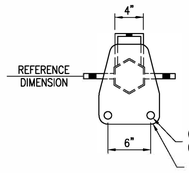
STRUCTURE TABLE	
STR #	HEIGHT
6-1	75'-0"



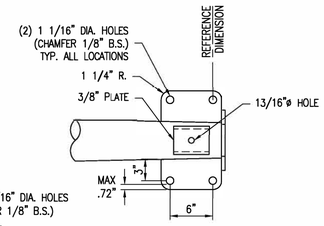
DETAIL
GROUNDING PAD
SCALE: N.T.S.
3 1



FRONT VIEW



SIDE SECTION



TOP VIEW

DETAIL
DISTRIBUTION VANGS/END PLATE
SCALE: N.T.S.
4 1

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

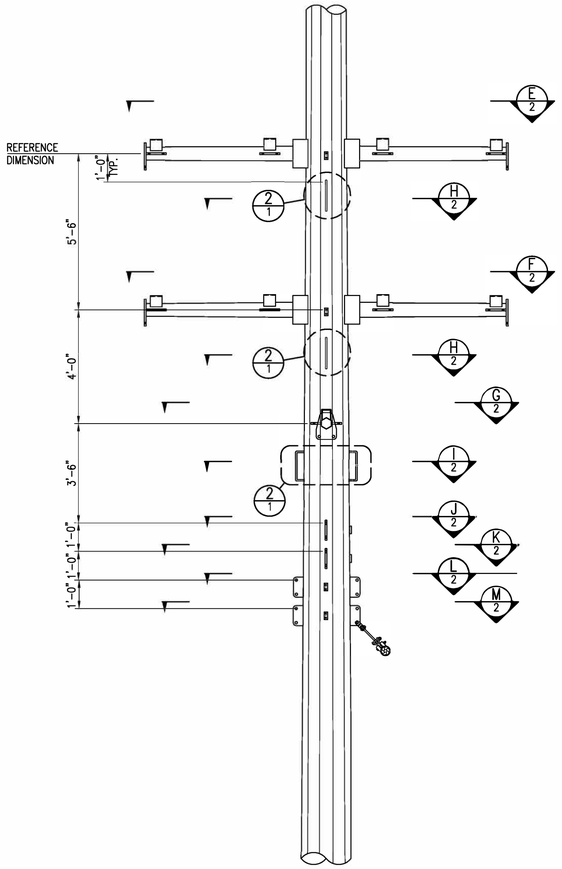
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

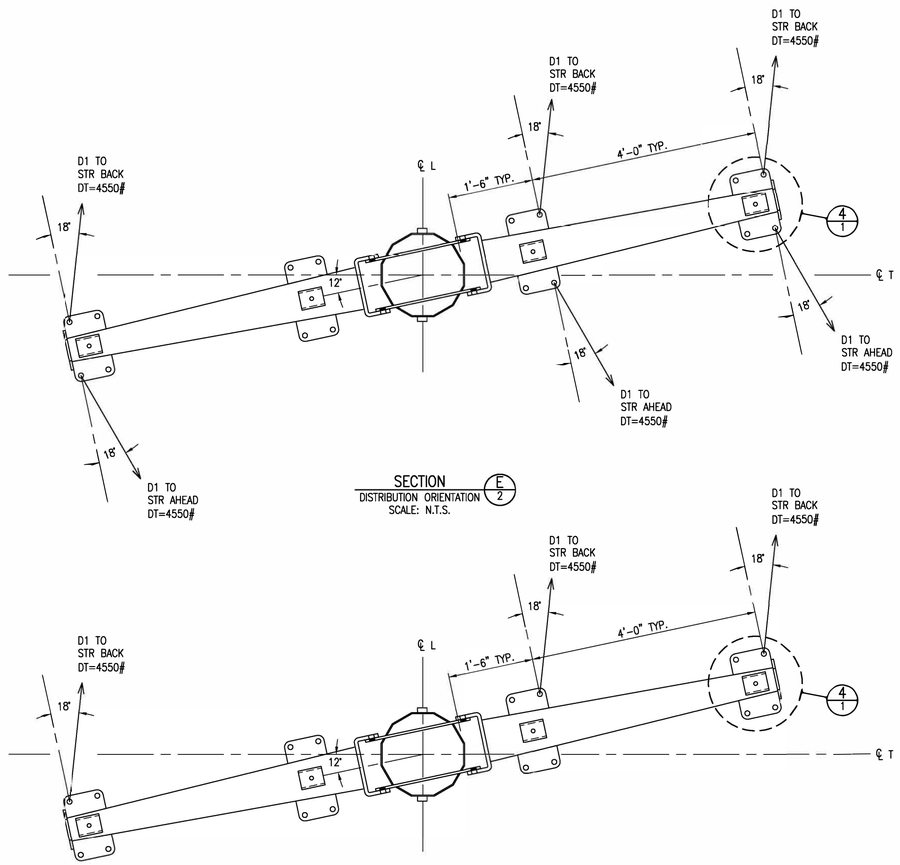
LOAD & DESIGN DETAIL
SCRC-ST-M1
STR 6-1

0 1" 2"

FILENAME BHE-LD-11-D-1.DWG
SCALE 3/16"=1'-0"
SHEET LD-11-1

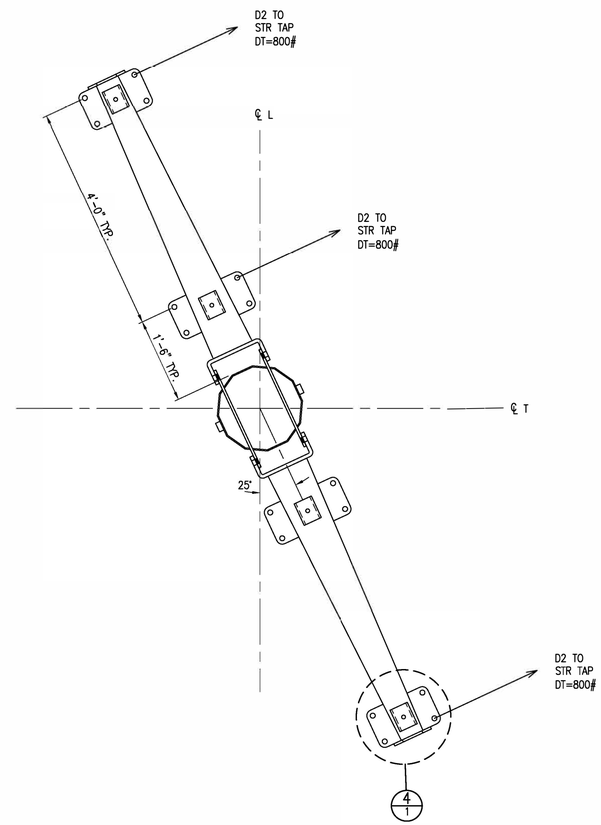


DETAIL 5/2
DISTRIBUTION
SCALE: N.T.S.

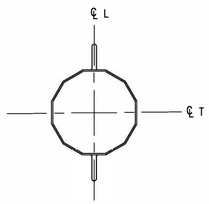


SECTION E/2
DISTRIBUTION ORIENTATION
SCALE: N.T.S.

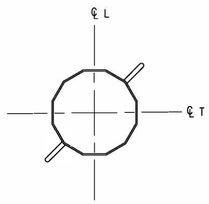
SECTION F/2
DISTRIBUTION ORIENTATION
SCALE: N.T.S.



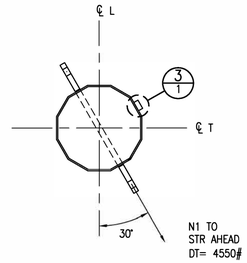
SECTION G/2
DISTRIBUTION ORIENTATION
SCALE: N.T.S.



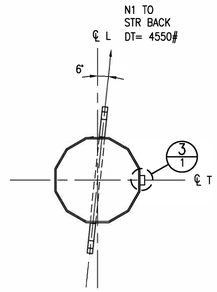
SECTION H/2
GROUND LOOP ORIENTATION
SCALE: N.T.S.



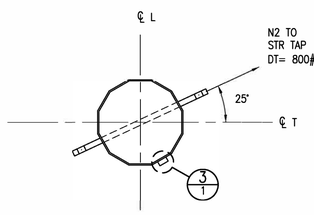
SECTION I/2
GROUND LOOP ORIENTATION
SCALE: N.T.S.



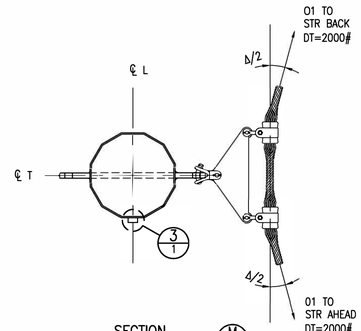
SECTION J/2
NEUTRAL AHEAD ORIENTATION
SCALE: N.T.S.



SECTION K/2
NEUTRAL BACK ORIENTATION
SCALE: N.T.S.



SECTION L/2
NEUTRAL TAP ORIENTATION
SCALE: N.T.S.



SECTION M/2
OPGW ORIENTATION
SCALE: N.T.S.

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

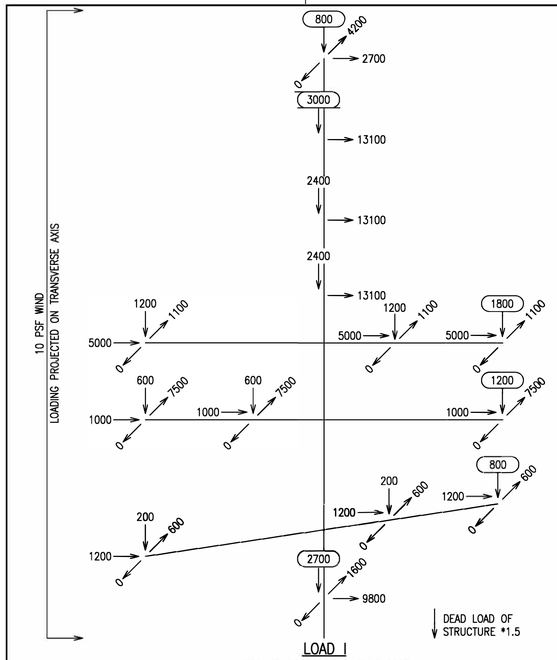
BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

LOAD & DESIGN DETAIL
SCRC-ST-M1
STR 6-1

0 1" 2"

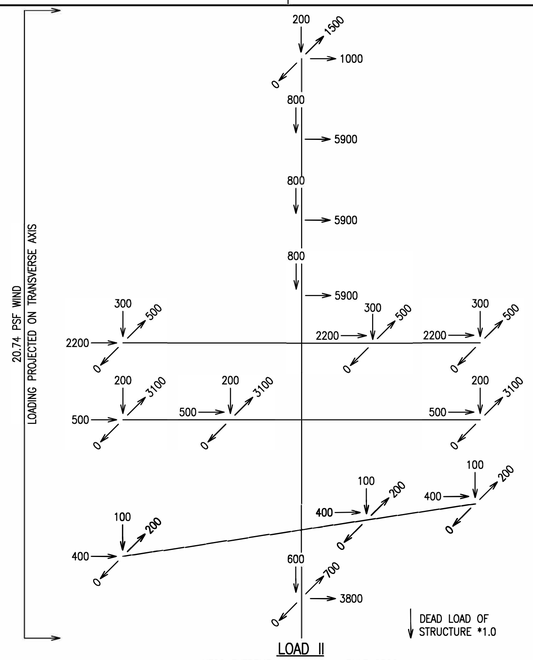
FILENAME BHE-LD-11-D-2.DWG
SCALE 3/16"=1'-0"

SHEET LD-11-2



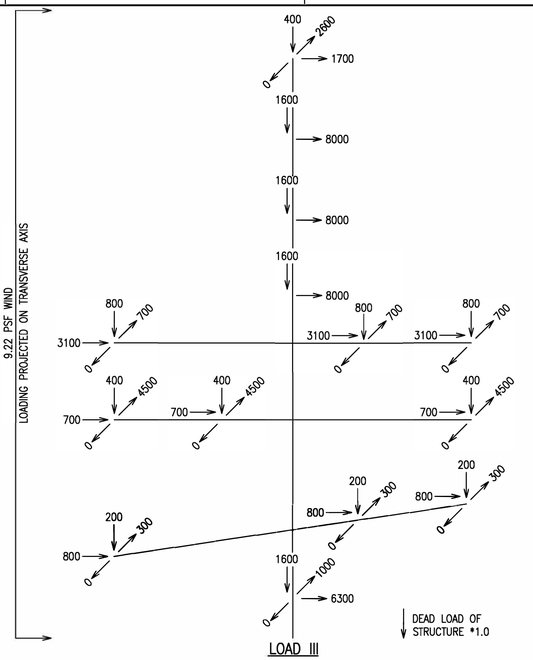
LOAD I

NESC HEAVY LOADING – RULE 250B
ALL WIRES INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 4 PSF WIND @ 0°F



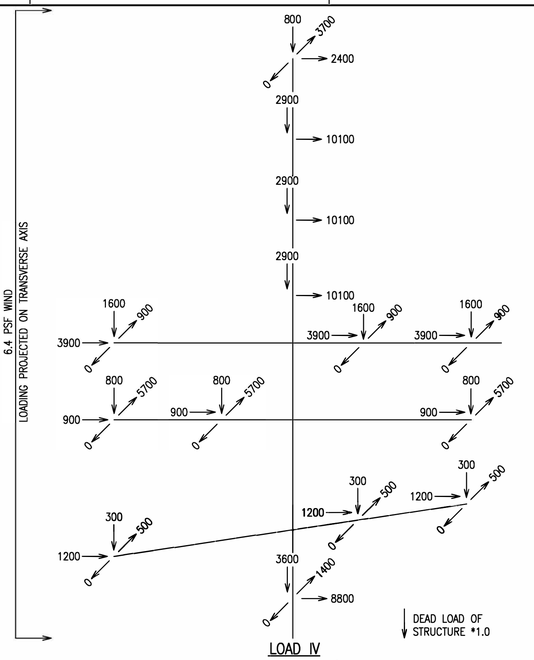
LOAD II

NESC EXTREME HIGH WIND – RULE 250C
ALL WIRES INTACT
NO ICE, 20.74 PSF WIND @ 60°F



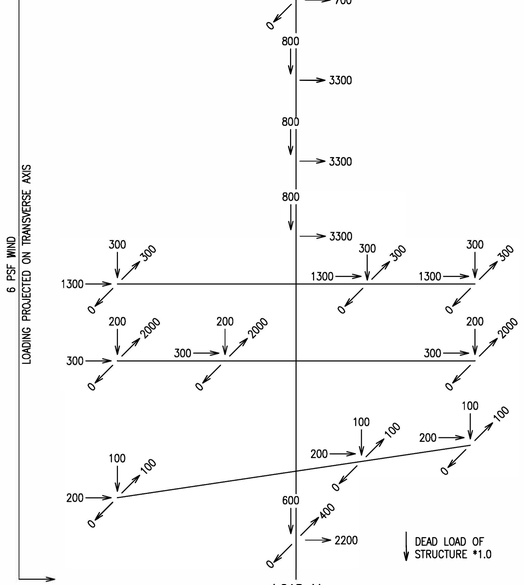
LOAD III

NESC CONCURRENT ICE/WIND – RULE 250D
ALL WIRES INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 9.22 PSF WIND @ 15°F



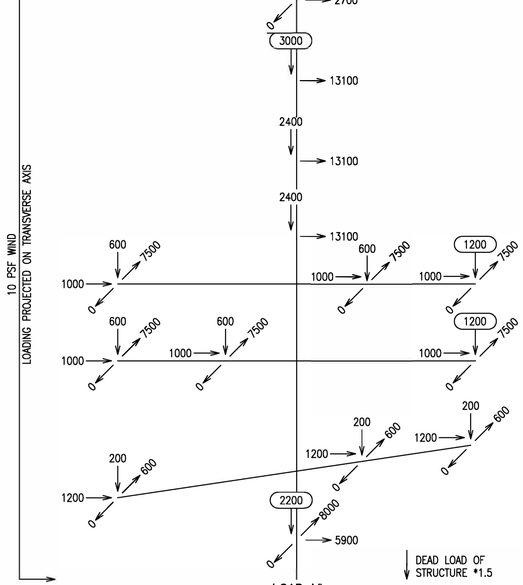
LOAD IV

BHE CONCURRENT ICE/WIND
ALL WIRES INTACT
1.0" RADIAL ICE @ 57 LBS/FT³, 6.4 PSF WIND @ 0°F



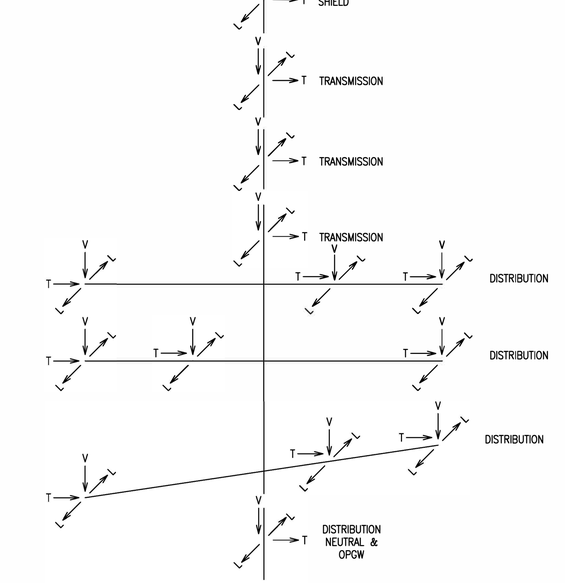
LOAD V

DEFLECTION LIMIT
ALL WIRES INTACT
NO ICE, 6 PSF WIND @ 60°F



LOAD VI

NESC HEAVY LOADING
NO DISTRIBUTION AHEAD SPAN
0.5" RADIAL ICE @ 57 LBS/FT³, 4 PSF WIND @ 0°F



TYPICAL

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1	6/12/2020	RECORD DRAWING
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DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

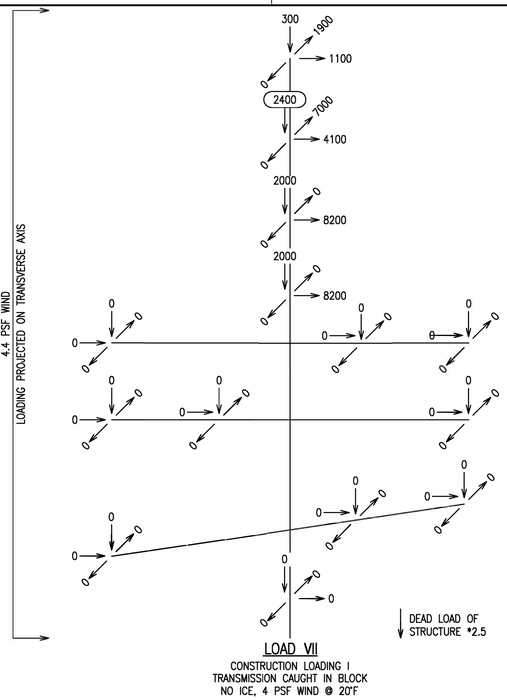
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

LOAD & DESIGN DETAIL
SCRC-ST-M1
STR 6-1

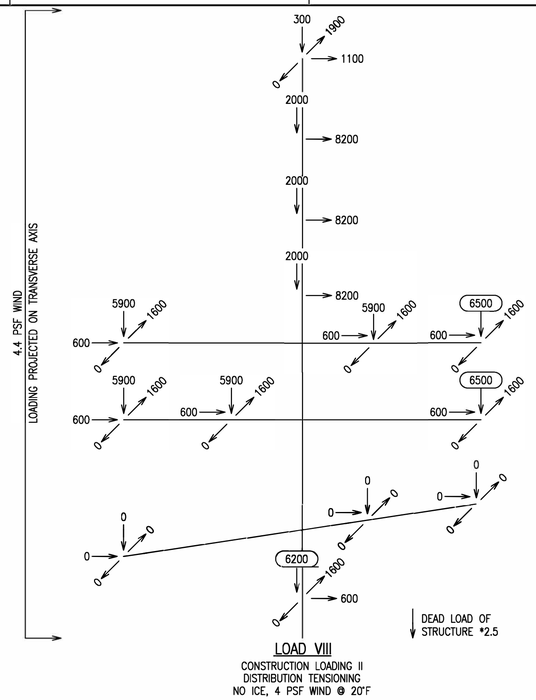
0 1" 2"

FILENAME: BHE-LD-11-D-3.DWG
SCALE: 3/16"=1'-0"
SHEET: LD-11-3



LOAD VII

CONSTRUCTION LOADING I
TRANSMISSION CAUGHT IN BLOCK
NO ICE, 4 PSF WIND @ 20°F



LOAD VIII

CONSTRUCTION LOADING II
DISTRIBUTION TENSIONING
NO ICE, 4 PSF WIND @ 20°F

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PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

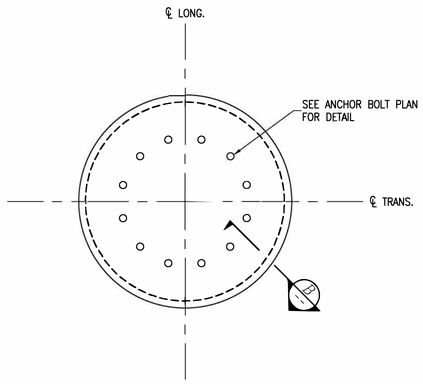
BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

LOAD & DESIGN DETAIL
SCRC-ST-M1
STR 6-1

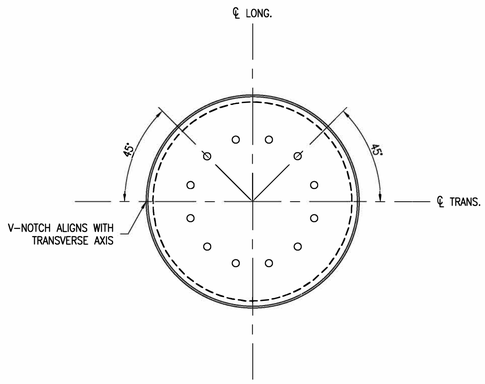
0 1" 2"

FILENAME: BHE-LD-11-D-4.DWG
SCALE: 3/16"=1'-0"

SHEET
LD-11-4



PIER PLAN VIEW
ROUND CAP



ANCHOR BOLT PLAN (TYP.)
SEE STEEL MANUFACTURER DRAWINGS FOR ANCHOR BOLT DETAIL

FOUNDATION DATA

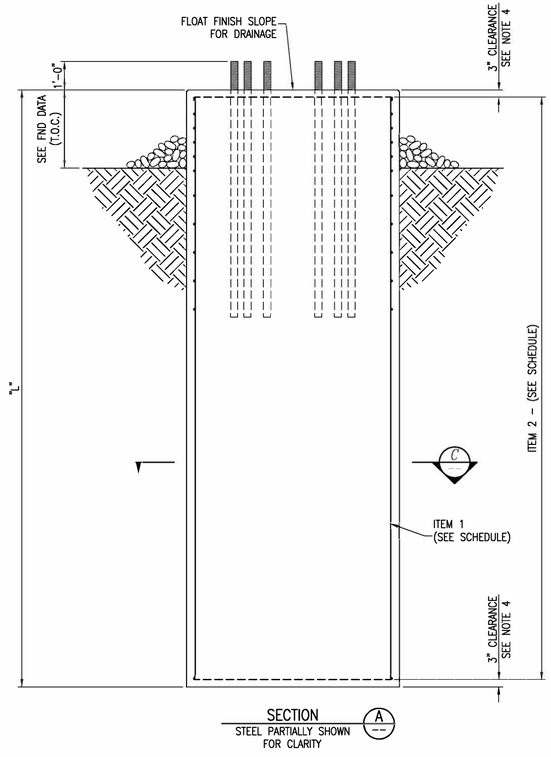
FOUNDATION	STRUCTURE INFORMATION				PIER DESIGN LOADS			ANCHOR BOLTS	PIER DATA								
FND-05	NUMBER	DRAWING	DESCRIPTION	LINE ANGLE (Δ)	MOMENT (FT-K)	AXIAL (K)	SHEAR (K)	DRAWING NUMBER	T.O.C. ELEVATION ABOVE GROUND	L	B	NEAT LINE (*) CONCRETE (CY)	ITEM	SIZE	QTY	LENGTH PER PIECE	ITEM 2 SPACING	SHAPE
FND-05-1	6-1	SCRC-ST-M1	75'-0" OVERALL HEIGHT SINGLE POLE DEADEND	55°43'55" RT	3997.9	38.0	83.1	-	1'-0"	20	7.0	28.5	1	11	18	19'-6"	-	STRAIGHT
													2	6	24	22'-11"	12"	78" RING O.D.

NOTES:

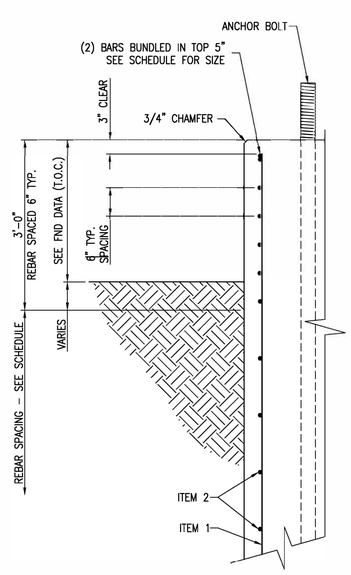
1. *ANCHOR BOLTS PROVIDED BY MANUFACTURER.
2. (*) NEAT LINE BASED ON MINIMUM DIMENSIONS.
3. O.D. = OUTSIDE DIAMETER OF ITEM 2 REBAR.
4. CLEAR DIMENSION SHALL BE MEASURED FROM THE OUTSIDE FACE OF PRINCIPAL REINFORCING.

GENERAL NOTES:

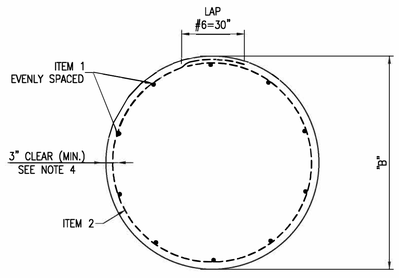
- REINFORCING STEEL SHALL CONFORM TO ASTM A-615 GRADE 60. ALL CLEAR DIMENSIONS MEASURED FROM OUTSIDE EDGE OF REINFORCING STEEL.
- CONCRETE: READY MIX CONCRETE SHALL CONFORM TO ASTM C-94.
  - A. CONCRETE STRENGTH: (MINIMUM 28 DAY COMPRESSIVE STRENGTH)
    CONCRETE PLACED IN DRY CONDITION - 4500 P.S.I.
    CONCRETE PLACED BELOW WATER TABLE USING TREMIE PIPE METHOD - 5000 P.S.I.
  - B. ENTRAINED AIR: PROVIDE AIR ENTRAINMENT IN CONCRETE RESULTING IN A TOTAL AIR CONTENT BY VOLUME OF 6% ± 1% PER ASTM C-260.
  - C. AGGREGATE: SHALL CONFORM TO ASTM C-33. MAXIMUM AGGREGATE SIZE THROUGHOUT SHALL BE 1 1/2".
  - D. SLUMP: SHALL BE 6-7 INCHES FOR CONCRETE.
  - E. WATER/ CEMENT RATIO: 0.45 MAX.
  - F. VIBRATION OF CONCRETE: SHALL BE LIMITED TO THE TOP TEN FEET OF THE FOUNDATION FOR CONCRETE PLACED BY THE TREMIE METHOD.
- SOIL OR ROCK CONDITIONS: WHERE SOIL DEPTHS, DEPTHS TO BEDROCK, OR THE CONDITIONS OF SOIL OR BEDROCK DIFFER FROM THAT SHOWN ON THE BORINGS, THE FOUNDATIONS ENGINEER SHALL BE CONTACTED.
- SEE SPECIFICATIONS AND DOCUMENTATION FOR EXCAVATION AND CONCRETE REQUIREMENTS.
- ALL PIERS SHALL BE FORMED FROM TOP OF FOUNDATION TO ONE FOOT BELOW GRADE BEFORE CONCRETE IS PLACED TO COMPLETE THE PIER.
- **GYPSUM PRESENT IN BORINGS. IN NO CASE SHALL PIERS TERMINATE IN A GYPSUM LAYER. IF THIS SHOULD OCCUR CONTACT ENGINEER.**



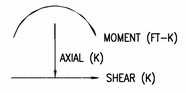
SECTION A
STEEL PARTIALLY SHOWN FOR CLARITY



SECTION B
FOUNDATION CAP
SCALE: N.T.S.



SECTION C
FOUNDATION
SCALE: N.T.S.



PIER DESIGN LOADS
SCALE: N.T.S.

ISSUE	DATE	DESCRIPTION
1	6/19/2020	RECORD DRAWING
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PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	N. VLAHOS
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

FOUNDATION DETAILS

0 1" 2"

FILENAME BHE-FND-05-01.DWG
SCALE NONE
SHEET **FND-05-1**

STRUCTURE DATA												TRANSMISSION ASSEMBLIES							COMMENTS
STR. #	STATION (FT)	AHEAD SPAN	LINE ANGLE				STR TYPE	POLE H&C	FND	FND REVEAL	GROUND	ANCHORS	GUYS	SHIELD ASSEMBLIES	CONDUCTOR ASSEMBLIES	OPGW SPLICE	DAMPERS	MISC.	
BEN FRENCH 2	0+00	121					SUB DE							1)T-4DS	3)T-BDE6D				
6-2	1+21	277	34°	46'	32"	LT	SCDE-69	1)80/1			1)TM-9	4)TA-P1	8)TGS-1, 8)TM-GM	2)T-4D, 1)T-4FDW	6)T-BDE6D, 3)T-SP1-B	1)T-FSC-1			
D6-1.1	3+19	198						1)25/4	EMBED: 6"-0"					1)T-4BF				1)TG-26C	INSTALL OPGW ATTACHMENT 0'-6" BELOW POLE TOP. INSET OPGW POLE.
6-1	3+98	97	55°	43'	55"	LT	SCRC-ST-M1	1)LD-11: 75'-0"	1)FND-05-1	1'-0"	1)TM-9ST, 1)TM-9SSJ			1)T-4DS, 1)T-4FCS	3)T-2SPB2		1)DPR-EHS-D1, 3)DPR-336-2T1	1)308-ST-M1, 1)310-ST-M1	
6	4+95 BOL 14+09 AOL	315	1°	08'	24"	RT	TCIDE-69UB-1	[LD-08: 125'-0"]	[1)FND-01-6]	[1'-0"]				1)T-4FDS	3)T-BDE6PB, 3)T-SP1-B, 3)T-BDE6PD	[1)T-FSCS-M2]			STRUCTURE IS UNDERBUILD ON WEST RAPID CITY 230KV PROJECT. OPGW TERMINATES HERE. SPLICES INTO SOUTH OPGW ON WEST RAPID CITY 230KV PROJECT.
7	17+25	326		28'	44"	LT	TCHP-69UB	[LD-02: 138'-0"]	[EMBED: 18'-0"]						3)T-PSD		3)DPR-795-2T1		STRUCTURE IS UNDERBUILD ON WEST RAPID CITY 230KV PROJECT.
8	20+51	335					TCHP-69UB	[LD-02: 133'-0"]	[EMBED: 18'-0"]						3)T-PSD		3)DPR-795-T1		STRUCTURE IS UNDERBUILD ON WEST RAPID CITY 230KV PROJECT.
9	23+86	351		04'	34"	RT	TCHP-69UB	[LD-02: 133'-0"]	[EMBED: 18'-0"]						3)T-SP		3)DPR-795-T1		STRUCTURE IS UNDERBUILD ON WEST RAPID CITY 230KV PROJECT. STRUCTURE USES CLAMP TOP INSULATORS.
10	27+36	211			51"	LT	TCHP-69UB	[LD-02: 133'-0"]	[EMBED: 18'-0"]						3)T-SP		3)DPR-795-T1		STRUCTURE IS UNDERBUILD ON WEST RAPID CITY 230KV PROJECT. STRUCTURE USES CLAMP TOP INSULATORS. FRAME ALL POST INSULATORS ON NORTH SIDE OF THE POLE.
11	29+47	263					TCHP-69UB	[LD-02: 128'-0"]	[EMBED: 18'-0"]						3)T-SP		3)DPR-795-T1		STRUCTURE IS UNDERBUILD ON WEST RAPID CITY 230KV PROJECT. STRUCTURE USES CLAMP TOP INSULATORS.
12	32+10	179		15'	41"	LT	TCHP-69UB	[LD-02: 128'-0"]	[EMBED: 18'-0"]						3)T-PSD		3)DPR-795-T1		STRUCTURE IS UNDERBUILD ON WEST RAPID CITY 230KV PROJECT.
13	33+89	218					TCHP-69UB	[LD-02: 128'-0"]	[EMBED: 18'-0"]						3)T-PSD		3)DPR-795-T1		STRUCTURE IS UNDERBUILD ON WEST RAPID CITY 230KV PROJECT.
14	36+07	216		13'	30"	LT	TCHP-69UB	[LD-02: 123'-0"]	[EMBED: 18'-0"]						3)T-PSD		3)DPR-795-T1		STRUCTURE IS UNDERBUILD ON WEST RAPID CITY 230KV PROJECT.
15	38+23	253		04'	48"	RT	TCIDE-69UB-2	[LD-09: 105'-0"]	[1)FND-01-7]	[1'-0"]				1),T-4DS, 1)T-4FDS	3)T-BDE6PD, 3)T-SP1-B, 3)T-BDE6PB	[1)T-FSCS-M3]	1)DPR-EHS-D1, 1)DPR-OPGW-D1, 3)DPR-336-D2		STRUCTURE IS UNDERBUILD ON WEST RAPID CITY 230KV PROJECT. OPGW AHEAD TERMINATES HERE. SPLICES INTO SOUTH OPGW ON WEST RAPID CITY 230KV PROJECT.
15-1	40+76	311		07'	06"	LT	SCHP	1)65/2			1)TM-9			1)T-4A, 1)T-4AF	3)T-SP-B				
15-2	43+87						SCHP	1)65/2			1)TM-9			1)T-4A, 1)T-4AF	3)T-SP- B				

NOTES:

XXX NEW

[XXX] EXISTING

*XXX RETIRE

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DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

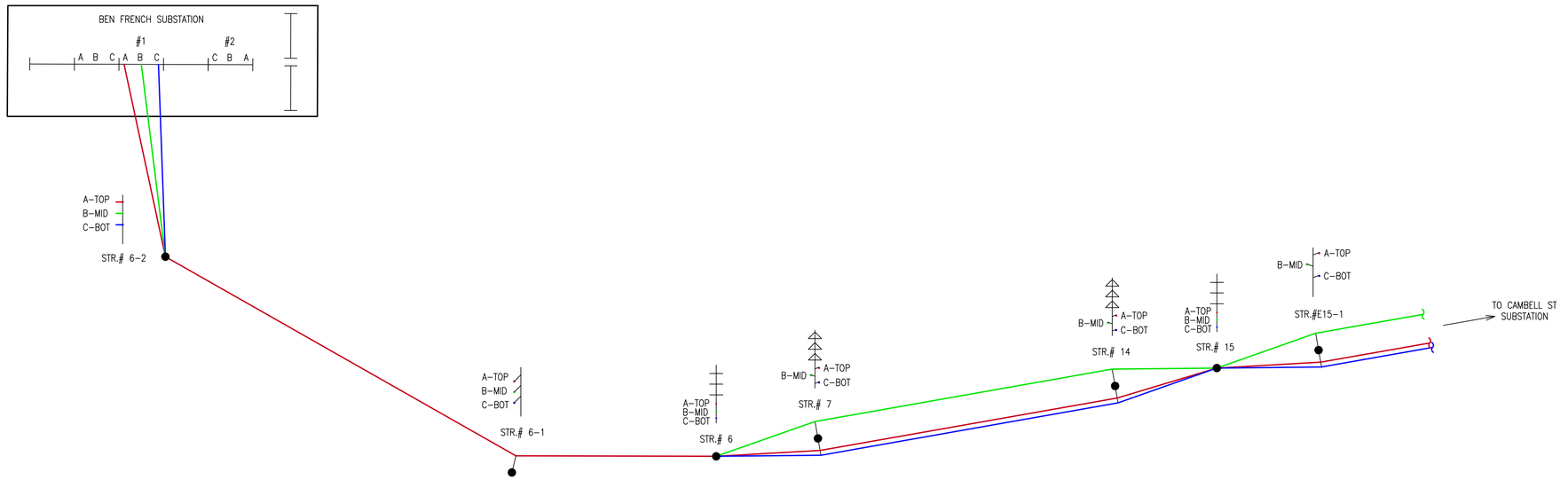
STAKING SHEETS

0 1" 2"

FILENAME BHE-SS-01-D-1.DWG

SCALE NONE

SHEET **SS-01**



NOTES:
1. CONTRACTOR TO VERIFY PHASING.
2. STRUCTURES SHOWN LOOKING AHEAD ON LINE.

LEGEND

A PHASE	
B PHASE	
C PHASE	
OTHER LINES	

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
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BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

PHASING DIAGRAM

0 1" 2"

FILENAME BHE–PH–01–D–1.DWG
SCALE N.T.S.

SHEET **PH-01**

FINAL SAG TABLE			336.4 KCMIL 26/7 ACSR "LINNET" 3500# INITIAL @ NESC HEAVY LOADING														6-2 to 6													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
6-2	245	277	1.71	1.91	2.15	2.43	2.73	3.07	3.41	3.76	4.11	4.45	4.79	5.11	5.43	5.61	5.75	3.91	4.14	4.39	4.66	4.94	5.24	5.52	5.80	6.06	6.31	6.54	6.76	6.97	7.08	7.17	
6-1		97	0.20	0.22	0.25	0.28	0.31	0.35	0.39	0.43	0.47	0.51	0.55	0.59	0.62	0.64	0.66	1.33	1.40	1.49	1.58	1.68	1.78	1.87	1.97	2.05	2.14	2.22	2.29	2.36	2.40	2.43	3)DPR-336-2T1
SUB-PHASE TENS. LBS			2606	2326	2068	1833	1629	1451	1304	1183	1084	999	929	870	820	794	773																SUBTOTAL DAMPERS NEEDED:6

FINAL SAG TABLE			336.4 KCMIL 26/7 ACSR "LINNET" 4035# @ NESC HEAVY LOADING														15 to 15-2													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
15	337	253	1.36	1.50	1.65	1.82	1.99	2.17	2.36	2.55	2.73	2.92	3.09	3.27	3.44	3.61	3.70	3.49	3.66	3.84	4.03	4.22	4.41	4.59	4.77	4.94	5.11	5.26	5.41	5.55	5.68	5.75	3)DPR-336-D2
15-1		311	2.10	2.31	2.54	2.80	3.07	3.35	3.64	3.93	4.22	4.50	4.77	5.04	5.30	5.56	5.71	4.33	4.54	4.77	5.00	5.24	5.48	5.71	5.93	6.14	6.34	6.53	6.72	6.89	7.05	7.14	
SUB-PHASE TENS. LBS			2670	2424	2200	1998	1823	1669	1537	1425	1327	1244	1173	1110	1055	1006	981																SUBTOTAL DAMPERS NEEDED:6

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E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

FINAL SAG TABLES

336.4 KCMIL 26/7 ACSR "LINNET"

0 1" 2"

FILENAME BHE-STC-01-D-1.DWG

SCALE NONE

SHEET **STC-01-1**

FINAL SAG TABLE			795 KCMIL 45/7 ACSR "TERN" 6930# INITIAL @ NESC HEAVY LOADING														6 to 15												
			SAG FT														3RD WAVE TIME SEC.												
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
6	290	315	1.69	1.83	1.99	2.17	2.39	2.66	2.95	3.28	3.64	4.01	4.40	4.78	5.16	5.53	5.90	3.89	4.04	4.21	4.41	4.63	4.87	5.14	5.42	5.71	5.99	6.27	6.54	6.79	7.03	7.26	
7		326	1.85	1.99	2.17	2.37	2.61	2.90	3.22	3.58	3.97	4.38	4.80	5.22	5.63	6.04	6.43	4.06	4.22	4.40	4.60	4.83	5.09	5.37	5.66	5.96	6.26	6.55	6.83	7.10	7.35	7.59	3)DPR-795-2T1
8		335	1.95	2.10	2.29	2.50	2.76	3.06	3.40	3.78	4.19	4.62	5.06	5.51	5.94	6.37	6.79	4.18	4.34	4.52	4.73	4.97	5.23	5.51	5.81	6.12	6.43	6.73	7.02	7.29	7.55	7.79	3)DPR-795-T1
9		351	2.13	2.30	2.50	2.74	3.02	3.35	3.72	4.14	4.59	5.06	5.54	6.03	6.51	6.98	7.44	4.37	4.54	4.73	4.95	5.20	5.47	5.77	6.08	6.41	6.73	7.04	7.34	7.63	7.90	8.16	3)DPR-795-T1
10		211	0.77	0.83	0.90	0.99	1.09	1.21	1.35	1.50	1.66	1.83	2.00	2.18	2.35	2.52	2.69	2.63	2.73	2.85	2.98	3.12	3.29	3.47	3.66	3.85	4.04	4.23	4.41	4.59	4.75	4.90	3)DPR-795-T1
11		263	1.20	1.29	1.40	1.54	1.69	1.88	2.09	2.32	2.58	2.84	3.11	3.38	3.65	3.91	4.17	3.27	3.40	3.54	3.71	3.89	4.10	4.32	4.56	4.80	5.04	5.27	5.50	5.72	5.92	6.11	3)DPR-795-T1
12		179	0.56	0.60	0.65	0.71	0.79	0.87	0.97	1.08	1.20	1.32	1.45	1.57	1.70	1.82	1.94	2.23	2.32	2.42	2.53	2.65	2.79	2.95	3.11	3.27	3.43	3.60	3.75	3.90	4.03	4.16	3)DPR-795-T1
13		218	0.82	0.89	0.97	1.06	1.17	1.29	1.44	1.60	1.77	1.95	2.14	2.33	2.51	2.69	2.87	2.71	2.82	2.94	3.07	3.23	3.40	3.58	3.78	3.98	4.18	4.37	4.56	4.74	4.91	5.07	3)DPR-795-T1
14		216	0.79	0.85	0.92	1.01	1.12	1.24	1.37	1.53	1.70	1.87	2.05	2.23	2.40	2.58	2.75	2.66	2.76	2.88	3.01	3.16	3.33	3.51	3.70	3.89	4.09	4.28	4.46	4.64	4.80	4.96	3)DPR-795-T1
SUB-PHASE TENS. LBS			6455	5981	5503	5031	4564	4115	3702	3330	3002	2725	2486	2286	2118	1976	1854																SUBTOTAL DAMPERS NEEDED:27

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

INITIAL SAG TABLES

795 KCMIL 45/7 ACSR "TERN"

0 1" 2"

FILENAME BHE-STC-02-D-1.DWG
SCALE NONE

SHEET
STC-02-1

FINAL SAG TABLE			AFL CC-55/443 "DNO-4748" OPGW 1630# INITIAL @ NESC HEAVY LOADING														6-2 to 6														
			SAG FT														3RD WAVE TIME SEC.														
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
6-2	155	198	1.51	1.68	1.90	2.14	2.39	2.64	2.90	3.14	3.38	3.62	3.84	4.06	4.27	4.47	4.67	3.67	3.88	4.12	4.37	4.62	4.86	5.09	5.30	5.50	5.69	5.86	6.02	6.18	6.33	6.46	
D6-1.1		79	0.23	0.26	0.29	0.33	0.37	0.41	0.45	0.49	0.52	0.56	0.60	0.63	0.66	0.69	0.72	1.45	1.53	1.62	1.72	1.82	1.91	2.00	2.09	2.17	2.24	2.31	2.37	2.43	2.49	2.54	
6-1		20	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.05	0.05	0.37	0.39	0.41	0.44	0.46	0.49	0.51	0.53	0.55	0.57	0.59	0.60	0.62	0.63	0.65	
D6.1		77	0.23	0.26	0.29	0.33	0.37	0.41	0.45	0.49	0.52	0.56	0.60	0.63	0.66	0.69	0.72	1.45	1.53	1.62	1.72	1.82	1.91	2.00	2.09	2.17	2.24	2.31	2.37	2.43	2.49	2.54	
SUB-PHASE TENS. LBS			950	853	754	670	600	542	495	456	424	396	373	353	336	321	307																SUBTOTAL DAMPERS NEEDED:0

FINAL SAG TABLE			AFL CC-55/443 "DNO-4748" OPGW 2745# INITIAL @ NESC HEAVY LOADING														15 to 15-2														
			SAG FT														3RD WAVE TIME SEC.														
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
15	285	253	1.30	1.40	1.52	1.65	1.80	1.95	2.12	2.29	2.46	2.64	2.82	3.00	3.18	3.35	3.52	3.41	3.54	3.69	3.84	4.01	4.18	4.35	4.52	4.69	4.86	5.02	5.18	5.33	5.48	5.61	1)DPR-OPGW-D1
15-1		311	1.99	2.16	2.34	2.54	2.76	3.00	3.25	3.51	3.79	4.06	4.34	4.61	4.88	5.16	5.41	4.22	4.39	4.57	4.77	4.97	5.18	5.39	5.61	5.82	6.03	6.23	6.42	6.61	6.79	6.96	
SUB-PHASE TENS. LBS			1760	1626	1501	1382	1270	1171	1080	999	927	864	809	761	719	681	649																SUBTOTAL DAMPERS NEEDED:1

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

FINAL SAG TABLES

AFL CC-55/443 "DNO-4748" OPGW

0 1" 2"

FILENAME BHE-STF-01-D-1.DWG

SCALE NONE

SHEET **STF-01-1**

FINAL SAG TABLE			3/8" 7 STRAND HS 2410# @ NESC HEAVY LOADING														6-2 to 6-1														
			SAG FT														3RD WAVE TIME SEC.														
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
6-2	277	277	2.03	2.17	2.31	2.46	2.61	2.78	2.94	3.11	3.29	3.47	3.65	3.84	4.01	4.19	4.37	4.27	4.40	4.54	4.69	4.84	4.98	5.13	5.28	5.42	5.57	5.72	5.86	5.99	6.12	6.25	
6-1																																	1)DPR-EHS-D1 BOL
SUB-PHASE TENS. LBS			1291	1212	1139	1069	1005	946	893	844	799	757	719	685	654	627	601																SUBTOTAL DAMPERS NEEDED:1

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

FINAL SAG TABLES

3/8" 7 STRAND HS

0 1" 2"

FILENAME BHE-STS-01-D-1.DWG

SCALE NONE

SHEET **STS-01-1**

						TCHP-69UB	SCHC-ST-M1	TCIDE-69UB-1	TCIDE-69UB-2	T-ADS	T-ADF	T-AFCS	T-AFDS	T-SP	T-SP1-8	T-PSD	T-2SPB2	T-BDEBPB	T-BDEBPD	TM-9ST	TM-9SSJ	TG-2GC (9"-12")	DPR-EHS-D1	DPR-OPGW-D1	DPR-336-T1	DPR-336-2T1	DPR-336-D2	336.4 ACSR	336.4 ACSR SPLICE	EXTRA
				Ben French-Cambell St - QTY:		8	1	1	1	2	1	1	2	9	6	15	3	6	6	1	1	1	2	1	21	6	3	50	3	1
ITEM NO.	QTY	DESCRIPTION	MANUFACTURER	MANUFACTURER PART #	CLIENT #																									
B603	5	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	BURNDY	50 FWSS	N.S.					1		1	1																	
B605	5	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	BURNDY	50 SWSSMD	N.S.					1		1	1																	
B614	5	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	FASTENAL	70207	N.S.					1		1	1																	
C104	50	CONDUCTOR, 336.4 KCMIL ACSR, 26/7 "LINNET"	SOUTHWIRE		N.S.																							1		
C902	26	WIRE, COPPER, #2 STRANDED, CLASS B	SOUTHWIRE		N.S.					6										10	4									
D17120	30	ROD, FULL THREADED, 7/8" X 120", ASTM A307 GRADE B	PORTLAND BOLT	13919-10'	N.S.	3		3	3																					
F111	1	3108.6 POLE BANDS, HEAVY DUTY, 9"-12" POLE	HUGHES	3108.6	18-1117																1									
F201	2	LINK, CONNECTING, 1/4" X 2" X 7 1/2", 15/16" HOLES, 24K LBS	HUGHES	3152	14-3152																2									
H100	6	AGS SOCKET EYE, 25K, 1-1/16"	PREFORMED	SE-5154	42-7020											2														
H102	2	SOCKET EYE, 18K, 1/2" WIDTH, 11/16" HOLE, 2-1/16" LENGTH	HUBBELL	SA04	N.S.					1																				
H500	2	Y-CLEVIS BALL, 30K	HUBBELL	YBC30	48-3054					1																				
H602	2	ANCHOR, SHACKLE, 3" LONG, 3/4" DIA., 7/8" DIA. PIN, 35K LBS	HUGHES	2865-B3	N.S.								1																	
H701	3	AGS YOKE PLATE, 18" SPACING, 5/8" PLATE, 40K	PREFORMED	YP-5908	48-5180											1														
H702	1	AGS YOKE PLATE, 18" SPACING, 1/2" PLATE, 30K	HUGHES	AS2585-Z	48-8510							1																		
H801	3	Y-CLEVIS, CLEVIS, 90, 3 1/4" LONG, 3/4" PIN, 30K LBS	HUBBELL	YCC3090	48-5208											1														
H900	2	Y-CLEVIS, EYE, 20K	ANDERSON	YCS-05	48-5206							2																		
H901	1	Y-CLEVIS, EYE, 90, 20K	ANDERSON	YCS-05-90	48-5207						1																			
H902	15	Y-CLEVIS, EYE, 90, 40K	HUBBELL	YCS-06-90-40	48-3053										1															
I111	6	INSULATOR, SUSPENSION, Y-CLEVIS BALL, 42.2" LENGTH, 25K LBS	MACLEAN	S14080031MXAL019	48-6925											2														
I220	15	INSULATOR, HORIZONTAL POST, DROP TONGUE, 69KV	HUBBELL	P25004350020	48-1007										1															
I250	15	INSULATOR, HORIZONTAL POST, CLAMPTOP, 69KV	HUBBELL	P25004351020	N.S.									1	1															
I300	12	INSULATOR, DEADEND, Y-CLEVIS BALL, 54" LENGTH, 25K LBS	MACLEAN	S14080042MXAL027	48-6927												1	1												
J200	1	FIBERLIGN SUSPENSION ASSY. W/ GROUNDWIRE	PREFORMED	4300104G	N.S.					1																				
J201	1	FIBERLIGN DOUBLE SUSPENSION ASSY. W/ GROUNDWIRE	PREFORMED	4300204G	N.S.						1																			
J300	2	FIBER OPTIC DEADEND, 18" U-BOLT (48 FIBER), W/ GROUND WIRE	PREFORMED	2801303G	N.S.								1																	
K301	6	CLAMP, TRUNNION, 336.4 KCMIL 26/7 ACSR "LINNET", 2,800 LBS	HUBBELL	TSC106	N.S.										1															
K350	9	AGS SUPPORT ASSEMBLY,795 ACSR-45/7 "TERN"	PREFORMED	AGS-5227	N.S.									1																
K500	15	AGS SUSPENSION ASSEMBLY, 25K, 795 ACSR-45/7 "TERN"	PREFORMED	AGS-5128	40-5114											1														
K505	3	AGS DOUBLE SUSPENSION ASSEMBLY, 50K, 336.4 ACSR-26/7 "LINNET"	PREFORMED	AGS-5813	N.S.											1														
L100	6	STRAIN CLAMP, DEADEND W/ SOCKET-EYE, 25K, 0.50 - 1.20 RANGE	HUBBELL	SD98-S	42-0087												1													
L101	6	STRAIN CLAMP, DEADEND W/ SOCKET-EYE, 30K, 0.50 - 1.20 RANGE	HUBBELL	SD-112-S	42-1120													1												
L300	2	STRAIN CLAMP, DE, 20K, 3/8" EHS	HUBBELL	SWDE55N	44-4053					1																				
M202	3	SPLICE, COMPRESSION, 336.4 26/7 ACSR "LINNET"	HUBBELL	A150813	N.S.																								1	
M500	5	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	HUBBELL	VHCL1012	N.S.					1		1	1																	
N107	120	NUT, SQUARE, 7/8"	HUGHES	N80	47-0242	12		12	12																					
N407	120	NUT, LOCK, MF TYPE, 7/8"	HUGHES	MF80	22-7856	12		12	12																					
O102	0.36	INHIBITOR, RUST (NO-OX-ID), 1 PT CAN, GRADE "A"	SANCHEM INC	NO-OX-ID "A" SPECIAL	N.S.										0.06															
P104	1	CLIP, BONDING, WITH 1/2" X 1 1/2" BOLT, 7/16" MAX. WIRE	HUGHES	2718.55	46-2718																1									
P500	1	ROD, GROUND, 5/8" X 8'-0", COPPERCLAD	GALVAN	6260G13	46-0588															1										
P701	1	CLAMP, GROUND ROD, 0.128 TO 0.460 RANGE, 5/8" ROD	CHANCE	C2030344	46-0058															1										
P820	3	CLAMP, VISE TYPE, LIGHTNING ARRESTOR GROUND, #2 STRANDED	HUBBELL	GC207	N.S.															1	2									
Q100	2	CLAMP, 3-BOLT, 6" LONG, 5/8" BOLT, 5/16" - 1/2" RANGE	MACLEAN	J931	18-5816					1																				
Q500	1	CONNECTOR, COMPRESSION #4 COPPER TO #4 COPPER	HOMAC	CC44	N.S.						1																			
Q550	2	CLAMP, SINGLE BOLT, VISE TYPE, 3/8" EHS TO #2 STR CU	HUBBELL	GA9020GLSS	46-6810					1																				
Q600	6	PARALLEL GROOVE CONNECTOR, 0.743 - 1.152 RANGE	AFL	482.2P	42-0482												1													
Q601	6	PARALLEL GROOVE CONNECTOR, 0.743 - 1.152 RANGE	AFL	483.3A	42-0483													1												
S110	3	SPIRAL VIBRATION DAMPER, 0.327" - 0.461" RANGE	PREFORMED	5050104	N.S.																	1	1							
S152	39	DAMPER, DOG BONE, 336.4 ACSR	HUBBELL	60715-11	N.S.																			1	2	2				
W322	60	WASHER, SQUARE, 4" X 1/4", 15/16" HOLE	HUGHES	SW4-80	N.S.	6		6	6																					
W410	60	WASHER, ROUND, 2" X 1/4", 15/16" HOLE	HUGHES	RW2-80	N.S.	6		6	6																					

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

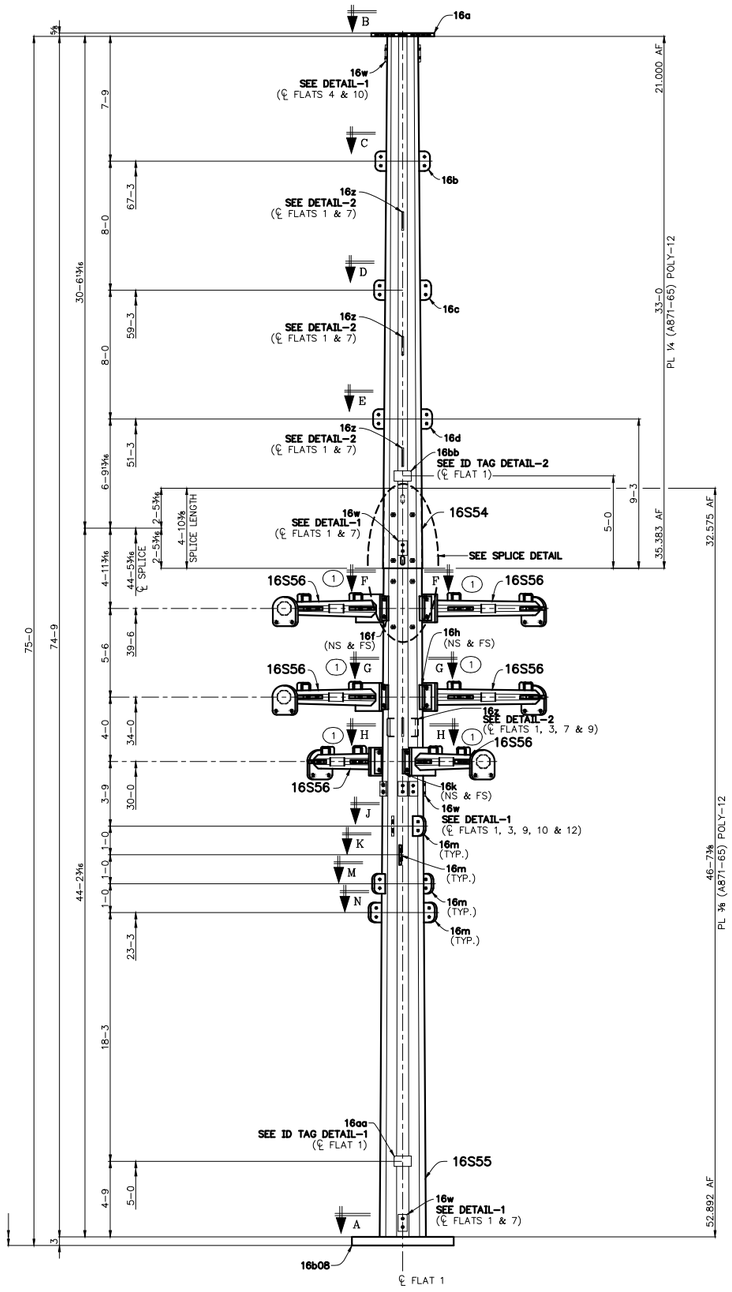
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

BEN FRENCH - CAMBELL ST
69KV TRANSMISSION LINE

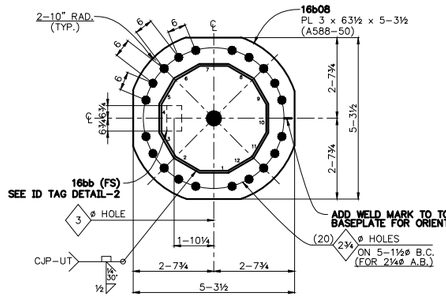
MATERIAL LIST

0 1" 2"

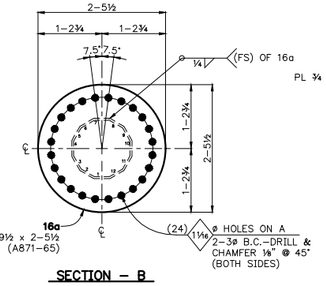
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SCALE NONE
SHEET ML-01



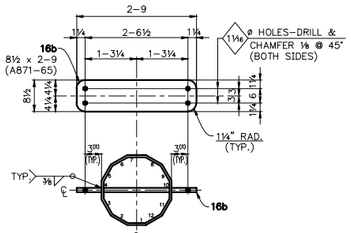
69KV TRANSMISSION POLE



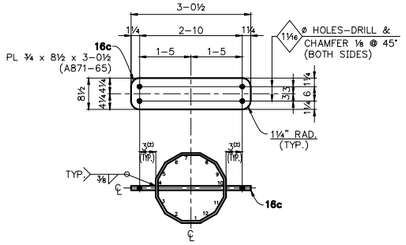
SECTION – A



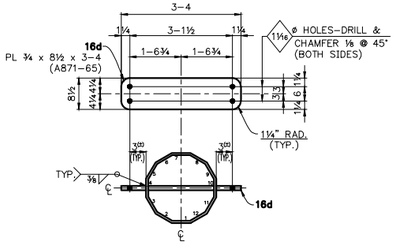
SECTION – B



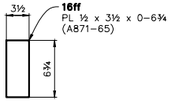
SECTION – C

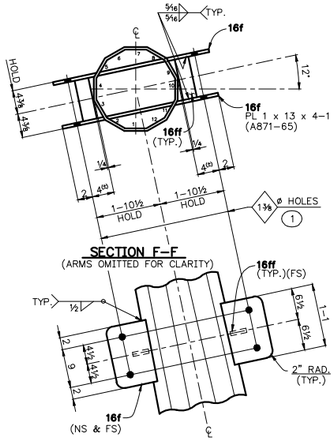


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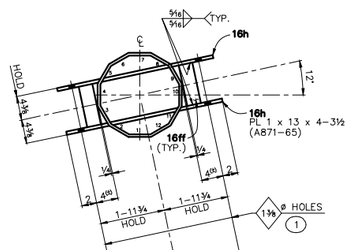


SECTION – E

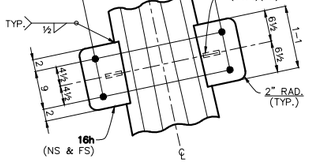


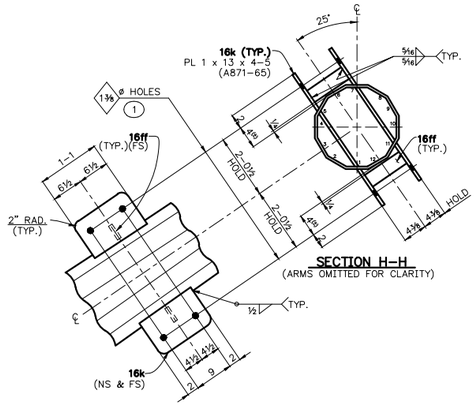


SECTION F-F
(ARMS OMITTED FOR CLARITY)

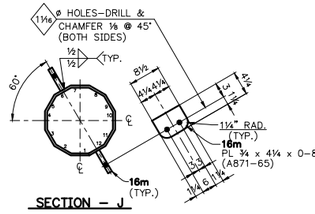


SECTION G-G
(ARMS OMITTED FOR CLARITY)





SECTION H-H
(ARMS OMITTED FOR CLARITY)



SECTION – J

MATERIAL REQ'D. FOR ASSEMBLY			
MARK	QTY.	DESCRIPTION	BLACK WT.
16S54	ONE	POLY-12 POLE	2,874
16S55	ONE	POLY-12 POLE	12,738
16S56	6	POLY-8 POLE (UNIT WT. = 258)	1,548
		TOTAL BLACK WT.	17,160#

HARDWARE REQD. FOR ASSEMBLY		
MARK	QTY.	DESCRIPTION
(1)	24	1¼ø x 4 (A325 TYPE-3) BOLTS W/ ONE-1¼ø H. FLATWASHER (F436 TYPE-3) EACH ONE-1¼ø H. HEX NUT LOCKNUT (A563-DH TYPE-3) EACH
(2)	ONE	SEE ANCHOR BOLT CAGE DETAIL ON SHEET E32.

MATERIAL BILLED FOR ONE MAKE (ONE) TIME

GENERAL NOTES:

1. ALL WELDS SHALL BE IN ACCORDANCE WITH A.W.S. (D1.1.) UNLESS NOTED OTHERWISE.
   a.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL BE U.T. TESTED IN ACCORDANCE WITH AWS & ASNDT.
   b.) ALL MATERIAL WELDED WITH E80-SERIES, LOW HYDROGEN ELECTRODES.
   c.) ALL FILLET WELDS AT JOINT TERMINATIONS OR ABRUPT CHANGES IN WELD DIRECTION SHALL HAVE END RETURNS TO WRAP CORNERS AS GEOMETRY PERMITS. IF JOINT GEOMETRY DOES NOT PERMIT A FULL SIZE RETURN, A SEAL WELD SHALL BE PROVIDED WHERE ACCESSIBLE.
   d.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL USE 3/16" X 1 1/4", (A36) STEEL BACKING (GALVANIZED POLES); (A588-50) (NON-GALVANIZED), MINIMUM. BACKING BARS SHALL BE SPLICED ON SHAFT FLATS ONLY, WITH A C.J.P. GROOVE WELD. BACKING BARS SHALL BE SEAL WELDED ALL AROUND, WHEN ACCESSIBLE.
   e.) LONGITUDINAL SEAM WELDS SHALL ACHIEVE A MINIMUM OF 80% PENETRATION. LONGITUDINAL SEAM WELDS SHALL ACHIEVE 100% PENETRATION WITHIN A MINIMUM OF 6" FROM THE ENDS OF THE SHAFT AND THE FULL LENGTH OF THE FEMALE SECTION IN THE SLIP JOINT.
2. LONGITUDINAL SEAM WELDS IN FEMALE SECTION OF THE SLIP JOINT SHALL BE FULL PENETRATION WELDS.
3. FOR PROPER SHAFT ALIGNMENT FOR ASSEMBLY, A 6" HORIZONTAL WELD BEAD AND A MARK NUMBER ARE POSITIONED ON EACH SHAFT AT EACH SPLICE. THE 6" HORIZONTAL WELD BEADS ARE ON MATCHING CORNERS. THE MARK NUMBER IS ON AN ADJACENT FLAT. THE HORIZONTAL WELD BEAD CORNERS SHALL BE ALIGNED TOP TO BOTTOM OF THE POLE. MATCH NUMBERS SHALL BE MATCHED FOR EACH SPLICE.
4. FIELD ASSEMBLY HOLES (1⅛ø) WITH 1"ø H. HEX NUTS ARE LOCATED ON OPPOSING SECTION FLATS ABOVE AND BELOW SPLICES FOR JACKING SHAFTS TOGETHER.
5. THE LOWER WELD ORIENTATION MARK AT EACH SPLICE LOCATION SHALL BE TELESCOPED IN THE FIELD TO WITHIN 24" OF THE UPPER WELD ORIENTATION MARK. AFTER TELESCOPED, THE SECTIONS SHOULD SHOW NO FURTHER MOVEMENT AND THERE SHOULD BE ADEQUATE METAL-TO-METAL CONTACT ON ALL FLATS.
6. TWO SLOTS (1⅛ø x 2½") WILL BE PROVIDED AT THE SLIP FITTED END OF EACH SHAFT.
7. POLE TAPER = 0.435848 IN/FT
8. FIELD BOLT SHIPPING QUANTITIES WILL INCLUDE A MAXIMUM 5% OVERAGE FOR BOLTS 1"ø OR LESS. FIELD BOLTS OVER 1"ø WILL BE EXACT COUNT UNLESS NOTED OTHERWISE.
9. ALL HARDWARE NOTED WITH "PT" SHALL BE PRE-TENSIONED PER THE TURN-OF-NUT METHOD. ALL OTHER HARDWARE SHALL BE SNUG-TIGHT. SPARE SHIPPING QUANTITIES WILL INCLUDE THREE EXTRA ASSEMBLIES OF EACH BOLT TYPE DESIGNATED AS "PT" FOR FIELD VERIFICATION OF PRE-TENSIONING METHOD.
10. **POLE SHALL BE SWEEP BLASTED DULLED AFTER FABRICATION.**

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL, DO NOT GALVANIZE.

(STR. 6-1) 19-9462PE30

DIS-TRAN Steel, LLC
P.O. BOX 5109 • ALEXANDRIA, LA, 71307-5709
PHONE 318-448-0274 • FAX 318-445-4454

WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

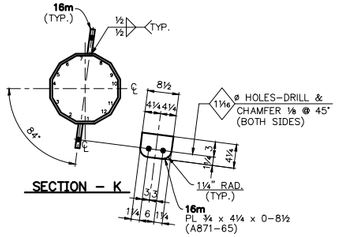
69KV TRANSMISSION POLE / ITEM – 20
ERECTION ELEVATION, SECTIONS & DETAILS

SCALE	DATE	JOB NUMBER	DRAWING NUMBER	REV. NO.
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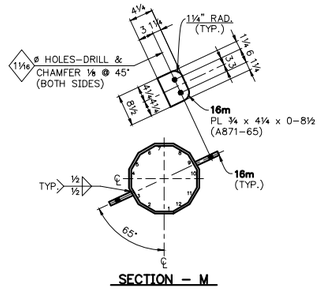
DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ

NOTICE TO ERECTOR
BACKCHARGES FOR CORRECTIVE WORK OR REPLACED MATERIALS WILL NOT BE ACCEPTED UNLESS EXPRESSLY AUTHORIZED BY DIS-TRAN BEFORE ANY SUCH COST ARE INCURRED.

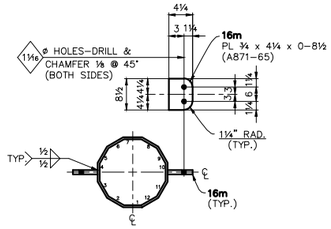
REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
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3					
4					
5					
6					
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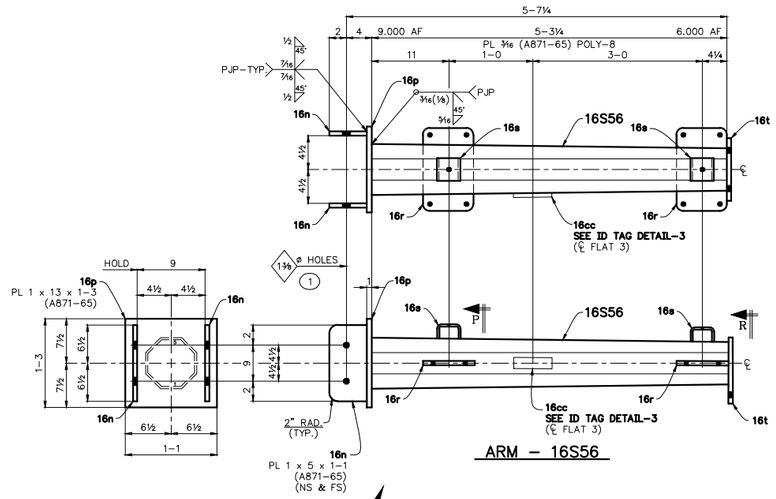
SECTION – K



SECTION – M

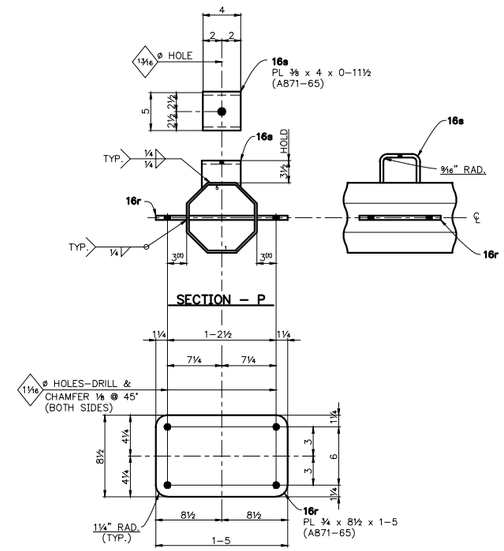


SECTION – N

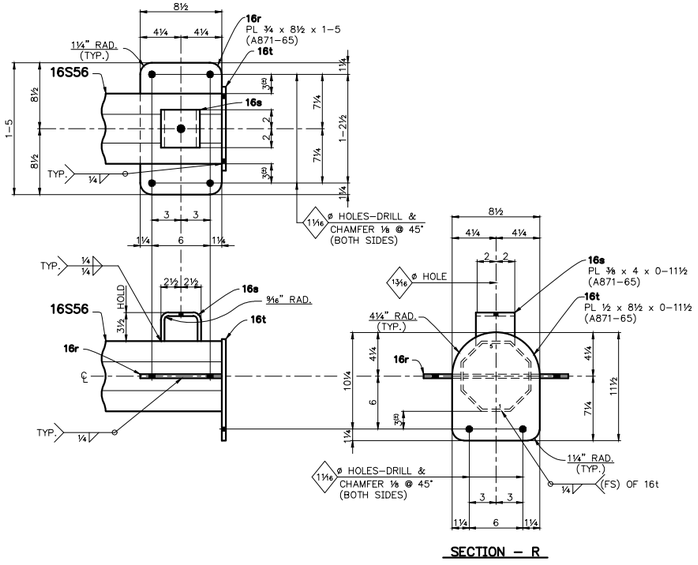


ARM – 16S56

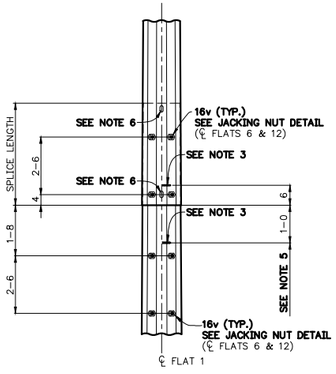
OUTBOARD ARM TO BE UPSWEPT ON A BEVEL OF 5/16 TO 12



SECTION – P

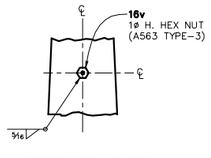


SECTION – R

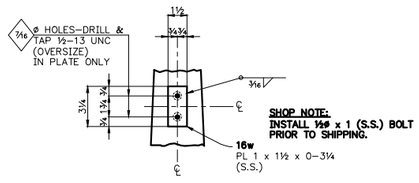


SPLICE DETAIL

(ARMS & DETAIL–1 REMOVED FOR CLARITY)



JACKING NUT DETAIL



DETAIL – 1

GROUNDING SCHEDULE

DIM'S TO CENTER OF GROUND PLATE

SEE DETAIL–1

POLE – 16S54		POLE – 16S55					
℄ OF FLATS 1 & 7	℄ OF FLATS 4 & 10	℄ OF FLAT 1	℄ OF FLAT 3	℄ OF FLAT 7	℄ OF FLAT 9	℄ OF FLAT 10	℄ OF FLAT 12
0–11	32–0	0–9	29–9	0–9	29–9	25–0	24–0
		23–0		33–9		26–0	
		33–9		39–3			
		39–3		40–10			
		40–10					

ALL DIMENSIONS FROM BOTTOM OF SHAFT

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL, DO NOT GALVANIZE.

(STR. 6–1)

19–9462PE31

NOTICE TO ERECTOR

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REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19

DIS-TRAN Steel, LLC
P.O. BOX 5109•ALEXANDRIA, LA, 71307–5709
PHONE 318–448–0274•FAX 318–445–4454

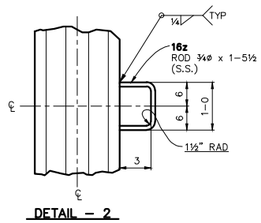
WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

69KV TRANSMISSION POLE / ITEM – 20

SECTIONS & DETAILS (CONTINUED)

SCALE	DATE	JOB NUMBER	DRAWING NUMBER	REV. NO.
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DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ

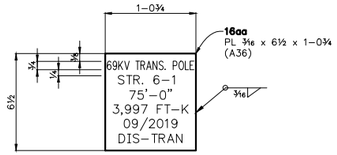


DETAIL – 2

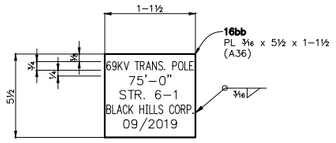
GROUND LOOP SCHEDULE
DIM'S TO CENTER OF GROUND LOOP
SEE DETAIL–2

POLE – 16S54	POLE – 16S55	
℄ OF FLATS 1 & 7	℄ OF FLATS 1 & 7	℄ OF FLATS 3 & 9
6–6	32–3	28–3
14–6	37–9	
22–6		

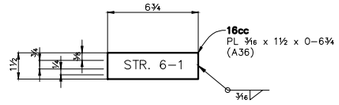
ALL DIMENSIONS FROM BOTTOM OF SHAFT



ID TAG DETAIL – 1



ID TAG DETAIL – 2



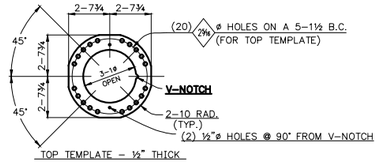
ID TAG DETAIL – 3

SPACE ANCHOR BOLTS 6" APART IN ALL FOUR QUADRANTS. START WITH THE FIRST ANCHOR BOLT ON THE 45° LINE AS SHOWN BELOW.

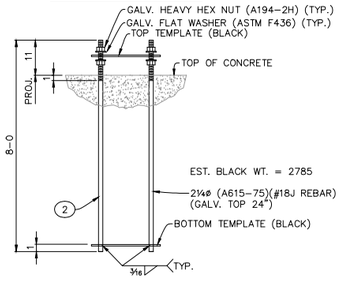


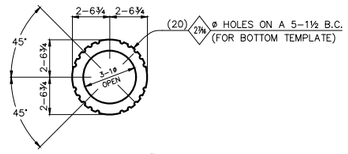
THEN LOCATE THE OTHER ANCHOR BOLTS 6" APART AS SHOWN BELOW.





TOP TEMPLATE – ½" THICK





BOTTOM TEMPLATE – ⅜" THICK

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL,
DO NOT GALVANIZE.

(STR. 6–1) 19–9462PE32

DIS-TRAN Steel, LLC
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WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

69KV TRANSMISSION POLE / ITEM – 20

SECTIONS & DETAILS (CONTINUED)

SCALE	DATE	JOB NUMBER	DRAWING NUMBER	REV. NO.
N.T.S.	07/12/19	19–9462P	E32	1

DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ

NOTICE TO ERECTOR
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REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19
2					
3					
4					

REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
5					
6					
7					
8					

BLACK HILLS ENERGY

WEST RAPID CITY TO BEN FRENCH 1 69KV TRANSMISSION LINE

DRAWING LIST

DRAWING #	DRAWING DESCRIPTION
DL-01	DRAWING LIST
	ROUTE MAP
RM-01	ROUTE MAP
	PLAN AND PROFILE DRAWINGS
PP-01	WEST RAPID CITY SUB – BF1 SUB
	STRUCTURE DETAILS
SD-01-1	SCDE-ST-M1
SD-02-1	SCDE-69
	ASSEMBLY DETAILS
AD-01-1	T-4A,B,S, T-4D(S), T-4C
AD-02-1	T-4F, T-4FD, T-4FC
AD-03-1	T-FDL, T-FSC-1
AD-04-1	T-SP(1), T-BPD, T-PSD
AD-05-1	T-BDE6PD, T-SDE6PD, TM-EXT-15, T-BDE6D
AD-06-1	TM-9ST, TM-9SD, TM-9SSJ, TM-9
AD-07-1	TD-1, TD-2
AD-08-1	TG-26, TA-P1, TGS-1(A), TM-GM
AD-09-1	TM-101 & TM-103, TP-A
AD-10-1	DPR-OPGW, DPR-795, DPR-EHS
	LOAD AND DESIGN DETAILS
LD-12-1	DESIGN DETAILS
LD-12-2	LOAD TREES
	FOUNDATION DETAILS
FND-03-1	STR 1D, STR 2D
	STAKING SHEETS
SS-01	STR SUB DE – STR BF1 SUB
	PHASING DIAGRAM
PH-01	PHASING DIAGRAM

DRAWING #	DRAWING DESCRIPTION
	SAG TABLES 795 KCMIL 45/7 ACSR "TERN"
STC-01-1	STR SUB DE – STR 1D, STR 1D – STR 2D, INITIAL
STC-02-1	STR 2D – STR 3D, FINAL
	SAG TABLES AFL CC-55/443 "DNO-4748" OPGW
STF-01-1	STR SUB DE – STR 1D, STR 1D – STR 2D, STR 2D – STR 3D, INITIAL
	SAG TABLES 3/8" 7 STRAND EHS
STS-01-1	STR SUB DE – STR 1D, INITIAL
	MATERIAL LIST
ML-01	MATERIAL LIST
	APPENDIX
	WEST RAPID CITY SUBSTATION REFERENCE DRAWINGS
WRC-C-101	GENERAL ARRANGEMENT
WRC-C-304	SECTIONS E AND F
WRC-C-320	BUS CONNECTION DETAILS
WRC-C-321	BUS CONNECTION DETAILS
WRC-C-380	MATERIAL LIST

1	REVISION
DESCRIPTION: RECORD DRAWINGS	
NAME: DATE: REG. NO.:	
PROJECT #: 10114217	ISSUE DATE: 6/12/2020
PROJECT MANAGER: J. ELLSWORTH	
DESIGN ENGINEER: J. PANKRATZ	
DRAWN BY: Z. JANSEN	

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 1
69KV TRANSMISSION LINE

DRAWING LIST

0 1" 2"

FILENAME BHE-DL-01-01.DWG
SCALE NONE
SHEET DL-01

N

WEST RAPID CITY SUBSTATION

BEN FRENCH SUBSTATION

CT GENERATORS

STATE HWY 445 DEADWOOD AVE

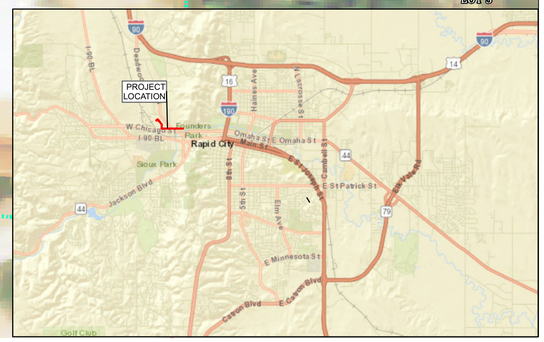
LOT C

LOT 3

E40
41
43A
42A
42C
1A
1B
1D
2D
E3D
E43C
E4D
2A
2B
2B-1
2A-1
2A-2
3
4
5
CT1
CT2
CT3
CT4
ECT1-1
ECT2-3
ECT3-3
E2A-3
ECA-1
ECA-2
ECB-1
ECB-2

LEGEND

- SUPPORT STRUCTURE
- SUBSTATION DEAD-END
- RETIRE SUPPORT STRUCTURE
- CT 4 - BEN FRENCH 2 69KV RETIREMENT
- LANGE - BEN FRENCH 2 69KV RETIREMENT
- LANGE - BEN FRENCH 1 69KV RETIREMENT
- LANGE - BEN FRENCH 3 69KV RETIREMENT
- OTHER 69KV TRANSMISSION LINE
- BEN FRENCH - CAMPBELL STREET 69KV TRANSMISSION LINE
- BEN FRENCH - CT'S 69KV TRANSMISSION LINE
- LANGE - BEN FRENCH 69KV TRANSMISSION LINE
- LANGE - WEST RAPID CITY 69KV TRANSMISSION LINE
- LANGE-SOUTH RAPID CITY 230KV TRANSMISSION LINE
- WEST RAPID CITY - BEN FRENCH 2 69KV TRANSMISSION LINE
- WEST RAPID CITY - BEN FRENCH 1 69KV TRANSMISSION LINE
- WEST RAPID CITY - CT4 69KV TRANSMISSION LINE
- WEST RAPID CITY 230KV TRANSMISSION LINE
- ELECTRIC EASEMENT
- UTILITY EASEMENT
- PROPERTY LINE
- QUARTER LINE
- SECTION LINE
- LEADER LINE



Black Hills Energy
Improving life with energy

HDR

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	09/11/2019	ISSUE FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CADD TECHNICIAN	Z. JANSEN
GIS TECHNICIAN	S.GRIFFIN
PROJECT NUMBER	10114217

BLACK HILLS POWER
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
69KV TERMINATIONS

ROUTE MAP

0 20 40 80 Feet

FILENAME: West Rapid City 69kV Terminations 22x34

SCALE: 1 inch = 50 feet

SHEET
RM-01



PLAN NOTES:

- STRUCTURE
- ALIGNMENT
- ALIGNMENT OF ANOTHER LINE

NOTES:

1. [XXX] – EXISTING ASSEMBLY
2. *XXX – RETIREMENT ASSEMBLY
3. T[XXX] – TRANSFER UNIT ASSEMBLY
4. SHIELD WIRE SHOWN AT 60°F (CREEP)
5. CONDUCTOR SHOWN AT 212°F (MAX SAG)

PROFILE NOTES:

- CONDUCTOR DAMPER
- SHIELD DAMPER
- OPGW SPLICE



ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 1
69KV TRANSMISSION LINE

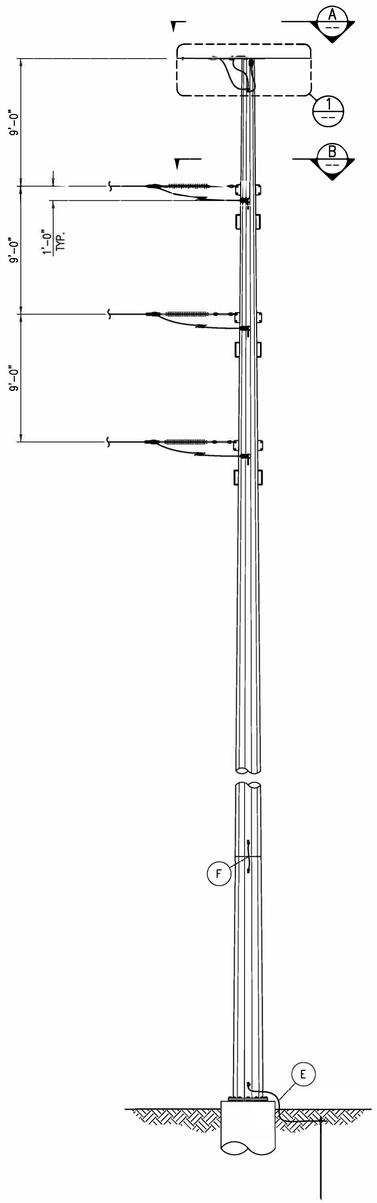
PLAN AND PROFILE

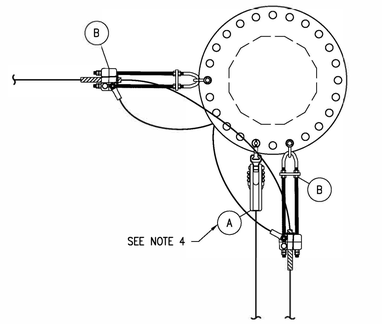
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FILENAME BHE-PP-01-D-1.DWG
SCALE H:1"=100' V:1"=20'
SHEET PP-01

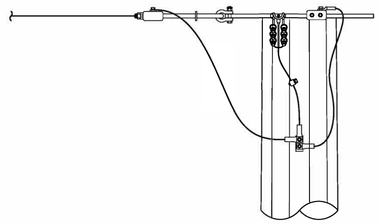
LIST OF ASSEMBLIES (CALLED OUT SEPARATELY)			
ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T-4DS	OHSW DEADEND ASSEMBLY - STEEL POLE	1
B	T-4FDS	OPGW DEADEND ASSEMBLY - STEEL POLE	2
C	T-BDE6PD	CONDUCTOR DEADEND ASSEMBLY	6
D	TM-EXT-15	EXTENSION LINK ASSEMBLY	6
E	TM-9ST	STEEL POLE GROUNDING ASSEMBLY	1
F	TM-9SSJ	STEEL POLE SLIP JOINT GROUNDING	1

NOTES:
1. SEE LOAD AND DESIGN DRAWINGS FOR STEEL DESIGN DETAILS.
2. SEE STEEL POLE MANUFACTURING DRAWINGS FOR STEEL POLE DETAILS.
3. STATIC/CONDUCTOR AND POLE GROUND ASSEMBLIES ARE SEPARATE UNITS.
4. STR 2B DOES NOT HAVE A ADDITIONAL T-4DS OHGW ASSEMBLY.

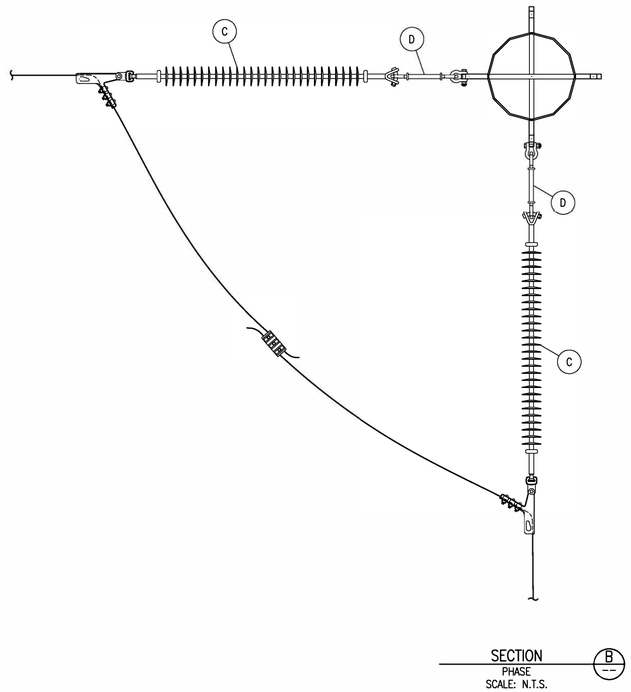




VIEW A
SHIELD
SCALE: N.T.S.



DETAIL 1
SHIELD GROUNDING
SCALE: N.T.S.



SECTION B
PHASE
SCALE: N.T.S.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
69KV SINGLE CIRCUIT DEADEND ON STEEL POLE
NON-TYPICAL

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: SCDE-ST-M1

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

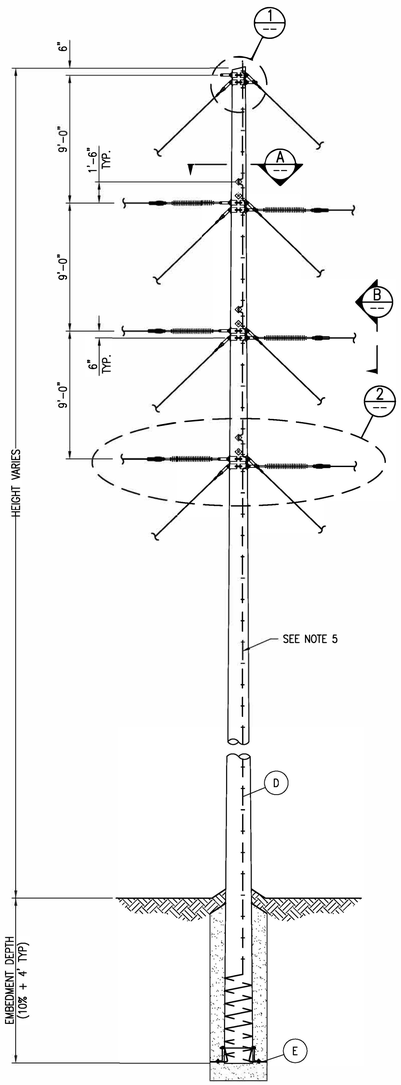
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 1
69KV TRANSMISSION LINE

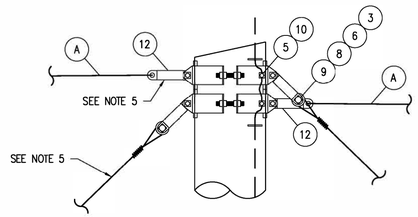
STRUCTURE DETAILS
69KV SC DEADEND ON STEEL POLE
STR 1D AND 2D

0 1" 2"

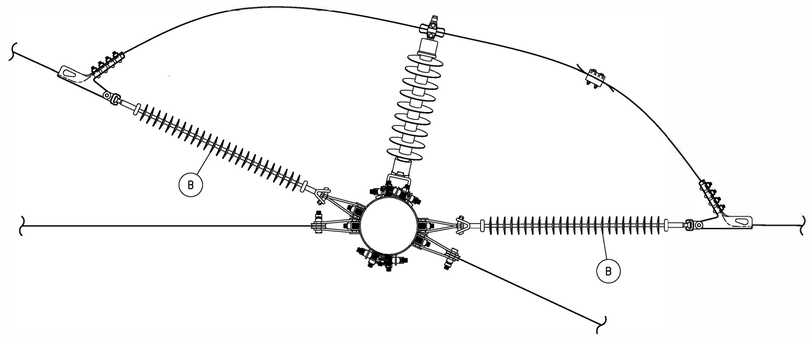
FILENAME: BHE-SD-01-D-1.DWG
SCALE: 3/16"=1'-0"
SHEET: **SD-01-1**



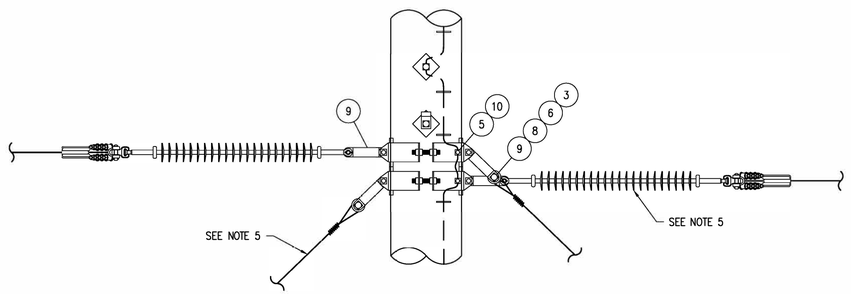
ELEVATION VIEW
SCALE: N.T.S.



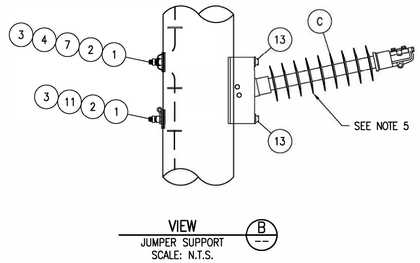
DETAIL 1
SHIELD ATTACHMENT
SCALE: N.T.S.



SECTION A
SCALE: N.T.S.



DETAIL 2
CONDUCTOR ATTACHMENT
SCALE: N.T.S.



VIEW B
JUMPER SUPPORT
SCALE: N.T.S.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY.
1	–	BOLT, MACHINE, 7/8" X REQ'D LENGTH	B270	HUGHES	–	6
1.1	20–7818	BOLT, MACHINE, 7/8" X 18"	B2718	HUGHES	B818–6	–
1.2	20–7820	BOLT, MACHINE, 7/8" X 20"	B2720	HUGHES	B820–6	–
1.3	20–7822	BOLT, MACHINE, 7/8" X 22"	B2722	HUGHES	B822–6	–
1.4	20–7824	BOLT, MACHINE, 7/8" X 24"	B2724	HUGHES	B824–6	–
2	22–4425	WASHER, SQ. CURVED, 4" X 1/4", 15/16" HOLE	W504	HUGHES	SCW4–80	6
3	22–7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	14
4	0407–0242	NUT, SQUARE, 7/8"	N107	HUGHES	N80	3
5	–	3108 POLE BANDS, HEAVY DUTY, REQ'D POLE DIAMETER	–	HUGHES	–	8
5.1	18–1116	3108 POLE BANDS, HEAVY DUTY, 7"–10" POLE	F110	HUGHES	3108.5	–
5.2	18–1117	3108 POLE BANDS, HEAVY DUTY, 9"–12" POLE	F111	HUGHES	3108.6	–
5.3	18–1118	3108 POLE BANDS, HEAVY DUTY, 11"–14" POLE	F112	HUGHES	3108.7	–
5.4	18–1119	3108 POLE BANDS, HEAVY DUTY, 13"–16" POLE	F113	HUGHES	3108.8	–
6	20–7803	BOLT, MACHINE, 7/8" X 3"	B273	HUGHES	B83–2	8
7	46–2728	CLIP, BONDING, FOR 7/8" DIA. BOLT, 5/16" MAX. WIRE	P207	HUGHES	2727.8	3
8	18–2808	GUY, ROLLER, 1 1/8" WR, 15/16" HOLE	G100	HUGHES	28082	8
9	14–3154	LINK, CONNECTING, 3/8" X 2" X 7 1/2", 15/16" HOLES, 38K LBS	F203	HUGHES	3154	28
10	46–2718	CLIP, BONDING, WITH 1/2" X 1 1/2" BOLT, 7/16" MAX. WIRE	P104	HUGHES	2718.55	8
11	N.S.	WASHER, SPRING, 15/16" HOLE	W207	HUGHES	2702.8	3
12	14–3152	LINK, CONNECTING, 1/4" X 2" X 7 1/2", 15/16" HOLES, 24K LBS	F201	HUGHES	3152	4
13	N.S.	WASHER, ROUND, 2" X 1/4", 15/16" HOLE	W410	HUGHES	RW2–80	6

TYPICAL ADDITIONAL ASSEMBLIES (CALLED OUT SEPARATELY)

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T–4D	OHSW DEADEND ASSEMBLY	2
	T–4FDW	OPGW DEADEND ASSEMBLY	
B	T–BDE6PD	CONDUCTOR DEADEND ASSEMBLY – POLYMER	6
	T–BDE6D	CONDUCTOR DEADEND ASSEMBLY – BELLS	
C	T–SP1	CONDUCTOR JUMPER ASSEMBLY	3
D	TM–9	WOOD POLE GROUNDING ASSEMBLY	1
E	TP–A	POLE ANCHOR ASSEMBLY	1

TYPICAL BOLTS (QTY)*

ITEM NO.	POLE CLASS		
	2–1	H1–H2	H3–H4
1.1	4	–	–
1.2	2	4	–
1.3	–	2	4
1.4	–	–	2

*SEE NOTE 3

TYPICAL POLE BANDS (QTY)*

ITEM NO.	POLE CLASS		
	2–1	H1–H2	H3–H4
5.1	2	–	–
5.2	4	2	2
5.3	2	4	2
5.4	–	2	4

*SEE NOTE 3

NOTES:

1. DRILLED HOLES SHALL BE 1/16" GREATER THAN THE SPECIFIED BOLT DIAMETER.
2. FIELD DRILLED HOLES SHALL BE THOROUGHLY TREATED.
3. BOLT LENGTHS AND POLE BAND DIAMETERS ARE ESTIMATED BASED ON STANDARD CLASS DOUGLAS FIR POLE DIMENSIONS. ACTUAL POLE DIAMETERS MAY VARY.
4. BOND ALL HARDWARE TO POLE GROUND UNIT.
5. POLE GROUND, GUYS, ANCHORS, POLE ANCHORS, JUMPER SUPPORT, AND STATIC/CONDUCTOR ASSEMBLIES ARE SEPARATE UNITS.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
69kV SINGLE CIRCUIT DEADEND
LIGHT TO HEAVY ANGLE WITH POST

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: SCDE-69

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 1
69KV TRANSMISSION LINE

STRUCTURE DETAILS
69KV SINGLE CIRCUIT DEADEND

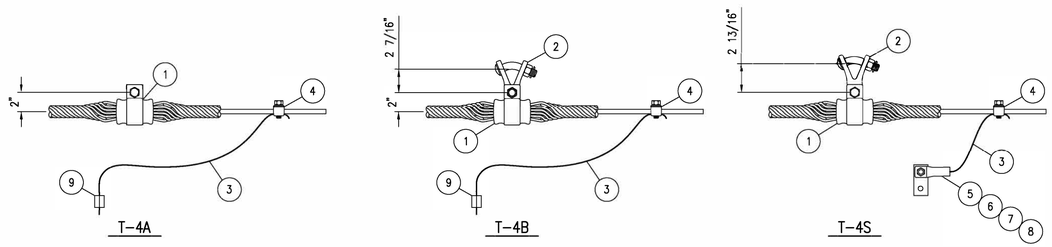
0 1" 2"

FILENAME: BHE–SD–02–D–1.DWG
SCALE: 3/16"=1'–0"
SHEET: SD-02-1

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4A QTY	T-4B QTY	T-4S QTY
1	40-7104	AGS SUSPENSION ASSY, 15K, 3/8" EHS	K400	PREFORMED	AGS-7104	1	1	1
2	48-5207	Y-CLEVIS - EYE, 90, 20K	H901	ANDERSON	YCS-05-90		1	1
3	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			2'	2'	6'
4	46-6810	CLAMP, SINGLE BOLT, VISE TYPE, 3/8" EHS TO #2 STR CU	Q550	HUBBELL	GA9020GLSS	1	1	1
5	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012			1
6	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207			1
7	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS			1
8	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD			1
9	36-0002	GROUND CLAMP, #2 STRANDED TO #4 SOLID	Q501	HOMAC	CC24	1	1	

*MAX. LINE ANGLE = 30°



OHSW SUSPENSION
3/8" EHS 7 STRAND GALV.

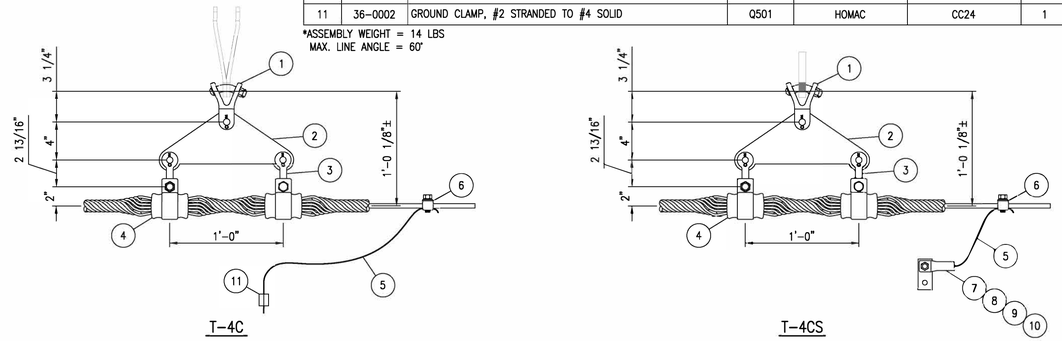
SHEET TITLE
TRANSMISSION ASSEMBLY
OHSW ATTACHMENT

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4A,B,S

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4C QTY	T-4CS QTY
1	48-5208	Y-CLEVIS, CLEVIS, 90, 3 1/4" LONG, 3/4" PIN, 30K	H801	HUBBELL	YCC3090	1	1
2	48-8510	AGS YOKE PLATE, 12" SPACING, 1/2" PLATE, 30K	H700	PREFORMED	YP-5907	1	1
3	48-5206	Y-CLEVIS, EYE, 20K	H900	ANDERSON	YCS-05	2	2
4	40-7804	AGS DOUBLE SUSPENSION ASSEMBLY, 15K, 3/8" EHS	K401	PREFORMED	AGS-7804	1	1
5	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			2'	6'
6	46-6810	CLAMP, SINGLE BOLT, VISE TYPE, 3/8" EHS TO #2 STR CU	Q550	HUBBELL	GA9020GLSS	1	1
7	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012		1
8	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207		1
9	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS		1
10	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD		1
11	36-0002	GROUND CLAMP, #2 STRANDED TO #4 SOLID	Q501	HOMAC	CC24	1	

*ASSEMBLY WEIGHT = 14 LBS
MAX. LINE ANGLE = 60°



OHSW DOUBLE SUSPENSION
3/8" EHS 7 STRAND GALV.

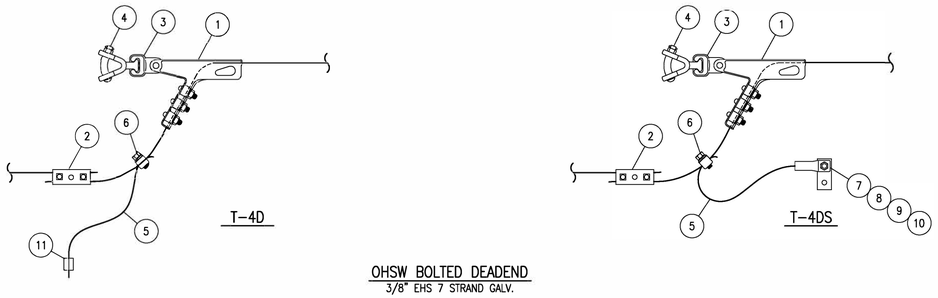
SHEET TITLE
TRANSMISSION ASSEMBLY
OHSW DOUBLE SUSPENSION

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4C

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4D QTY	T-4DS QTY
1	44-4053	STRAIN CLAMP, DE, 20K, 3/8" EHS	L300	HUBBELL	SWDE55N	1	1
2	18-5816	CLAMP, 3-BOLT, 6" LONG, 5/8" BOLT, 5/16" - 1/2" RANGE	Q100	MACLEAN	J931	1	1
3	N.S.	SOCKET EYE, 18K, 1/2" WIDTH, 11/16" HOLE, 2-1/16" LENGTH	H102	HUBBELL	SA04	1	1
4	48-3054	Y-CLEVIS BALL, 30K	H500	HUBBELL	YBC30	1	1
5	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			2'	6'
6	46-6810	CLAMP, SINGLE BOLT, VISE TYPE, 3/8" EHS TO #2 STR CU	Q550	HUBBELL	GA9020GLSS	1	1
7	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012		1
8	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207		1
9	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS		1
10	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD		1
11	36-0002	GROUND CLAMP, #2 STRANDED TO #4 SOLID	Q501	HOMAC	CC24	1	

*ONE ITEM (2) WILL BE REQUIRED FOR EVERY TWO ASSEMBLIES



OHSW BOLTED DEADEND
3/8" EHS 7 STRAND GALV.

SHEET TITLE
TRANSMISSION ASSEMBLY
OHSW DEADEND

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4D(S)

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 1
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
OHSW ASSEMBLIES

0 1" 2"

FILENAME BHE-AD-01-D-1.DWG
SCALE N.T.S.

SHEET
AD-01-1

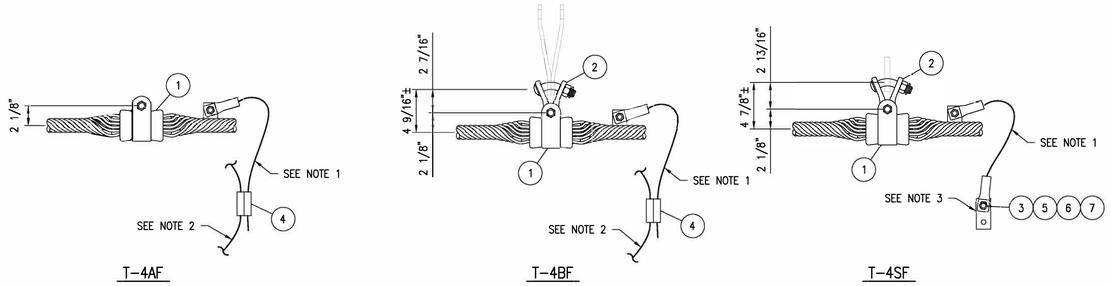
NOTES:

1. #4 STRANDED COPPER WITH CONNECTOR AND BOLTS. FURNISHED WITH ITEM 1.
2. WOOD POLE GROUND.
3. STEEL POLE NEMA PAD.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4AF QTY	T-4BF QTY	T-4SF QTY
1	N.S.	FIBERLIGN SUSPENSION ASSY, W/ GROUNDWIRE	J200	PREFORMED	4300104G	1	1	1
2	48-5207	Y-CLEVIS - EYE, 90, 20K	H901	ANDERSON	YCS-05-90		1	1
3	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012			1
4	N.S.	CONNECTOR, COMPRESSION #4 COPPER TO #4 COPPER	Q500	HOMAC	CC44	1	1	
5	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207			1
6	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS			1
7	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD			1

*MAX. LINE ANGLE = 30°



T-4AF T-4BF T-4SF

OPGW SUSPENSION
0.443" OPGW CABLE

SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW ATTACHMENT

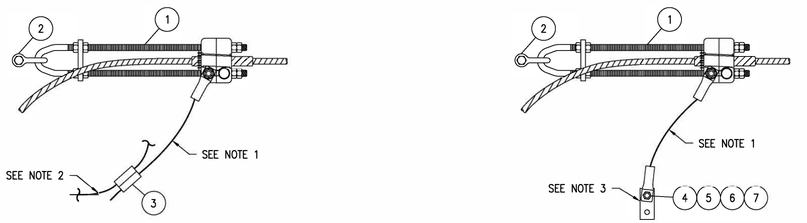
REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4F

NOTES:

1. #4 STRANDED COPPER WITH CONNECTOR AND BOLTS. FURNISHED WITH ITEM 1.
2. WOOD POLE GROUND.
3. STEEL POLE NEMA PAD.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4FDW QTY	T-4FDS QTY
1	N.S.	FIBER OPTIC DEADEND, 18" U-BOLT (48 FIBER), W/GROUNDWIRE	J300	PREFORMED	2801303G	1	1
2	N.S.	ANCHOR, SHACKLE, 3" LONG, 3/4" DIA., 7/8" DIA. PIN, 35K LBS	H602	HUGHES	2865-B3	1	1
3	N.S.	CONNECTOR, COMPRESSION #4 COPPER TO #4 COPPER	Q500	HOMAC	CC44	1	
4	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012		1
5	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207		1
6	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS		1
7	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD		1



T-4FDW T-4FDS

OPGW DEADEND
0.443" OPGW CABLE

SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW DEADEND

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4FD

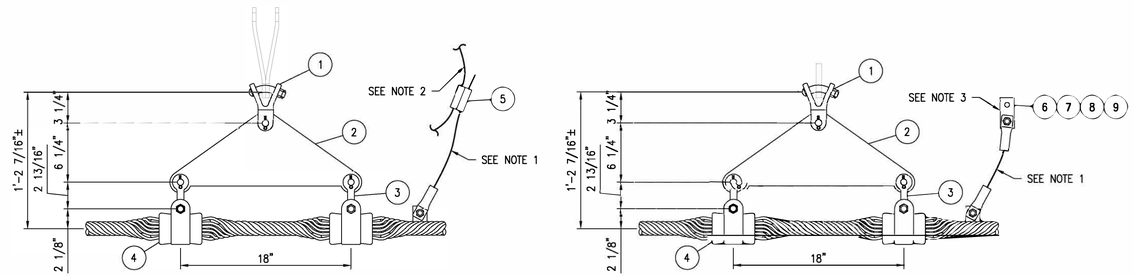
NOTES:

1. #4 STRANDED COPPER WITH CONNECTOR AND BOLTS. FURNISHED WITH ITEM 1.
2. WOOD POLE GROUND.
3. STEEL POLE NEMA PAD.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4FC QTY	T-4FCS QTY
1	48-5208	Y-CLEVIS, CLEVIS, 90, 3 1/4" LONG, 3/4" PIN, 30K	H801	HUBBELL	YCC3090	1	
2	48-8510	AGS YOKE PLATE, 18" SPACING, 1/2" PLATE, 30K	H702	HUGHES	AS2585-Z	1	1
3	48-5206	Y-CLEVIS, EYE, 20K	H900	ANDERSON	YCS-05	2	2
4	N.S.	FIBERLIGN DOUBLE SUSPENSION ASSY, W/ GROUNDWIRE	J201	PREFORMED	4300204G	1	1
5	N.S.	CONNECTOR, COMPRESSION #4 COPPER TO #4 COPPER	Q500	HOMAC	CC44	1	
6	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012		1
7	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207		1
8	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS		1
9	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD		1

*MAX. LINE ANGLE = 60°



T-4FC T-4FCS

OPGW DOUBLE SUSPENSION
0.433" OPGW CABLE

SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW DOUBLE SUSPENSION

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4FC

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 1
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
OPGW ASSEMBLIES

0 1" 2"

FILENAME BHE-AD-02-D-1.DWG
SCALE N.T.S.

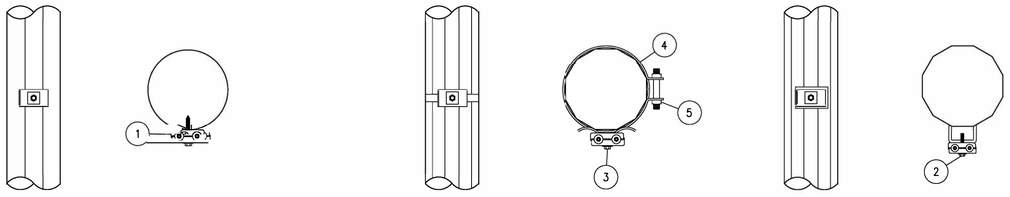
SHEET
AD-02-1

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-FDL-W QTY	T-FDL-S1 QTY	T-FDL-S2 QTY
1	N.S.	DOWNLEAD CUSHION KIT 0.443 OPGW W/ HARDWARE FOR WOOD POLE	J401	PREFORMED	8003041-H1	1	–	–
2	N.S.	DOWNLEAD CUSHION KIT, 0.443" OPGW W/ 1/2" -13 X 3" MOUNTING KIT	J403	PREFORMED	8003041-H3	–	–	1
3	N.S.	DOWNLEAD CUSHION KIT, 0.443" OPGW W/ BANDING BRACKET	J402	PREFORMED	8003041-B1	–	1	–
4	N.S.	BOLT-A-BAND, 3/4" X REQ'D LENGTH	J950	ALUMA-FORM	3/4-201-SSB-100	–	10'	–
5	N.S.	BUCKLE, BANDING, FOR 3/4" BANDING	J951	ALUMA-FORM	BAB-38	–	1	–

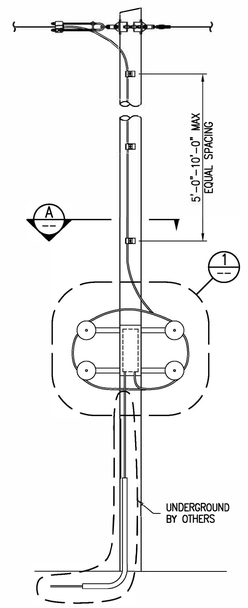
NOTES:

1. OPGW CONTINUOUS TO SPLICE BOX.
2. UNIT CONSISTS OF ONE DOWNLEAD CUSHION INSTALLED. SPECIFIC QUANTITY REQUIRED WILL VARY WITH STRUCTURE HEIGHT.



SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW DOWNLEAD

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-FDL

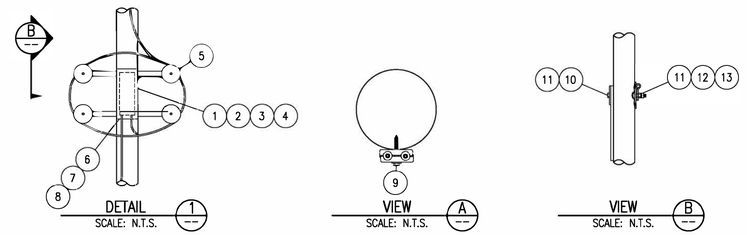


LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	6" X 22" COYOTE CLOSURE KIT W/ 6 PORT END PLATE	J510	PREFORMED	8006659	1
2	N.S.	SPLICE TRAY KIT, 36 COUNT TRAY	J600	PREFORMED	80805514	2
3	N.S.	VERTICAL MOUNTING BRACKET KIT	J502	PREFORMED	8003472	1
4	N.S.	COYOTE DEFENDER FOR 6"X 22" CLOSURE	J511	PREFORMED	8003492	1
5	N.S.	VERTICAL CABLE STORAGE ASSEMBLY	J501	PREFORMED	8003569	1
6	N.S.	CLOSURE END PLATE GROMMETS, 7/8" PORT, 0.443" OPGW	J700	PREFORMED	8003597	1
7	N.S.	FUTURE CABLE PORT KIT, 7/8" PORT	J720	PREFORMED	8003371	3
8	N.S.	GROMMET PLUG, 3/4" PORT, QTY 2	J730	PREFORMED	80806037	1
9	N.S.	DOWNLEAD CUSHION KIT 0.443 OPGW W/ HARDWARE FOR WOOD POLE	J401	PREFORMED	8003041-H1	10
10	N.S.	BOLT, MACHINE, 5/8" X REQ'D LENGTH	B250	HUGHES	–	2
11	N.S.	WASHER, SQUARE, 2" X 1/4", 11/16"	W304	HUGHES	SW2-60	4
12	N.S.	WASHER, SPRING, 11/16" HOLE	W205	HUGHES	2702.6	2
13	N.S.	NUT, LOCK, MF TYPE, 5/8"	N405	HUGHES	MF60	2

NOTES:

1. SEE T-FDL FOR MORE DETAIL.
2. OPGW CONTINUOUS TO SPLICE BOX.
3. COIL 50 FEET OF OPGW AROUND COIL BRACKET ON DOWNLEAD.



SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW SPLICE CASE - 1 OPGW
WOOD POLE

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-FSC-1

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 1
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
OPGW SPLICE DETAILS

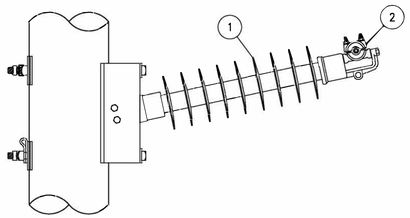
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FILENAME BHE-AD-03-D-1.DWG
SCALE N.T.S.

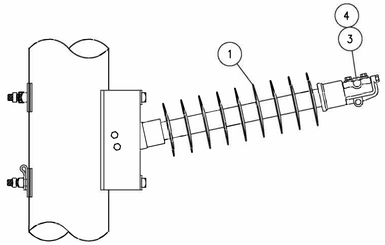
SHEET
AD-03-1

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-SP QTY	T-SP1 QTY
1	N.S.	INSULATOR, HORIZONTAL POST, CLAMPTOP, 69KV	I250	HUBBELL	P250043S1020	1	1
2	N.S.	AGS SUPPORT ASSEMBLY, 795 KCMIL 45/7 ACSR "TERN"	K350	PREFORMED	AGS-5227	1	–
3	48-7020	CLAMP, TRUNNION, 795 KCMIL 45/7 ACSR "TERN", 2,800 LBS	K300	HUBBELL	TSC150	–	1
4	N.S.	INHIBITOR, RUST (NO-OX-ID), 1 PT CAN, GRADE "A"	O102	SANCHEM INC	NO-OX-ID "A" SPECIAL	–	0.06



CONDUCTOR SUPPORT T-SP
795 ACSR-45/7 "TERN"



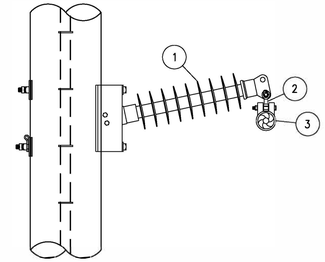
JUMPER SUPPORT T-SP1
795 ACSR-45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
69kV HORIZONTAL CLAMPTOP
795 ACSR - 45/7 "TERN"

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-SP(1)

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	INSULATOR, HORIZONTAL POST, DROP TONGUE, 69KV	I220	HUBBELL	P250043S0020	1
2	48-3053	Y-CLEVIS, EYE, 90, 40K	H902	HUBBELL	YCS-06-90-40	1
3	40-5114	AGS SUPSENSION ASSEMBLY, 25K, 795 ACSR-45/7 "TERN"	K500	PREFORMED	AGS-5128	1



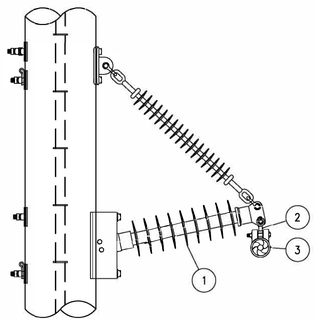
69kV HORIZONTAL POST
795 ACSR-45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
69kV HORIZONTAL POST
795 ACSR - 45/7 "TERN"

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-PSD

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	INSULATOR, HORIZONTAL BRACED POST ASSEMBLY, 69KV	I200	HUBBELL	BLP043G12000	1
2	48-3053	Y-CLEVIS, EYE, 90, 40K	H902	HUBBELL	YCS-06-90-40	1
3	40-5114	AGS SUPSENSION ASSEMBLY, 25K, 795 ACSR-45/7 "TERN"	K500	PREFORMED	AGS-5128	1



69kV BRACED POST ASSEMBLY
795 ACSR-45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
69kV BRACED POST ASSEMBLY
795 ACSR - 45/7 "TERN"

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-BPD

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 1
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
POST INSULATOR ASSEMBLIES
795 KCMIL 45/7 ACSR "TERN"

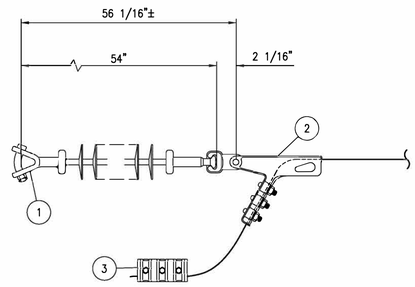
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FILENAME BHE-AD-04-D-1.DWG
SCALE N.T.S.

SHEET
AD-04-1

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48-6927	INSULATOR, DEADEND, Y-CLEVIS BALL, 54" LENGTH, 25K	I300	MACLEAN	S14080042MXAL027	1
2	42-1120	STRAIN CLAMP, DEADEND W/ SOCKET-EYE, 30K, 0.50 - 1.20 RANGE	L101	HUBBELL	SD112S	1
3	42-0483	PARALLEL GROOVE CONNECTOR, 0.743 - 1.152 RANGE	Q601	AFL	483.3P	1

*ONE ITEM (3) WILL BE REQUIRED FOR EVERY TWO ASSEMBLIES

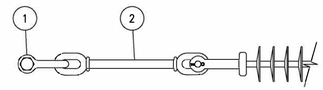


CONDUCTOR BOLTED DEADEND
795 ACSR-45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
CONDUCTOR BOLTED DEADEND
POLYMER

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-BDE6PD

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	ANCHOR SHACKLE, 3.5" LONG, 7/8" DIA, 3/4" PIN, 60K LBS	H603	HUBBELL	AS50BNK	1
2	N.S.	HOT LINK EXTENSION, CHAIN EYE - CHAIN EYE, 15" LONG, 30K LBS	H400	HUBBELL	H003015	1



TM-EXT-15
15" EXTENSION LINK

SHEET TITLE
TRANSMISSION ASSEMBLY
15" EXTENSION LINK

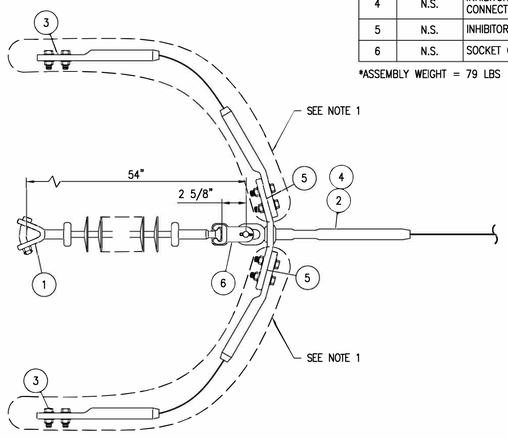
REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TM-EXT-15

NOTE:

1. JUMPERS AND TERMINALS SUPPLIED BY SUBSTATION, INSTALLED BY TRANSMISSION. SEE WEST RAPID CITY SUBSTATION REFERENCE SHEETS IN APPENDIX.

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48-6927	INSULATOR, DEADEND, Y-CLEVIS BALL, 54" LENGTH, 25K	I300	MACLEAN	S14080042MXAL027	1
2	42-8230	COMPRESSION DEADEND ASSY, DOUBLE TONGUE, W/ 15' TERMINAL "TERN"	L502	AFL	VED-123	1
3	N.S.	BOLT, NUT, BELLEVILLE, FLAT, STAINLESS STEEL ASSEMBLY	B606	CMC	SBA20-50	8
4	N.S.	INHIBITOR, FILLER COMPOUND, GRITTED, COMPRESSION CONNECTIONS, 8 oz.	O100	HUBBELL	VSG8B	1.5
5	N.S.	INHIBITOR, FILLER COMPOUND, NON-GRITTED, PAD TO PAD, 8 OZ	O101	HUBBELL	VS8B	0.6
6	N.S.	SOCKET CLEVIS, 30K	H200	HUBBELL	SC30	1

*ASSEMBLY WEIGHT = 79 LBS



CONDUCTOR SUBSTATION DEADEND
795 ACSR-45/7 "TERN"

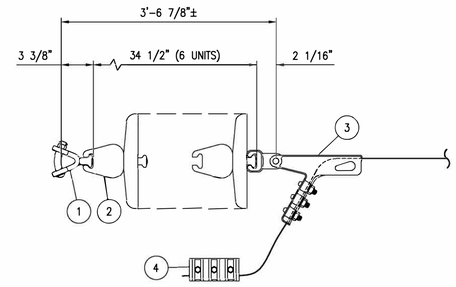
SHEET TITLE
TRANSMISSION ASSEMBLY
CONDUCTOR SUBSTATION DEADEND
POLYMER

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-SDE6PD

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48-3054	Y-CLEVIS, BALL, 30K	H500	HUBBELL	YBC30	1
2	N.S.	GLASS INSULATOR, 30K LB, M&E, ANSI CL 52-5, 10" X 5 3/4"	I102	SEDIVER	N14/146	6
3	42-1120	STRAIN CLAMP, DEADEND W/ SOCKET-EYE, 30K, 0.50 - 1.20 RANGE	L101	HUBBELL	SD112S	1
4	42-0483	PARALLEL GROOVE CONNECTOR, 0.743 - 1.152 RANGE	Q601	AFL	483.3P	1

*ONE ITEM (4) WILL BE REQUIRED FOR EVERY TWO ASSEMBLIES

ASSEMBLY WEIGHT = 75 LBS



CONDUCTOR BOLTED DEADEND
795 ACSR-45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
CONDUCTOR BOLTED DEADEND

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-BDE6D

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 1
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
DEADEND INSULATOR ASSEMBLIES
795 KCMIL 45/7 ACSR "TERN"

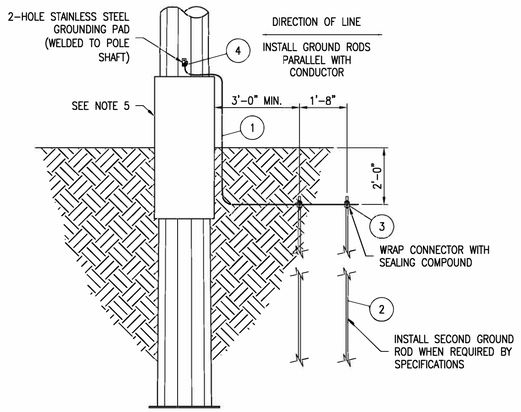
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FILENAME BHE-AD-05-D-1.DWG
SCALE N.T.S.

SHEET
AD-05-1

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			10'
2	46-0588	ROD, GROUND, 5/8" X 8'-0", COPPERCLAD	P500	GALVAN	6260G13	1
3	46-0058	CLAMP, GROUND ROD, 0.128 TO 0.460 RANGE, 5/8" ROD	P701	CHANCE	C2030344	1
4	N.S.	CLAMP, VISE TYPE, LIGHTNING ARRESTOR GROUND, #2 STRANDED	P820	HUBBELL	GC207	1



STEEL POLE GROUNDING DETAIL
SCALE: N.T.S.

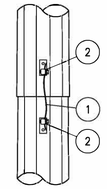
SPECIFICATIONS FOR DRIVEN GROUND ROD INSTALLATION:

1. INSTALL 8'-0" OF GROUND ROD AND TEST THE RESISTANCE LEVEL. WHEN RESISTANCE IS 25Ω OR LESS, NO ADDITIONAL STEPS ARE NEEDED.
2. IF RESISTANCE IS 25Ω OR GREATER, INSTALL AN ADDITIONAL 8'-0" OF GROUND ROD AS SHOWN:
   - TEST RESISTANCE WITH 1ST ROD CONNECTED TO 2ND ROD WITH #2 CU FOR COMBINED PARALLEL RESISTANCE VALUE. RECORD RESISTANCE VALUE.
3. AFTER DRIVING TWO (2) GROUND RODS AS NOTED ABOVE AND THE COMBINED RESISTANCE IS 25Ω OR GREATER, THE ELECTRICAL ENGINEERING DEPARTMENT SHOULD BE CONSULTED FOR FURTHER ACTION.
4. BOND STATIC WIRE TO POLE GROUND, USE FARGO CONNECTOR (ITEM #5).
5. GROUNDING THE SAME FOR STEEL POLE ON CONCRETE PIER FOUNDATIONS.

SHEET TITLE: **TRANSMISSION ASSEMBLY STEEL POLE GROUNDING**
REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: TM-9ST

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			4'
2	N.S.	CLAMP, VISE TYPE, LIGHTNING ARRESTOR GROUND, #2 STRANDED	P820	HUBBELL	GC207	2

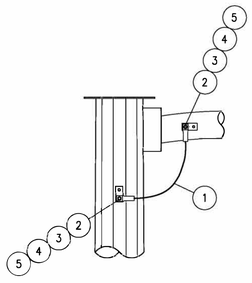


TM-9SSJ
SLIP JOINT
SCALE: N.T.S.

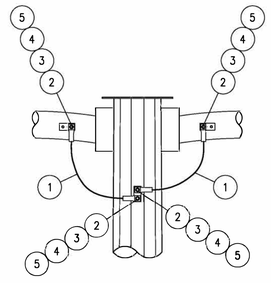
SHEET TITLE: **TRANSMISSION ASSEMBLY STEEL POLE SLIP JOINT GROUNDING**
REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: TM-9SSJ

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	9SD-1	9SD-2
1	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	5'	10'
2	N.S.	COMPRESSION TERMINAL, COPPER, #6 – 1/0 AWG STRANDED	2	4
3	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	2	4
4	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	2	4
5	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	2	4

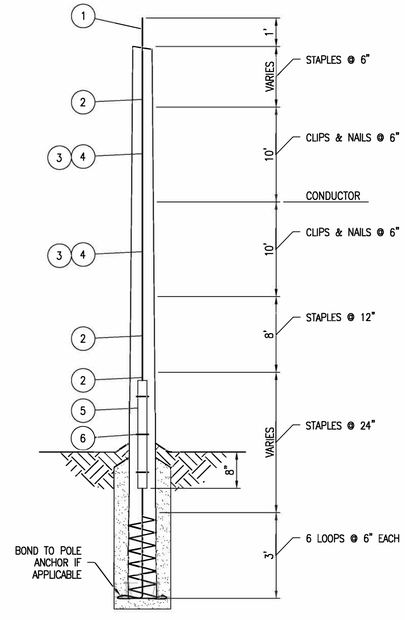


TM-9SD-1
SINGLE DAVIT GROUNDING
SCALE: N.T.S.



TM-9SD-2
DOUBLE DAVIT GROUNDING
SCALE: N.T.S.

SHEET TITLE: **TRANSMISSION ASSEMBLY STEEL POLE DAVIT ARM GROUNDING**
REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: TM-9SD



LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	36-4000	GROUNDWIRE, #4CU SD, 40% CONDUCTIVITY	C901			125'
2	46-7494	STAPLE, CUT (SLASH) 1 1/2" X 3/8" CU-COATED, BARBED	P600	MACLEAN	J7682	50
3	46-7460	NAIL, 10D, CU-COATED	P150	MACLEAN	J7260	40
4	46-2729	CLIP, CU-COATED	P151	KEARNEY	5730-1	40
5	46-2503	WOOD MOULDING, 1-11/16" X 8'	P300	HUGHES	2503.8	1
6	46-2504	MOULDING STAPLES, 1-3/4" X 3-1/2"	P400	HUBBELL	C2050222	3

NOTES:

1. BOND ALL POLE HARDWARE TO POLE GROUND. USE BONDING CLIP.
2. ON 230/69kV CONSTRUCTION, BOND ALL 69kV HARDWARE.
3. GROUND WIRE SHALL BE INSTALLED FOR THE FULL LENGTH OF EACH POLE, ACROSS THE BOTTOM, AND BACK UP IN WRAP TURNS AS SHOWN. STAPLE THE WRAPS AT EACH INTERSECTION OF THE DOWNLEAD, AND EVERY 12" FOR THE LENGTH OF THE WRAPS.
4. THIS UNIT INCLUDES THE MEASURE AND RECORDING OF EACH POLE'S FOOTING RESISTANCE, AFTER POLE SETTING IS COMPLETED AND BEFORE INSTALLING THE OHSW.
5. FOR FOOTING RESISTANCES GREATER THAN 15 OHMS, GROUNDING CONNECTIONS SHALL BE USED TO BOND TOGETHER THE GROUND WIRES OF EACH POLE AND GUY ANCHORS IF APPLICABLE.
6. IF THE FOOTING RESISTANCE READS GREATER THAN 15 OHMS AFTER INSTALLATION PROCEDURES PER NOTE 5, CONTRACTOR SHALL NOTIFY THE ENGINEER FOR FURTHER GROUNDING INSTRUCTIONS.
7. BOND STATIC WIRE TO POLE GROUND, USE FARGO CONNECTOR. (ITEM #5)
8. SEE INDIVIDUAL STRUCTURE DRAWINGS FOR REMAINING DIMENSIONS.

SHEET TITLE: **TRANSMISSION ASSEMBLY WOOD POLE GROUNDING**
REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: TM-9

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 1
69KV TRANSMISSION LINE

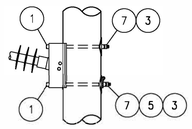
ASSEMBLY DETAILS
GROUNDING ASSEMBLIES

0 1" 2"
FILENAME: BHE-AD-06-D-1.DWG
SCALE: N.T.S.
SHEET: AD-06-1

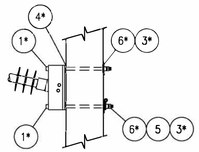
LIST OF MATERIAL

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	1A	1B	1C	1D
1	N.S.	BOLT, MACHINE, 7/8" X REQ'D LENGTH	B270			2	2*	2	–
2	N.S.	ROD, FULL THREADED, 7/8" X REQ'D LENGTH, W/ 4 NUTS	D170			–	–	–	2
3	22–7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	2	2*	2	4
4	N.S.	POLE SHIM, GAIN BASE TO FLAT	V400	N/A	N/A	–	1*	–	–
5	N.S.	WASHER, SPRING, 15/16" HOLE	W207	HUGHES	2702.8	1	1	–	–
6	N.S.	WASHER, SQUARE, 4" X 1/4", 15/16" HOLE	W322	HUGHES	SW4–80	–	2*	2	2
7	22–4425	WASHER, SQ. CURVED, 4" X 1/4", 15/16" HOLE	W504	HUGHES	SCW4–80	2	–	–	–

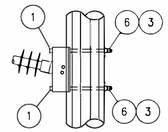
(*) DENOTES MATERIAL SUPPLIED BY LAMINATED POLE MANUFACTURER



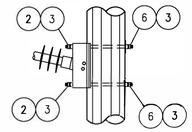
TD–1A
ROUND WOOD POLE ASSEMBLY
SCALE: N.T.S.



TD–1B
LAMINATED POLE ASSEMBLY
SCALE: N.T.S.



TD–1C
STEEL POLE ASSEMBLY
SCALE: N.T.S.



TD–1D
LARGE STEEL POLE ASSEMBLY
SCALE: N.T.S.

NOTES:

1. STRENGTH LIMITATIONS OF 7/8" BOLTS.
   - A. SINGLE SHEAR THROUGH THREADS 17,270 LBS.
   - B. SINGLE SHEAR THROUGH SHAFT 24,350 LBS.
   - C. MINIMUM TENSILE STRENGTH 25,400 LBS.

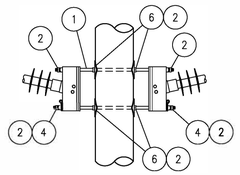
SHEET TITLE
TRANSMISSION ASSEMBLY
SINGLE INSULATOR BASE TO POLE ASSEMBLY

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TD-1

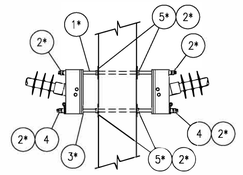
LIST OF MATERIAL

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	2A	2B	2C
1	N.S.	ROD, FULL THREADED, 7/8" X REQ'D LENGTH, W/ 4 NUTS	D170			2	2*	2
2	22–7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	8	8*	8
3	N.S.	POLE SHIM, GAIN BASE TO FLAT	V400	N/A	N/A	–	2*	–
4	N.S.	WASHER, SPRING, 15/16" HOLE	W207	HUGHES	2702.8	2	2	–
5	N.S.	WASHER, SQUARE, 4" X 1/4", 15/16" HOLE	W322	HUGHES	SW4–80	–	4*	4
6	22–4425	WASHER, SQ. CURVED, 4" X 1/4", 15/16" HOLE	W504	HUGHES	SCW4–80	4	–	–

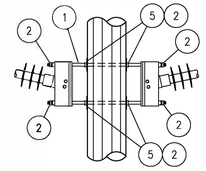
(*) DENOTES MATERIAL SUPPLIED BY LAMINATED POLE MANUFACTURER



TD–2A
ROUND WOOD POLE ASSEMBLY
SCALE: N.T.S.



TD–2B
LAMINATED POLE ASSEMBLY
SCALE: N.T.S.



TD–2C
STEEL POLE ASSEMBLY
SCALE: N.T.S.

NOTES:

1. STRENGTH LIMITATIONS OF 7/8" BOLTS.
   - A. SINGLE SHEAR THROUGH THREADS 17,270 LBS.
   - B. SINGLE SHEAR THROUGH SHAFT 24,350 LBS.
   - C. MINIMUM TENSILE STRENGTH 25,400 LBS.

SHEET TITLE
TRANSMISSION ASSEMBLY
DOUBLE INSULATOR BASE TO POLE ASSEMBLY

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TD-2

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 1
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
INSULATOR BASE TO POLE ASSEMBLIES

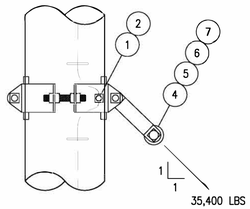
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FILENAME BHE–AD–07–D–1.DWG
SCALE N.T.S.

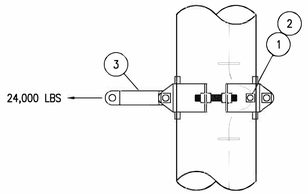
SHEET
AD-07-1

LIST OF MATERIALS

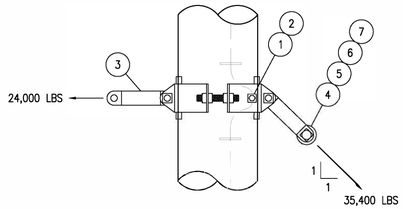
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	TG-26B QTY	TG-26C QTY	TG-26D QTY	TG-26E QTY
1	N.S.	POLE BAND ASSY. HEAVY DUTY, REQ'D POLE DIAMETER	–	HUGHES	–	1	1	1	1
1.1	18-1116	POLE BANDS, HEAVY DUTY, 7"-10" POLE	F110	HUGHES	3108.5	–	–	–	–
1.2	18-1117	POLE BANDS, HEAVY DUTY, 9"-12" POLE	F111	HUGHES	3108.6	–	–	–	–
1.3	18-1118	POLE BANDS, HEAVY DUTY, 11"-14" POLE	F112	HUGHES	3108.7	–	–	–	–
1.4	18-1119	POLE BANDS, HEAVY DUTY, 13"-16" POLE	F113	HUGHES	3108.8	–	–	–	–
2	46-2718	CLIP, BONDING, WITH 1/2" X 1 1/2" BOLT, 7/16" MAX. WIRE	P104	HUGHES	2718.55	1	1	1	1
3	14-3152	LINK, CONNECTING, 1/4" X 2" X 7 1/2", 15/16" HOLES, 24K LBS	F201	HUGHES	3152	–	2	2	–
4	14-3154	LINK, CONNECTING, 3/8" X 2" X 7 1/2", 15/16" HOLES, 38K LBS	F203	HUGHES	3154	2	–	2	4
5	18-2808	GUY, ROLLER, 1 1/8" WR, 15/16" HOLE	G100	HUGHES	28082	1	–	1	2
6	20-7803	MACHINE BOLT, 7/8" X 3"	B273	HUGHES	B83-2	1	–	1	2
7	22-7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	1	–	1	2



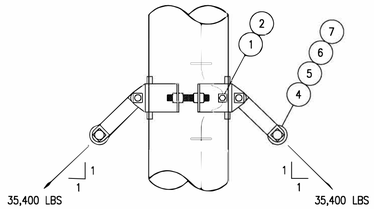
TG-26B



TG-26C



TG-26D



TG-26E

NOTES:

1. THE INDICATED LOADS ARE DESIGN MAXIMUMS.
2. FOR GUY SLOPES MORE THAN 1V TO 1H, THE MAXIMUM VERTICAL CAPACITY SHOULD NOT EXCEED 25,000 LBS.
3. WHEN TWO GUY ATTACHMENTS ARE NEEDED. THE ADDITIONAL POLE BAND SHALL BE 6' BELOW THE FIRST ONE.

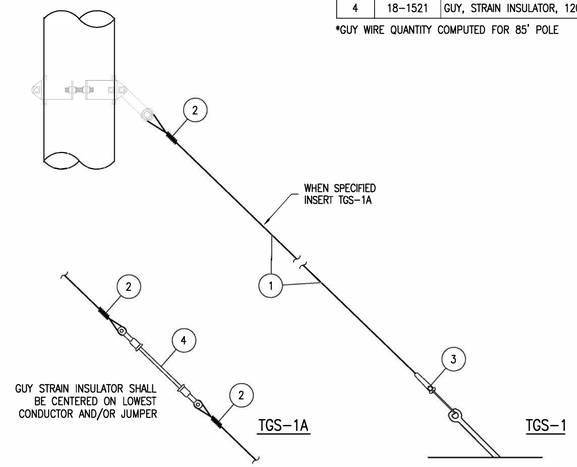
SHEET TITLE
TRANSMISSION ASSEMBLY
POLE BAND ASSEMBLIES

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TG-26

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	TGS-1 QTY	TGS-1A QTY
1	18-7167	WIRE, GALVANIZED, 7 STEEL STRAND, 7/16" EHS	C801	–	–	110'	110'
2	18-7168	GUY DEADEND GRIP, FOR 7/16" EHS	G601	PREFORMED	GDE-1108	1	3
3	18-0716	GUY, STRANDVISE, 7/16" EHS, SHORT BAIL	G902	MACLEAN	5203	1	1
4	18-1521	GUY, STRAIN INSULATOR, 120" LONG, 21K LBS, ROLLER, ROLLER	G200	HUGHES	CF694-120R2	–	1

*GUY WIRE QUANTITY COMPUTED FOR 85' POLE



TGS-1A

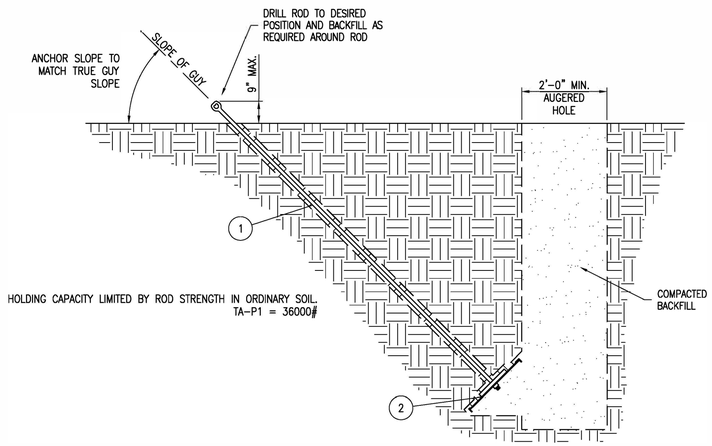
TGS-1

SHEET TITLE
TRANSMISSION ASSEMBLY
SINGLE GUY ASSEMBLIES
7/16" EHS

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TGS-1(A)

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	TA-P1 QTY
1	18-1102	ROD, ANCHOR, TWIN EYE 1" X 10', 36K	A100	MACLEAN	J7540	1
2	18-1024	ANCHOR, CROSS-PLATE TYPE, 400 IN BEARING AREA, 1" ROD	A200	MACLEAN	J3524	1

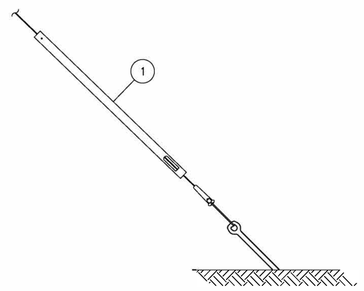


SHEET TITLE
TRANSMISSION ASSEMBLY
PLATE ANCHOR
AUGERED

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TA-P1

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	GUY, GUARD, 2" X 8'-0", FULL ROUND, YELLOW	G400	MACLEAN	J1493Y	1



GUY MARKER

SHEET TITLE
TRANSMISSION ASSEMBLY
GUY MARKER

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TM-GM

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 1
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
GUY AND ANCHOR ASSEMBLIES

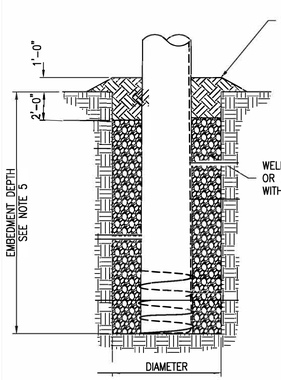
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SCALE N.T.S.

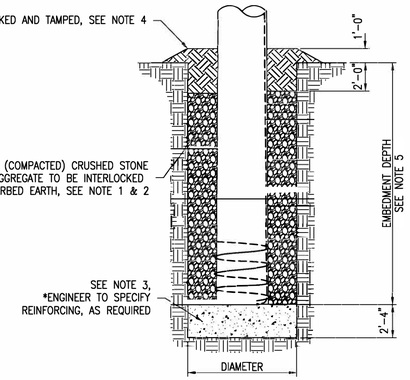
SHEET
AD-08-1

POLE STABILITY FOUNDATION					
IMPORTED GRANULAR BACKFILL					
POLE HT.–CL.	EMBEDMENT DEPTH (FT)	DIAMETER (FT)	POLE WIDTH (IN)	POLE WEIGHT (LB)	APPROX. QTY. CUBIC YDS. (10% + 4 FT)
60–1	10	4.0*	18.0	–	3.2
70–1	11	4.0*	18.9	–	3.6
80–H1	12	4.0*	20.9	–	3.8
90–H2	13	4.0*	23.2	–	4.0
100–H2	14	4.0*	24.0	–	4.2

(*) HOLE DIAMTER AS NEEDED TO TAMP ALL THE WAY AROUND THE POLE.



TM–101
IMPORTED BACKFILL
SCALE: N.T.S.



TM–103
IMPORTED BACKFILL AND BEARING REINFORCEMENT
SCALE: N.T.S.

GRADATION FOR IMPORTED GRANULAR BACKFILL	
SIZE OF GRAVEL OR CRUSHED STONE	SIZE OF MESH (IN)
100% BY WEIGHT TO PASS 1" SCREEN	1.00
60%–90% BY WEIGHT TO PASS 1/2" SCREEN	0.500
40%–60% BY WEIGHT TO PASS NO. 4 SCREEN	0.187
25%–50% BY WEIGHT TO PASS NO. 8 SCREEN	0.0937
20%–40% BY WEIGHT TO PASS NO. 16 SCREEN	0.0469
15%–30% BY WEIGHT TO PASS NO. 40 SCREEN	0.0165

IMPORTANT

EACH POLE SHALL BE BACKFILLED FROM BOTTOM TO TOP BY ONE LABORER SHOVELING FILL AND TWO OTHERS USING PNEUMATIC TAMPERS.

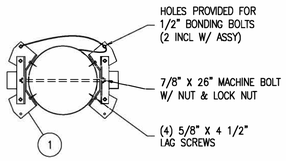
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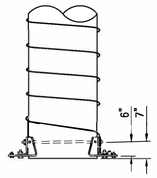
1. GRADATION FOR IMPORTED BACKFILL IS SHOWN IN THE TABLE. THE AGGREGATE SHALL BE WELL MIXED IN A STOCK PILE, AND PNEUMATICALLY PLACED AND TAMPED IN 6–INCH LIFTS.
2. THE SPECIFICATION FOR AGGREGATE GIVEN IN THE TABLE IS MINIMUM. IN AREAS WHERE SMALLER FINES ARE AVAILABLE AT COMPARABLE COST, IT IS RECOMMENDED THAT THE ENGINEER SPECIFY SMALLER FINES.
3. CONCRETE SHALL BE 2000 PSI HIGH EARLY STRENGTH CONCRETE. IT SHALL BE DEPOSITED IN A MANNER WHICH WILL PREVENT SEGREGATION OF THE AGGREGATE AND CEMENT. CARE SHOULD BE TAKEN TO AVOID GETTING DIRT MIXED WITH THE CONCRETE. THE POLE SHALL NOT BE SET UNTIL THE CONCRETE BEARING BASE HAS ATTAINED SUFFICIENT STRENGTH TO SUPPORT THE POLE. DURING THE PLACEMENT OF POLE, AVOID BUMPING CONCRETE BASE.
4. WELL TAMPED NATIVE BACKFILL SHOULD BE PLACED AROUND THE POLE AS SHOWN.
5. SEE STRUCTURE DRAWINGS FOR EMBEDMENT DEPTHS.

SHEET TITLE
TRANSMISSION ASSEMBLY
POLE STABILITY FOUNDATION

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TM-101 & TM-103

LIST OF MATERIALS						
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	18–1895	ANCHOR ASSEMBLY WITH BOLTS; PAIR	F300	HUGHES	A–1895–2	1





SHEET TITLE
TRANSMISSION ASSEMBLY
POLE ANCHOR ASSEMBLY

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TP-A

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

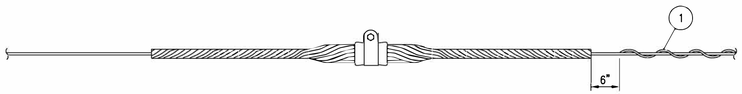
WEST RAPID CITY - BEN FRENCH 1
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
POLE STABILITY ASSEMBLIES

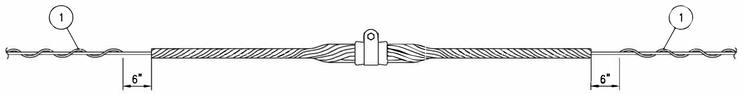
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FILENAME BHE–AD–09–D–1.DWG
SCALE N.T.S.
SHEET **AD-09-1**

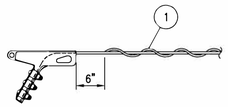
LIST OF MATERIALS								
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T1 QTY	2T1 QTY	D1 QTY
1	N.S.	SPIRAL VIBRATION DAMPER, 0.327" – 0.461" RANGE	S110	PREFORMED	5050104	1	2	1



DPR–EHS–T1



DPR–EHS–2T1



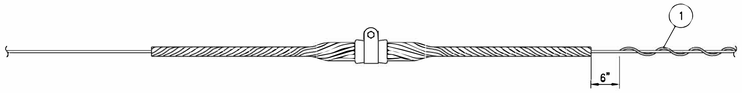
DPR–EHS–D1

SHEET TITLE
TRANSMISSION ASSEMBLY
DAMPER - 3/8" EHS

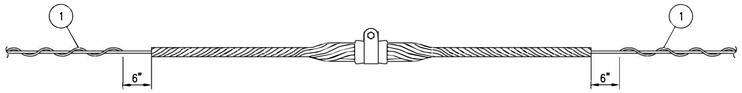
REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
DPR-EHS

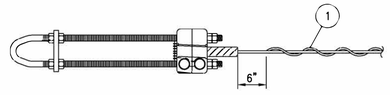
LIST OF MATERIALS								
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T1 QTY	2T1 QTY	D1 QTY
1	N.S.	SPIRAL VIBRATION DAMPER, 0.327" – 0.461" RANGE	S110	PREFORMED	5050104	1	2	1



DPR–OPGW–T1



DPR–OPGW–2T1



DPR–OPGW–D1

SHEET TITLE
TRANSMISSION ASSEMBLY
DAMPER - OPGW

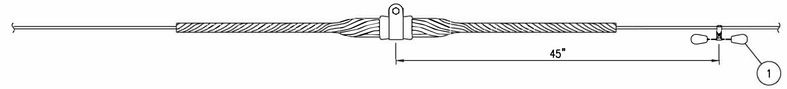
REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
DPR-OPGW

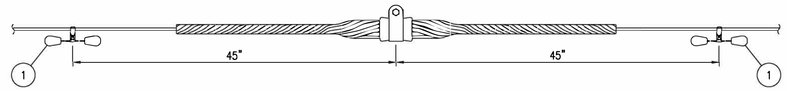
LIST OF MATERIALS								
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T1 QTY	2T1 QTY	D1 QTY	D2 QTY
1	N.S.	DAMPER, DOGBONE, 795 ACSR	S150	HUBBELL	60710–12	1	2	1	2

NOTES:

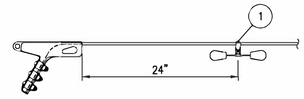
1. FIRST DAMPER AT SUSPENSION SPAN ENDS SHALL BE LOCATED FROM CENTER OF DAMPER CLAMP TO THE SUSPENSION SUPPORT PER REFERENCED DIMENSION.
2. THE ORIENTATION OF THE WEIGHTS ALONG THE CONDUCTOR IS OPTIONAL. (I.E. WHETHER THE LARGE WEIGHT IS TOWARD THE TOWER OR TOWARD THE SPAN. ORIENT THE DAMPER FOR EASY ACCESS TO THE BOLT AND TO OBTAIN VISUAL ASSURANCE OF POSITIVE CONDUCTOR SEATING.
3. FOLLOW MANUFACTURER'S INSTALLATION INSTRUCTIONS IN DELIVERY BOX.
4. SEE SAG TABLES FOR INSTALLATION DIRECTION ON THE LINE.



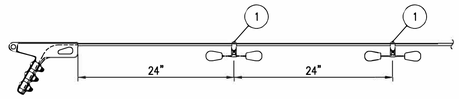
DPR–795–T1



DPR–795–2T1



DPR–795–D1



DPR–795–D2

SHEET TITLE
TRANSMISSION ASSEMBLY
DAMPER - 795 ACSR

REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
DPR-795

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 1
69KV TRANSMISSION LINE

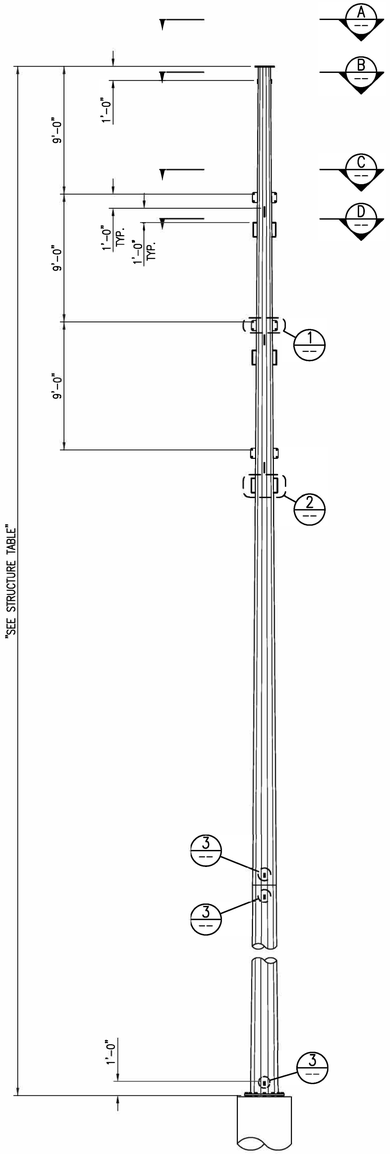
ASSEMBLY DETAILS
DAMPER ASSEMBLIES

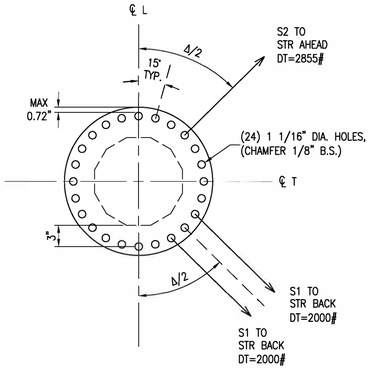
0 1" 2"

FILENAME BHE–AD–10–D–1.DWG

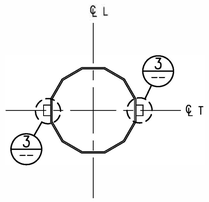
SCALE N.T.S.

SHEET **AD-10-1**

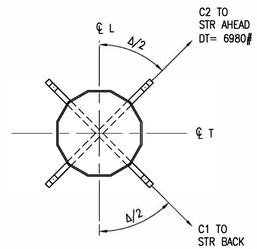




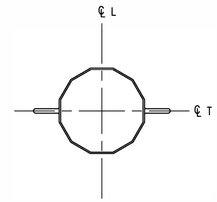
VIEW A
SHIELD ORIENTATION
SCALE: N.T.S.



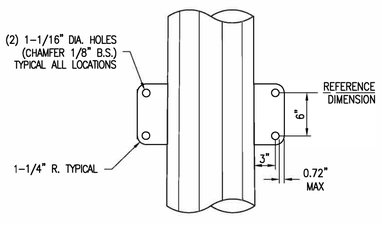
SECTION B
SHIELD NEMA PAD ORIENTATION
SCALE: N.T.S.



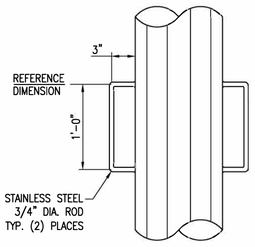
SECTION C
CONDUCTOR ORIENTATION
SCALE: N.T.S.



SECTION D
GROUND LOOP ORIENTATION
SCALE: N.T.S.

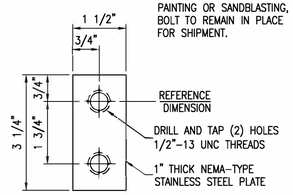


DETAIL 1
CONDUCTOR VANGS
SCALE: N.T.S.



DETAIL 2
GROUNDING LOOP
SCALE: N.T.S.

NOTE:
PLUG WITH 1/2"ø X 3/4" MACHINE BOLT BEFORE PAINTING OR SANDBLASTING, BOLT TO REMAIN IN PLACE FOR SHIPMENT.



DETAIL 3
GROUNDING PAD
SCALE: N.T.S.

GENERAL NOTES

MAXIMUM SHIELD WIRE VANG THICKNESS = 3/4"
MAXIMUM CONDUCTOR VANG THICKNESS = 1"
LOAD TREE VALUES ARE ULTIMATE, INCLUDE OVERLOAD FACTORS, AND ARE SHOWN IN POUNDS.

DESIGN CRITERIA

(S1) SHIELD WIRE IS AFL CC-55/443 "DNO-4748" OPGW, MAXIMUM TENSION AT NESC HEAVY LOADING: 2000# R.S.= 300'
(S2) SHIELD WIRE IS AFL CC-55/443 "DNO-4748" OPGW, MAXIMUM TENSION AT NESC HEAVY LOADING: 2855# R.S.= 300'
(C1) CONDUCTOR IS 795 KCMIL 45/7 ACSR "TERN" MAXIMUM TENSION AT NESC HEAVY LOADING: 3000# R.S.= 300'
(C2) CONDUCTOR IS 795 KCMIL 45/7 ACSR "TERN" MAXIMUM TENSION AT NESC HEAVY LOADING: 6980# R.S.= 300'

WIND SPAN: 400'
WEIGHT SPAN: 600' AT NESC HEAVY LOADING
HEIGHT OF STR.: SEE STRUCTURE TABLE
ACTUAL ANGLE (Δ): SEE STRUCTURE TABLE
DESIGN MAXIMUM ANGLE: 92°00'00"

SPECIFICATIONS

1. POLES TO BE DESIGNED PER SECTION 33 71 16.23 TUBULAR STEEL POLES SPECIFICATIONS.
2. ALL STEEL TO BE WEATHERING STEEL.
3. POLES TO HAVE EITHER SLIP JOINTS OR BOLTED FLANGE TYPE SPLICES, WHICHEVER IS MORE COST EFFECTIVE.
   A. IF SLIP JOINTS ARE USED, INSTALL GROUND PADS (DETAIL 4) ABOVE AND BELOW THE SLIP JOINT.
4. STRUCTURES SHALL BE DESIGNED ASSUMING DRILLED PIER TYPE FOUNDATION.
5. THE CIRCLED LOADINGS SHOWN IN LOAD TREES CONVEY THE ADDITIONAL VERTICAL LOAD THAT WILL BE APPLIED TO THE STRUCTURE BY LINE PERSONNEL DURING CONSTRUCTION AND MAINTENANCE OPERATIONS.
   A. IT IS REQUIRED THAT ALL CONDUCTOR ATTACHMENT SUPPORTS BE DESIGNED TO MEET THIS REQUIREMENT. HOWEVER, AS THE LOADING WILL BE APPLIED TO ONLY ONE PHASE AT ANY GIVEN TIME, THE SHAFT MAY BE DESIGNED FOR ITS APPLICATION AT A SINGLE CONTROLLING PHASE LOCATION TO BE DETERMINED BY THE STEEL MANUFACTURER.

DEFLECTION

SEE TUBULAR STEEL POLE SPECIFICATION FOR DEFLECTION OF THE SHAFT UNDER LOAD CASE V.

STRUCTURE TABLE		
STR #	HEIGHT	LINE ANGLE (Δ)
1D	75'-0"	88°00'00"
2D	75'-0"	84°00'00"
42A	95'-0"	85°00'00"

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

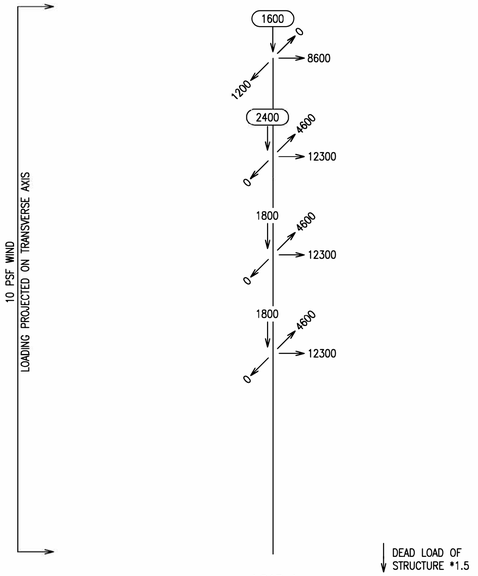
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 1
LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

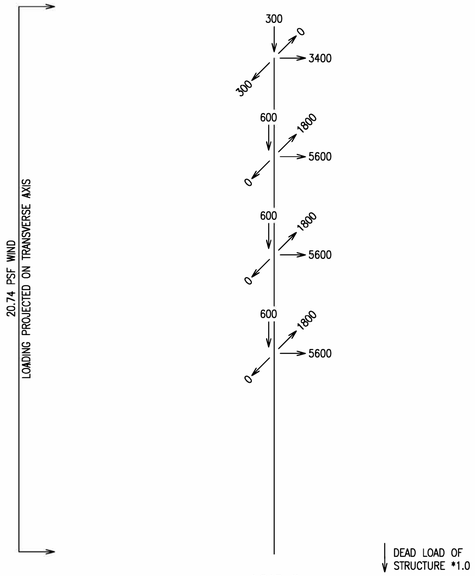
LOAD & DESIGN DETAIL
SCDE-ST-M1
STR 1D, STR 2D, & STR 42A

0 1" 2"

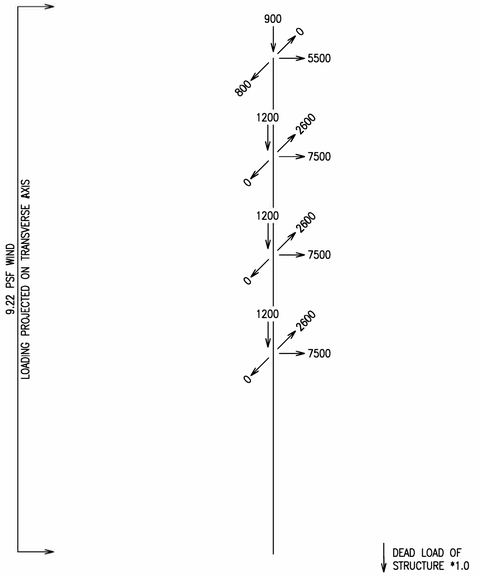
FILENAME BHE-LD-12-D-1.DWG
SCALE 3/16"=1'-0"
SHEET LD-12-1



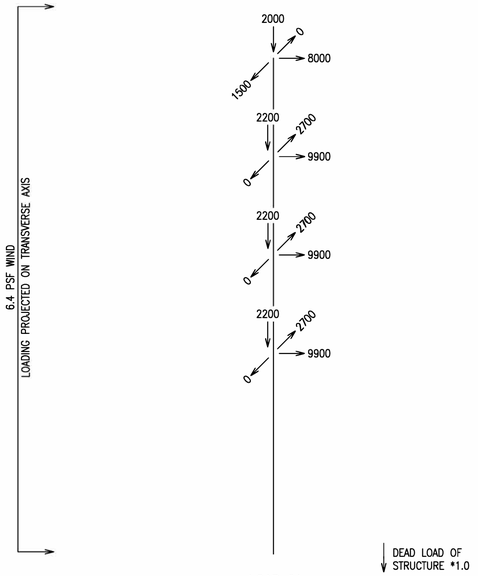
LOAD I
NESC HEAVY LOADING – RULE 250B
ALL WIRES INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 4 PSF WIND @ 0°F



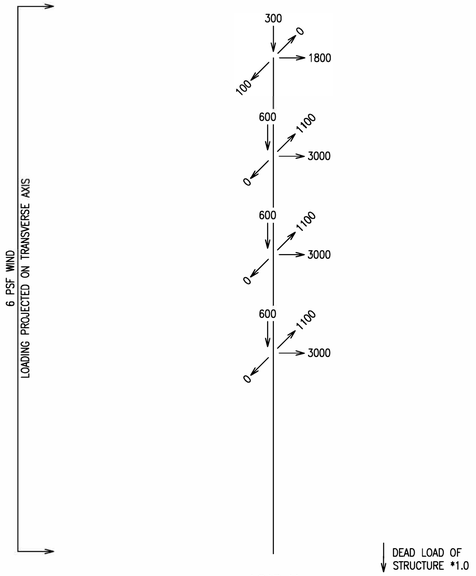
LOAD II
NESC EXTREME HIGH WIND – RULE 250C
ALL WIRES INTACT
NO ICE, 20.74 PSF WIND @ 60°F



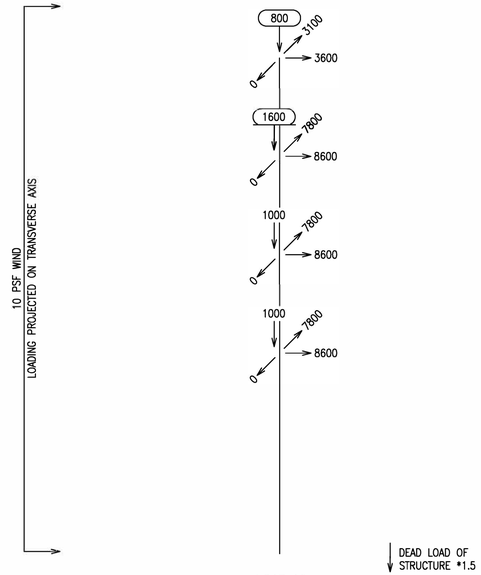
LOAD III
NESC CONCURRENT ICE/WIND – RULE 250D
ALL WIRES INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 9.22 PSF WIND @ 15°F



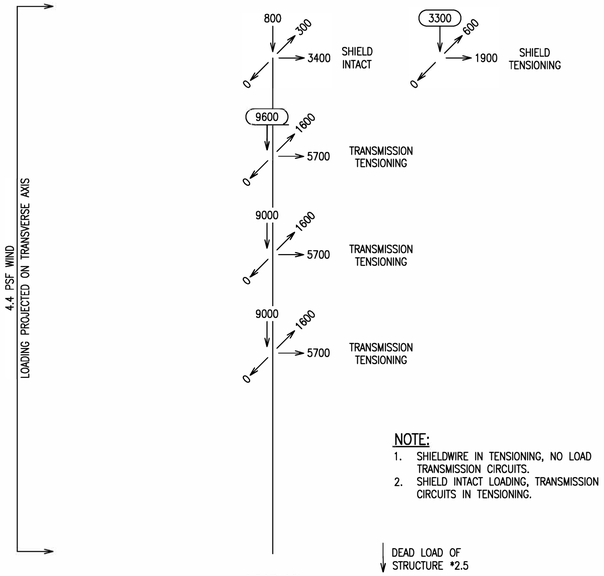
LOAD IV
BHE CONCURRENT ICE/WIND
ALL WIRES INTACT
1.0" RADIAL ICE @ 57 LBS/FT³, 6.4 PSF WIND @ 0°F



LOAD V
DEFLECTION LIMIT
ALL WIRES INTACT
NO ICE, 6 PSF WIND @ 60°F

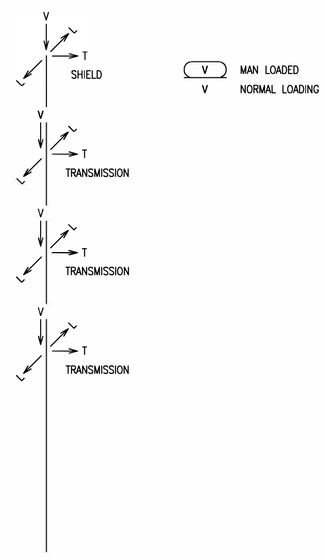


LOAD VI
TERMINAL
AHEAD SPAN INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 4 PSF WIND @ 0°F



NOTE:
1. SHIELDWIRE IN TENSIONING, NO LOAD TRANSMISSION CIRCUITS.
2. SHIELD INTACT LOADING, TRANSMISSION CIRCUITS IN TENSIONING.

LOAD VII
CONSTRUCTION LOADING
SEE NOTE
NO ICE, 4 PSF WIND @ 20°F



TYPICAL

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

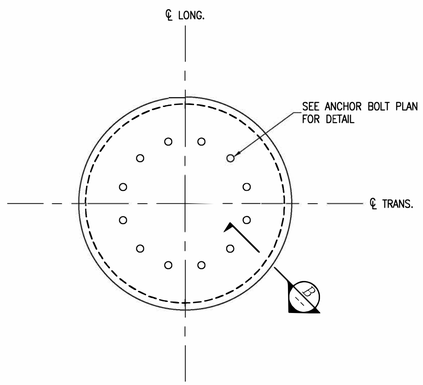
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 1
LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

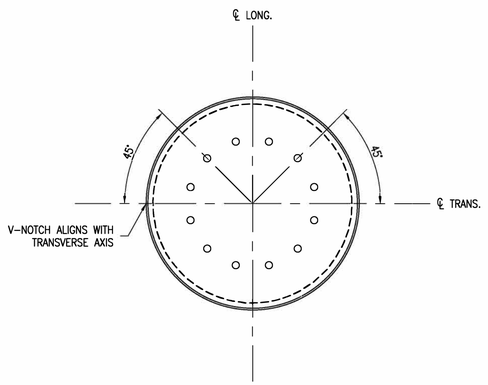
LOAD & DESIGN DETAIL
SCDE-ST-M1
STR 1D, STR 2D, & STR 42A

0 1" 2"

FILENAME BHE-LD-12-D-2.DWG
SCALE 3/16"=1'-0"
SHEET LD-12-2



PIER PLAN VIEW
ROUND CAP



ANCHOR BOLT PLAN (TYP.)
SEE STEEL MANUFACTURER DRAWINGS FOR ANCHOR BOLT DETAIL

FOUNDATION DATA

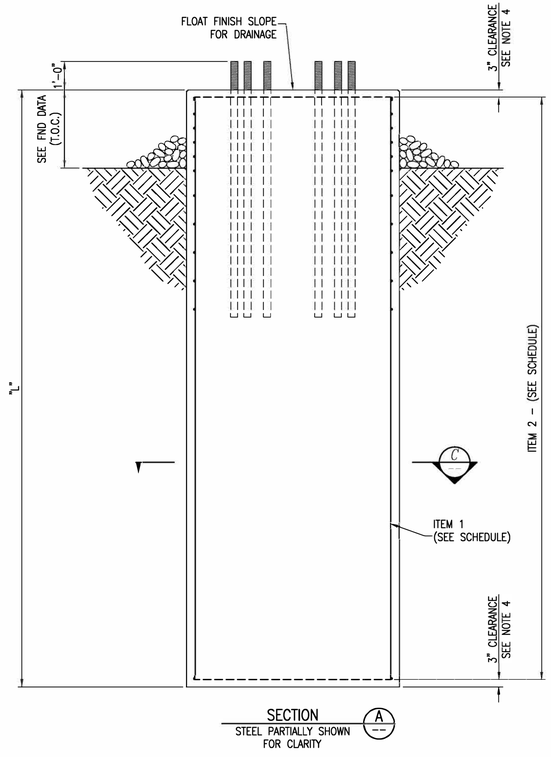
FOUNDATION	STRUCTURE INFORMATION				PIER DESIGN LOADS			ANCHOR BOLTS	PIER DATA								
FND-03	NUMBER	DRAWING	DESCRIPTION	LINE ANGLE (Δ)	MOMENT (FT-K)	AXIAL (K)	SHEAR (K)	DRAWING NUMBER	T.O.C. ELEVATION ABOVE GROUND	L	B	NEAT LINE (*) CONCRETE (CY)	ITEM	SIZE	QTY	LENGTH PER PIECE	ITEM 2 SPACING	SHAPE
FND-03-1	1D	SCDE-ST-M1	75'-0" OVERALL HEIGHT SINGLE POLE DEADEND	88°18'38" LT	2961.8	24.9	49.6	–	1'-0"	25	7.0	35.6	1	11	18	24'-6"	–	STRAIGHT
													2	6	29	22'-11"	12"	78" RING O.D.
FND-03-2	2D	SCDE-ST-M1	75'-0" OVERALL HEIGHT SINGLE POLE DEADEND	83°46'28" LT	2961.8	24.9	49.6	–	1'-0"	25	7.0	35.6	1	11	18	24'-6"	–	STRAIGHT
													2	6	29	22'-11"	12"	78" RING O.D.

NOTES:

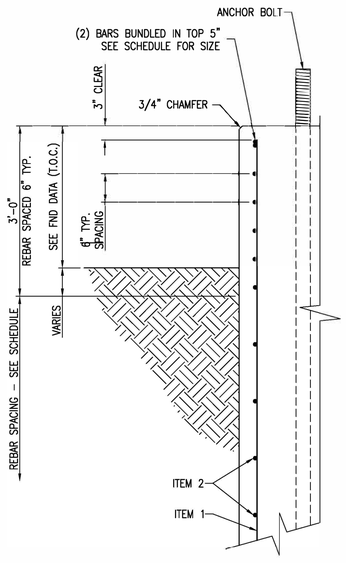
1. *ANCHOR BOLTS PROVIDED BY MANUFACTURER.
2. (*) NEAT LINE BASED ON MINIMUM DIMENSIONS.
3. O.D. = OUTSIDE DIAMETER OF ITEM 2 REBAR.
4. CLEAR DIMENSION SHALL BE MEASURED FROM THE OUTSIDE FACE OF PRINCIPAL REINFORCING.

GENERAL NOTES:

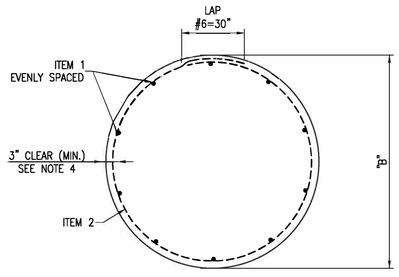
- REINFORCING STEEL SHALL CONFORM TO ASTM A-615 GRADE 60. ALL CLEAR DIMENSIONS MEASURED FROM OUTSIDE EDGE OF REINFORCING STEEL.
- CONCRETE: READY MIX CONCRETE SHALL CONFORM TO ASTM C-94.
  - A. CONCRETE STRENGTH: (MINIMUM 28 DAY COMPRESSIVE STRENGTH)
    CONCRETE PLACED IN DRY CONDITION – 4500 P.S.I.
    CONCRETE PLACED BELOW WATER TABLE USING TREMIE PIPE METHOD – 5000 P.S.I.
  - B. ENTRAINED AIR: PROVIDE AIR ENTRAINMENT IN CONCRETE RESULTING IN A TOTAL AIR CONTENT BY VOLUME OF 6% ± 1% PER ASTM C-260.
  - C. AGGREGATE: SHALL CONFORM TO ASTM C-33. MAXIMUM AGGREGATE SIZE THROUGHOUT SHALL BE 1 1/2".
  - D. SLUMP: SHALL BE 6-7 INCHES FOR CONCRETE.
  - E. WATER/ CEMENT RATIO: 0.45 MAX.
  - F. VIBRATION OF CONCRETE: SHALL BE LIMITED TO THE TOP TEN FEET OF THE FOUNDATION FOR CONCRETE PLACED BY THE TREMIE METHOD.
- SOIL OR ROCK CONDITIONS: WHERE SOIL DEPTHS, DEPTHS TO BEDROCK, OR THE CONDITIONS OF SOIL OR BEDROCK DIFFER FROM THAT SHOWN ON THE BORINGS, THE FOUNDATIONS ENGINEER SHALL BE CONTACTED.
- SEE SPECIFICATIONS AND DOCUMENTATION FOR EXCAVATION AND CONCRETE REQUIREMENTS.
- ALL PIERS SHALL BE FORMED FROM TOP OF FOUNDATION TO ONE FOOT BELOW GRADE BEFORE CONCRETE IS PLACED TO COMPLETE THE PIER.
- **GYPSUM PRESENT IN BORINGS. IN NO CASE SHALL PIERS TERMINATE IN A GYPSUM LAYER. IF THIS SHOULD OCCUR CONTACT ENGINEER.**



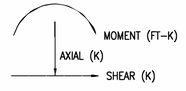
SECTION A
STEEL PARTIALLY SHOWN FOR CLARITY



SECTION B
FOUNDATION CAP
SCALE: N.T.S.



SECTION C
FOUNDATION
SCALE: N.T.S.



PIER DESIGN LOADS
SCALE: N.T.S.

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	N. VLAHOS
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 1
69KV TRANSMISSION LINE

FOUNDATION DETAILS

0 1" 2"

FILENAME BHE-FND-03-01.DWG
SCALE NONE
SHEET **FND-03-1**

STRUCTURE DATA												TRANSMISSION ASSEMBLIES							COMMENTS
STR. #	STATION (FT)	AHEAD SPAN	LINE ANGLE				STR TYPE	POLE H&C	FND	FND REVEAL	GROUND	ANCHORS	GUYS	SHIELD ASSEMBLIES	CONDUCTOR ASSEMBLIES	OPGW SPLICE	DAMPERS	MISC.	
SUB DE	0+00	155					DT-01-69							1)T-4FDS, 1)T-4D	3)T-SDE6PD	SPLICE BY SUBSTATION			OPGW TO MIDDLE STATIC MAST.
1D	1+55	133	88°	18'	38"	LT	SCDE-ST-M1	1)LD-12:75'-0"	1)FND-03-1	1'-0"	1)TM-9ST, 1)TM-9SSJ			1)T-4DS, 2)T-4FDS	6)T-BDE6PD, 6)TM-EXT-15		1)DPR-OPGW-D1		
2D	2+88	256	83°	46'	28"	LT	SCDE-ST-M1	1)LD-12:75'-0"	1)FND-03-2	1'-0"	1)TM-9ST, 1)TM-9SSJ			2)T-4FDS	6)T-BDE6PD, 6)TM-EXT-15		1)DPR-OPGW-D1		
3D	5+44	182	87°	14'	25"	RT	SCDE-69	1)75/2			1)TM-9	6)TA-P1	8)TGS-1, 8)TM-GM	1)T-4FDW, 1)T-4D	6)T-BDE6PD	1)T-FSC-1	1)DPR-OPGW-D1		OPGW TERMINATES HERE
4D	7+26	149	29°	16'	29"	RT	SCDE-69	1)75/1			1)TM-9	6)TA-P1	7)TGS-1, 7)TM-GM	3)T-4D	8)T-BDE6PD				
BF 2	8+75						SUB DE							2)T-4DS	3)T-BDE6D				

NOTES:

XXX NEW

[XXX] EXISTING

*X/./ RETIRE

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 1
69KV TRANSMISSION LINE

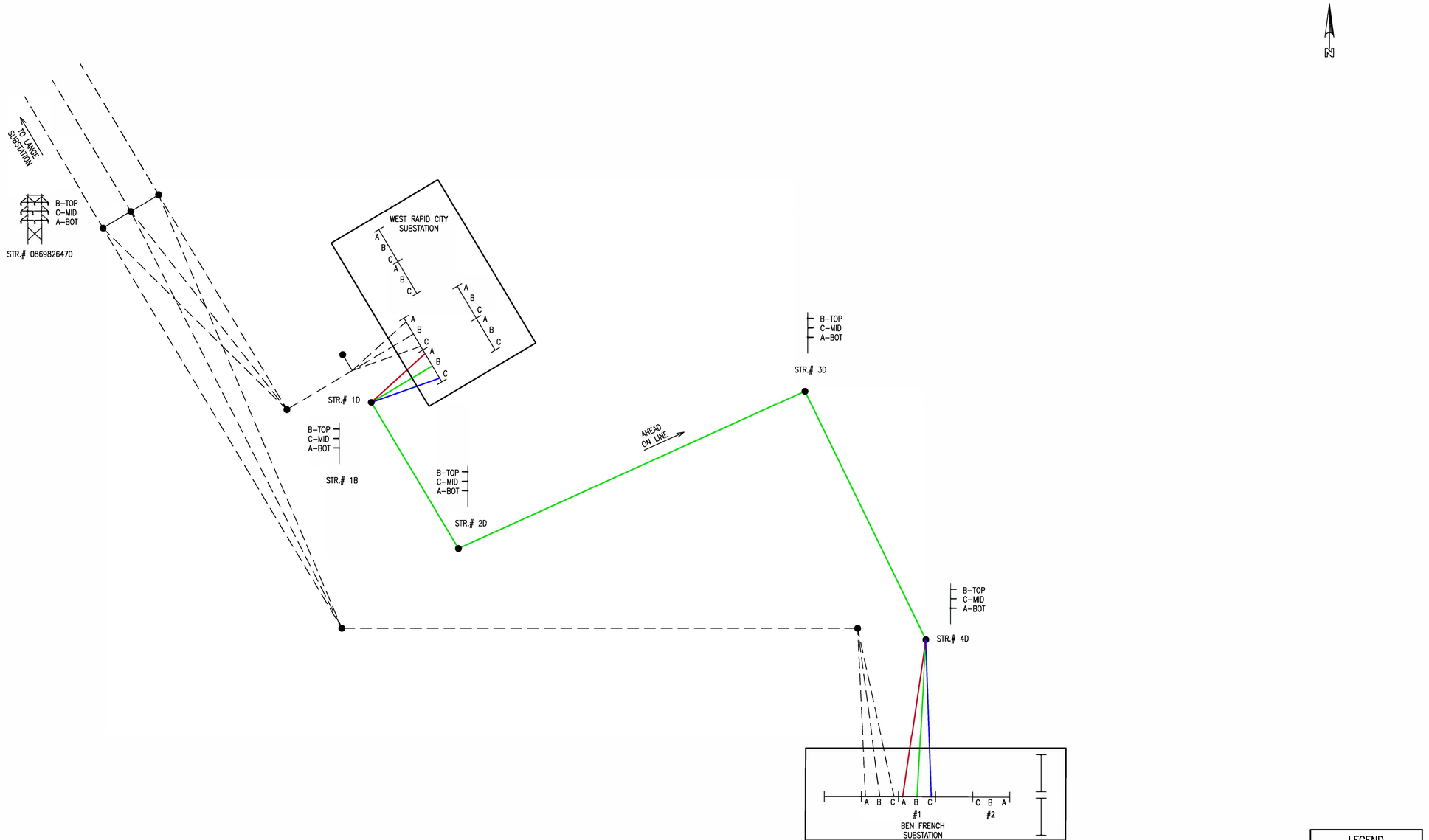
STAKING SHEETS

0 1" 2"

FILENAME BHE-SS-01-D-1.DWG

SCALE NONE

SHEET **SS-01**



NOTES:
1. CONTRACTOR TO VERIFY PHASING.
2. STRUCTURES SHOWN LOOKING AHEAD ON LINE.

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

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BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 1
69KV TRANSMISSION LINE

PHASING DIAGRAM

0 1" 2"

FILENAME BHE–PH–01–D–1.DWG
SCALE N.T.S.

SHEET **PH-01**

INITIAL SAG TABLE			795 KCMIL 45/7 ACSR "TERN" 2500# @ NESC HEAVY LOADING														SUB DE to 1D													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
SUB DE	155	155	1.92	2.13	2.34	2.54	2.73	2.89	3.06	3.21	3.36	3.51	3.65	3.78	3.91	4.04	4.16	4.14	4.37	4.58	4.77	4.94	5.09	5.23	5.36	5.49	5.60	5.71	5.81	5.92	6.01	6.10	
SUB-PHASE TENS. LBS			1390	1249	1137	1047	978	921	872	829	792	760	731	705	681	660	641																SUBTOTAL DAMPERS NEEDED:0

INITIAL SAG TABLE			795 KCMIL 45/7 ACSR "TERN" 2500# @ NESC HEAVY LOADING														1D to 2D													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
1D	133	133	1.17	1.37	1.57	1.76	1.93	2.09	2.24	2.38	2.52	2.65	2.78	2.90	3.02	3.13	3.24	3.24	3.50	3.74	3.96	4.15	4.32	4.48	4.62	4.75	4.87	4.99	5.09	5.20	5.30	5.39	
SUB-PHASE TENS. LBS			1622	1389	1216	1085	988	912	851	799	755	718	685	657	632	608	588																SUBTOTAL DAMPERS NEEDED:0

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BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 1
69KV TRANSMISSION LINE

INITIAL SAG TABLES

795 KCMIL 45/7 ACSR "TERN"

0 1" 2"

FILENAME BHE-STC-01-D-1.DWG

SCALE NONE

SHEET **STC-01-1**

FINAL SAG TABLE			795 KCMIL 45/7 ACSR "TERN" 2155# @ NESC HEAVY LOADING														2D to 3D													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
2D	256	256	8.08	8.27	8.44	8.62	8.78	8.93	9.09	9.24	9.39	9.53	9.69	9.83	9.96	10.10	10.24	8.50	8.60	8.69	8.78	8.86	8.94	9.02	9.09	9.16	9.23	9.31	9.38	9.44	9.51	9.57	
SUB-PHASE TENS. LBS			899	879	860	843	827	813	799	786	774	762	750	740	730	719	710																SUBTOTAL DAMPERS NEEDED:0

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E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 1
69KV TRANSMISSION LINE

FINAL SAG TABLES

795 KCMIL 45/7 ACSR "TERN"

0 1" 2"

FILENAME BHE-STC-02-D-1.DWG

SCALE NONE

SHEET **STC-02-1**

INITIAL SAG TABLE			AFL CC-55/443 "DNO-4748" OPGW 1500# @ NESC HEAVY LOADING														SUB DE to 1D												
			SAG FT														3RD WAVE TIME SEC.												
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
SUB DE	155	155	1.21	1.35	1.48	1.63	1.77	1.91	2.05	2.19	2.33	2.46	2.58	2.71	2.83	2.94	3.06	3.29	3.47	3.64	3.81	3.98	4.14	4.29	4.43	4.56	4.69	4.81	4.92	5.03	5.13	5.23	
SUB-PHASE TENS. LBS			730	658	597	544	501	463	431	404	381	360	343	327	313	301	290																SUBTOTAL DAMPERS NEEDED:0

INITIAL SAG TABLE			AFL CC-55/443 "DNO-4748" OPGW 1285# @ NESC HEAVY LOADING														1D to 2D												
			SAG FT														3RD WAVE TIME SEC.												
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
1D	133	133	1.06	1.18	1.30	1.43	1.55	1.67	1.79	1.91	2.02	2.13	2.23	2.33	2.43	2.52	2.62	3.08	3.25	3.42	3.57	3.73	3.87	4.00	4.13	4.25	4.36	4.47	4.57	4.66	4.75	4.84	1)DPR-OPGW-D1 AOL
SUB-PHASE TENS. LBS			594	533	482	440	405	376	351	330	312	296	282	270	259	249	240																SUBTOTAL DAMPERS NEEDED:1

INITIAL SAG TABLE			AFL CC-55/443 "DNO-4748" OPGW 1385# @ NESC HEAVY LOADING														2D to 3D												
			SAG FT														3RD WAVE TIME SEC.												
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
2D	256	256	6.41	6.55	6.69	6.82	6.96	7.09	7.22	7.35	7.48	7.60	7.73	7.85	7.97	8.09	8.21	7.57	7.65	7.73	7.81	7.89	7.97	8.04	8.11	8.18	8.25	8.31	8.38	8.44	8.51	8.57	1)DPR-OPGW-D1 AOL
SUB-PHASE TENS. LBS			371	363	355	348	341	335	329	323	318	312	307	303	298	294	290																SUBTOTAL DAMPERS NEEDED:1

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CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 1
69KV TRANSMISSION LINE

INITIAL SAG TABLES

AFL CC-55/443 "DNO-4748" OPGW

0 1" 2"

FILENAME BHE-STF-01-D-1.DWG

SCALE NONE

SHEET **STF-01-1**

INITIAL SAG TABLE			3/8" 7 STRAND EHS 1360# @ NESC HEAVY LOADING														SUB DE to 1D												
			SAG FT														3RD WAVE TIME SEC.												
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
SUB DE	155	155	1.48	1.59	1.71	1.83	1.94	2.06	2.17	2.28	2.38	2.49	2.59	2.69	2.79	2.88	2.97	3.64	3.77	3.91	4.04	4.17	4.29	4.40	4.51	4.62	4.72	4.81	4.90	4.99	5.08	5.16	
SUB-PHASE TENS. LBS			560	520	484	453	426	403	382	363	347	333	320	308	297	288	278																SUBTOTAL DAMPERS NEEDED:0

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DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 1
69KV TRANSMISSION LINE

INITIAL SAG TABLES

3/8" 7 STRAND EHS

0 1" 2"

FILENAME BHE-STS-01-D-1.DWG

SCALE NONE

SHEET **STS-01-1**

						SCDE-ST-M1	DT-U1-69	T-4D	T-4DS	T-4FDW	T-4PDS	T-FSC-1	T-BPE6PD	T-SDE5PD	TM-EXT-15	TM-9ST	TM-9SSJ	DPR-OPGW-01	3/8" EHS	DNO-4748	795 ACSR	EXTRA
				West Rapid City - Ben French 2 - QTY:		2	1	1	1	1	5	1	12	3	12	2	2	2	200	1000	1000	1
ITEM NO.	QTY	DESCRIPTION	MANUFACTURER	MANUFACTURER PART #	CLIENT #																	
B2526	2	BOLT, MACHINE, 5/8" X 26"	HUGHES	B626-6	N.S.							2										
B603	6	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	BURNDY	50 FWSS	N.S.				1		1											
B605	6	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	BURNDY	50 SWSSMD	N.S.				1		1											
B606	24	BOLT, NUT, BELLEVILLE, FLAT, STAINLESS STEEL, ASSEMBLY	CMC	SBA20-50	N.S.								8									
B614	6	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	FASTENAL	70207	N.S.				1		1											
C107	1000	CONDUCTOR, 795 KCMIL ACSR, 45/7 "TERN"	SOUTHWIRE		N.S.																1	
C800	200	WIRE, GALVANIZED, 7 STEEL STRAND, 3/8" EHS	MITCHELL		N.S.														1			
C902	36	WIRE, COPPER, #2 STRANDED, CLASS B	SOUTHWIRE		N.S.			2	6							10	4					
H102	2	SOCKET EYE, 18K, 1/2" WIDTH, 11/16" HOLE, 2-1/16" LENGTH	HUBBELL	SA04	N.S.			1	1													
H200	3	SOCKET CLEVIS, 30K	HUBBELL	SC30	N.S.									1								
H400	12	HOT LINK EXTENSION, CHAIN EYE - CHAIN EYE, 15" LONG, 30K LBS	HUBBELL	HOO3015	N.S.										1							
H500	2	Y-CLEVIS BALL, 30K	HUBBELL	YBC30	48-3054			1	1													
H602	6	ANCHOR, SHACKLE, 3" LONG, 3/4" DIA., 7/8" DIA. PIN, 35K LBS	HUGHES	2865-B3	N.S.					1	1											
H603	12	ANCHOR, SHACKLE, 3.5" LONG, 7/8" DIA., 3/4" DIA. PIN, 60K LBS	HUBBELL	AS50BNK	N.S.										1							
I300	15	INSULATOR, DEADEND, Y-CLEVIS BALL, 54" LENGTH, 25K LBS	MACLEAN	S14080042MXAL027	48-6927								1	1								
J100	1000	AFL CC-55/443 "DNO-4748" OPGW	AFL	DNO-4748	N.S.															1		
J300	6	FIBER OPTIC DEADEND, 18" U-BOLT (48 FIBER), W/ GROUND WIRE	PREFORMED	2801303G	N.S.					1	1											
J401	10	DOWNLEAD CUSHION KIT 0.443 OPGW W/ HARDWARE FOR WOOD POLE	PREFORMED	8663041-H1	N.S.							10										
J501	1	VERTICAL CABLE STORAGE ASSEMBLY	PREFORMED	8003569	N.S.							1										
J502	1	VERTICAL MOUNTING BRACKET KIT	PREFORMED	8003472	N.S.							1										
J510	1	6" X 22" COYOTE CLOSURE KIT W/ 6 PORT END PLATE	PREFORMED	8006659	N.S.							1										
J511	1	COYOTE DEFENDER FOR 6" X 22" CLOSURE	PREFORMED	8003492	N.S.							1										
J600	2	SPLICE TRAY KIT, 36 COUNT TRAY	PREFORMED	80805514	N.S.							2										
J700	1	CLOSURE END PLATE GROMMETS, 7/8" PORT, 0.443" OPGW	PREFORMED	8003597	N.S.							1										
J720	3	FUTURE CABLE PORT KIT, 7/8" PORT	PREFORMED	8003371	N.S.							3										
J730	1	GROMMET PLUG, 3/4" PORT, QTY 2	PREFORMED	80806037	N.S.							1										
L101	12	STRAIN CLAMP, DEADEND W/ SOCKET-EYE, 30K, 0.50 - 1.20 RANGE	HUBBELL	SD-112-S	42-1120								1									
L300	2	STRAIN CLAMP, DE, 20K, 3/8" EHS	HUBBELL	SWDE55N	44-4053			1	1													
L502	3	COMPRESSION DEADEND ASSY, DOUBLE TONGUE, W/ 15' TERMINAL "TERN"	AFL	VED-123	42-8230									1								
M500	6	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	HUBBELL	VHCL1012	N.S.				1		1											
N405	2	NUT, LOCK, MF TYPE, 5/8"	HUGHES	MF60	N.S.							2										
O100	4.5	INHIBITOR, FILLER COMPOUND, GRITTED, COMPRESSION CONNECTIONS, 8 oz.	HUBBELL	VS68B	N.S.								1.5									
O101	1.8	INHIBITOR, FILLER COMPOUND, NON-GRITTED, PAD TO PAD, 8 OZ	HUBBELL	VS8B	N.S.								0.6									
P500	2	ROD, GROUND, 5/8" X 8'-0", COPPERCLAD	GALVAN	6260G13	46-0588										1							
P701	2	CLAMP, GROUND ROD, 0.128 TO 0.460 RANGE, 5/8" ROD	CHANCE	C2030344	46-0058										1							
P820	6	CLAMP, VISE TYPE, LIGHTNING ARRESTOR GROUND, #2 STRANDED	HUBBELL	GC207	N.S.										1	2						
Q100	2	CLAMP, 3-BOLT, 6" LONG, 5/8" BOLT, 5/16" - 1/2" RANGE	MACLEAN	J931	18-5816			1	1													
Q500	1	CONNECTOR, COMPRESSION #4 COPPER TO #4 COPPER	HOMAC	CC44	N.S.					1												
Q501	1	GROUND CLAMP, #2 STRANDED TO #4 SOLID	HOMAC	CC24	36-0002			1														
Q550	2	CLAMP, SINGLE BOLT, VISE TYPE, 3/8" EHS TO #2 STR CU	HUBBELL	GA9020GLSS	46-6810			1	1													
Q551	1	CLAMP, SINGLE BOLT, #4 STR CU TO 4/0 AWG STR. CU	HUBBELL	LC1602	N.S.		1															
Q552	1	CLAMP, VISE TYPE, 3/8 EHS TO 4/0 AWG STR CU	HUBBELL	GA9040L55	N.S.		1															
Q601	12	PARALLEL GROOVE CONNECTOR, 0.743 - 1.152 RANGE	AFL	483.3A	42-0483								1									
S110	2	SPIRAL VIBRATION DAMPER, 0.327" - 0.461" RANGE	PREFORMED	5050104	N.S.													1				
W205	2	WASHER, SPRING, 11/16" HOLE	HUGHES	2702.6	N.S.							2										
W304	4	WASHER, SQUARE, 2" X 1/4", 11/16" HOLE	HUGHES	SW2-60	N.S.							4										

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CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

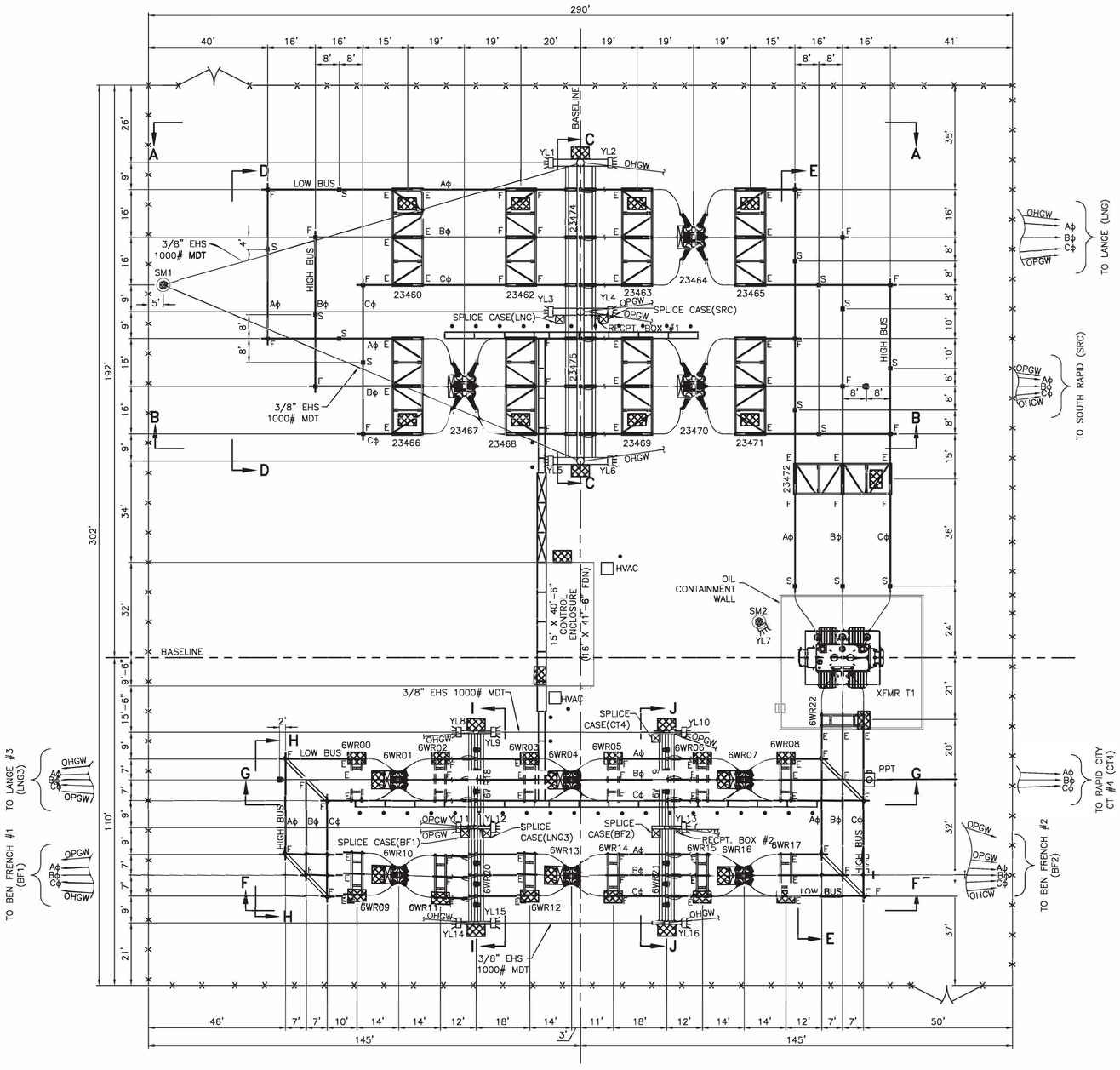
WEST RAPID CITY - BEN FRENCH 1
69KV TRANSMISSION LINE

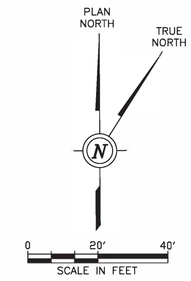
MATERIAL LIST

0 1" 2"

FILENAME BHE-ML-01-D-1.DWG
SCALE NONE

SHEET **ML-01**





NOTES:

1. 230 kV LOW AND HIGH BUS SHALL BE 3–1/2" AL IPS, SCH. 40, 6063–T6 ALUM. ALLOY WITH 795 ACSR "DRAKE" DAMPENING CABLE.
2. 230 kV BREAKER JUMPERS SHALL BE MADE OF DOUBLE 1272 AAC "NARCISSUS" CONDUCTORS.
3. 230 kV TRANSFORMER JUMPERS SHALL BE MADE OF SINGLE 1272 AAC "NARCISSUS" CONDUCTORS.
4. 69 kV BUS SHALL BE 3–1/2" AL IPS, SCH. 40, 6063–T6 ALUM. ALLOY WITH 795 ACSR "DRAKE" DAMPENING CABLE.
5. 69 kV BREAKER JUMPERS SHALL BE MADE OF DOUBLE 1272 AAC "NARCISSUS" CONDUCTORS.
6. 69 kV TRANSFORMER JUMPERS SHALL BE MADE OF DOUBLE 1272 AAC "NARCISSUS" CONDUCTORS.
7. BUS COUPLING LOCATIONS SHALL BE DETERMINED BY CONTRACTOR AS NEEDED BASED UPON BUS LENGTHS USED. LOCATE AS NEEDED PER THE SPECIFICATIONS. CONTRACTOR SHALL ACQUIRE 40' LONG BUS PIPE AND LIMIT USE OF COUPLERS ON LONG SPANS. DO NOT USE COUPLERS OR EXCESS SHORTER BUS PIECES TO CREATE A LONGER PIECE LESS THAN 40' IN LENGTH.

LEGEND:

- F FIXED (WELDED)
- E EXPANSION
- S SLIP
- FLOOD LIGHT
- YARD RECEPTACLE BOX
- SAFETY BOLLARD
- CABLE TRENCH DRIVE SECTION (HS20 RATED)
- CABLE TRENCH PEDESTRIAN SECTION
- CHAINLINK FENCE
- OPERATOR PLATFORM

REGISTERED PROFESSIONAL ENGINEER — REG. NO. 10443 — PAUL D. KONECHNE — SOUTH DAKOTA

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly Registered Professional Engineer under the laws of the State of South Dakota.

By _____
Paul D. Konechne, P.E.

Registration Number 10443 Date: 01-18-19

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DGR ENGINEERING
ROCK RAPIDS, IOWA
(712) 472-2531

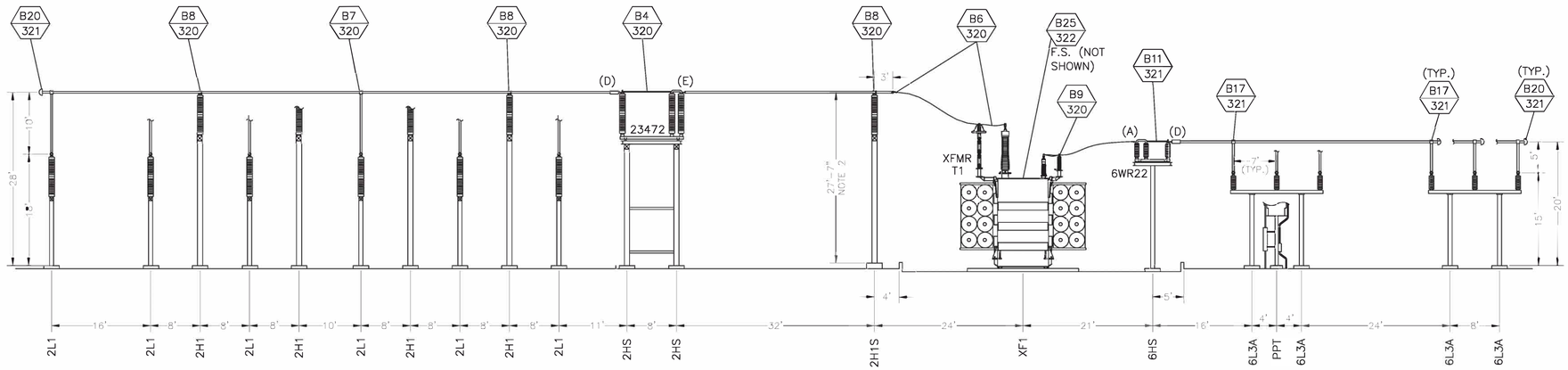
DATE	DRAWN BY	NO.	APPROVED BY	REVISION DESCRIPTION
01-19	KLV	0	PJK	FOR CONSTRUCTION

BLACK HILLS ENERGY

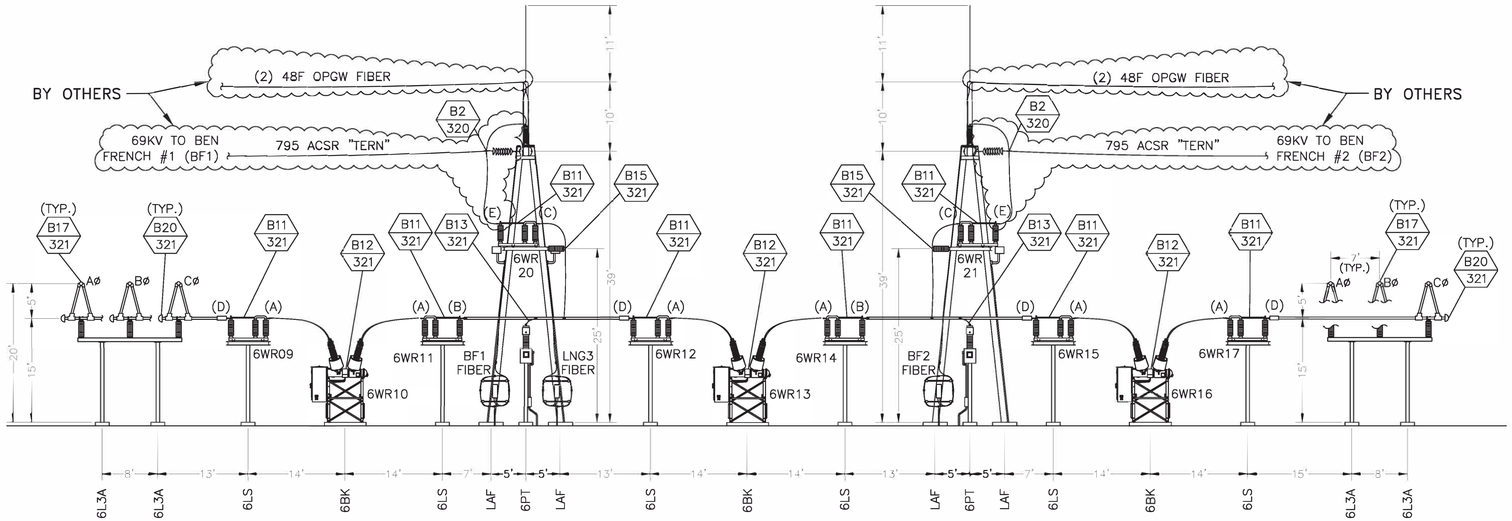
WEST RAPID CITY SUBSTATION

GENERAL ARRANGEMENT

DRAWN BY KLV DATE 08-18
APPROVED BY PJK DATE 08-18
DWG NO. WRC-C-101
REVISION 0



SECTION E–E



SECTION F–F

NOTES:

1. BUS COUPLING LOCATIONS SHALL BE DETERMINED BY CONTRACTOR AS NEEDED BASED UPON BUS LENGTHS PROCURED.
2. 2H1S STRUCTURE IS 5" SHORTER THAN 2H1 STRUCTURES.

LEGEND

- B27 / 320 — DETAIL # / DWG #
- 1L1 — STRUCTURE #
- (A) — SUB–DETAIL ASSIGNMENT

0' 10' 20'
SCALE IN FEET

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DRAWN BY KLV DATE 09-18
APPROVED BY PJK DATE 09-18

BLACK HILLS ENERGY

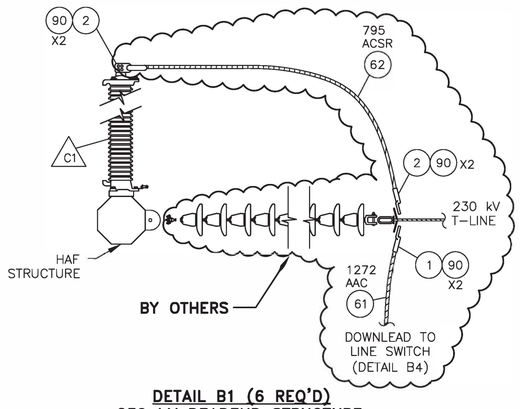
WEST RAPID CITY SUBSTATION

SECTIONS E AND F

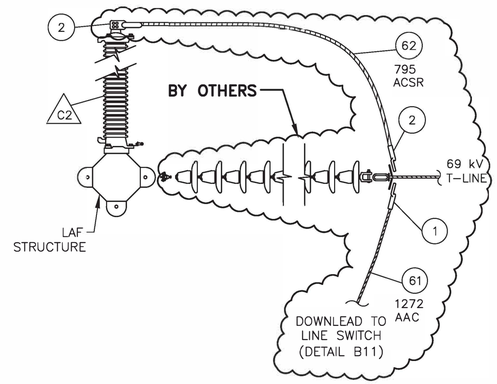
DWG NO. WRC–C–304 REVISION 0

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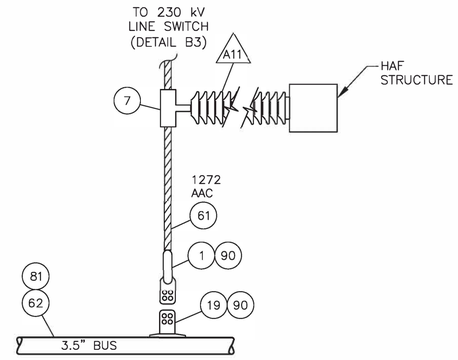
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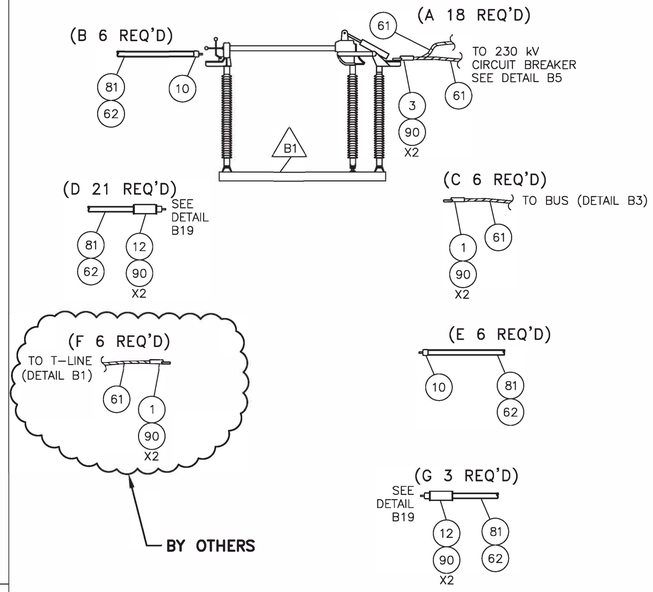
DETAIL B1 (6 REQ'D)
230 kV DEADEND STRUCTURE
T–LINE ATTACHMENT DETAIL



DETAIL B2 (12 REQ'D)
69 kV DEADEND STRUCTURE
T–LINE ATTACHMENT DETAIL



DETAIL B3 (6 REQ'D)
BUS CONNECTION DETAIL
230 kV DOWNLEAD CONNECTIONS

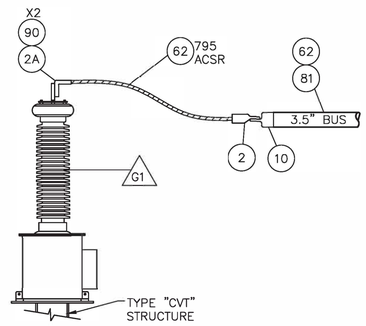


DETAIL B4
230 kV DISCONNECT SWITCH
CONNECTION DETAIL

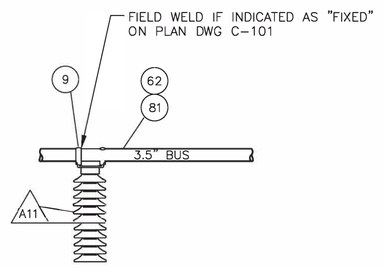
DETAIL B5 (9 REQ'D)
230 kV PCB CONNECTION DETAIL

DETAIL B6 (3 REQ'D)
230/69 kV TRANSFORMER HIGHSIDE
CONNECTION DETAIL

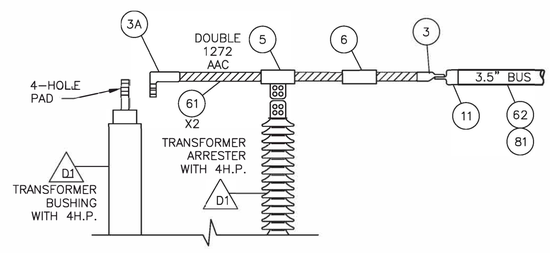
DETAIL B7 (12 REQ'D)
230 kV BUS BI–LEVEL
SUPPORT ASSEMBLY DETAIL



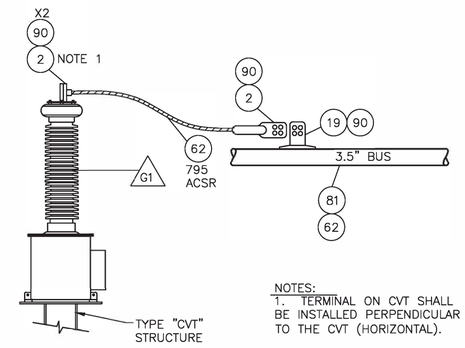
DETAIL B10A (1 REQ'D)
230 kV BUS CVT
CONNECTION DETAIL



DETAIL B8 (14 REQ'D)
230 kV BUS SUPPORT
ASSEMBLY DETAIL



DETAIL B9 (3 REQ'D)
230/69 kV TRANSFORMER LOWSIDE
CONNECTION DETAIL



DETAIL B10 (6 REQ'D)
230 kV LINE CVT
CONNECTION DETAIL

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REGISTERED PROFESSIONAL ENGINEER — REG. NO. 10443 PAUL D. KONECHNE — SOUTH DAKOTA

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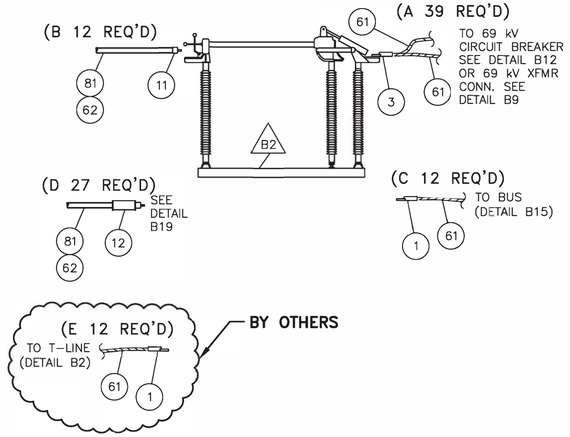
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BLACK HILLS ENERGY

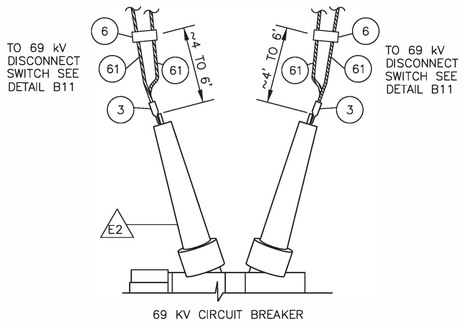
WEST RAPID CITY SUBSTATION

BUS CONNECTION DETAILS

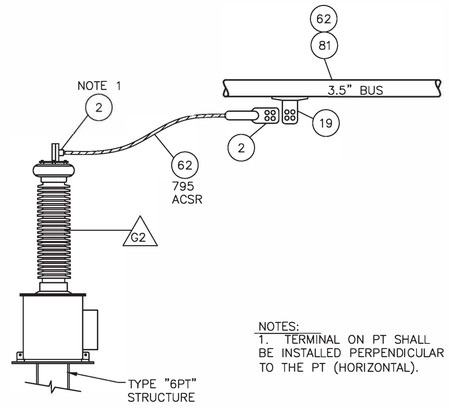
DRAWN BY KLV DATE 10-18
APPROVED BY PDK DATE 10-18
DWG NO. WRC-C-320 REVISION 0



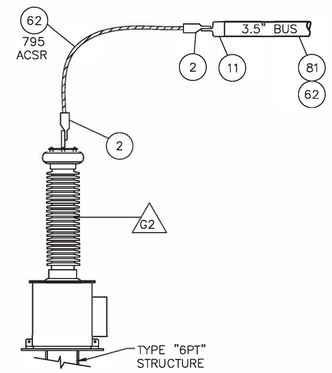
DETAIL B11
69 kV DISCONNECT SWITCH CONNECTION DETAIL



DETAIL B12 (18 REQ'D)
69 kV PCB CONNECTION DETAIL



DETAIL B13 (12 REQ'D)
69 kV LINE PT'S CONNECTION DETAIL



DETAIL B14 (1 REQ'D)
69 kV BUS PT CONNECTION DETAIL

DETAIL B15 (12 REQ'D)
BUS CONNECTION DETAIL
69 kV DOWNLEAD CONNECTIONS

DETAIL B16 (1 REQ'D)
69 kV POWER PT CONNECTION DETAIL

DETAIL B17 (12 REQ'D)
69 kV BUS BI-LEVEL SUPPORT ASSEMBLY DETAIL

DETAIL B18 (AS REQ'D)
BUS COUPLER JOINT

DETAIL B19
EXPANSION BUS TERMINAL DETAIL

DETAIL B20 (39 REQ'D)
END CAP DETAIL

DETAIL B21 (AS REQ'D)
69 kV 4-HOLE NEMA PAD CONNECTIONS

DETAIL B22 (AS REQ'D)
230 kV 4-HOLE NEMA PAD CONNECTIONS

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BLACK HILLS ENERGY

WEST RAPID CITY SUBSTATION

BUS CONNECTION DETAILS

DRAWN BY KLV DATE 10-18
APPROVED BY PDK DATE 10-18
DWG NO. WRC-C-321
REVISION NO. 0

Item No.	OFM	Catalog Number	Description	Manufacturer	"Total Required"
1	X	WCF-136-D	CONNECTOR, TERMINAL, WELDED, 1272 AAC TO 4" NEMA 4HP	ANDERSON	75
1A	X	WCF-136-D-Y45	CONNECTOR, TERMINAL, WELDED, 1272 AAC TO 4" NEMA 4HP, 45°	ANDERSON	3
1B	X	WCF-136-D-Y90	CONNECTOR, TERMINAL, WELDED, 1272 AAC TO 4" NEMA 4HP, 90°	ANDERSON	3
2	X	WCF-106-D	CONNECTOR, TERMINAL, WELDED, 795 ACSR TO 4" NEMA 4HP	ANDERSON	77
2A	X	WCF-106-D-Y90	CONNECTOR, TERMINAL, WELDED, 795 ACSR TO 4" NEMA 4HP, 90°	ANDERSON	1
3	X	W2CF-136-D	CONNECTOR, TERMINAL, WELDED, (2) 1272 AAC TO 4" NEMA 4HP	ANDERSON	114
3A	X	W2CF-136-D-Y90	CONNECTOR, TERMINAL, WELDED, (2) 1272 AAC TO 4" NEMA 4HP, 90°	ANDERSON	3
4	X	ORT-2114-D	CONNECTOR, TEE, COMPRESSION, 1272 AAC MAIN TO 4" NEMA 4HP	ANDERSON	3
4A	X	ATCF-15401	CONNECTOR, TEE, BOLTED, 1272 AAC MAIN TO 4" NEMA 4HP	ANDERSON	3
5	X	110-121-CSTD-4-90	CONNECTOR, SPACER, BOLTED, (2) 1272 AAC, 4" SPACING TO 4" NEMA 4HP, 90°	TRAVIS (PDU)	3
6	X	APCS-15-4	CONNECTOR, SPACER, BOLTED, (2) 1272 AAC, 4" SPACING	ANDERSON	69
7	X	HVCS-12995	BUS SUPPORT, BOLTED, EHV, 1272 AAC TO 5" BOLT CIRCLE	ANDERSON	6
8	X	ACS-163	BUS SUPPORT, BOLTED, 1272 AAC TO 3" BOLT CIRCLE	ANDERSON	12
9	X	WTH-34-5	BUS SUPPORT, WELDED/SLIP, 3-1/2" IPS TO 5" BOLT CIRCLE	ANDERSON	38
10	X	WSTFE-34-D-CF-EHV	CONNECTOR, TERMINAL, WELDED, EHV, 3-1/2" IPS TO 4" NEMA 4HP, CENTER FORMED, WITH BOLT SHIELD	ANDERSON	16
11	X	WSTF-34-D-CF	CONNECTOR, TERMINAL, WELDED, 3-1/2" IPS TO 4" NEMA 4HP, CENTER FORMED	ANDERSON	17
12	X	WFTFV-34D	CONNECTOR, TERMINAL, WELDED, EXPANSION, 3-1/2" IPS TO 4" NEMA 4HP, 90°	ANDERSON	51
13	X	WTT-15-3424	FITTING, WELDED TEE, 15 DEGREE, 3-1/2" IPS MAIN TO 2-1/2" IPS TAP	ANDERSON	24
14	X	WTT-15-3434	FITTING, WELDED TEE, 15 DEGREE, 3-1/2" IPS MAIN TO 3-1/2" IPS TAP	ANDERSON	24
15	X	WTT2-15-3424	FITTING, WELDED VEE, 15 DEGREE, 3-1/2" IPS MAIN TO 2-1 /2" IPS VEE	ANDERSON	12
16	X	WTT2-15-3434	FITTING, WELDED VEE, 15 DEGREE, 3-1/2" IPS MAIN TO 3-1 /2" IPS VEE	ANDERSON	12
17	X	WCI-3434	FITTING, COUPLER, WELDED, INTERNAL, 3-1/2" IPS TO 3-1/2" IPS	ANDERSON	13
18	X	WLI45-3434	FITTING, COUPLER, WELDED, 45°, INTERNAL, 3-1/2" IPS TO 3-1/2" IPS	ANDERSON	6
19	X	WTTFR-30-60-D	FITTING, TEE, WELDED, 3"-6" IPS RUN TO 4" NEMA 4HP, INLINE PAD	ANDERSON	36
20	X	WEB34	FITTING, CORONA BELL, WELDED, INTERNAL FIT, 3-1/2" IPS	ANDERSON	39
41	X	E/INS-150-G	WILDLIFE PROTECTOR, SPLIT TUBING, GRAY, FOR 1272 AAC, 20 KV PHASE-GND	MIDSUN GROUP	10'
42	X	E/FTP-250G	WILDLIFE PROTECTOR, FUSING TAPE, GRAY, 2.5" WIDE, FOR EXPOSED CONNECTORS & W/ITEM 41 & 43	MIDSUN GROUP	AS REQ'D
43	X	E/BSC-350	WILDLIFE PROTECTOR, COVER FOR XFMR ARRESTERS	MIDSUN GROUP	3
44	X	E/BC-DBL-LEAD	WILDLIFE PROTECTOR, BUSHING COVER FOR TRANSFORMER	MIDSUN GROUP	3
61	X	NARCISSUS	CONDUCTOR, 1272 MCM AAC, 61 STRANDING	ALCOA	2500'
62	X	TERN	CONDUCTOR, 795 MCM ACSR 45/7 STRANDING, FOR HIGH VOLTAGE CONNECTIONS	ALCOA	500'
62	X	TERN	CONDUCTOR, 795 MCM ACSR 45/7 STRANDING, FOR BUS DAMPENING	ALCOA	2000'
80		2.5" - 6063-T6	CONDUCTOR, BUS, 2-1/2" IPS, SCHEDULE 40 ALUMINUM, 40' LENGTHS	ALCOA	200'
81		3.5" - 6063-T6	CONDUCTOR, BUS, 3-1/2" IPS, SCHEDULE 40 ALUMINUM, 40' LENGTHS	ALCOA	2520'
90	X	EVHS-D	HARDWARE SHIELDS, EHV, 4" NEMA 4HP (BOLT SHIELDS)	ANDERSON	230
91		HBS-XXX	STAINLESS STEEL BOLTS, 1/2" FOR ALUMINUM BUS CONNECTIONS, CONTRACTOR TO DETERMINE LENGTH	ANDERSON	AS REQ'D
92		BW500	STAINLESS STEEL BELLEVILLE WASHER, 1/2", 1.06" O.D.	ANDERSON	AS REQ'D
93		HNB500	SILICON BRONZE NUT, HIGH STRENGTH, 1/2"	ANDERSON	AS REQ'D
94		HFS5001	STAINLESS STEEL WASHER, 1/2", 1.13" O.D.	ANDERSON	AS REQ'D
96		PENETROX A	ELECTRICAL FILLER COMPOUND, NON-PETROLEUM BASED	BURNDY	AS REQ'D
200		4/0 COPPER	CONDUCTOR, 4/0 STRANDED SOFT DRAWN COPPER		14,000'
201		633400	GROUND ROD, 3/4" DIAMETER, 10' LONG, COPPER CLAD	ERICO	106
202		CR-34	GROUND ROD COUPLING, FOR CONNECTING MULTIPLE GROUND RODS OR DRIVE STUDS	ERICO	70
203		DS34	GROUND ROD DRIVING STUD	ERICO	20
205		GYR182Q	MOLD, GROUNDING CONNECTOR, EXOTHERMIC, 4/0 CABLE-3/4" GROUND ROD (USE 150 WELD)	ERICO	4
206		XBQ2Q2Q	MOLD, GROUNDING CONNECTOR, EXOTHERMIC, 4/0 CABLE - 4/0 CABLE CROSS (USE 250 WELD)	ERICO	25
207		TAC2Q2Q	MOLD, GROUNDING CONNECTOR, EXOTHERMIC, 4/0 CABLE - 4/0 CABLE TEE (USE 150 WELD)	ERICO	40
208		SSC2Q	MOLD, GROUNDING CONNECTOR, EXOTHERMIC, 4/0 CABLE - 4/0 CABLE SPLICE (USE 90 WELD)	ERICO	3
210		90	WELD METAL, 90 CARTRIDGE SIZE, FOR USE WITH ITEM 208	ERICO	40
211		150	WELD METAL, 150 CARTRIDGE SIZE, FOR USE WITH ITEMS 205 & 207	ERICO	400
212		250	WELD METAL, 250 CARTRIDGE SIZE, FOR USE WITH ITEM 206	ERICO	350
221		GC-141A-02	CONNECTOR, BRONZE, BOLTED, 1-4/0 COPPER TO FLAT SURFACE	ANDERSON	650
222		GC-143A-02	CONNECTOR, BRONZE, BOLTED, 2-4/0 COPPER TO FLAT SURFACE	ANDERSON	200
223		K3	CONNECTOR, BRONZE, BOLTED, 2 PARALLEL 4/0 COPPER	ANDERSON	150
224		K1	CONNECTOR, BRONZE, BOLTED, 2 PARALLEL #4 COPPER	ANDERSON	10
225		SWL-025-B	CONNECTOR, BRONZE, BOLTED, #4-4/0 COPPER TO NEMA 2HP	ANDERSON	80
226		C-4	CONNECTOR, BOLTED, 1-#4 SOLID COPPER TO TYPE A4 BARBED WIRE/FENCE FABRIC	ANDERSON	200
227		GC-111-5B	CONNECTOR, BOLTED, 1-#4 SOLID COPPER TO 1-5/8" FENCE TOP RAIL/GATE FRAME	ANDERSON	60
228		GC-110-82C	CONNECTOR, BOLTED, 2-4/0 STRANDED COPPER TO 2-1/2" FENCE LINE POST	ANDERSON	20
229		GC-110-102C	CONNECTOR, BOLTED, 2-4/0 STRANDED COPPER TO 3" FENCE CORNER POST	ANDERSON	4
230		GC-110-142C	CONNECTOR, BOLTED, 2-4/0 STRANDED COPPER TO 4" GATE POST	ANDERSON	4
231		GC-109-06	CONNECTOR, BOLTED, FLEXIBLE COPPER BRAID TO 2" GATE FRAME	ANDERSON	8
233		GB-100-3B	FLEXIBLE COPPER BRAID 24" LONG WITH TIN PLATED FERRULES EACH END	ANDERSON	8
240		#4 SD SOLID CU	CONDUCTOR, #4 SOLID SOFTDRAWN COPPER		500'
241		#6 SD SOLID CU	CONDUCTOR, #6 SOLID SOFTDRAWN COPPER		150'
242		3/8" EHS	CONDUCTOR, 7 WIRE, 3/8" EXTRA HIGH STRENGTH STEEL		500'
250		SWDE46N	DEADEND, BOLTED, STATIC WIRE, 3/8" EHS STEEL, QUADRANT STRAIN CLAMP	ANDERSON	8
251		YCS-04-90	Y-CLEVIS EYE, FOR STATIC WIRE DEADEND, 90°	ANDERSON	8

Item No.	OFM	Catalog Number	Description	Manufacturer	"Total Required"
271	X	804-LL8-400PE	FIBER OPTIC CABLE, MULTIMODE DUPLEX		400'
272	X	12048R101	FIBER OPTIC CABLE, MULTI-FIBER	SUPERIOR ESSEX	1460'
273	X	DF4X1C-XXXX	CONDUIT, INNERDUCT, 1" ORANGE CORROGATED W/TAPE	CARLON	1500'
280	X		CONTROL CABLE, (3) CONDUCTOR #12, 3/C-#12 SH		350'
281	X		CONTROL CABLE, (2) CONDUCTOR #10, 2/C-#10 SH		3600'
282	X		CONTROL CABLE, SHIELDED, (4) CONDUCTOR #10, 4/C-#10 SH		500'
283	X		CONTROL CABLE, SHIELDED, (9) CONDUCTOR #10, 9/C-#10 SH		5500'
284	X		CONTROL CABLE, SHIELDED, (12) CONDUCTOR #10, 12/C-#10 SH		5600'
285	X		CONTROL CABLE, (2) CONDUCTOR #6, 2/C-#6 SH		1500'
286	X		CONTROL CABLE, (3) CONDUCTOR #6, 3/C-#6 SH		2100'
287	X		POWER CABLE, (1) CONDUCTOR 500 MCM, 1/C-500		1000'
291			TERMINAL CONNECTORS, CONTROL CABLE, VARIOUS SIZES		1850
292			TERMINAL CONNECTORS, CONTROL CABLE, SHIELD		130
293			TERMINAL CONNECTORS, POWER CABLE, 500 MCM		18
294			CABLE MARKERS		1 LOT
300			CONDUIT, BELOW-GRADE, VARIOUS SIZES, SCHEDULE 40 PVC AND ASSOCIATED FITTINGS AND PULL WIRE		1 LOT
301			CONDUIT, STATION POWER RISERS, 90° ELBOW, 3-1/2" RIGID GALVANIZED STEEL, 40" MIN RADIUS		4
310			CONDUIT, ABOVE-GRADE, VARIOUS SIZES, RIGID GALVANIZED STEEL AND ASSOCIATED FITTINGS		1 LOT
311			CONDUIT, ABOVE-GRADE, VARIOUS SIZES, LIQUID-TIGHT FLEXIBLE AND ASSOCIATED FITTINGS		1 LOT
330			ANTI-CORROSION TAPE, FOR RIGID GALVANIZED STEEL INSTALLED BELOW GRADE		1 LOT
380	X		CABLE TRENCH ASSEMBLY	TRENWA	1 LOT
381	X		CABLE TRENCH GROUND CLAMPS	TRENWA	90
382			DRAIN TILE, 4" PERFORATED, HDPE, WITH COUPLINGS & ACCESSORIES AS NEEDED		630'
383			OUTLET, DRAIN TILE, 4", PREFABRICATED CMP, FLARED END, WITH RODENT GUARD		2
384			FENCE POST, MARKER FOR DRAIN TILE OUTLET		2
390			CONDUIT MARKER		9
400	X	FXL-56L-190-5K-W-U-Y-GR	FLOOD LIGHT, LED, 120-277 VAC, 187 WATT (400W MH EQUIVALENT)	HUBBELL	16
401	X	4024CM53	FLOOD LIGHT SLIP-FITTER, STEEL FOR 2" PIPE, 2 3/8" O.D. YOKE MOUNT	HUBBELL	16
402	X	6387	FLOOD LIGHT WALL BRACKET, 2" SLIP FITTER, GRAY	HOLOPHANE	16
500		FENCE	CHAIN-LINK FENCE SYSTEM		1184'
501		GATES	GATE, CHAIN-LINK DOUBLE GATE, 24' TOTAL WIDTH, WITH ONE PERSONNEL GATE		2

NOTES:
1. SEE PROJECT SPECIFICATIONS AND DETAIL DRAWINGS FOR FURTHER MATERIAL DETAILS AS NEEDED.
2. SUPPLIER SHALL BE RESPONSIBLE FOR PROVIDING OFM QUANTITIES AS REQUIRED TO COMPLETE THE PROJECT.
3. QUANTITIES OF CONTRACTOR-FURNISHED MATERIALS SHALL BE VERIFIED BY CONTRACTOR.
4. OWNER SHALL BE NOTIFIED OF ANY QUANTITIES THAT MAY BE SHOWN INCORRECTLY ON THIS DRAWING.

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DATE	DRAWN BY	NO.	APPROVED BY	REVISION DESCRIPTION
01-19	KLV	0	PJK	FOR CONSTRUCTION

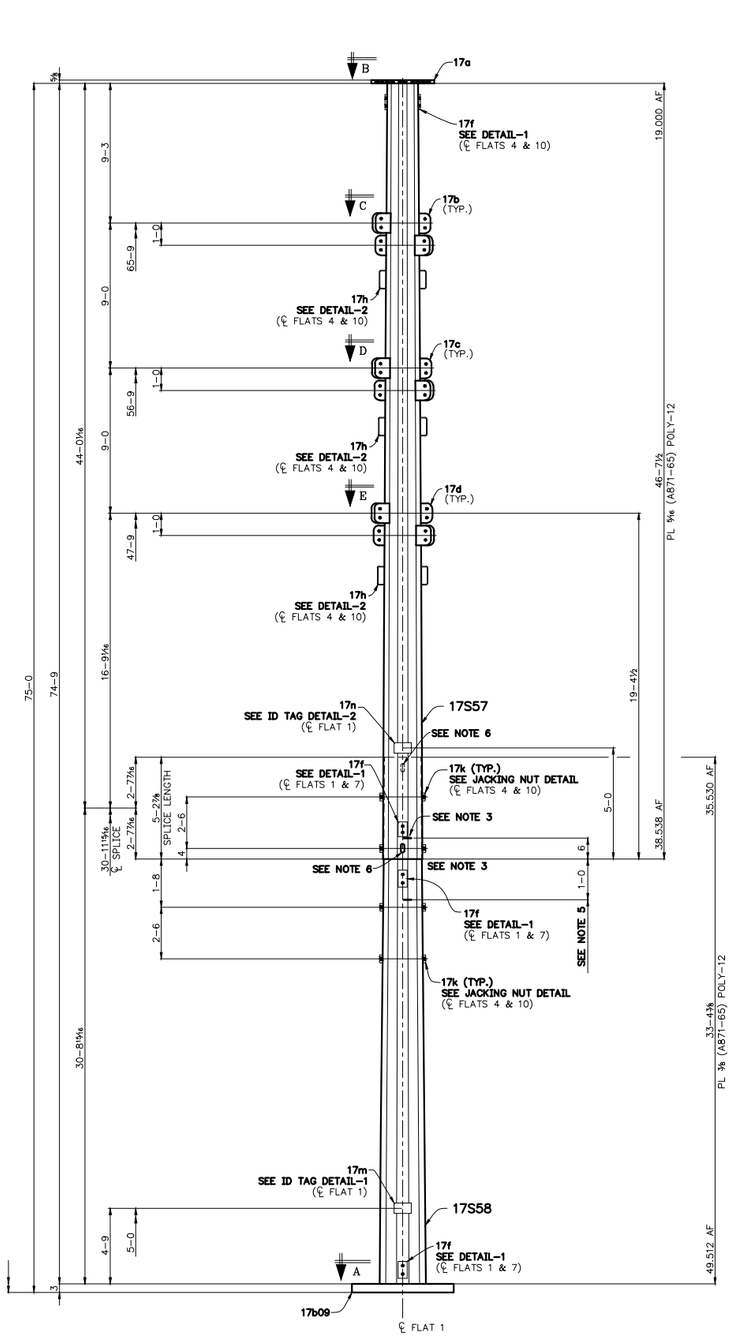
BLACK HILLS ENERGY

WEST RAPID CITY SUBSTATION

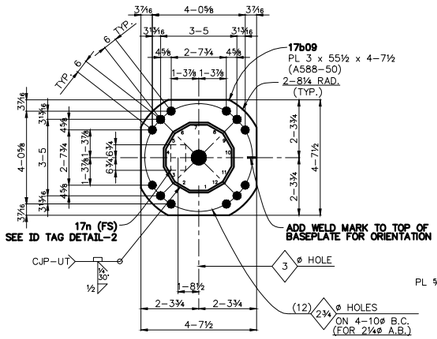
MATERIAL LIST

DRAWN BY KLV DATE 01-19
APPROVED BY PJK DATE 01-19

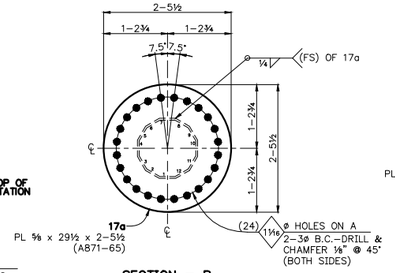
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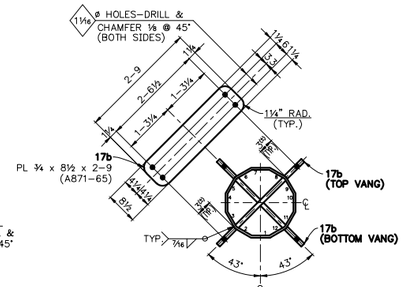
69KV TRANSMISSION POLE



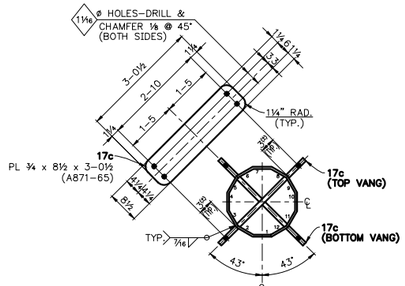
SECTION – A



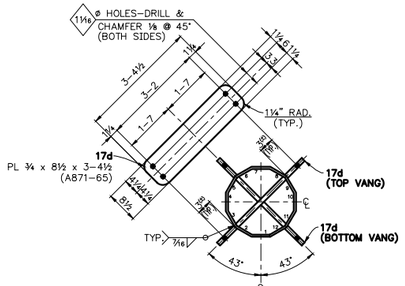
SECTION – B



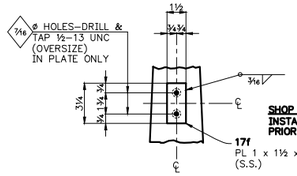
SECTION – C



SECTION – D



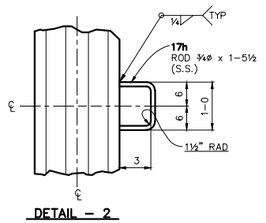
SECTION – E



DETAIL – 1

GROUNDING SCHEDULE DIM'S TO CENTER OF GROUND PLATE SEE DETAIL–1	
POLE – 17S57	POLE – 17S58
℄ OF FLATS 1 & 7	℄ OF FLATS 4 & 10	℄ OF FLATS 1 & 7
0–11	45–7½	0–9
		27–2½

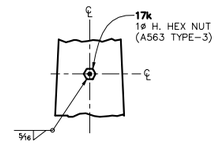
ALL DIMENSIONS FROM BOTTOM OF SHAFT



DETAIL – 2

GROUND LOOP SCHEDULE DIM'S TO CENTER OF GROUND LOOP SEE DETAIL–2
POLE – 17S57
℄ OF FLATS 4 & 10
17–1½
26–1½
35–1½

ALL DIMENSIONS FROM BOTTOM OF SHAFT



JACKING NUT DETAIL

MATERIAL REQ'D. FOR ASSEMBLY			
MARK	QTY.	DESCRIPTION	BLACK WT.
17S57	ONE	POLY–12 POLE	5,074
17S58	ONE	POLY–12 POLE	8,380
		TOTAL BLACK WT.	13,454#

HARDWARE REQD. FOR ASSEMBLY		
MARK	QTY.	DESCRIPTION
(1)	ONE	SEE ANCHOR BOLT CAGE DETAIL ON SHEET E34.

MATERIAL BILLED FOR ONE MAKE (2) TIMES

GENERAL NOTES:

1. ALL WELDS SHALL BE IN ACCORDANCE WITH A.W.S. (D1.1.) UNLESS NOTED OTHERWISE.
   a.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL BE U.T. TESTED IN ACCORDANCE WITH AWS & ASNDT.
   b.) ALL MATERIAL WELDED WITH E80–SERIES, LOW HYDROGEN ELECTRODES.
   c.) ALL FILLET WELDS AT JOINT TERMINATIONS OR ABRUPT CHANGES IN WELD DIRECTION SHALL HAVE END RETURNS TO WRAP CORNERS AS GEOMETRY PERMITS. IF JOINT GEOMETRY DOES NOT PERMIT A FULL SIZE RETURN, A SEAL WELD SHALL BE PROVIDED WHERE ACCESSIBLE.
   d.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL USE 3/16" X 1 1/4", (A36) STEEL BACKING (GALVANIZED POLES); (A588–50) (NON–GALVANIZED), MINIMUM. BACKING BARS SHALL BE SPLICED ON SHAFT FLATS ONLY, WITH A C.J.P. GROOVE WELD. BACKING BARS SHALL BE SEAL WELDED ALL AROUND, WHEN ACCESSIBLE.
   e.) LONGITUDINAL SEAM WELDS SHALL ACHIEVE A MINIMUM OF 80% PENETRATION. LONGITUDINAL SEAM WELDS SHALL ACHIEVE 100% PENETRATION WITHIN A MINIMUM OF 6" FROM THE ENDS OF THE SHAFT AND THE FULL LENGTH OF THE FEMALE SECTION IN THE SLIP JOINT.
2. LONGITUDINAL SEAM WELDS IN FEMALE SECTION OF THE SLIP JOINT SHALL BE FULL PENETRATION WELDS.
3. FOR PROPER SHAFT ALIGNMENT FOR ASSEMBLY, A 6" HORIZONTAL WELD BEAD AND A MARK NUMBER ARE POSITIONED ON EACH SHAFT AT EACH SPLICE. THE 6" HORIZONTAL WELD BEADS ARE ON MATCHING CORNERS. THE MARK NUMBER IS ON AN ADJACENT FLAT. THE HORIZONTAL WELD BEAD CORNERS SHALL BE ALIGNED TOP TO BOTTOM OF THE POLE. MATCH NUMBERS SHALL BE MATCHED FOR EACH SPLICE.
4. FIELD ASSEMBLY HOLES (1⅛ø) WITH 1"ø H. HEX NUTS ARE LOCATED ON OPPOSING SECTION FLATS ABOVE AND BELOW SPLICES FOR JACKING SHAFTS TOGETHER.
5. THE LOWER WELD ORIENTATION MARK AT EACH SPLICE LOCATION SHALL BE TELESCOPED IN THE FIELD TO WITHIN 24" OF THE UPPER WELD ORIENTATION MARK. AFTER TELESCOPED, THE SECTIONS SHOULD SHOW NO FURTHER MOVEMENT AND THERE SHOULD BE ADEQUATE METAL–TO–METAL CONTACT ON ALL FLATS.
6. TWO SLOTS (1½ø x 2½") WILL BE PROVIDED AT THE SLIP FITTED END OF EACH SHAFT.
7. POLE TAPER = 0.419053 IN/FT
8. FIELD BOLT SHIPPING QUANTITIES WILL INCLUDE A MAXIMUM 5% OVERAGE FOR BOLTS 1"ø OR LESS. FIELD BOLTS OVER 1"ø WILL BE EXACT COUNT UNLESS NOTED OTHERWISE.
9. ALL HARDWARE NOTED WITH "PT" SHALL BE PRE–TENSIONED PER THE TURN–OF–NUT METHOD. ALL OTHER HARDWARE SHALL BE SNUG–TIGHT. SPARE SHIPPING QUANTITIES WILL INCLUDE THREE EXTRA ASSEMBLIES OF EACH BOLT TYPE DESIGNATED AS "PT" FOR FIELD VERIFICATION OF PRE–TENSIONING METHOD.
10. **POLE SHALL BE SWEEP BLASTED DULLED AFTER FABRICATION.**

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL,
DO NOT GALVANIZE.

(STR. 1D & 2D) 19–9462PE33

DIS-TRAN Steel, LLC
P.O. BOX 5109•ALEXANDRIA, LA, 71307–5709
PHONE 318–448–0274•FAX 318–445–4454

WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

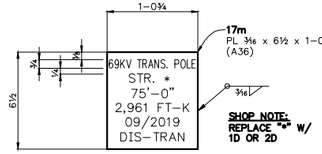
69KV TRANSMISSION POLE / ITEM – 21
ERECTION ELEVATION, SECTIONS & DETAILS

SCALE	DATE	JOB NUMBER	DRAWING NUMBER	REV. NO.
N.T.S.	07/12/19	19–9462P	E33	1

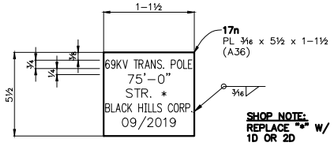
DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ

NOTICE TO ERECTOR
BACKCHARGES FOR CORRECTIVE WORK OR REPLACED MATERIALS WILL NOT BE ACCEPTED UNLESS EXPRESSLY AUTHORIZED BY DIS–TRAN BEFORE ANY SUCH COST ARE INCURRED.

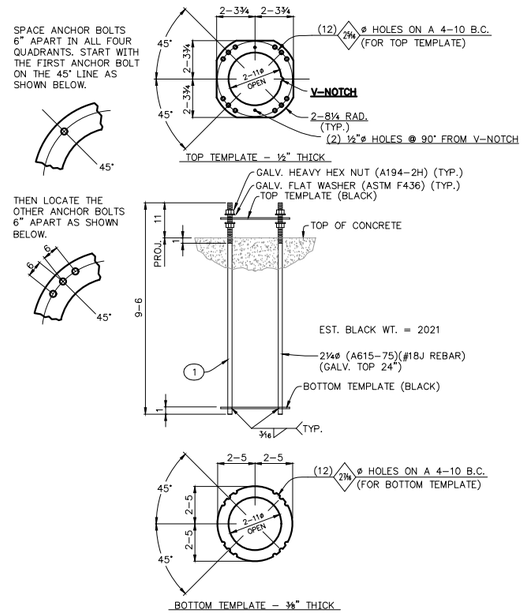
REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19
2					
3					
4					
5					
6					
7					
8					



ID TAG DETAIL – 1



ID TAG DETAIL – 2



SHOP NOTE:
ALL MATERIAL WEATHERING STEEL,
DO NOT GALVANIZE.

(STR. 1D & 2D) 19–9462PE34

DIS-TRAN Steel, LLC
P.O. BOX 5109•ALEXANDRIA, LA, 71307–5709
PHONE 318–448–0274•FAX 318–445–4454

WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

69KV TRANSMISSION POLE / ITEM – 21

SECTIONS & DETAILS (CONTINUED)

SCALE	DATE	JOB NUMBER	DRAWING NUMBER	REV. NO.
N.T.S.	07/12/19	19–9462P	E34	1

DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ

NOTICE TO ERECTOR
BACKCHARGES FOR CORRECTIVE WORK OR REPLACED MATERIALS WILL NOT BE ACCEPTED UNLESS EXPRESSLY AUTHORIZED BY DIS–TRAN BEFORE ANY SUCH COST ARE INCURRED.

REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19

BLACK HILLS ENERGY

WEST RAPID CITY TO BEN FRENCH 2 69KV TRANSMISSION LINE

DRAWING LIST

DRAWING #	DRAWING DESCRIPTION
DL-01	DRAWING LIST
	ROUTE MAP
RM-01	ROUTE MAP
	PLAN AND PROFILE DRAWINGS
PP-01	WEST RAPID CITY SUB – BF2 SUB
	STRUCTURE DETAILS
SD-01-1	SCUBDE-M2
SD-02-1	SCDE-ST-M4
SD-03-1	DT-01-69
	ASSEMBLY DETAILS
AD-01-1	T-4A,B,S, T-4D(S), T-4C
AD-02-1	T-4F, T-4FD, T-4FC
AD-03-1	T-FDL, T-FSCS-1
AD-04-1	T-SP(1), T-BPD, T-PSD
AD-05-1	T-BDE6PD, T-SDE6PD, TM-EXT-15, T-BDE6D
AD-06-1	TM-9ST, TM-9SD, TM-9SSJ, TM-9
AD-07-1	TD-1, TD-2
AD-08-1	DPR-OPGW, DPR-795, DPR-EHS
AD-09-1	TM-101 & TM-103, TP-A
	LOAD AND DESIGN DETAILS
LD-10-1	STR 2B-1, DESIGN DETAILS
LD-10-2	STR 2B-1, LOAD TREES
	FOUNDATION DETAILS
FND-02-1	STR 2B-1
	STAKING SHEETS
SS-01	STR SUB 2 – STR BF2 SUB
	PHASING DIAGRAM
PH-01	PHASING DIAGRAM

DRAWING #	DRAWING DESCRIPTION
	SAG TABLES 795 KCMIL 45/7 ACSR "TERN"
STC-01-1	STR SUB 2 – STR 2B, STR 2B – STR 2B-1, INITIAL
STC-02-1	STR 2B-1 – STR BF2 SUB, FINAL
	SAG TABLES AFL CC-55/443 "DNO-4748" OPGW
STF-01-1	STR SUB 2 – STR 2B, STR 2B – STR 2B-1, INITIAL
	SAG TABLES 3/8" 7 STRAND EHS
STS-01-1	STR 2B – STR SUB 2, INITIAL
	SAG TABLES 3/8" 7 STRAND HS
STS-02-1	STR 2B-1 – STR BF2 SUB, FINAL
	MATERIAL LIST
ML-01	MATERIAL LIST
	APPENDIX
	WEST RAPID CITY SUBSTATION REFERENCE DRAWINGS
WRC-C-101	GENERAL ARRANGEMENT
WRC-C-304	SECTIONS E AND F
WRC-C-320	BUS CONNECTION DETAILS
WRC-C-321	BUS CONNECTION DETAILS
WRC-C-380	MATERIAL LIST

1	REVISION
DESCRIPTION: RECORD DRAWINGS	
NAME: DATE: REG. NO.:	
PROJECT #: 10114217	ISSUE DATE: 6/12/2020
PROJECT MANAGER: J. ELLSWORTH	
DESIGN ENGINEER: J. PANKRATZ	
DRAWN BY: Z. JANSEN	

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 2
69KV TRANSMISSION LINE

DRAWING LIST

0 1" 2"

FILENAME BHE-DL-01-01.DWG
SCALE NONE

SHEET **DL-01**

N

WEST RAPID CITY SUBSTATION

BEN FRENCH SUBSTATION

CT GENERATORS

STATE HWY 445 DEADWOOD AVE

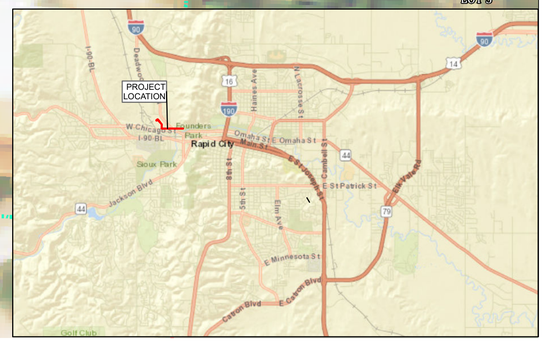
LOT C

LOT 3

E40
41
43A
42A
42C
1A
1B
1D
2D
E3D
E43C
E4D
2A
2B
2B-1
2A-1
2A-2
3
4
5
CT1
CT2
CT3
CT4
ECT1-1
ECT2-3
ECT3-3
E2A-3
ECA-1
ECA-2
ECB-1
ECB-2

LEGEND

- SUPPORT STRUCTURE
- SUBSTATION DEAD-END
- RETIRE SUPPORT STRUCTURE
- CT 4 - BEN FRENCH 2 69KV RETIREMENT
- LANGE - BEN FRENCH 2 69KV RETIREMENT
- LANGE - BEN FRENCH 1 69KV RETIREMENT
- LANGE - BEN FRENCH 3 69KV RETIREMENT
- OTHER 69KV TRANSMISSION LINE
- BEN FRENCH - CAMPBELL STREET 69KV TRANSMISSION LINE
- BEN FRENCH - CT'S 69KV TRANSMISSION LINE
- LANGE - BEN FRENCH 69KV TRANSMISSION LINE
- LANGE - WEST RAPID CITY 69KV TRANSMISSION LINE
- LANGE-SOUTH RAPID CITY 230KV TRANSMISSION LINE
- WEST RAPID CITY - BEN FRENCH 2 69KV TRANSMISSION LINE
- WEST RAPID CITY - BEN FRENCH 1 69KV TRANSMISSION LINE
- WEST RAPID CITY - CT4 69KV TRANSMISSION LINE
- WEST RAPID CITY 230KV TRANSMISSION LINE
- ELECTRIC EASEMENT
- UTILITY EASEMENT
- PROPERTY LINE
- QUARTER LINE
- SECTION LINE
- LEADER LINE



Black Hills Energy
Improving life with energy

HDR

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	09/11/2019	ISSUE FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CADD TECHNICIAN	Z. JANSEN
GIS TECHNICIAN	S.GRIFFIN
PROJECT NUMBER	10114217

BLACK HILLS POWER
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY 69KV TERMINATIONS

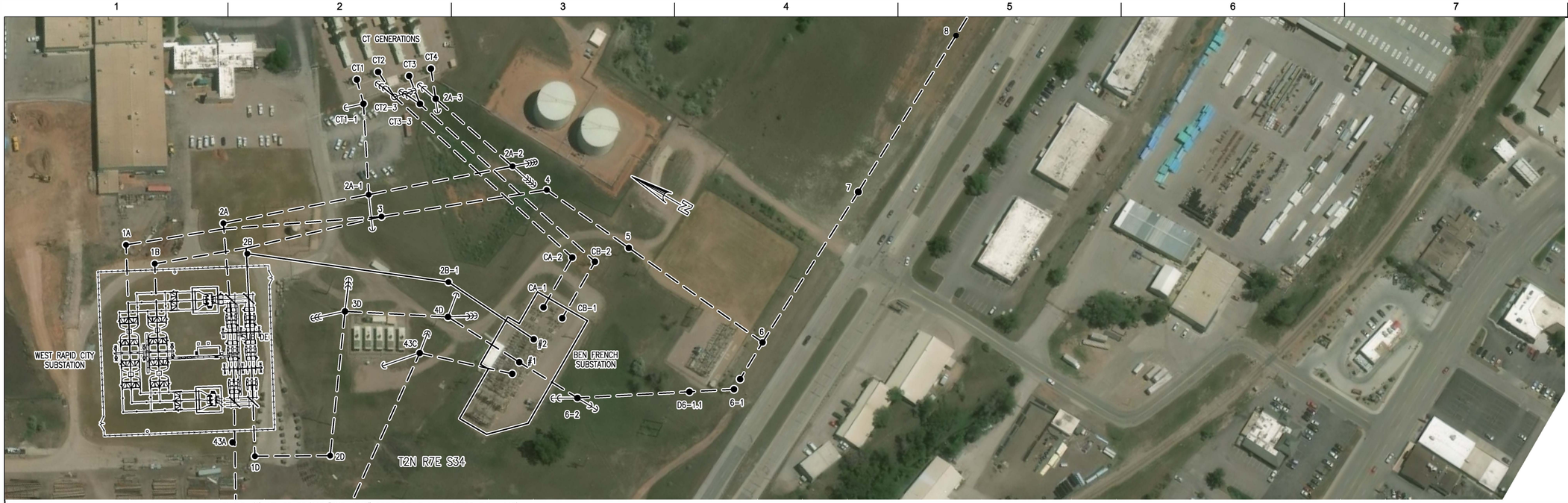
ROUTE MAP

0 20 40 80 Feet

FILENAME: West Rapid City 69kV Terminations 22x34

SCALE: 1 inch = 50 feet

SHEET: RM-01



PLAN NOTES:

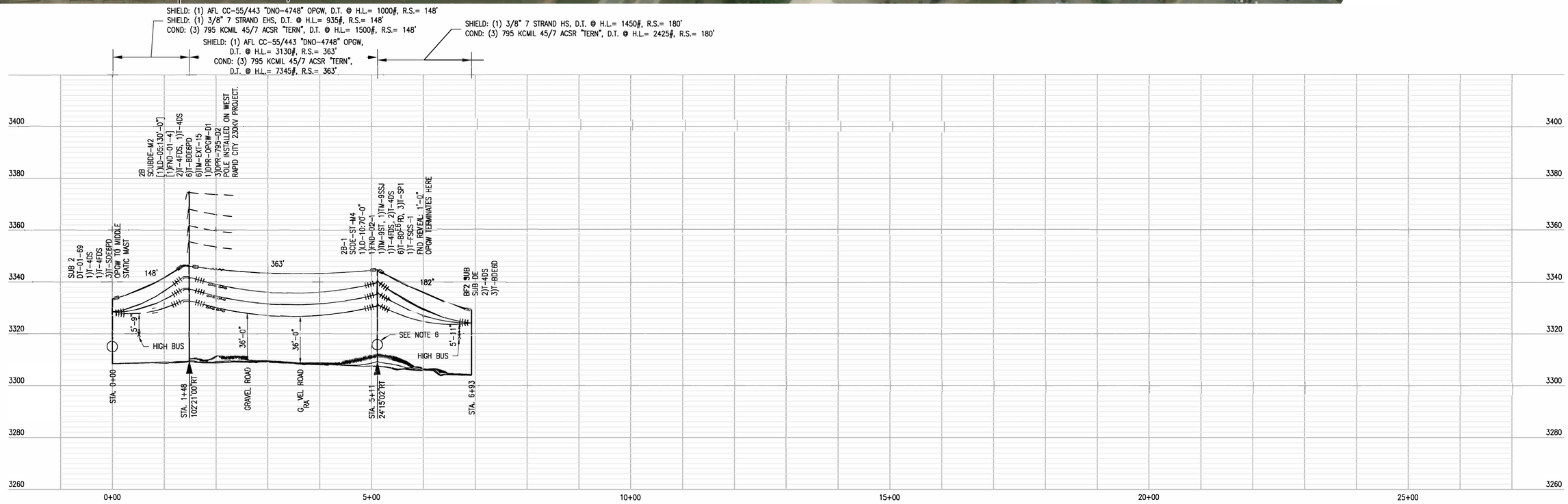
- ● STRUCTURE
- —— ALIGNMENT
- — — ALIGNMENT OF ANOTHER LINE

NOTES:

1. [XXX] – EXISTING ASSEMBLY
2. *XXX – RETIREMENT ASSEMBLY
3. T[XXX] – TRANSFER UNIT ASSEMBLY
4. SHIELD WIRE SHOWN AT 60°F (CREEP)
5. CONDUCTOR SHOWN AT 212°F (MAX SAG)

PROFILE NOTES:

- CONDUCTOR DAMPER
- SHIELD DAMPER
- OPGW SPLICE



ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

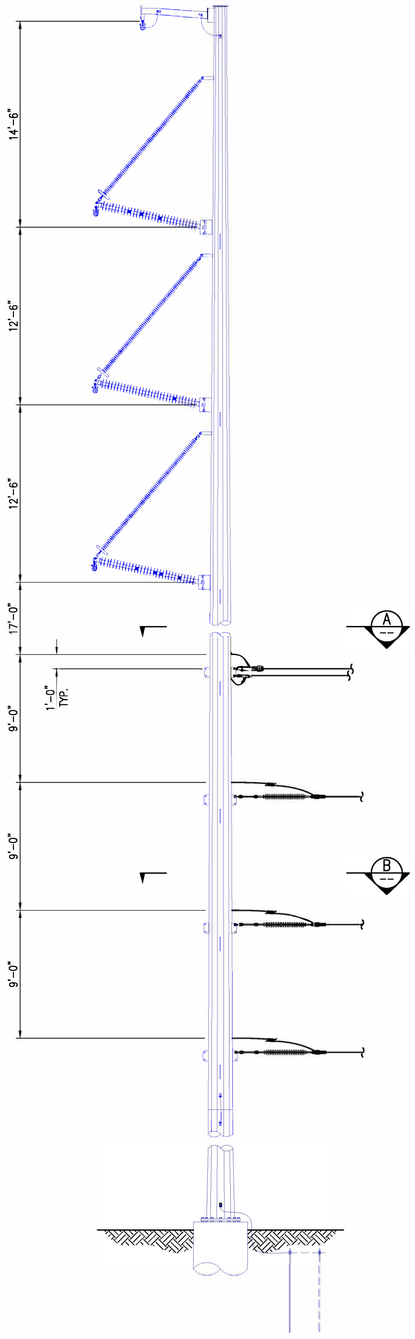
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

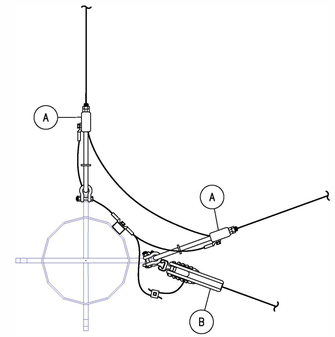
WEST RAPID CITY - BEN FRENCH 2
69KV TRANSMISSION LINE

PLAN AND PROFILE

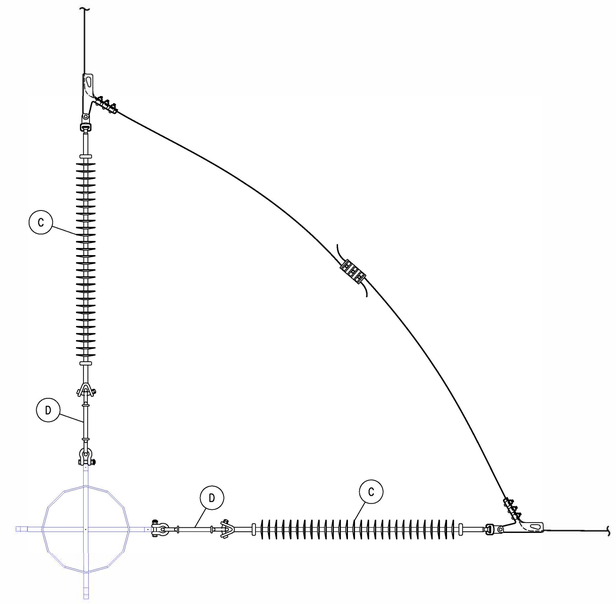
0 1" 2"

FILENAME	BHE-PP-01-D-1.DWG
SCALE	H:1"=100' V:1"=20'
SHEET	PP-01





SECTION A
SHIELD
SCALE: N.T.S.



SECTION B
PHASE
SCALE: N.T.S.

LIST OF ASSEMBLIES (CALLED OUT SEPARATELY)

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T-4FDS	OPGW DEADEND ASSEMBLY - STEEL POLE	2
B	T-4DS	OHSW DEADEND ASSEMBLY - STEEL POLE	1
C	T-BDE6PD	CONDUCTOR DEADEND ASSEMBLY	6
D	TM-EXT-15	EXTENSION LINK ASSEMBLY	6

NOTES:

1. SEE LOAD AND DESIGN DRAWINGS FOR STEEL DESIGN DETAILS.
2. SEE STEEL POLE MANUFACTURING DRAWINGS FOR STEEL POLE DETAILS.
3. STATIC/CONDUCTOR ASSEMBLIES ARE SEPARATE UNITS.
4. BLUE ASSEMBLIES ARE CALLED OUT IN THE WEST RAPID CITY 230 KV TRANSMISSION LINE.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
69KV SINGLE CIRCUIT UNDERBUILD DEADEND
NON-TYPICAL

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: SCUBDE-M2

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 2
69KV TRANSMISSION LINE

STRUCTURE DETAILS
69KV SINGLE CIRCUIT UNDERBUILD DEADEND
STR 2B

0 1" 2"

FILENAME: BHE-SD-01-D-1.DWG
SCALE: 3/16"=1'-0"
SHEET: SD-01-1

LIST OF MATERIALS

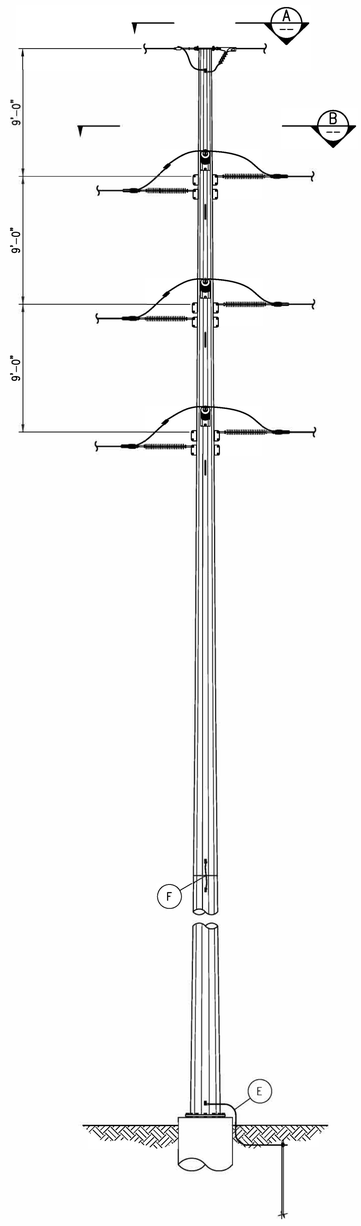
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY.
1	N.S.	ROD, FULL THREADED, 7/8" X REQ'D LENGTH, W/ SQUARE NUTS	D170	HUGHES	–	6
2	22-7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	12
3	N.S.	WASHER, SQUARE, 4" X 1/4", 15/16" HOLE	W322	HUGHES	SW4-80	6

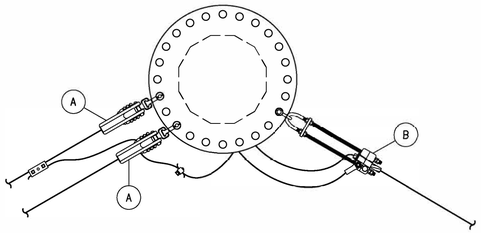
NOTES:

1. POLE GROUNDS AND STATIC/CONDUCTOR ASSEMBLIES ARE CALLED OUT SEPARATELY.

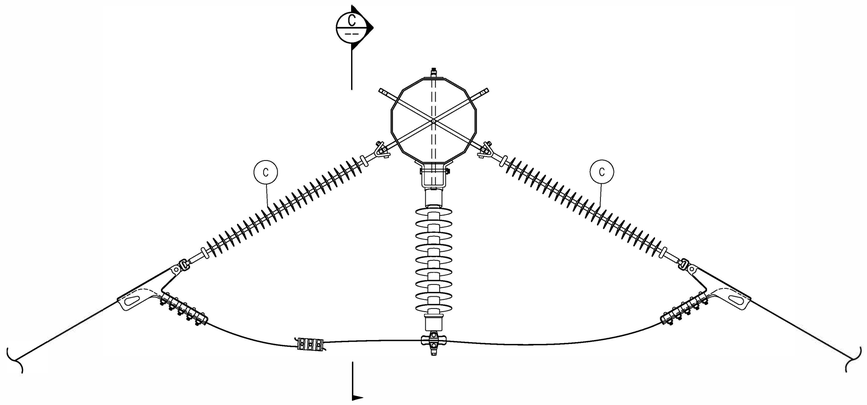
TYPICAL ADDITIONAL ASSEMBLIES (CALLED OUT SEPARATELY)

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T-4DS	SHIELD DEADEND ASSEMBLY	2
B	T-4FDS	OPGW DEADEND ASSEMBLY	1
C	T-BDE6PD	CONDUCTOR DEADEND ASSEMBLY	6
D	T-SP1	CONDUCTOR JUMPER ASSEMBLY	3
E	TM-9ST	GROUNDING ASSEMBLY	1
F	TM-9SSJ	STEEL POLE SLIP JOINT GROUNDING	1

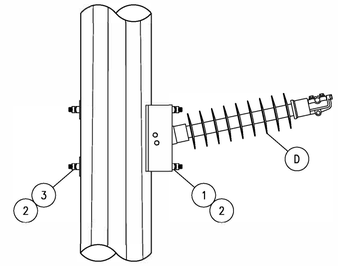




VIEW A
SHIELD
SCALE: N.T.S.



SECTION B
PHASE
SCALE: N.T.S.



VIEW C
JUMPER POST
SCALE: N.T.S.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
69kV SINGLE CIRCUIT DEADEND ON STEEL POLE
NON-TYPICAL

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: SCDE-ST-M4

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 2
69KV TRANSMISSION LINE

STRUCTURE DETAILS
69KV SINGLE CIRCUIT DEADEND
STEEL POLE
STR 2B-1

0 1" 2"

FILENAME: BHE-SD-02-D-1.DWG
SCALE: 3/16"=1'-0"
SHEET: **SD-02-1**

LIST OF PARTS

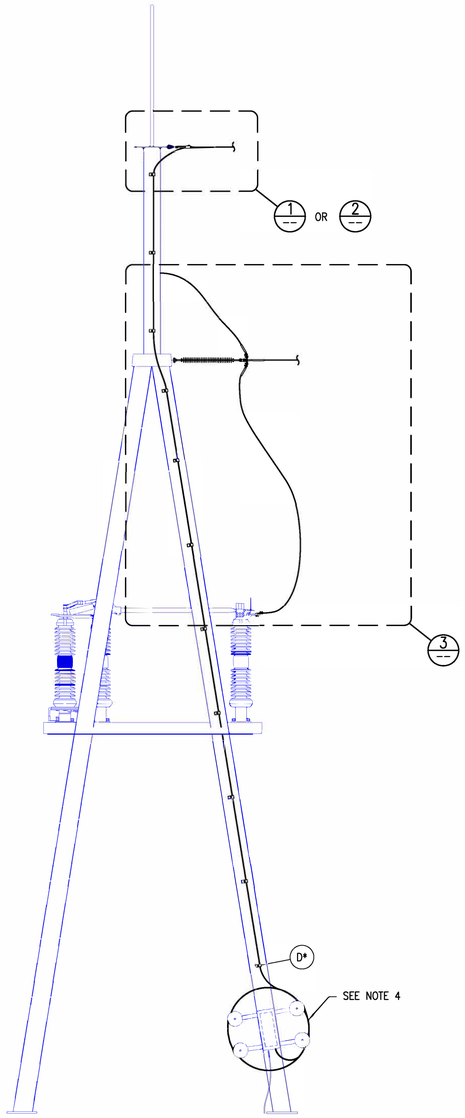
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	CLAMP, SINGLE BOLT, #4 STR CU TO 4/0 AWG STR. CU	Q551	HUBBELL	LC1602	1
2	N.S.	CLAMP, VISE TYPE, 3/8" EHS TO 4/0 AWG STR CU	Q552	HUBBELL	GA9040L55	1

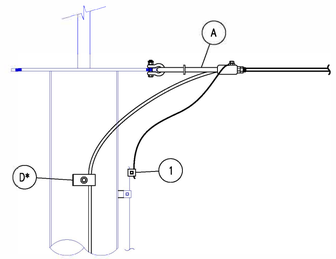
TYPICAL ADDITIONAL ASSEMBLIES (CALLED OUT SEPARATELY)

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T-4FDS	OPGW DEADEND ASSEMBLY - STEEL POLE	1
B	T-4D	OHSW DEADEND ASSEMBLY	1
C	T-SDE6PD	CONDUCTOR SUBSTATION DEADEND ASSEMBLY	3
D*	N/A	DOWNLEAD CLAMPS	AS REQ'D

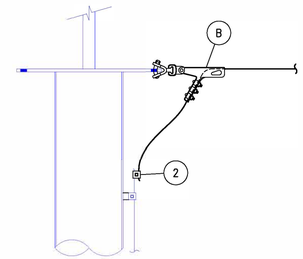
NOTES:

1. BLUE ASSEMBLIES ARE SUPPLIED AND INSTALLED BY THE SUBSTATION CONTRACTOR.
2. (*) ITEMS ARE SUPPLIED BY THE SUBSTATION CONTRACTOR AND INSTALLED BY THE TRANSMISSION CONTRACTOR.
3. MINIMUM BEND RADIUS FOR OPGW IS 9 INCHES.
4. COIL 50 FEET OF OPGW ON THE COIL BRACKET, CAP AND TAPE THE ENDS.
5. COORDINATE WITH SUBSTATION CONTRACTOR FOR PARTS SUPPLIED BY SUBSTATION.

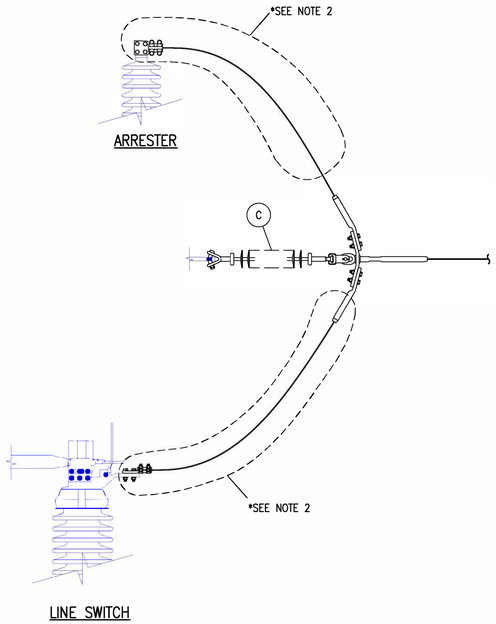




DETAIL 1
OPGW
SCALE: N.T.S.



DETAIL 2
OHSW
SCALE: N.T.S.



LINE SWITCH

DETAIL 3
PHASE
SCALE: N.T.S.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
SUBSTATION DEADEND TOWER CONNECTION

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: DT-01-69

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 2
69KV TRANSMISSION LINE

STRUCTURE DETAILS
SUBSTATION DEADEND TOWER CONNECTION

0 1" 2"

FILENAME: BHE-SD-03-D-1.DWG
SCALE: 3/16"=1'-0"
SHEET: **SD-03-1**

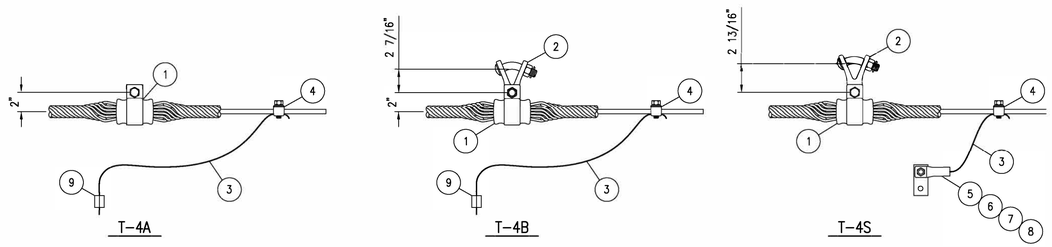
1 2 3 4 5 6 7 8

D C B A

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4A QTY	T-4B QTY	T-4S QTY
1	40-7104	AGS SUSPENSION ASSY, 15K, 3/8" EHS	K400	PREFORMED	AGS-7104	1	1	1
2	48-5207	Y-CLEVIS - EYE, 90, 20K	H901	ANDERSON	YCS-05-90		1	1
3	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			2'	2'	6'
4	46-6810	CLAMP, SINGLE BOLT, VISE TYPE, 3/8" EHS TO #2 STR CU	Q550	HUBBELL	GA9020GLSS	1	1	1
5	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012			1
6	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207			1
7	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS			1
8	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD			1
9	36-0002	GROUND CLAMP, #2 STRANDED TO #4 SOLID	Q501	HOMAC	CC24	1	1	

*MAX. LINE ANGLE = 30°



OHSW SUSPENSION
3/8" EHS 7 STRAND GALV.

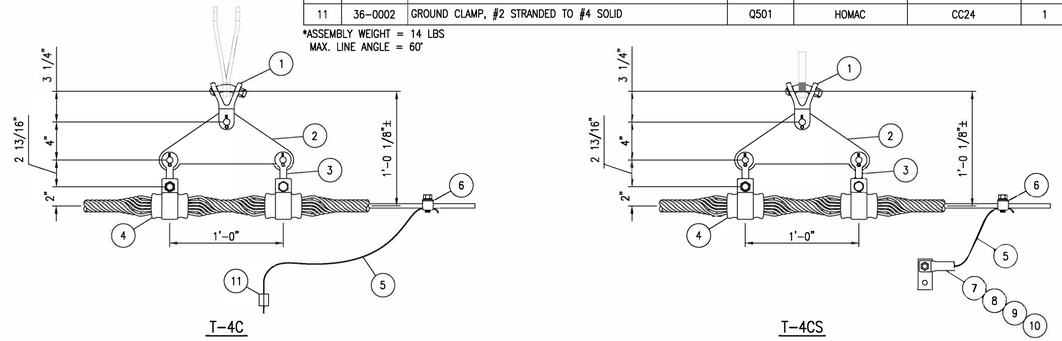
SHEET TITLE
TRANSMISSION ASSEMBLY
OHSW ATTACHMENT

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4A,B,S

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4C QTY	T-4CS QTY
1	48-5208	Y-CLEVIS, CLEVIS, 90, 3 1/4" LONG, 3/4" PIN, 30K	H801	HUBBELL	YCC3090	1	1
2	48-8510	AGS YOKE PLATE, 12" SPACING, 1/2" PLATE, 30K	H700	PREFORMED	YP-5907	1	1
3	48-5206	Y-CLEVIS, EYE, 20K	H900	ANDERSON	YCS-05	2	2
4	40-7804	AGS DOUBLE SUSPENSION ASSEMBLY, 15K, 3/8" EHS	K401	PREFORMED	AGS-7804	1	1
5	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			2'	6'
6	46-6810	CLAMP, SINGLE BOLT, VISE TYPE, 3/8" EHS TO #2 STR CU	Q550	HUBBELL	GA9020GLSS	1	1
7	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012		1
8	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207		1
9	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS		1
10	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD		1
11	36-0002	GROUND CLAMP, #2 STRANDED TO #4 SOLID	Q501	HOMAC	CC24	1	

*ASSEMBLY WEIGHT = 14 LBS
MAX. LINE ANGLE = 60°



OHSW DOUBLE SUSPENSION
3/8" EHS 7 STRAND GALV.

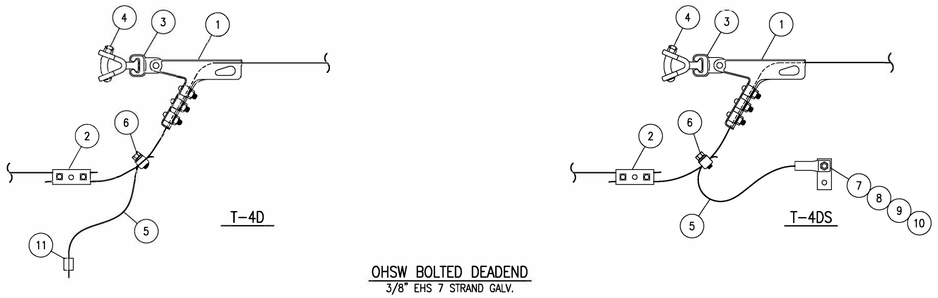
SHEET TITLE
TRANSMISSION ASSEMBLY
OHSW DOUBLE SUSPENSION

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4C

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4D QTY	T-4DS QTY
1	44-4053	STRAIN CLAMP, DE, 20K, 3/8" EHS	L300	HUBBELL	SWDE55N	1	1
2	18-5816	CLAMP, 3-BOLT, 6" LONG, 5/8" BOLT, 5/16" - 1/2" RANGE	Q100	MACLEAN	J931	1	1
3	N.S.	SOCKET EYE, 18K, 1/2" WIDTH, 11/16" HOLE, 2-1/16" LENGTH	H102	HUBBELL	SA04	1	1
4	48-3054	Y-CLEVIS BALL, 30K	H500	HUBBELL	YBC30	1	1
5	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			2'	6'
6	46-6810	CLAMP, SINGLE BOLT, VISE TYPE, 3/8" EHS TO #2 STR CU	Q550	HUBBELL	GA9020GLSS	1	1
7	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012		1
8	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207		1
9	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS		1
10	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD		1
11	36-0002	GROUND CLAMP, #2 STRANDED TO #4 SOLID	Q501	HOMAC	CC24	1	

*ONE ITEM (2) WILL BE REQUIRED FOR EVERY TWO ASSEMBLIES



OHSW BOLTED DEADEND
3/8" EHS 7 STRAND GALV.

SHEET TITLE
TRANSMISSION ASSEMBLY
OHSW DEADEND

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4D(S)

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 2
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
OHSW ASSEMBLIES

0 1" 2"

FILENAME BHE-AD-01-D-1.DWG
SCALE N.T.S.

SHEET
AD-01-1

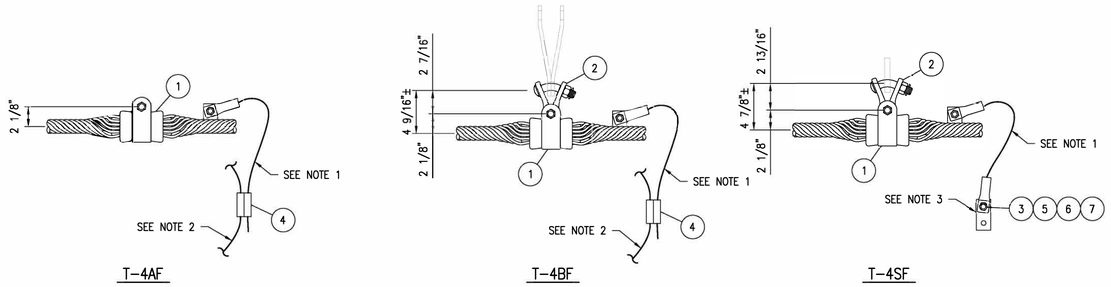
NOTES:

1. #4 STRANDED COPPER WITH CONNECTOR AND BOLTS. FURNISHED WITH ITEM 1.
2. WOOD POLE GROUND.
3. STEEL POLE NEMA PAD.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4AF QTY	T-4BF QTY	T-4SF QTY
1	N.S.	FIBERLIGN SUSPENSION ASSY, W/ GROUNDWIRE	J200	PREFORMED	4300104G	1	1	1
2	48-5207	Y-CLEVIS - EYE, 90, 20K	H901	ANDERSON	YCS-05-90		1	1
3	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012			1
4	N.S.	CONNECTOR, COMPRESSION #4 COPPER TO #4 COPPER	Q500	HOMAC	CC44	1	1	
5	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207			1
6	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS			1
7	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD			1

*MAX. LINE ANGLE = 30°



T-4AF T-4BF T-4SF

OPGW SUSPENSION
0.443" OPGW CABLE

SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW ATTACHMENT

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4F

NOTES:

1. #4 STRANDED COPPER WITH CONNECTOR AND BOLTS. FURNISHED WITH ITEM 1.
2. WOOD POLE GROUND.
3. STEEL POLE NEMA PAD.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4FDW QTY	T-4FDS QTY
1	N.S.	FIBER OPTIC DEADEND, 18" U-BOLT (48 FIBER), W/GROUNDWIRE	J300	PREFORMED	2801303G	1	1
2	N.S.	ANCHOR, SHACKLE, 3" LONG, 3/4" DIA., 7/8" DIA. PIN, 35K LBS	H602	HUGHES	2865-B3	1	1
3	N.S.	CONNECTOR, COMPRESSION #4 COPPER TO #4 COPPER	Q500	HOMAC	CC44	1	
4	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012		1
5	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207		1
6	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS		1
7	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD		1



T-4FDW T-4FDS

OPGW DEADEND
0.443" OPGW CABLE

SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW DEADEND

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4FD

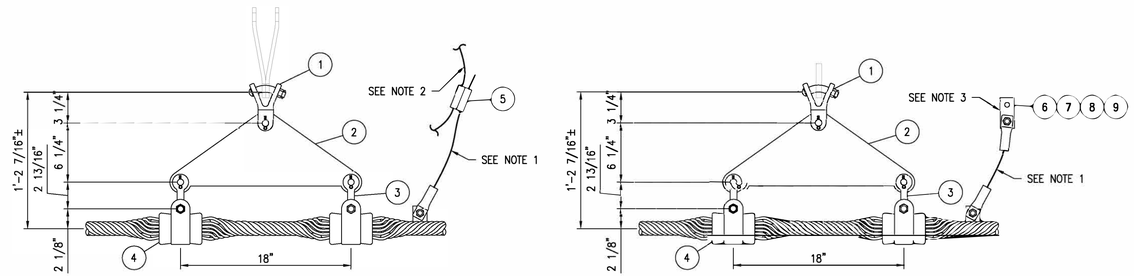
NOTES:

1. #4 STRANDED COPPER WITH CONNECTOR AND BOLTS. FURNISHED WITH ITEM 1.
2. WOOD POLE GROUND.
3. STEEL POLE NEMA PAD.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4FC QTY	T-4FCS QTY
1	48-5208	Y-CLEVIS, CLEVIS, 90, 3 1/4" LONG, 3/4" PIN, 30K	H801	HUBBELL	YCC3090	1	
2	48-8510	AGS YOKE PLATE, 18" SPACING, 1/2" PLATE, 30K	H702	HUGHES	AS2585-Z	1	1
3	48-5206	Y-CLEVIS, EYE, 20K	H900	ANDERSON	YCS-05	2	2
4	N.S.	FIBERLIGN DOUBLE SUSPENSION ASSY, W/ GROUNDWIRE	J201	PREFORMED	4300204G	1	1
5	N.S.	CONNECTOR, COMPRESSION #4 COPPER TO #4 COPPER	Q500	HOMAC	CC44	1	
6	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012		1
7	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207		1
8	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS		1
9	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD		1

*MAX. LINE ANGLE = 60°



T-4FC T-4FCS

OPGW DOUBLE SUSPENSION
0.433" OPGW CABLE

SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW DOUBLE SUSPENSION

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4FC

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 2
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
OPGW ASSEMBLIES

0 1" 2"

FILENAME BHE-AD-02-D-1.DWG
SCALE N.T.S.

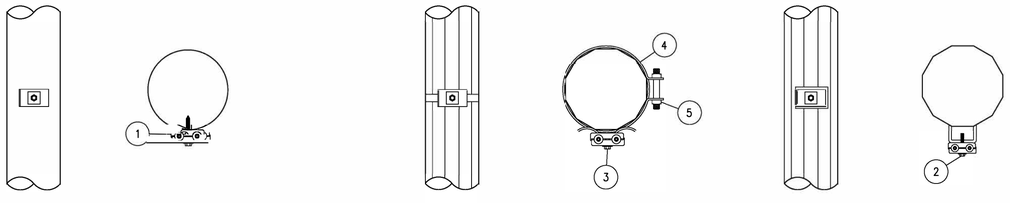
SHEET
AD-02-1

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-FDL-W QTY	T-FDL-S1 QTY	T-FDL-S2 QTY
1	N.S.	DOWNLEAD CUSHION KIT 0.443 OPGW W/ HARDWARE FOR WOOD POLE	J401	PREFORMED	8003041-H1	1	–	–
2	N.S.	DOWNLEAD CUSHION KIT, 0.443" OPGW W/ 1/2" -13 X 3" MOUNTING KIT	J403	PREFORMED	8003041-H3	–	–	1
3	N.S.	DOWNLEAD CUSHION KIT, 0.443" OPGW W/ BANDING BRACKET	J402	PREFORMED	8003041-B1	–	1	–
4	N.S.	BOLT-A-BAND, 3/4" X REQ'D LENGTH	J950	ALUMA-FORM	3/4-201-SSB-100	–	10'	–
5	N.S.	BUCKLE, BANDING, FOR 3/4" BANDING	J951	ALUMA-FORM	BAB-38	–	1	–

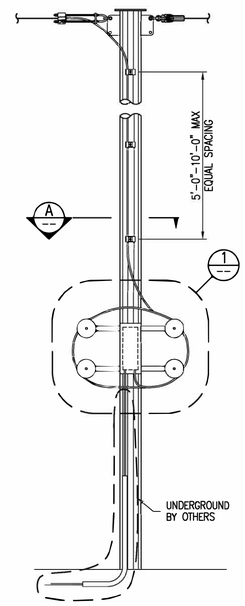
NOTES:

1. OPGW CONTINUOUS TO SPLICE BOX.
2. UNIT CONSISTS OF ONE DOWNLEAD CUSHION INSTALLED. SPECIFIC QUANTITY REQUIRED WILL VARY WITH STRUCTURE HEIGHT.



SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW DOWNLEAD

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-FDL

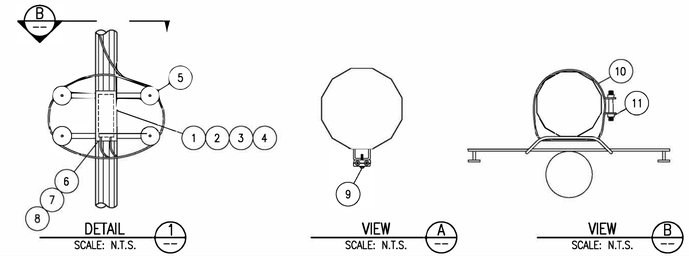


LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	6" X 22" COYOTE CLOSURE KIT W/ 6 PORT END PLATE	J510	PREFORMED	8006659	1
2	N.S.	SPLICE TRAY KIT, 36 COUNT TRAY	J600	PREFORMED	80805514	2
3	N.S.	VERTICAL MOUNTING BRACKET KIT	J502	PREFORMED	8003472	1
4	N.S.	COYOTE DEFENDER FOR 6"X 22" CLOSURE	J511	PREFORMED	8003492	1
5	N.S.	VERTICAL CABLE STORAGE ASSEMBLY	J501	PREFORMED	8003569	1
6	N.S.	CLOSURE END PLATE GROMMETS, 7/8" PORT, 0.443" OPGW	J700	PREFORMED	8003597	1
7	N.S.	FUTURE CABLE PORT KIT, 7/8" PORT	J720	PREFORMED	8003371	3
8	N.S.	GROMMET PLUG, 3/4" PORT, QTY 2	J730	PREFORMED	80806037	1
9	N.S.	DOWNLEAD CUSHION KIT, 0.443 OPGW W/ 1/2"-13 X 3" MOUNTING KIT	J403	PREFORMED	8003041-H3	14
10	N.S.	BOLT-A-BAND, 3/4" X REQ'D LENGTH	J950	ALUMA-FORM	3/4-201-SSB-100	40'
11	N.S.	BUCKLE, BANDING, FOR 3/4" BANDING	J951	ALUMA-FORM	BAB-38	2

NOTES:

1. OPGW CONTINUOUS TO SPLICE BOX.
2. COIL 50 FEET OF OPGW AROUND COIL BRACKET ON DOWNLEAD.



SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW SPLICE CASE - SINGLE OPGW
STEEL POLE

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-FSCS-1

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 2
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
OPGW SPLICE DETAILS

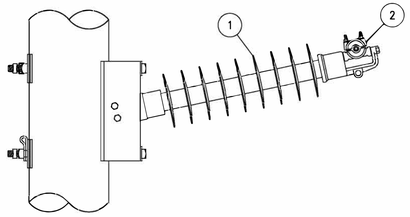
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SCALE N.T.S.

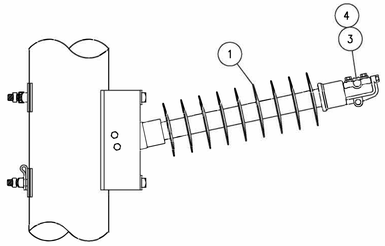
SHEET
AD-03-1

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-SP QTY	T-SP1 QTY
1	N.S.	INSULATOR, HORIZONTAL POST, CLAMPTOP, 69KV	I250	HUBBELL	P250043S1020	1	1
2	N.S.	AGS SUPPORT ASSEMBLY, 795 KCMIL 45/7 ACSR "TERN"	K350	PREFORMED	AGS-5227	1	–
3	48-7020	CLAMP, TRUNNION, 795 KCMIL 45/7 ACSR "TERN", 2,800 LBS	K300	HUBBELL	TSC150	–	1
4	N.S.	INHIBITOR, RUST (NO-OX-ID), 1 PT CAN, GRADE "A"	O102	SANCHEM INC	NO-OX-ID "A" SPECIAL	–	0.06



CONDUCTOR SUPPORT T-SP
795 ACSR-45/7 "TERN"



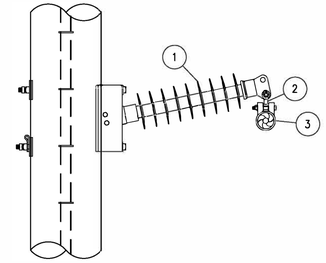
JUMPER SUPPORT T-SP1
795 ACSR-45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
69kV HORIZONTAL CLAMPTOP
795 ACSR - 45/7 "TERN"

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-SP(1)

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	INSULATOR, HORIZONTAL POST, DROP TONGUE, 69KV	I220	HUBBELL	P250043S0020	1
2	48-3053	Y-CLEVIS, EYE, 90, 40K	H902	HUBBELL	YCS-06-90-40	1
3	40-5114	AGS SUPSENSION ASSEMBLY, 25K, 795 ACSR-45/7 "TERN"	K500	PREFORMED	AGS-5128	1



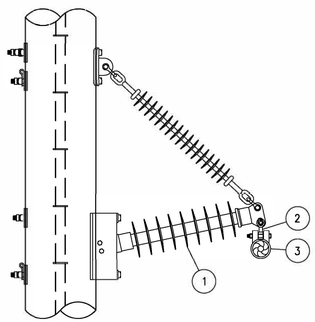
69kV HORIZONTAL POST
795 ACSR-45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
69kV HORIZONTAL POST
795 ACSR - 45/7 "TERN"

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-PSD

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	INSULATOR, HORIZONTAL BRACED POST ASSEMBLY, 69KV	I200	HUBBELL	BLP043G12000	1
2	48-3053	Y-CLEVIS, EYE, 90, 40K	H902	HUBBELL	YCS-06-90-40	1
3	40-5114	AGS SUPSENSION ASSEMBLY, 25K, 795 ACSR-45/7 "TERN"	K500	PREFORMED	AGS-5128	1



69kV BRACED POST ASSEMBLY
795 ACSR-45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
69kV BRACED POST ASSEMBLY
795 ACSR - 45/7 "TERN"

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-BPD

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 2
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
POST INSULATOR ASSEMBLIES
795 KCMIL 45/7 ACSR "TERN"

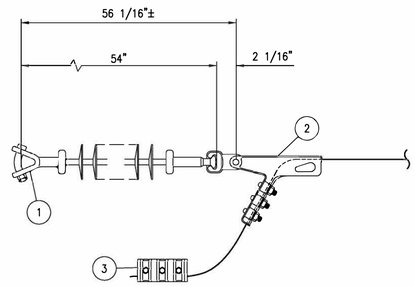
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FILENAME BHE-AD-04-D-1.DWG
SCALE N.T.S.

SHEET
AD-04-1

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48-6927	INSULATOR, DEADEND, Y-CLEVIS BALL, 54" LENGTH, 25K	I300	MACLEAN	S14080042MXAL027	1
2	42-1120	STRAIN CLAMP, DEADEND W/ SOCKET-EYE, 30K, 0.50 - 1.20 RANGE	L101	HUBBELL	SD112S	1
3	42-0483	PARALLEL GROOVE CONNECTOR, 0.743 - 1.152 RANGE	Q601	AFL	483.3P	1

*ONE ITEM (3) WILL BE REQUIRED FOR EVERY TWO ASSEMBLIES

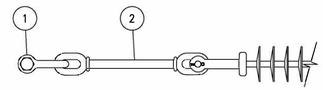


CONDUCTOR BOLTED DEADEND
795 ACSR-45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
CONDUCTOR BOLTED DEADEND
POLYMER

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-BDE6PD

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	ANCHOR SHACKLE, 3.5" LONG, 7/8" DIA, 3/4" PIN, 60K LBS	H603	HUBBELL	AS50BNK	1
2	N.S.	HOT LINK EXTENSION, CHAIN EYE - CHAIN EYE, 15" LONG, 30K LBS	H400	HUBBELL	H003015	1



TM-EXT-15
15" EXTENSION LINK

SHEET TITLE
TRANSMISSION ASSEMBLY
15" EXTENSION LINK

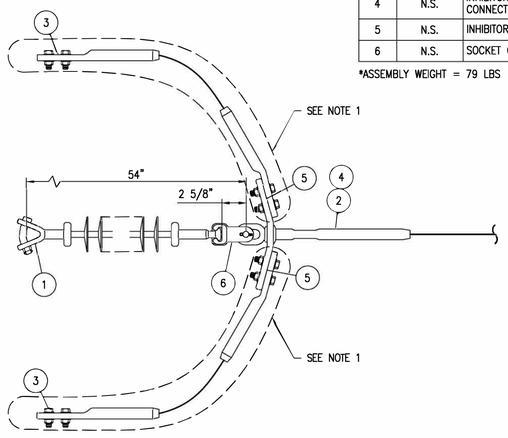
REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TM-EXT-15

NOTE:

1. JUMPERS AND TERMINALS SUPPLIED BY SUBSTATION, INSTALLED BY TRANSMISSION. SEE WEST RAPID CITY SUBSTATION REFERENCE SHEETS IN APPENDIX.

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48-6927	INSULATOR, DEADEND, Y-CLEVIS BALL, 54" LENGTH, 25K	I300	MACLEAN	S14080042MXAL027	1
2	42-8230	COMPRESSION DEADEND ASSY, DOUBLE TONGUE, W/ 15' TERMINAL "TERN"	L502	AFL	VED-123	1
3	N.S.	BOLT, NUT, BELLEVILLE, FLAT, STAINLESS STEEL ASSEMBLY	B606	CMC	SBA20-50	8
4	N.S.	INHIBITOR, FILLER COMPOUND, GRITTED, COMPRESSION CONNECTIONS, 8 oz.	O100	HUBBELL	VSG8B	1.5
5	N.S.	INHIBITOR, FILLER COMPOUND, NON-GRITTED, PAD TO PAD, 8 OZ	O101	HUBBELL	VS8B	0.6
6	N.S.	SOCKET CLEVIS, 30K	H200	HUBBELL	SC30	1

*ASSEMBLY WEIGHT = 79 LBS



CONDUCTOR SUBSTATION DEADEND
795 ACSR-45/7 "TERN"

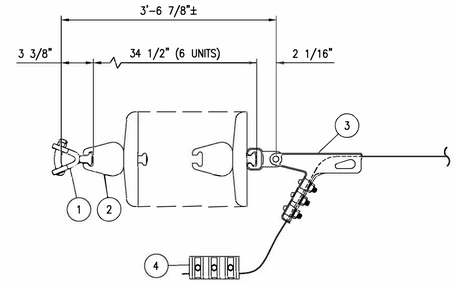
SHEET TITLE
TRANSMISSION ASSEMBLY
CONDUCTOR SUBSTATION DEADEND
POLYMER

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-SDE6PD

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48-3054	Y-CLEVIS, BALL, 30K	H500	HUBBELL	YBC30	1
2	N.S.	GLASS INSULATOR, 30K LB, M&E, ANSI CL 52-5, 10" X 5 3/4"	I102	SEDIVER	N14/146	6
3	42-1120	STRAIN CLAMP, DEADEND W/ SOCKET-EYE, 30K, 0.50 - 1.20 RANGE	L101	HUBBELL	SD112S	1
4	42-0483	PARALLEL GROOVE CONNECTOR, 0.743 - 1.152 RANGE	Q601	AFL	483.3P	1

*ONE ITEM (4) WILL BE REQUIRED FOR EVERY TWO ASSEMBLIES

ASSEMBLY WEIGHT = 75 LBS



CONDUCTOR BOLTED DEADEND
795 ACSR-45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
CONDUCTOR BOLTED DEADEND

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-BDE6D

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 2
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
DEADEND INSULATOR ASSEMBLIES
795 KCMIL 45/7 ACSR "TERN"

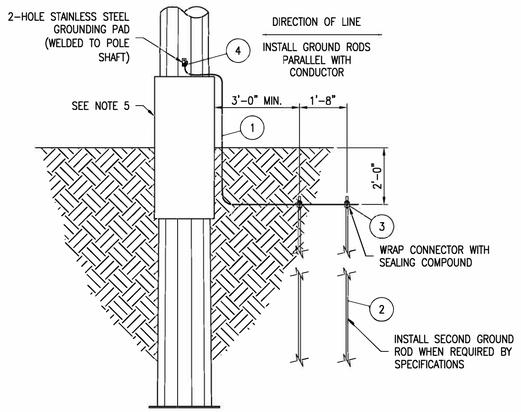
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FILENAME BHE-AD-05-D-1.DWG
SCALE N.T.S.

SHEET
AD-05-1

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			10'
2	46-0588	ROD, GROUND, 5/8" X 8'-0", COPPERCLAD	P500	GALVAN	6260G13	1
3	46-0058	CLAMP, GROUND ROD, 0.128 TO 0.460 RANGE, 5/8" ROD	P701	CHANCE	C2030344	1
4	N.S.	CLAMP, VISE TYPE, LIGHTNING ARRESTOR GROUND, #2 STRANDED	P820	HUBBELL	GC207	1



STEEL POLE GROUNDING DETAIL
SCALE: N.T.S.

SPECIFICATIONS FOR DRIVEN GROUND ROD INSTALLATION:

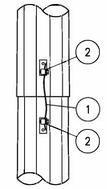
1. INSTALL 8'-0" OF GROUND ROD AND TEST THE RESISTANCE LEVEL. WHEN RESISTANCE IS 25Ω OR LESS, NO ADDITIONAL STEPS ARE NEEDED.
2. IF RESISTANCE IS 25Ω OR GREATER, INSTALL AN ADDITIONAL 8'-0" OF GROUND ROD AS SHOWN:
   - TEST RESISTANCE WITH 1ST ROD CONNECTED TO 2ND ROD WITH #2 CU FOR COMBINED PARALLEL RESISTANCE VALUE. RECORD RESISTANCE VALUE.
3. AFTER DRIVING TWO (2) GROUND RODS AS NOTED ABOVE AND THE COMBINED RESISTANCE IS 25Ω OR GREATER, THE ELECTRICAL ENGINEERING DEPARTMENT SHOULD BE CONSULTED FOR FURTHER ACTION.
4. BOND STATIC WIRE TO POLE GROUND, USE FARGO CONNECTOR (ITEM #5).
5. GROUNDING THE SAME FOR STEEL POLE ON CONCRETE PIER FOUNDATIONS.

SHEET TITLE: **TRANSMISSION ASSEMBLY**
STEEL POLE GROUNDING

REFERENCE SHEET: **1 OF 1**
EXHIBIT NUMBER: **TM-9ST**

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			4'
2	N.S.	CLAMP, VISE TYPE, LIGHTNING ARRESTOR GROUND, #2 STRANDED	P820	HUBBELL	GC207	2



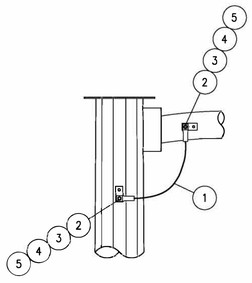
TM-9SSJ
SLIP JOINT
SCALE: N.T.S.

SHEET TITLE: **TRANSMISSION ASSEMBLY**
STEEL POLE SLIP JOINT GROUNDING

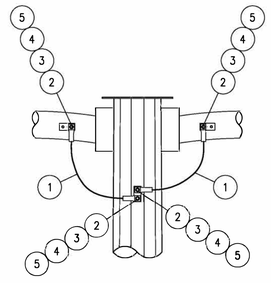
REFERENCE SHEET: **1 OF 1**
EXHIBIT NUMBER: **TM-9SSJ**

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	9SD-1	9SD-2
1	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			5'	10'
2	N.S.	COMPRESSION TERMINAL, COPPER, #6 – 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012	2	4
3	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207	2	4
4	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS	2	4
5	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD	2	4



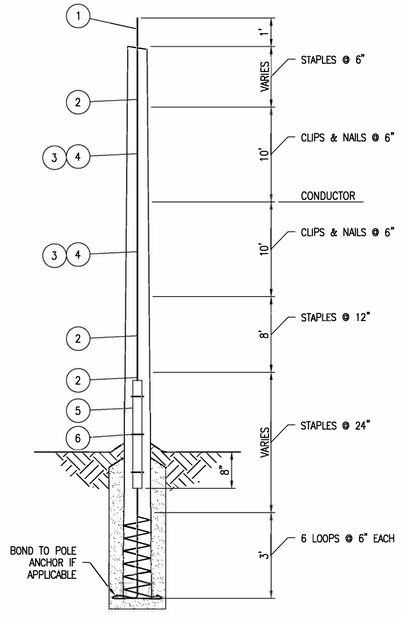
TM-9SD-1
SINGLE DAVIT GROUNDING
SCALE: N.T.S.



TM-9SD-2
DOUBLE DAVIT GROUNDING
SCALE: N.T.S.

SHEET TITLE: **TRANSMISSION ASSEMBLY**
STEEL POLE DAVIT ARM GROUNDING

REFERENCE SHEET: **1 OF 1**
EXHIBIT NUMBER: **TM-9SD**



LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	36-4000	GROUNDWIRE, #4CU SD, 40% CONDUCTIVITY	C901			125'
2	46-7494	STAPLE, CUT (SLASH) 1 1/2" X 3/8" CU-COATED, BARBED	P600	MACLEAN	J7682	50
3	46-7460	NAIL, 10D, CU-COATED	P150	MACLEAN	J7260	40
4	46-2729	CLIP, CU-COATED	P151	KEARNEY	5730-1	40
5	46-2503	WOOD MOULDING, 1-11/16" X 8'	P300	HUGHES	2503.8	1
6	46-2504	MOULDING STAPLES, 1-3/4" X 3-1/2"	P400	HUBBELL	C2050222	3

NOTES:

1. BOND ALL POLE HARDWARE TO POLE GROUND. USE BONDING CLIP.
2. ON 230/69kV CONSTRUCTION, BOND ALL 69kV HARDWARE.
3. GROUND WIRE SHALL BE INSTALLED FOR THE FULL LENGTH OF EACH POLE, ACROSS THE BOTTOM, AND BACK UP IN WRAP TURNS AS SHOWN. STAPLE THE WRAPS AT EACH INTERSECTION OF THE DOWNLEAD, AND EVERY 12" FOR THE LENGTH OF THE WRAPS.
4. THIS UNIT INCLUDES THE MEASURE AND RECORDING OF EACH POLE'S FOOTING RESISTANCE, AFTER POLE SETTING IS COMPLETED AND BEFORE INSTALLING THE OHSW.
5. FOR FOOTING RESISTANCES GREATER THAN 15 OHMS, GROUNDING CONNECTIONS SHALL BE USED TO BOND TOGETHER THE GROUND WIRES OF EACH POLE AND GUY ANCHORS IF APPLICABLE.
6. IF THE FOOTING RESISTANCE READS GREATER THAN 15 OHMS AFTER INSTALLATION PROCEDURES PER NOTE 5, CONTRACTOR SHALL NOTIFY THE ENGINEER FOR FURTHER GROUNDING INSTRUCTIONS.
7. BOND STATIC WIRE TO POLE GROUND, USE FARGO CONNECTOR. (ITEM #5)
8. SEE INDIVIDUAL STRUCTURE DRAWINGS FOR REMAINING DIMENSIONS.

SHEET TITLE: **TRANSMISSION ASSEMBLY**
WOOD POLE GROUNDING

REFERENCE SHEET: **1 OF 1**
EXHIBIT NUMBER: **TM-9**

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 2
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
GROUNDING ASSEMBLIES

0 1" 2"

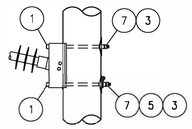
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SCALE: N.T.S.

SHEET: **AD-06-1**

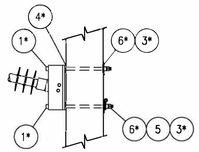
LIST OF MATERIAL

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	1A	1B	1C	1D
1	N.S.	BOLT, MACHINE, 7/8" X REQ'D LENGTH	B270			2	2*	2	–
2	N.S.	ROD, FULL THREADED, 7/8" X REQ'D LENGTH, W/ 4 NUTS	D170			–	–	–	2
3	22–7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	2	2*	2	4
4	N.S.	POLE SHIM, GAIN BASE TO FLAT	V400	N/A	N/A	–	1*	–	–
5	N.S.	WASHER, SPRING, 15/16" HOLE	W207	HUGHES	2702.8	1	1	–	–
6	N.S.	WASHER, SQUARE, 4" X 1/4", 15/16" HOLE	W322	HUGHES	SW4–80	–	2*	2	2
7	22–4425	WASHER, SQ. CURVED, 4" X 1/4", 15/16" HOLE	W504	HUGHES	SCW4–80	2	–	–	–

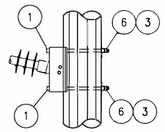
(*) DENOTES MATERIAL SUPPLIED BY LAMINATED POLE MANUFACTURER



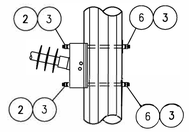
TD–1A
ROUND WOOD POLE ASSEMBLY
SCALE: N.T.S.



TD–1B
LAMINATED POLE ASSEMBLY
SCALE: N.T.S.



TD–1C
STEEL POLE ASSEMBLY
SCALE: N.T.S.



TD–1D
LARGE STEEL POLE ASSEMBLY
SCALE: N.T.S.

NOTES:

1. STRENGTH LIMITATIONS OF 7/8" BOLTS.
   A. SINGLE SHEAR THROUGH THREADS 17,270 LBS.
   B. SINGLE SHEAR THROUGH SHAFT 24,350 LBS.
   C. MINIMUM TENSILE STRENGTH 25,400 LBS.

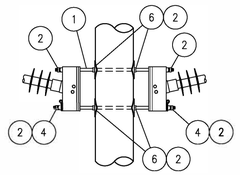
SHEET TITLE
TRANSMISSION ASSEMBLY
SINGLE INSULATOR BASE TO POLE ASSEMBLY

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TD-1

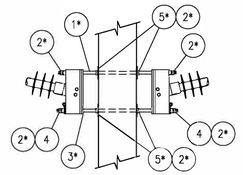
LIST OF MATERIAL

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	2A	2B	2C
1	N.S.	ROD, FULL THREADED, 7/8" X REQ'D LENGTH, W/ 4 NUTS	D170			2	2*	2
2	22–7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	8	8*	8
3	N.S.	POLE SHIM, GAIN BASE TO FLAT	V400	N/A	N/A	–	2*	–
4	N.S.	WASHER, SPRING, 15/16" HOLE	W207	HUGHES	2702.8	2	2	–
5	N.S.	WASHER, SQUARE, 4" X 1/4", 15/16" HOLE	W322	HUGHES	SW4–80	–	4*	4
6	22–4425	WASHER, SQ. CURVED, 4" X 1/4", 15/16" HOLE	W504	HUGHES	SCW4–80	4	–	–

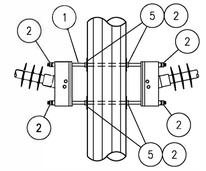
(*) DENOTES MATERIAL SUPPLIED BY LAMINATED POLE MANUFACTURER



TD–2A
ROUND WOOD POLE ASSEMBLY
SCALE: N.T.S.



TD–2B
LAMINATED POLE ASSEMBLY
SCALE: N.T.S.



TD–2C
STEEL POLE ASSEMBLY
SCALE: N.T.S.

NOTES:

1. STRENGTH LIMITATIONS OF 7/8" BOLTS.
   A. SINGLE SHEAR THROUGH THREADS 17,270 LBS.
   B. SINGLE SHEAR THROUGH SHAFT 24,350 LBS.
   C. MINIMUM TENSILE STRENGTH 25,400 LBS.

SHEET TITLE
TRANSMISSION ASSEMBLY
DOUBLE INSULATOR BASE TO POLE ASSEMBLY

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TD-2

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 2
69KV TRANSMISSION LINE

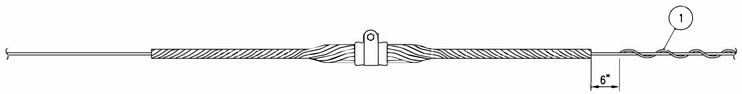
ASSEMBLY DETAILS
INSULATOR BASE TO POLE ASSEMBLIES

0 1" 2"

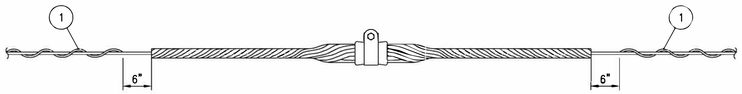
FILENAME BHE–AD–07–D–1.DWG
SCALE N.T.S.

SHEET
AD-07-1

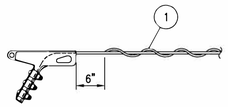
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T1 QTY	2T1 QTY	D1 QTY
1	N.S.	SPIRAL VIBRATION DAMPER, 0.327" – 0.461" RANGE	S110	PREFORMED	5050104	1	2	1



DPR–EHS–T1



DPR–EHS–2T1



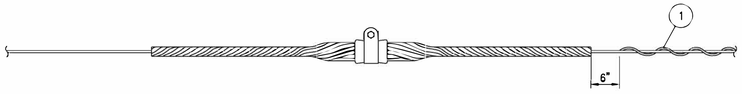
DPR–EHS–D1

SHEET TITLE
TRANSMISSION ASSEMBLY
DAMPER - 3/8" EHS

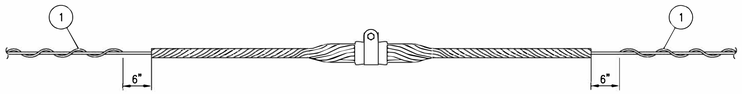
REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
DPR-EHS

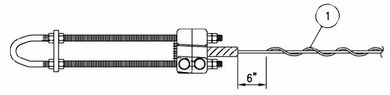
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T1 QTY	2T1 QTY	D1 QTY
1	N.S.	SPIRAL VIBRATION DAMPER, 0.327" – 0.461" RANGE	S110	PREFORMED	5050104	1	2	1



DPR–OPGW–T1



DPR–OPGW–2T1



DPR–OPGW–D1

SHEET TITLE
TRANSMISSION ASSEMBLY
DAMPER - OPGW

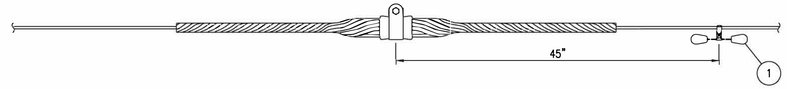
REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
DPR-OPGW

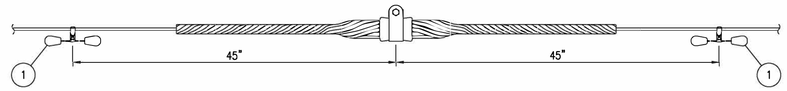
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T1 QTY	2T1 QTY	D1 QTY	D2 QTY
1	N.S.	DAMPER, DOGBONE, 795 ACSR	S150	HUBBELL	60710–12	1	2	1	2

NOTES:

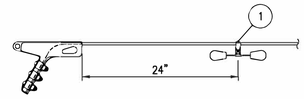
1. FIRST DAMPER AT SUSPENSION SPAN ENDS SHALL BE LOCATED FROM CENTER OF DAMPER CLAMP TO THE SUSPENSION SUPPORT PER REFERENCED DIMENSION.
2. THE ORIENTATION OF THE WEIGHTS ALONG THE CONDUCTOR IS OPTIONAL. (I.E. WHETHER THE LARGE WEIGHT IS TOWARD THE TOWER OR TOWARD THE SPAN. ORIENT THE DAMPER FOR EASY ACCESS TO THE BOLT AND TO OBTAIN VISUAL ASSURANCE OF POSITIVE CONDUCTOR SEATING.
3. FOLLOW MANUFACTURER'S INSTALLATION INSTRUCTIONS IN DELIVERY BOX.
4. SEE SAG TABLES FOR INSTALLATION DIRECTION ON THE LINE.



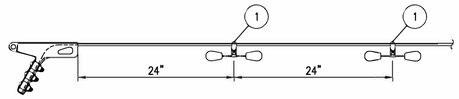
DPR–795–T1



DPR–795–2T1



DPR–795–D1



DPR–795–D2

SHEET TITLE
TRANSMISSION ASSEMBLY
DAMPER - 795 ACSR

REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
DPR-795

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 2
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
DAMPER ASSEMBLIES

0 1" 2"

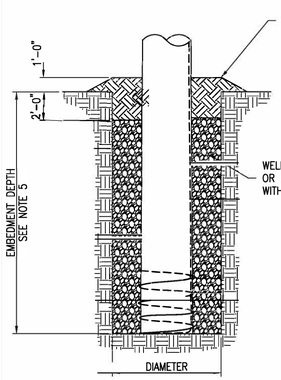
FILENAME BHE–AD–08–D–1.DWG
SCALE N.T.S.

SHEET
AD-08-1

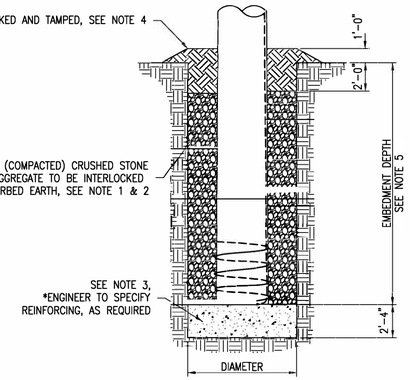
POLE STABILITY FOUNDATION
IMPORTED GRANULAR BACKFILL

POLE HT.–CL.	EMBEDMENT DEPTH (FT)	DIAMETER (FT)	POLE WIDTH (IN)	POLE WEIGHT (LB)	APPROX. QTY. CUBIC YDS. (10% + 4 FT)
60–1	10	4.0*	18.0	–	3.2
70–1	11	4.0*	18.9	–	3.6
80–H1	12	4.0*	20.9	–	3.8
90–H2	13	4.0*	23.2	–	4.0
100–H2	14	4.0*	24.0	–	4.2

(*) HOLE DIAMTER AS NEEDED TO TAMP ALL THE WAY AROUND THE POLE.



TM–101
IMPORTED BACKFILL
SCALE: N.T.S.



TM–103
IMPORTED BACKFILL AND BEARING REINFORCEMENT
SCALE: N.T.S.

GRADATION FOR IMPORTED GRANULAR BACKFILL	
SIZE OF GRAVEL OR CRUSHED STONE	SIZE OF MESH (IN)
100% BY WEIGHT TO PASS 1" SCREEN	1.00
60%–90% BY WEIGHT TO PASS 1/2" SCREEN	0.500
40%–60% BY WEIGHT TO PASS NO. 4 SCREEN	0.187
25%–50% BY WEIGHT TO PASS NO. 8 SCREEN	0.0937
20%–40% BY WEIGHT TO PASS NO. 16 SCREEN	0.0469
15%–30% BY WEIGHT TO PASS NO. 40 SCREEN	0.0165

IMPORTANT

EACH POLE SHALL BE BACKFILLED FROM BOTTOM TO TOP BY ONE LABORER SHOVELING FILL AND TWO OTHERS USING PNEUMATIC TAMPERS.

NOTES:

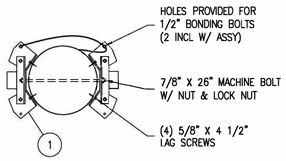
1. GRADATION FOR IMPORTED BACKFILL IS SHOWN IN THE TABLE. THE AGGREGATE SHALL BE WELL MIXED IN A STOCK PILE, AND PNEUMATICALLY PLACED AND TAMPED IN 6–INCH LIFTS.
2. THE SPECIFICATION FOR AGGREGATE GIVEN IN THE TABLE IS MINIMUM. IN AREAS WHERE SMALLER FINES ARE AVAILABLE AT COMPARABLE COST, IT IS RECOMMENDED THAT THE ENGINEER SPECIFY SMALLER FINES.
3. CONCRETE SHALL BE 2000 PSI HIGH EARLY STRENGTH CONCRETE. IT SHALL BE DEPOSITED IN A MANNER WHICH WILL PREVENT SEGREGATION OF THE AGGREGATE AND CEMENT. CARE SHOULD BE TAKEN TO AVOID GETTING DIRT MIXED WITH THE CONCRETE. THE POLE SHALL NOT BE SET UNTIL THE CONCRETE BEARING BASE HAS ATTAINED SUFFICIENT STRENGTH TO SUPPORT THE POLE. DURING THE PLACEMENT OF POLE, AVOID BUMPING CONCRETE BASE.
4. WELL TAMPED NATIVE BACKFILL SHOULD BE PLACED AROUND THE POLE AS SHOWN.
5. SEE STRUCTURE DRAWINGS FOR EMBEDMENT DEPTHS.

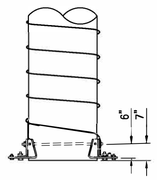
SHEET TITLE
TRANSMISSION ASSEMBLY
POLE STABILITY FOUNDATION

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TM-101 & TM-103

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	18–1895	ANCHOR ASSEMBLY WITH BOLTS; PAIR	F300	HUGHES	A–1895–2	1





SHEET TITLE
TRANSMISSION ASSEMBLY
POLE ANCHOR ASSEMBLY

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TP-A

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

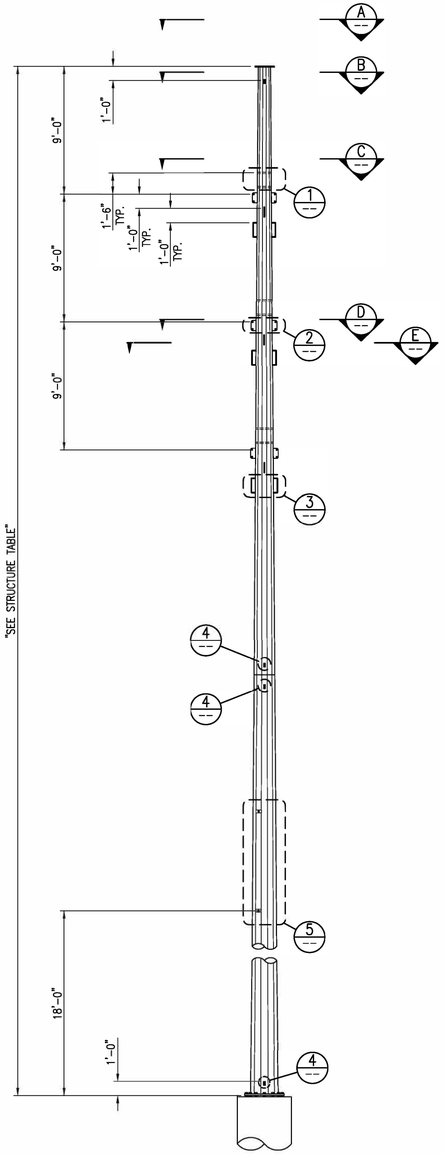
WEST RAPID CITY - BEN FRENCH 2
69KV TRANSMISSION LINE

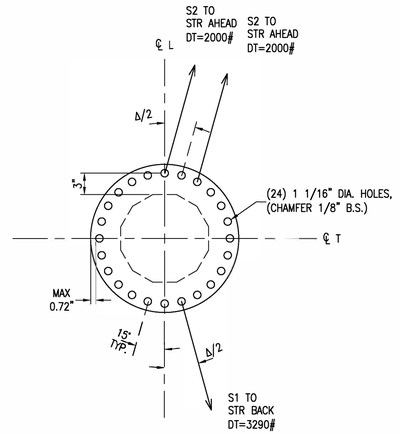
ASSEMBLY DETAILS
POLE STABILITY ASSEMBLIES

0 1" 2"

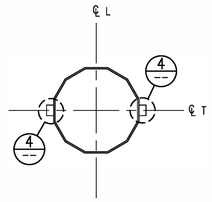
FILENAME BHE–AD–09–D–1.DWG
SCALE N.T.S.

SHEET
AD-09-1

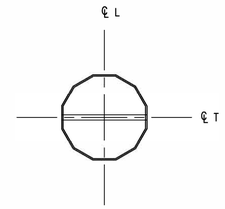




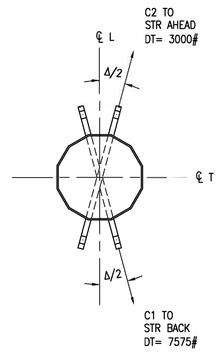
VIEW
SHIELD ORIENTATION
SCALE: N.T.S.
A



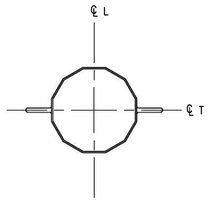
SECTION
SHIELD NEMA PAD ORIENTATION
SCALE: N.T.S.
B



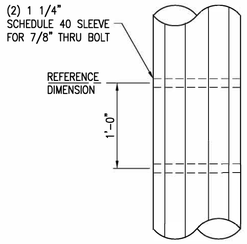
SECTION
JUMPER POST ORIENTATION
SCALE: N.T.S.
C



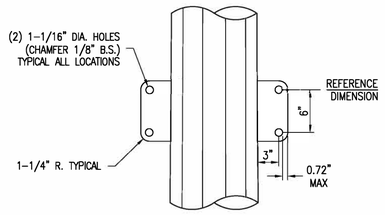
SECTION
CONDUCTOR ORIENTATION
SCALE: N.T.S.
D



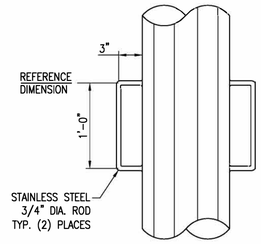
SECTION
GROUND LOOP ORIENTATION
SCALE: N.T.S.
E



DETAIL
JUMPER POST ATTACHMENT
SCALE: N.T.S.
1

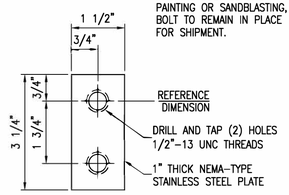


DETAIL
CONDUCTOR VANGS
SCALE: N.T.S.
2

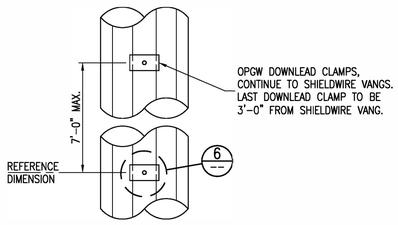


DETAIL
GROUNDING LOOP
SCALE: N.T.S.
3

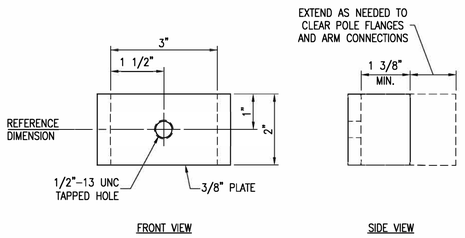
NOTE:
PLUG WITH 1/2"ø X 3/4" MACHINE BOLT BEFORE PAINTING OR SANDBLASTING, BOLT TO REMAIN IN PLACE FOR SHIPMENT.



DETAIL
GROUNDING PAD
SCALE: N.T.S.
4



DETAIL
OPGW BRACKET ATTACHMENT
SCALE: N.T.S.
5



SECTION
OPGW DOWNLEAD
BRACKET
SCALE: N.T.S.
6

GENERAL NOTES

MAXIMUM SHIELD WIRE VANG THICKNESS = 3/4"
MAXIMUM CONDUCTOR VANG THICKNESS = 1"
LOAD TREE VALUES ARE ULTIMATE, INCLUDE OVERLOAD FACTORS, AND ARE SHOWN IN POUNDS.

DESIGN CRITERIA

(S1) SHIELD WIRE IS AFL CC-55/443 "DNO-4748" OPGW, MAXIMUM TENSION AT NESC HEAVY LOADING: 3290# R.S.= 400'
(S2) SHIELD WIRE IS 3/8" 7 STRAND STEEL EHS, MAXIMUM TENSION AT NESC HEAVY LOADING: 2000# R.S.= 200'
(C1) CONDUCTOR IS 795 KCMIL 45/7 ACSR "TERN" MAXIMUM TENSION AT NESC HEAVY LOADING: 7575# R.S.= 400'
(C2) CONDUCTOR IS 795 KCMIL 45/7 ACSR "TERN" MAXIMUM TENSION AT NESC HEAVY LOADING: 3000# R.S.= 200'

WIND SPAN: 350'
WEIGHT SPAN: 600' AT NESC HEAVY LOADING
HEIGHT OF STR.: SEE STRUCTURE TABLE
ACTUAL ANGLE (Δ): 24°00'00"
DESIGN MAXIMUM ANGLE: 30°00'00"

SPECIFICATIONS

1. POLES TO BE DESIGNED PER SECTION 33 71 16.23 TUBULAR STEEL POLES SPECIFICATIONS.
2. ALL STEEL TO BE WEATHERING STEEL.
3. POLES TO HAVE EITHER SLIP JOINTS OR BOLTED FLANGE TYPE SPLICES, WHICHEVER IS MORE COST EFFECTIVE.
   A. IF SLIP JOINTS ARE USED, INSTALL GROUND PADS (DETAIL 4) ABOVE AND BELOW SLIP JOINT.
4. STRUCTURES SHALL BE DESIGNED ASSUMING DRILLED PIER TYPE FOUNDATION.
5. THE CIRCLED LOADINGS SHOWN IN LOAD TREES CONVEY THE ADDITIONAL VERTICAL LOAD THAT WILL BE APPLIED TO THE STRUCTURE BY LINE PERSONNEL DURING CONSTRUCTION AND MAINTENANCE OPERATIONS.
   A. IT IS REQUIRED THAT ALL CONDUCTOR ATTACHMENT SUPPORTS BE DESIGNED TO MEET THIS REQUIREMENT. HOWEVER, AS THE LOADING WILL BE APPLIED TO ONLY ONE PHASE AT ANY GIVEN TIME, THE SHAFT MAY BE DESIGNED FOR ITS APPLICATION AT A SINGLE CONTROLLING PHASE LOCATION TO BE DETERMINED BY THE STEEL MANUFACTURER.

DEFLECTION

SEE TUBULAR STEEL POLE SPECIFICATION FOR DEFLECTION OF THE SHAFT UNDER LOAD CASE V.

STRUCTURE TABLE	
STR #	HEIGHT
2B-1	70'-0"

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

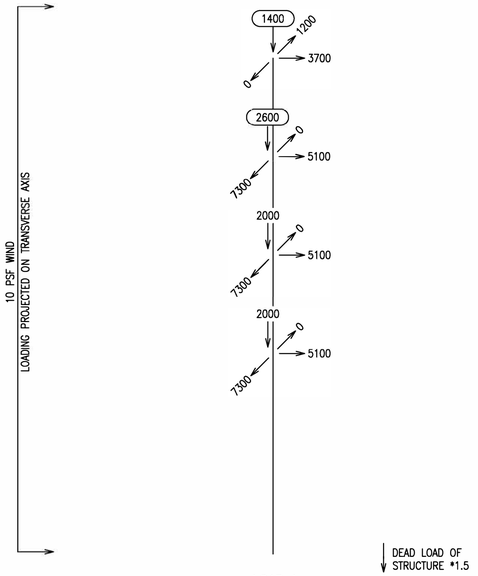
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 2
69KV TRANSMISSION LINE

LOAD & DESIGN DETAIL
SCDE-ST-M4
STR 2B-1

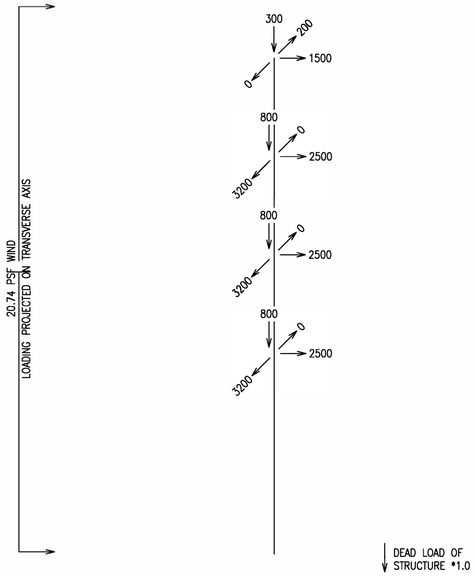
0 1" 2"

FILENAME BHE-LD-10-D-1.DWG
SCALE 3/16"=1'-0"
SHEET LD-10-1



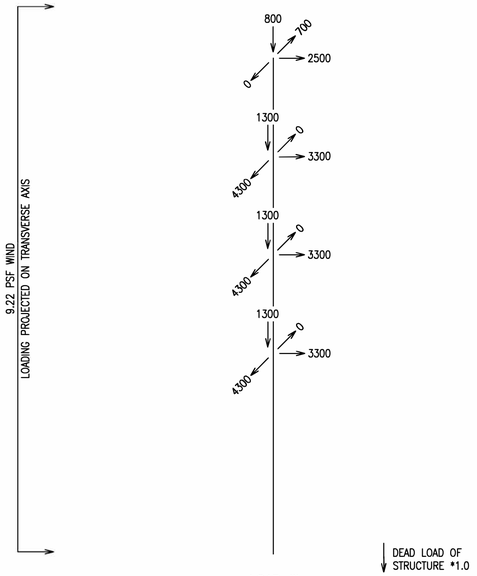
LOAD I

NESC HEAVY LOADING – RULE 250B
ALL WIRES INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 4 PSF WIND @ 0°F



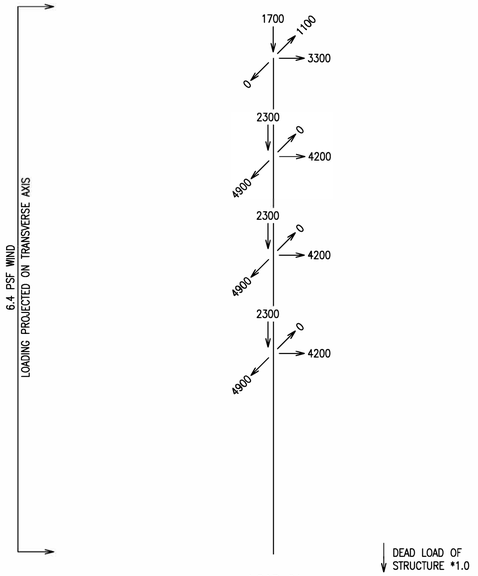
LOAD II

NESC EXTREME HIGH WIND – RULE 250C
ALL WIRES INTACT
NO ICE, 20.74 PSF WIND @ 60°F



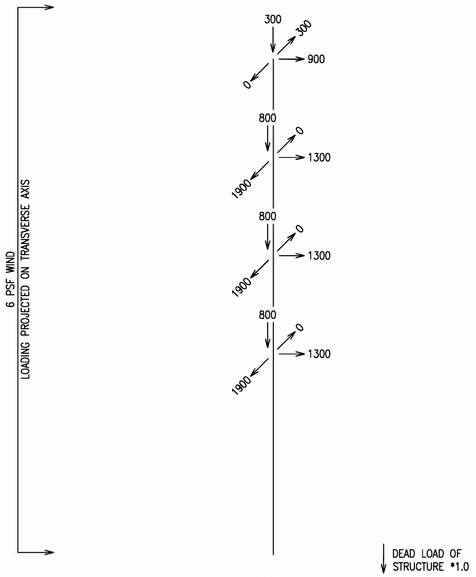
LOAD III

NESC CONCURRENT ICE/WIND – RULE 250D
ALL WIRES INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 9.22 PSF WIND @ 15°F



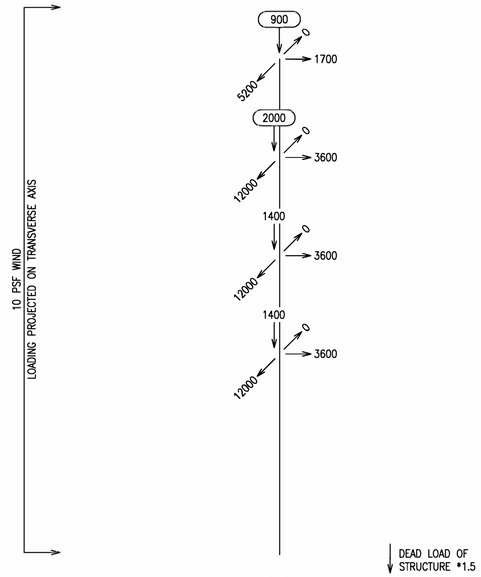
LOAD IV

BHE CONCURRENT ICE/WIND
ALL WIRES INTACT
1.0" RADIAL ICE @ 57 LBS/FT³, 6.4 PSF WIND @ 0°F



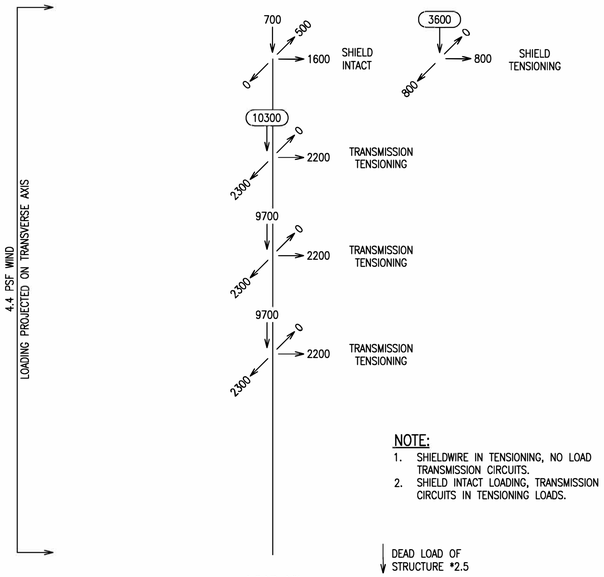
LOAD V

DEFLECTION LIMIT
ALL WIRES INTACT
NO ICE, 6 PSF WIND @ 60°F



LOAD VI

TERMINAL
BACK SPAN INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 4 PSF WIND @ 0°F

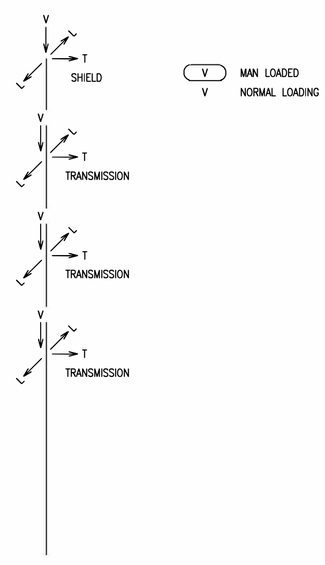


LOAD VII

CONSTRUCTION LOADING
SEE NOTE
NO ICE, 4 PSF WIND @ 20°F

NOTE:

1. SHIELDWIRE IN TENSIONING, NO LOAD TRANSMISSION CIRCUITS.
2. SHIELD INTACT LOADING, TRANSMISSION CIRCUITS IN TENSIONING LOADS.



TYPICAL

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

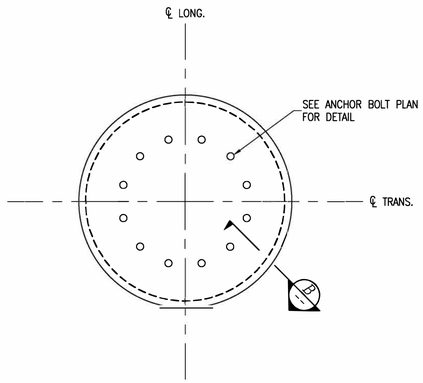
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 2
69KV TRANSMISSION LINE

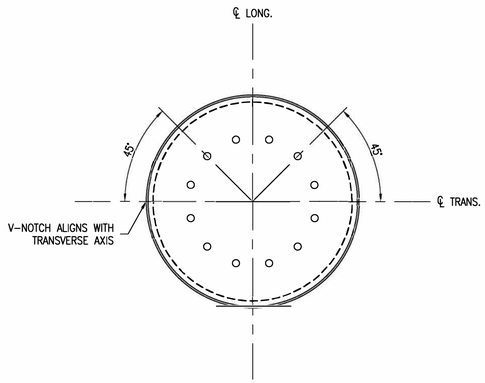
LOAD & DESIGN DETAIL
SCDE-ST-M4
STR 2B-1

0 1" 2"

FILENAME: BHE-LD-10-D-2.DWG
SCALE: 3/16"=1'-0"
SHEET: LD-10-2



PIER PLAN VIEW
ROUND CAP



ANCHOR BOLT PLAN (TYP.)
SEE STEEL MANUFACTURER DRAWINGS FOR ANCHOR BOLT DETAIL

FOUNDATION DATA

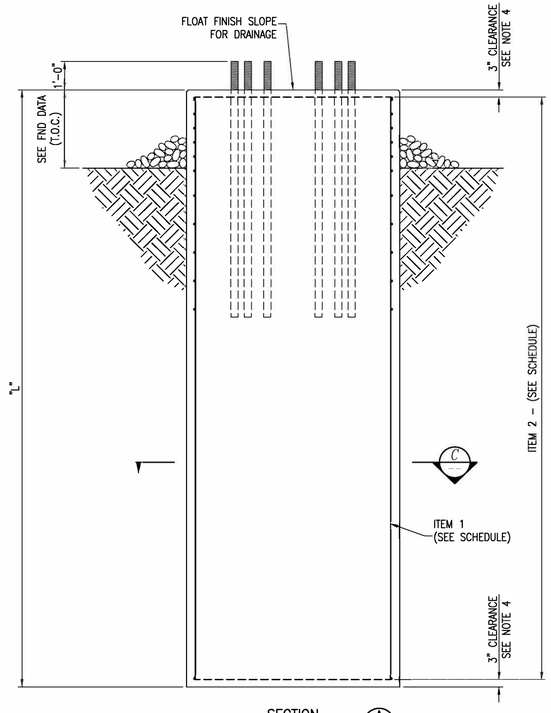
FOUNDATION	STRUCTURE INFORMATION				PIER DESIGN LOADS			ANCHOR BOLTS	PIER DATA								
FND-02	NUMBER	DRAWING	DESCRIPTION	LINE ANGLE (Δ)	MOMENT (FT-K)	AXIAL (K)	SHEAR (K)	DRAWING NUMBER	T.O.C. ELEVATION ABOVE GROUND	L	B	NEAT LINE (*) CONCRETE (CY)	ITEM	SIZE	QTY	LENGTH PER PIECE	ITEM 2 SPACING	SHAPE
FND-02-1	2B-1	SCDE-ST-M4	70'-0" OVERALL HEIGHT SINGLE POLE DEADEND	24°15'02" RT	2395.1	19.8	43.7	-	1'-0"	24	6.5	29.5	1	11	16	23'-6"	-	STRAIGHT
													2	6	28	21'-4"	12"	72" RING O.D.

NOTES:

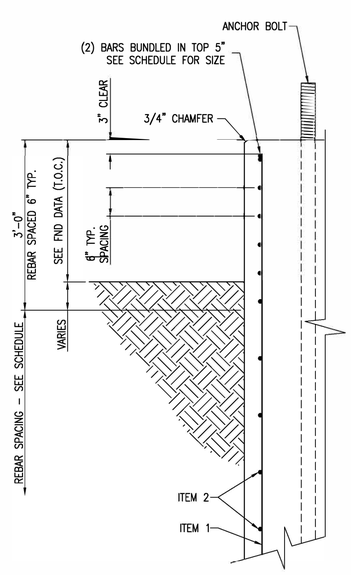
1. *ANCHOR BOLTS PROVIDED BY MANUFACTURER.
2. (*) NEAT LINE BASED ON MINIMUM DIMENSIONS.
3. O.D. = OUTSIDE DIAMETER OF ITEM 2 REBAR.
4. CLEAR DIMENSION SHALL BE MEASURED FROM THE OUTSIDE FACE OF PRINCIPAL REINFORCING.

GENERAL NOTES:

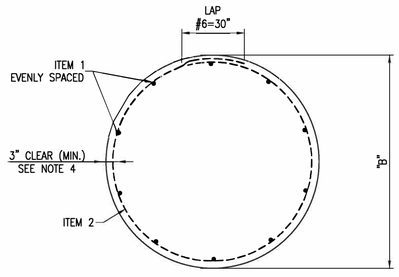
- REINFORCING STEEL SHALL CONFORM TO ASTM A-615 GRADE 60. ALL CLEAR DIMENSIONS MEASURED FROM OUTSIDE EDGE OF REINFORCING STEEL.
- CONCRETE: READY MIX CONCRETE SHALL CONFORM TO ASTM C-94.
  - A. CONCRETE STRENGTH: (MINIMUM 28 DAY COMPRESSIVE STRENGTH)
    CONCRETE PLACED IN DRY CONDITION - 4500 P.S.I.
    CONCRETE PLACED BELOW WATER TABLE USING TREMIE PIPE METHOD - 5000 P.S.I.
  - B. ENTRAINED AIR: PROVIDE AIR ENTRAINMENT IN CONCRETE RESULTING IN A TOTAL AIR CONTENT BY VOLUME OF 6% ± 1% PER ASTM C-260.
  - C. AGGREGATE: SHALL CONFORM TO ASTM C-33. MAXIMUM AGGREGATE SIZE THROUGHOUT SHALL BE 1 1/2".
  - D. SLUMP: SHALL BE 6-7 INCHES FOR CONCRETE.
  - E. WATER/ CEMENT RATIO: 0.45 MAX.
  - F. VIBRATION OF CONCRETE: SHALL BE LIMITED TO THE TOP TEN FEET OF THE FOUNDATION FOR CONCRETE PLACED BY THE TREMIE METHOD.
- SOIL OR ROCK CONDITIONS: WHERE SOIL DEPTHS, DEPTHS TO BEDROCK, OR THE CONDITIONS OF SOIL OR BEDROCK DIFFER FROM THAT SHOWN ON THE BORINGS, THE FOUNDATIONS ENGINEER SHALL BE CONTACTED.
- SEE SPECIFICATIONS AND DOCUMENTATION FOR EXCAVATION AND CONCRETE REQUIREMENTS.
- ALL PIERS SHALL BE FORMED FROM TOP OF FOUNDATION TO ONE FOOT BELOW GRADE BEFORE CONCRETE IS PLACED TO COMPLETE THE PIER.
- **GYPSUM PRESENT IN BORINGS. IN NO CASE SHALL PIERS TERMINATE IN A GYPSUM LAYER. IF THIS SHOULD OCCUR CONTACT ENGINEER.**



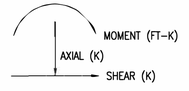
SECTION A
STEEL PARTIALLY SHOWN FOR CLARITY



SECTION B
FOUNDATION CAP
SCALE: N.T.S.



SECTION C
FOUNDATION
SCALE: N.T.S.



PIER DESIGN LOADS
SCALE: N.T.S.

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DESIGN ENGINEER	N. VLAHOS
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 2
69KV TRANSMISSION LINE

FOUNDATION DETAILS

0 1" 2"

FILENAME BHE-FND-02-01.DWG
SCALE NONE
SHEET **FND-02-1**

STRUCTURE DATA												TRANSMISSION ASSEMBLIES							COMMENTS
STR. #	STATION (FT)	AHEAD SPAN	LINE ANGLE				STR TYPE	POLE H&C	FND	FND REVEAL	GROUND	ANCHORS	GUYS	SHIELD ASSEMBLIES	CONDUCTOR ASSEMBLIES	OPGW SPLICE	DAMPERS	MISC.	
SUB 2	0+00	148					DT-01-69							1)T-4DS, 1)T-4FDS	3)T-SDE6PD	SPLICE BY SUBSTATION			OPGW TO MIDDLE STATIC MAST
2B	1+48	363	102°	21'	00"	RT	SCUBDE-M2	[1)LD-05: 130'-0"]	[1)FND-01-4]	[1'-0"]				2)T-4FDS, 1)T-4DS	6)T-BDE6PD, 6)TM-EXT-15		1)DPR-OPGW-D1, 3)DPR-795-D2		POLE INSTALLED ON WEST RAPID CITY 230KV PROJECT.
2B-1	5+11	182	24°	15'	02"	RT	SCDE-ST-M4	1)LD-10:70'-0"	1)FND-02-1	1'-0"	1)TM-9ST, 1)TM-9SSJ			1)T-4FDS, 2)T-4DS	6)T-BDE6PD, 3)T-SP1	1)T-FSCS-1			OPGW TERMINATES HERE.
BEN FRENCH 1	6+93						SUB DE							2)T-4DS	3)T-BDE6D				

NOTES:

XXX NEW
[XXX] EXISTING
*XXX RETIRE

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E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

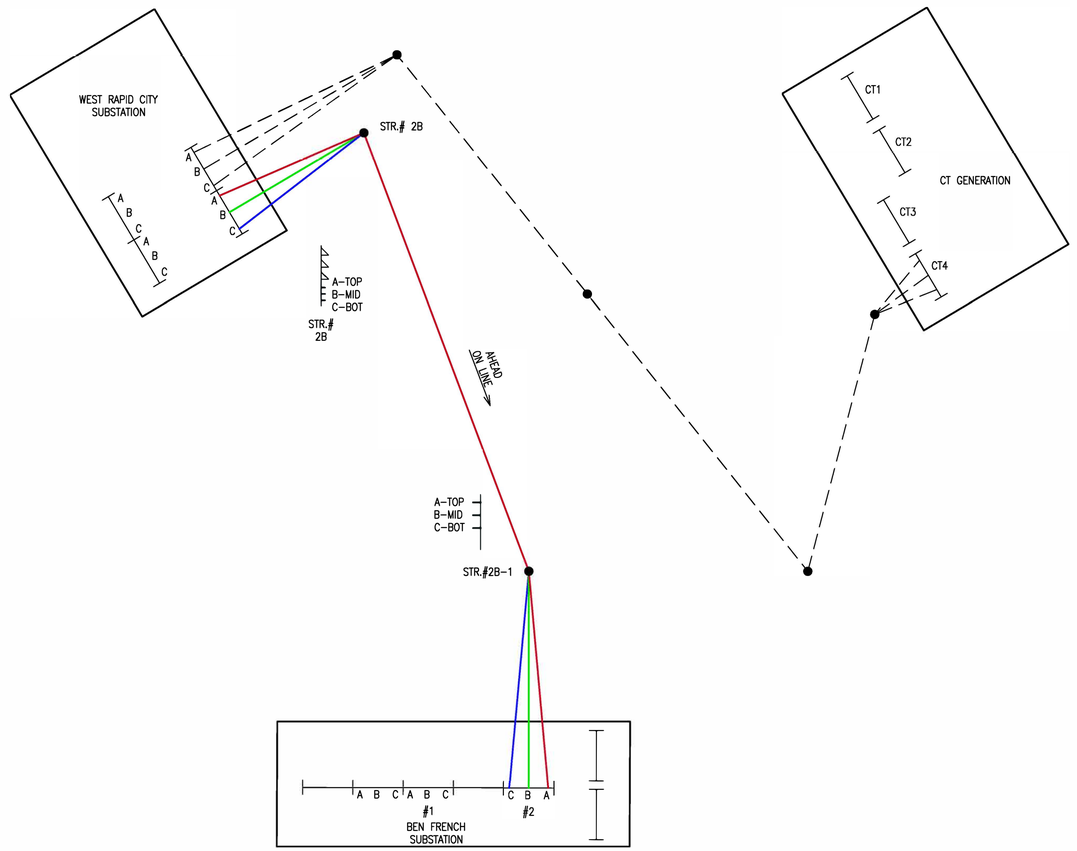
WEST RAPID CITY - BEN FRENCH 2
69KV TRANSMISSION LINE

STAKING SHEETS

0 1" 2"

FILENAME BHE-SS-01-D-1.DWG
SCALE NONE

SHEET **SS-01**



NOTES:
1. CONTRACTOR TO VERIFY PHASING.
2. STRUCTURES SHOWN LOOKING AHEAD ON LINE.

LEGEND	
A PHASE	
B PHASE	
C PHASE	
OTHER LINES	

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 2
69KV TRANSMISSION LINE

PHASING DIAGRAM

0 1" 2"

FILENAME BHE–PH–01–D–1.DWG
SCALE N.T.S.

SHEET **PH-01**

INITIAL SAG TABLE			795 KCMIL 45/7 ACSR "TERN" 1500# @ NESC HEAVY LOADING														SUB 2 to 2B													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
SUB 2	148	148	3.34	3.46	3.57	3.67	3.77	3.87	3.97	4.05	4.14	4.23	4.30	4.38	4.47	4.54	4.58	5.47	5.56	5.65	5.73	5.81	5.88	5.96	6.02	6.08	6.15	6.20	6.26	6.32	6.37	6.40	
SUB-PHASE TENS. LBS			634	613	594	577	562	547	534	523	512	502	493	484	474	467	463																SUBTOTAL DAMPERS NEEDED:0

INITIAL SAG TABLE			795 KCMIL 45/7 ACSR "TERN" 7345# @ NESC HEAVY LOADING														2B to 2B-1													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
2B	363	363	2.22	2.39	2.58	2.81	3.06	3.34	3.66	3.99	4.34	4.71	5.08	5.45	5.81	6.17	6.52	4.46	4.62	4.81	5.01	5.23	5.47	5.72	5.98	6.23	6.49	6.74	6.98	7.21	7.43	7.64	3)DPR-795-D2
SUB-PHASE TENS. LBS			6411	5966	5518	5078	4662	4266	3900	3572	3285	3029	2809	2620	2456	2313	2189																SUBTOTAL DAMPERS NEEDED:6

ISSUE	DATE	DESCRIPTION
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DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 2
69KV TRANSMISSION LINE

INITIAL SAG TABLES

795 KCMIL 45/7 ACSR "TERN"

0 1" 2"

FILENAME BHE-STC-01-D-1.DWG

SCALE NONE

SHEET **STC-01-1**

FINAL SAG TABLE			795 KCMIL 45/7 ACSR "TERN" 2425# INITIAL @ NESC HEAVY LOADING														2B-1 to BF2 SUB													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
2B-1	180	182	3.21	3.43	3.64	3.84	4.01	4.18	4.34	4.50	4.66	4.81	4.95	5.09	5.23	5.37	5.51	5.36	5.54	5.70	5.86	5.99	6.12	6.23	6.35	6.45	6.56	6.66	6.75	6.84	6.93	7.02	
SUB-PHASE TENS. LBS			1146	1074	1013	960	918	881	848	818	791	766	744	723	704	686	669																SUBTOTAL DAMPERS NEEDED:0

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DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 2
69KV TRANSMISSION LINE

FINAL SAG TABLES

795 KCMIL 45/7 ACSR "TERN"

0 1" 2"

FILENAME BHE-STC-02-D-1.DWG

SCALE NONE

SHEET **STC-02-1**

INITIAL SAG TABLE			AFL CC-55/443 "DNO-4748" OPGW 1000# @ NESC HEAVY LOADING														SUB 2 to 2B													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
SUB 2	148	148	2.61	2.70	2.79	2.88	2.96	3.04	3.13	3.20	3.28	3.36	3.43	3.51	3.58	3.65	3.72	4.83	4.92	5.00	5.07	5.15	5.22	5.29	5.35	5.42	5.48	5.54	5.60	5.66	5.71	5.77	
SUB-PHASE TENS. LBS			272	263	254	246	239	233	227	221	216	211	207	202	198	194	191																SUBTOTAL DAMPERS NEEDED:0

INITIAL SAG TABLE			AFL CC-55/443 "DNO-4748" OPGW 3130# @ NESC HEAVY LOADING														2B to 2B-1													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
2B	363	358	2.36	2.51	2.66	2.83	3.01	3.20	3.40	3.62	3.84	4.07	4.31	4.56	4.80	5.04	5.29	4.60	4.74	4.88	5.03	5.19	5.35	5.52	5.69	5.86	6.04	6.21	6.38	6.55	6.72	6.88	1)DNO-OPGW-D1
SUB-PHASE TENS. LBS			1973	1860	1751	1649	1551	1457	1371	1289	1214	1145	1082	1024	973	925	882																SUBTOTAL DAMPERS NEEDED:1

ISSUE	DATE	DESCRIPTION
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DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 2
69KV TRANSMISSION LINE

INITIAL SAG TABLES

AFL CC-55/443 "DNO-4748" OPGW

0 1" 2"

FILENAME BHE-STF-01-D-1.DWG

SCALE NONE

SHEET **STF-01-1**

INITIAL SAG TABLE			3/8" 7 STRAND EHS 935# @ NESC HEAVY LOADING														2B to SUB 2														
			SAG FT														3RD WAVE TIME SEC.														
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
2B	148	148	2.69	2.76	2.83	2.90	2.97	3.03	3.10	3.16	3.22	3.28	3.34	3.40	3.46	3.51	3.57	4.91	4.97	5.03	5.09	5.15	5.21	5.26	5.31	5.37	5.42	5.47	5.51	5.56	5.61	5.65	
SUB-PHASE TENS. LBS			245	239	233	227	222	218	213	209	205	201	197	194	191	188	185																SUBTOTAL DAMPERS NEEDED:0

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DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 2
69KV TRANSMISSION LINE

INITIAL SAG TABLES

3/8" 7 STRAND EHS

0 1" 2"

FILENAME BHE-STS-01-D-1.DWG

SCALE NONE

SHEET **STS-01-1**

FINAL SAG TABLE			3/8" 7 STRAND HS 1450# @ NESC HEAVY LOADING														2B-1 to BF2 SUB													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
2B-1	180	182	2.18	2.31	2.44	2.57	2.70	2.82	2.95	3.07	3.18	3.30	3.41	3.52	3.62	3.73	3.83	4.41	4.55	4.67	4.80	4.91	5.02	5.13	5.24	5.33	5.43	5.52	5.61	5.69	5.77	5.85	
SUB-PHASE TENS. LBS			524	494	467	444	423	405	387	372	359	346	335	325	315	306	298																SUBTOTAL DAMPERS NEEDED:0

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 2
69KV TRANSMISSION LINE

FINAL SAG TABLES

3/8" 7 STRAND HS

0 1" 2"

FILENAME BHE-STS-02-D-1.DWG

SCALE NONE

SHEET **STS-02-1**

						SCDE-ST-M4	SCUBBE-M2	DT-D1-69	T-ADS	T-ADS1	T-FGCS-1	T-SP1	T-BDE9PD	T-SD56PD	TM-EXT-15	TM-9ST	TM-9SSU	DPR-DPDW-D1	DPR-795-D2	7/8" EHS	DNO-4748	795-ACSR	EXTRA
				West Rapid City - Ben French 1 - QTY:		1	1	1	4	4	1	3	12	3	6	1	1	1	3	200	800	1800	1
ITEM NO.	QTY	DESCRIPTION	MANUFACTURER	MANUFACTURER PART #	CLIENT #																		
B603	8	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	BURNDY	50 FWSS	N.S.				1	1													
B605	8	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	BURNDY	50 SWSSMD	N.S.				1	1													
B606	24	BOLT, NUT, BELLEVILLE, FLAT, STAINLESS STEEL, ASSEMBLY	CMC	SBA20-50	N.S.								8										
B614	8	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	FASTENAL	70207	N.S.				1	1													
C107	1800	CONDUCTOR, 795 KCMIL ACSR, 45/7 "TERN"	SOUTHWIRE		N.S.																	1	
C800	200	WIRE, GALVANIZED, 7 STEEL STRAND, 3/8" EHS	MITCHELL		N.S.															1			
C902	38	WIRE, COPPER, #2 STRANDED, CLASS B	SOUTHWIRE		N.S.				6						10	4							
D1742	6	ROD, FULL THREADED, 7/8" X 42", W/ 4 NUTS	HUGHES	TR842-F	N.S.	6																	
H102	4	SOCKET EYE, 18K, 1/2" WIDTH, 11/16" HOLE, 2-1/16" LENGTH	HUBBELL	SA04	N.S.				1														
H200	3	SOCKET CLEVIS, 30K	HUBBELL	SC30	N.S.									1									
H400	6	HOT LINK EXTENSION, CHAIN EYE - CHAIN EYE, 15" LONG, 30K LBS	HUBBELL	HOO3015	N.S.										1								
H500	4	Y-CLEVIS BALL, 30K	HUBBELL	YBC30	48-3054				1														
H602	4	ANCHOR, SHACKLE, 3" LONG, 3/4" DIA., 7/8" DIA. PIN, 35K LBS	HUGHES	2865-B3	N.S.					1													
H603	6	ANCHOR, SHACKLE, 3.5" LONG, 7/8" DIA., 3/4" DIA. PIN, 60K LBS	HUBBELL	AS50BNK	N.S.										1								
I250	3	INSULATOR, HORIZONTAL POST, CLAMPTOP, 69KV	HUBBELL	P250043S1020	N.S.						1												
I300	15	INSULATOR, DEADEND, Y-CLEVIS BALL, 54" LENGTH, 25K LBS	MACLEAN	S14080042MXAL027	48-6927							1	1										
J100	800	AFL CC-55/443 "DNO-4748" OPGW	AFL	DNO-4748	N.S.																1		
J300	4	FIBER OPTIC DEADEND, 18" U-BOLT (48 FIBER), W/ GROUND WIRE	PREFORMED	2801303G	N.S.					1													
J403	14	DOWNLEAD CUSHION KIT, 0.443 OPGW W/ 1/2"-13 X 3" MOUNTING KIT	PREFORMED	8003041-H3	N.S.						14												
J501	1	VERTICAL CABLE STORAGE ASSEMBLY	PREFORMED	8003569	N.S.						1												
J502	1	VERTICAL MOUNTING BRACKET KIT	PREFORMED	8003472	N.S.						1												
J510	1	6" X 22" COYOTE CLOSURE KIT W/ 6 PORT END PLATE	PREFORMED	8006659	N.S.						1												
J511	1	COYOTE DEFENDER FOR 6" X 22" CLOSURE	PREFORMED	8003492	N.S.						1												
J600	2	SPLICE TRAY KIT, 36 COUNT TRAY	PREFORMED	80805514	N.S.						2												
J700	1	CLOSURE END PLATE GROMMETS, 7/8" PORT, 0.443" OPGW	PREFORMED	8003597	N.S.						1												
J720	3	FUTURE CABLE PORT KIT, 7/8" PORT	PREFORMED	8003371	N.S.						3												
J730	1	GROMMET PLUG, 3/4" PORT, QTY 2	PREFORMED	80806037	N.S.						1												
J950	40	BOLT-A-BAND 3/4" X REQ'D LENGTH	PREFORMED	BAB-38XX	N.S.						40												
J951	2	BUCKLE, BANDING, FOR 3/4" BANDING	PREFORMED	BAB-38	N.S.						2												
K300	3	CLAMP, TRUNNION, 795 KCMIL 45/7 ACSR "TERN", 2,800 LBS	HUBBELL	TSC150	48-7020							1											
L101	12	STRAIN CLAMP, DEADEND W/ SOCKET-EYE, 30K, 0.50 - 1.20 RANGE	HUBBELL	SD-112-S	42-1120								1										
L300	4	STRAIN CLAMP, DE, 20K, 3/8" EHS	HUBBELL	SWDE55N	44-4053				1														
L502	3	COMPRESSION DEADEND ASSY, DOUBLE TONGUE, W/ 15" TERMINAL "TERN"	AFL	VED-123	42-8230									1									
M500	8	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	HUBBELL	VHCL1012	N.S.				1	1													
N407	12	NUT, LOCK, MF TYPE, 7/8"	HUGHES	MF80	22-7856	12																	
O100	4.5	INHIBITOR, FILLER COMPOUND, GRITTED, COMPRESSION CONNECTIONS, 8 oz.	HUBBELL	VS68B	N.S.									1.5									
O101	1.8	INHIBITOR, FILLER COMPOUND, NON-GRITTED, PAD TO PAD, 8 OZ	HUBBELL	VS8B	N.S.									0.6									
O102	0.18	INHIBITOR, RUST (NO-OX-ID), 1 PT CAN, GRADE "A"	SANCHEM INC	NO-OX-ID "A" SPECIAL	N.S.							0.06											
P500	1	ROD, GROUND, 5/8" X 8'-0", COPPERCLAD	GALVAN	6260G13	46-0588										1								
P701	1	CLAMP, GROUND ROD, 0.128 TO 0.460 RANGE, 5/8" ROD	CHANCE	C2030344	46-0058										1								
P820	3	CLAMP, VISE TYPE, LIGHTNING ARRESTOR GROUND, #2 STRANDED	HUBBELL	GC207	N.S.										1	2							
Q100	4	CLAMP, 3-BOLT, 6" LONG, 5/8" BOLT, 5/16" - 1/2" RANGE	MACLEAN	J931	18-5816				1														
Q550	4	CLAMP, SINGLE BOLT, VISE TYPE, 3/8" EHS TO #2 STR CU	HUBBELL	GA9020GLSS	46-6810				1														
Q551	1	CLAMP, SINGLE BOLT, #4 STR CU TO 4/0 AWG STR. CU	HUBBELL	LC1602	N.S.			1															
Q552	1	CLAMP, VISE TYPE, 3/8 EHS TO 4/0 AWG STR CU	HUBBELL	GA9040L55	N.S.			1															
Q601	12	PARALLEL GROOVE CONNECTOR, 0.743 - 1.152 RANGE	AFL	483.3A	42-0483								1										
S110	1	SPIRAL VIBRATION DAMPER, 0.327" - 0.461" RANGE	PREFORMED	5050104	N.S.												1						
S150	6	DAMPER, DOG BONE, 795 ACSR	HUBBELL	60710-12	N.S.													2					
W322	6	WASHER, SQUARE, 4" X 1/4", 15/16" HOLE	HUGHES	SW4-80	N.S.	6																	

ISSUE	DATE	DESCRIPTION
1	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
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PROJECT NUMBER	10114217

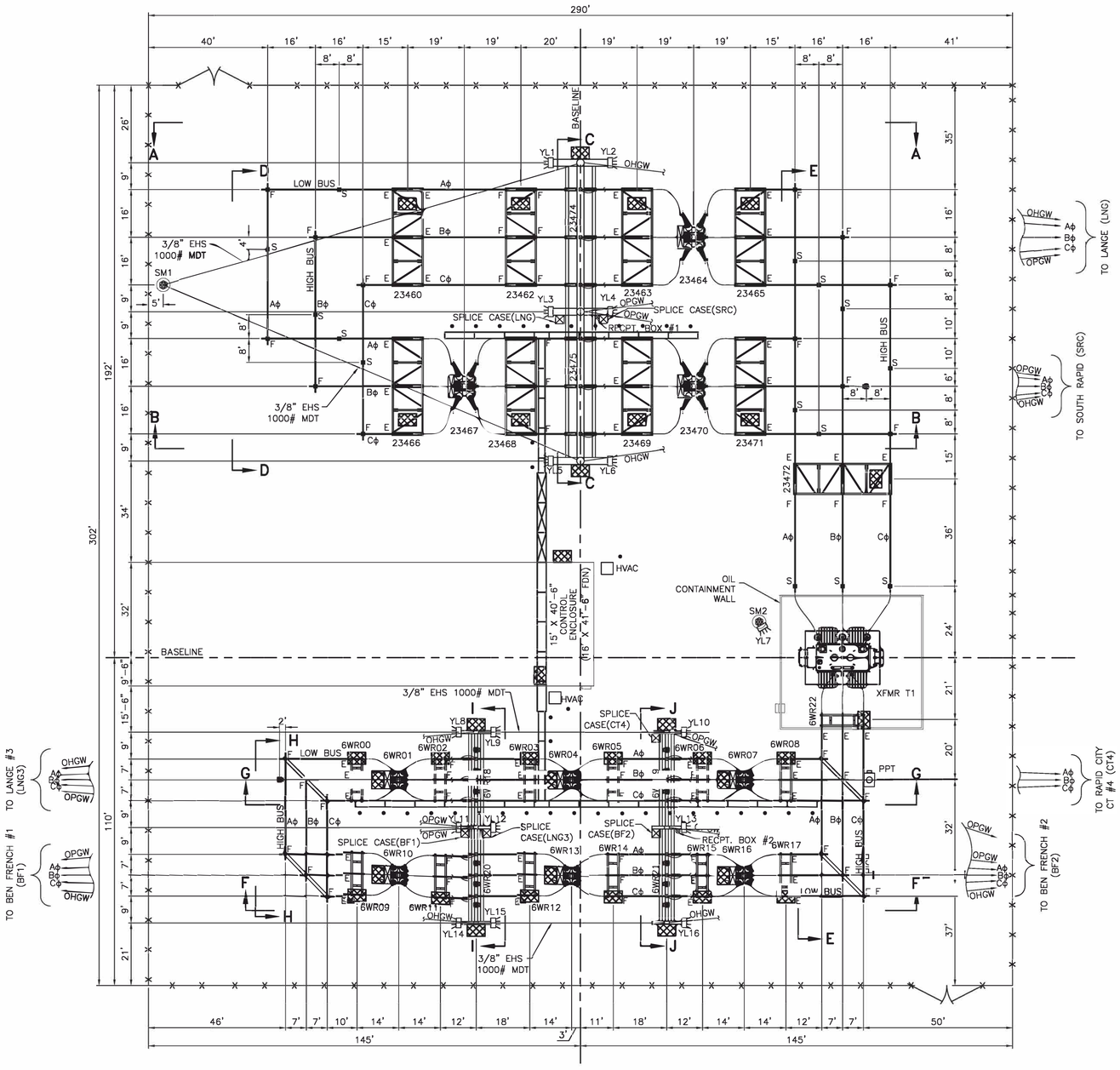
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 2
69KV TRANSMISSION LINE

MATERIAL LIST

0 1" 2"

FILENAME BHE-ML-01-D-1.DWG
SCALE NONE
SHEET ML-01



NOTES:

1. 230 kV LOW AND HIGH BUS SHALL BE 3–1/2" AL IPS, SCH. 40, 6063–T6 ALUM. ALLOY WITH 795 ACSR "DRAKE" DAMPENING CABLE.
2. 230 kV BREAKER JUMPERS SHALL BE MADE OF DOUBLE 1272 AAC "NARCISSUS" CONDUCTORS.
3. 230 kV TRANSFORMER JUMPERS SHALL BE MADE OF SINGLE 1272 AAC "NARCISSUS" CONDUCTORS.
4. 69 kV BUS SHALL BE 3–1/2" AL IPS, SCH. 40, 6063–T6 ALUM. ALLOY WITH 795 ACSR "DRAKE" DAMPENING CABLE.
5. 69 kV BREAKER JUMPERS SHALL BE MADE OF DOUBLE 1272 AAC "NARCISSUS" CONDUCTORS.
6. 69 kV TRANSFORMER JUMPERS SHALL BE MADE OF DOUBLE 1272 AAC "NARCISSUS" CONDUCTORS.
7. BUS COUPLING LOCATIONS SHALL BE DETERMINED BY CONTRACTOR AS NEEDED BASED UPON BUS LENGTHS USED. LOCATE AS NEEDED PER THE SPECIFICATIONS. CONTRACTOR SHALL ACQUIRE 40' LONG BUS PIPE AND LIMIT USE OF COUPLERS ON LONG SPANS. DO NOT USE COUPLERS OR EXCESS SHORTER BUS PIECES TO CREATE A LONGER PIECE LESS THAN 40' IN LENGTH.

LEGEND:

- F FIXED (WELDED)
- E EXPANSION
- S SLIP
- FLOOD LIGHT
- YARD RECEPTACLE BOX
- SAFETY BOLLARD
- CABLE TRENCH DRIVE SECTION (HS20 RATED)
- CABLE TRENCH PEDESTRIAN SECTION
- CHAINLINK FENCE
- OPERATOR PLATFORM

REGISTERED PROFESSIONAL ENGINEER — REG. NO. 10443 — PAUL D. KONECHNE — SOUTH DAKOTA

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly Registered Professional Engineer under the laws of the State of South Dakota.

By _____ Paul D. Konechne, P.E.

Registration Number 10443 Date: 01-18-19

P:\042331\15\DWG\WRC-C-101.DWG

DGR ENGINEERING
ROCK RAPIDS, IOWA
(712) 472-2531

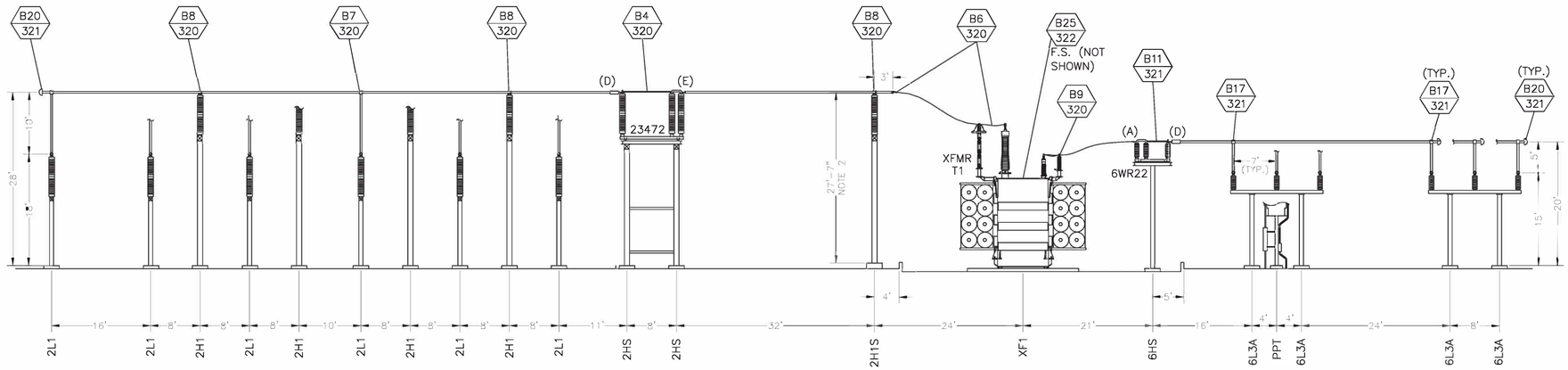
DATE	DRAWN BY	NO.	APPROVED BY	REVISION DESCRIPTION
01-19	KLV	0	PJK	FOR CONSTRUCTION

BLACK HILLS ENERGY

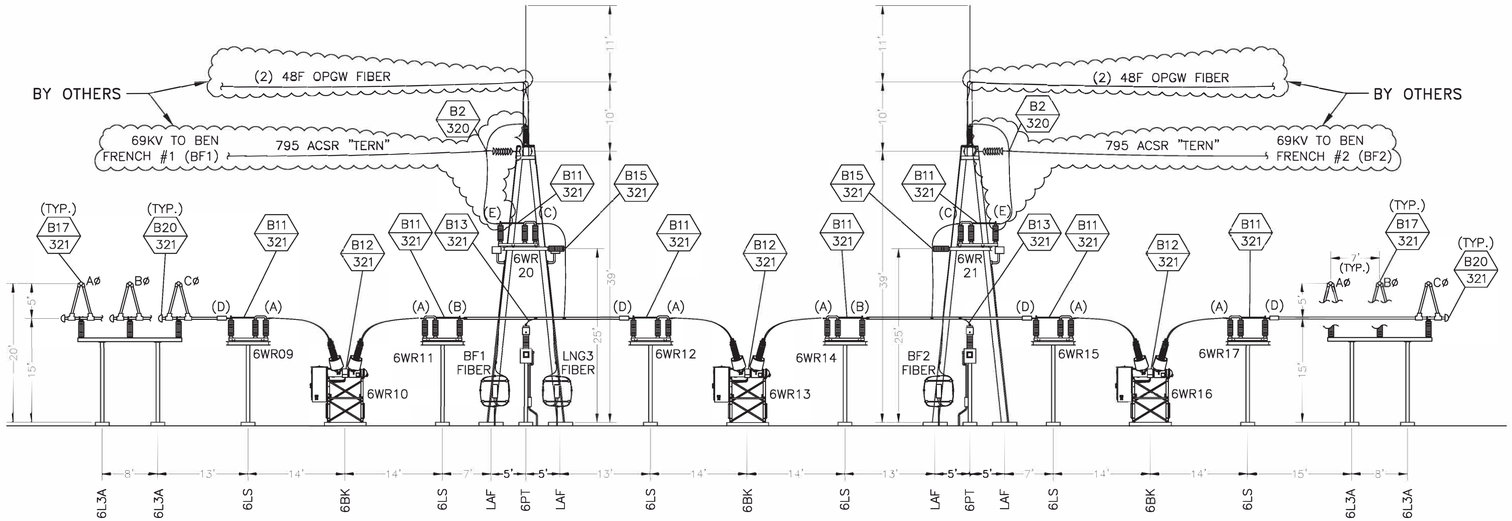
WEST RAPID CITY SUBSTATION

GENERAL ARRANGEMENT

DRAWN BY KLV DATE 08-18 | APPROVED BY PJK DATE 08-18 | DWG NO. WRC-C-101 | REVISION NO. 0



SECTION E–E



SECTION F–F

NOTES:

1. BUS COUPLING LOCATIONS SHALL BE DETERMINED BY CONTRACTOR AS NEEDED BASED UPON BUS LENGTHS PROCURED.
2. 2H1S STRUCTURE IS 5" SHORTER THAN 2H1 STRUCTURES.

LEGEND

- B27 / 320 — DETAIL # / DWG #
- 1L1 — STRUCTURE #
- (A) — SUB–DETAIL ASSIGNMENT

0' 10' 20'
SCALE IN FEET

REGISTERED PROFESSIONAL ENGINEER — REG. NO. 10443 PAUL D. KONECHNE — SOUTH DAKOTA

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly Registered Professional Engineer under the laws of the State of South Dakota.

By _____
Paul D. Konechne, P.E.

Registration Number 10443 Date: 01-18-19

DATE	DRAWN BY	NO.	APPROVED BY	REVISION DESCRIPTION
01-19	KLV	0	PJK	FOR CONSTRUCTION

BLACK HILLS ENERGY

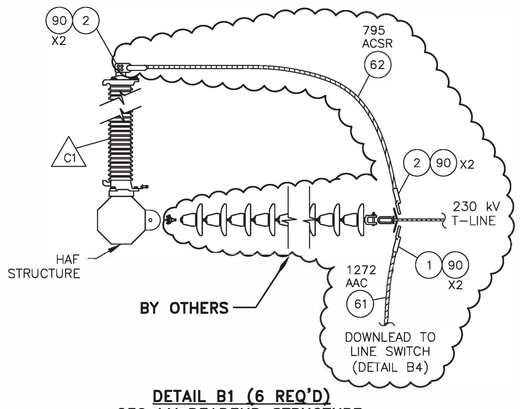
WEST RAPID CITY SUBSTATION

SECTIONS E AND F

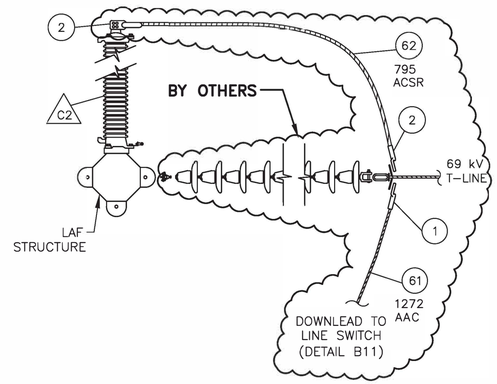
DRAWN BY KLV DATE 09-18
APPROVED BY PJK DATE 09-18
DWG NO. WRC–C–304 REVISION 0

DGR ENGINEERING
ROCK RAPIDS, IOWA
(712) 472-2531

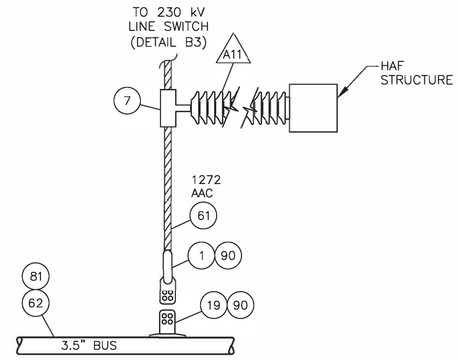
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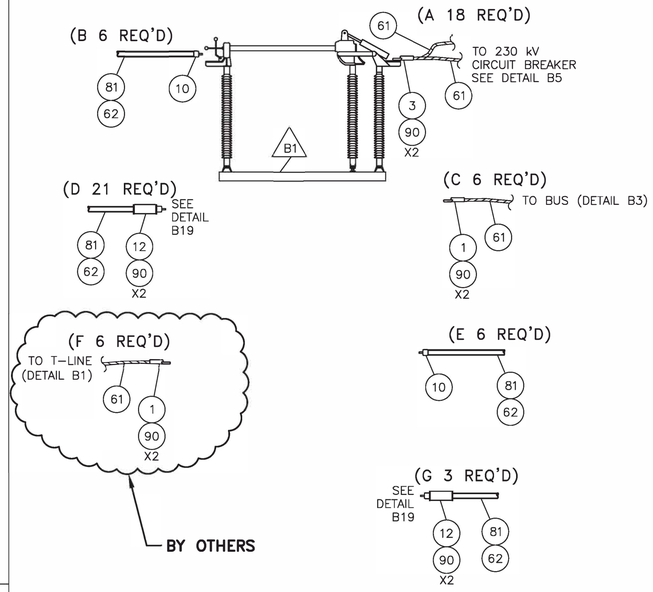
DETAIL B1 (6 REQ'D)
230 kV DEADEND STRUCTURE
T–LINE ATTACHMENT DETAIL



DETAIL B2 (12 REQ'D)
69 kV DEADEND STRUCTURE
T–LINE ATTACHMENT DETAIL



DETAIL B3 (6 REQ'D)
BUS CONNECTION DETAIL
230 kV DOWNLEAD CONNECTIONS

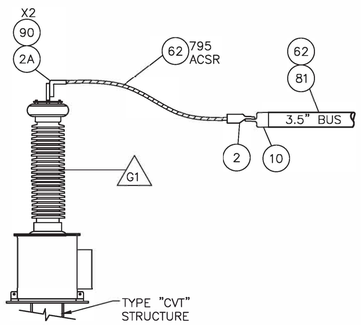


DETAIL B4
230 kV DISCONNECT SWITCH
CONNECTION DETAIL

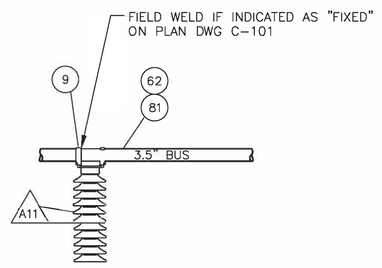
DETAIL B5 (9 REQ'D)
230 kV PCB CONNECTION DETAIL

DETAIL B6 (3 REQ'D)
230/69 kV TRANSFORMER HIGHSIDE
CONNECTION DETAIL

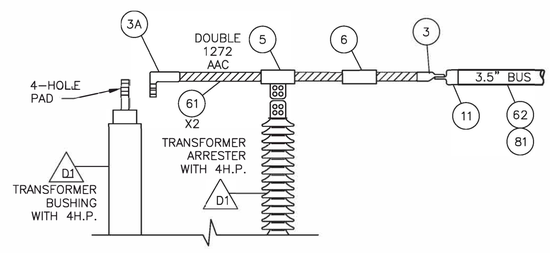
DETAIL B7 (12 REQ'D)
230 kV BUS BI–LEVEL
SUPPORT ASSEMBLY DETAIL



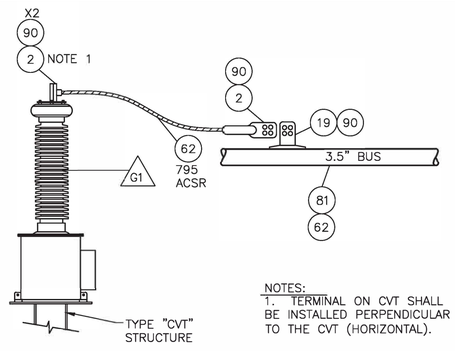
DETAIL B10A (1 REQ'D)
230 kV BUS CVT
CONNECTION DETAIL



DETAIL B8 (14 REQ'D)
230 kV BUS SUPPORT
ASSEMBLY DETAIL



DETAIL B9 (3 REQ'D)
230/69 kV TRANSFORMER LOWSIDE
CONNECTION DETAIL



DETAIL B10 (6 REQ'D)
230 kV LINE CVT
CONNECTION DETAIL

REGISTERED PROFESSIONAL ENGINEER
REG. NO.
10443
PAUL D.
KONECHNE
SOUTH DAKOTA

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By _____
Paul D. Konechne, P.E.

Registration Number 10443 Date: 01-18-19

DATE	DRAWN BY	NO.	APPROVED BY	REVISION DESCRIPTION
01-19	KLV	0	PDK	FOR CONSTRUCTION

BLACK HILLS ENERGY

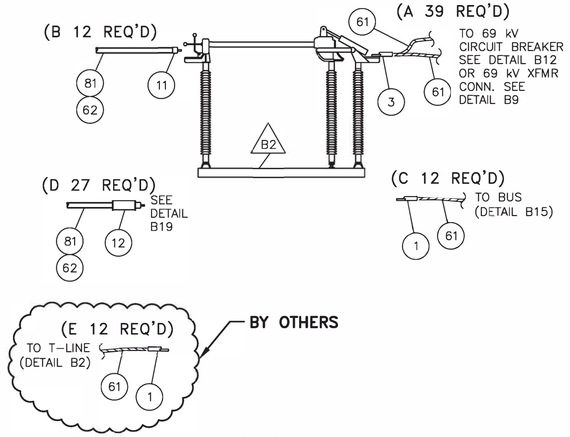
WEST RAPID CITY SUBSTATION

BUS CONNECTION DETAILS

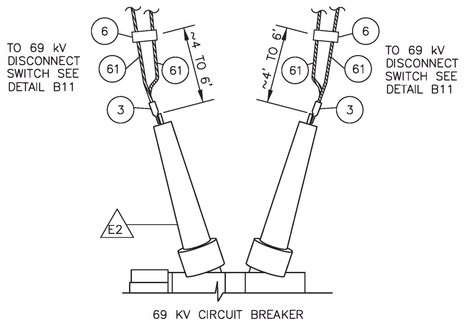
DRAWN BY KLV DATE 10-18
APPROVED BY PDK DATE 10-18
DWG NO. WRC-C-320 REVISION 0

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ROCK RAPIDS, IOWA
(712) 472-2531

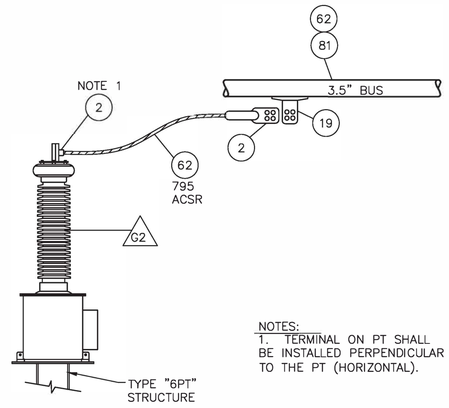
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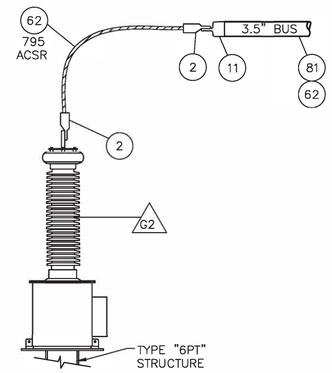
DETAIL B11
69 kV DISCONNECT SWITCH CONNECTION DETAIL



DETAIL B12 (18 REQ'D)
69 kV PCB CONNECTION DETAIL



DETAIL B13 (12 REQ'D)
69 kV LINE PT'S CONNECTION DETAIL



DETAIL B14 (1 REQ'D)
69 kV BUS PT CONNECTION DETAIL

DETAIL B15 (12 REQ'D)
BUS CONNECTION DETAIL
69 kV DOWNLEAD CONNECTIONS

DETAIL B16 (1 REQ'D)
69 kV POWER PT CONNECTION DETAIL

DETAIL B17 (12 REQ'D)
69 kV BUS BI-LEVEL SUPPORT ASSEMBLY DETAIL

DETAIL B18 (AS REQ'D)
BUS COUPLER JOINT

DETAIL B19
EXPANSION BUS TERMINAL DETAIL

DETAIL B20 (39 REQ'D)
END CAP DETAIL

DETAIL B21 (AS REQ'D)
69 kV 4-HOLE NEMA PAD CONNECTIONS

DETAIL B22 (AS REQ'D)
230 kV 4-HOLE NEMA PAD CONNECTIONS

P:\04233\15\DWG\WRC-C-321.DWG

DGR ENGINEERING
ROCK RAPIDS, IOWA
(712) 472-2531

REGISTERED PROFESSIONAL ENGINEER — REG. NO. 10443 — PAUL D. KONECHNE — SOUTH DAKOTA

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By _____
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Registration Number 10443 Date: 01-18-19

NO.	DATE	BY	APPROVED BY	REVISION DESCRIPTION
0	01-19	KLV	PDK	FOR CONSTRUCTION

BLACK HILLS ENERGY

WEST RAPID CITY SUBSTATION

BUS CONNECTION DETAILS

DRAWN BY KLV DATE 10-18
APPROVED BY PDK DATE 10-18
DWG NO. WRC-C-321 REVISION NO. 0

Item No.	OFM	Catalog Number	Description	Manufacturer	"Total Required"
1	X	WCF-136-D	CONNECTOR, TERMINAL, WELDED, 1272 AAC TO 4" NEMA 4HP	ANDERSON	75
1A	X	WCF-136-D-Y45	CONNECTOR, TERMINAL, WELDED, 1272 AAC TO 4" NEMA 4HP, 45°	ANDERSON	3
1B	X	WCF-136-D-Y90	CONNECTOR, TERMINAL, WELDED, 1272 AAC TO 4" NEMA 4HP, 90°	ANDERSON	3
2	X	WCF-106-D	CONNECTOR, TERMINAL, WELDED, 795 ACSR TO 4" NEMA 4HP	ANDERSON	77
2A	X	WCF-106-D-Y90	CONNECTOR, TERMINAL, WELDED, 795 ACSR TO 4" NEMA 4HP, 90°	ANDERSON	1
3	X	W2CF-136-D	CONNECTOR, TERMINAL, WELDED, (2) 1272 AAC TO 4" NEMA 4HP	ANDERSON	114
3A	X	W2CF-136-D-Y90	CONNECTOR, TERMINAL, WELDED, (2) 1272 AAC TO 4" NEMA 4HP, 90°	ANDERSON	3
4	X	ORT-2114-D	CONNECTOR, TEE, COMPRESSION, 1272 AAC MAIN TO 4" NEMA 4HP	ANDERSON	3
4A	X	ATCF-15401	CONNECTOR, TEE, BOLTED, 1272 AAC MAIN TO 4" NEMA 4HP	ANDERSON	3
5	X	110-121-CSTD-4-90	CONNECTOR, SPACER, BOLTED, (2) 1272 AAC, 4" SPACING TO 4" NEMA 4HP, 90°	TRAVIS (PDU)	3
6	X	APCS-15-4	CONNECTOR, SPACER, BOLTED, (2) 1272 AAC, 4" SPACING	ANDERSON	69
7	X	HVCS-12995	BUS SUPPORT, BOLTED, EHV, 1272 AAC TO 5" BOLT CIRCLE	ANDERSON	6
8	X	ACS-163	BUS SUPPORT, BOLTED, 1272 AAC TO 3" BOLT CIRCLE	ANDERSON	12
9	X	WTH-34-5	BUS SUPPORT, WELDED/SLIP, 3-1/2" IPS TO 5" BOLT CIRCLE	ANDERSON	38
10	X	WSTFE-34-D-CF-EHV	CONNECTOR, TERMINAL, WELDED, EHV, 3-1/2" IPS TO 4" NEMA 4HP, CENTER FORMED, WITH BOLT SHIELD	ANDERSON	16
11	X	WSTF-34-D-CF	CONNECTOR, TERMINAL, WELDED, 3-1/2" IPS TO 4" NEMA 4HP, CENTER FORMED	ANDERSON	17
12	X	WFTFV-34D	CONNECTOR, TERMINAL, WELDED, EXPANSION, 3-1/2" IPS TO 4" NEMA 4HP, 90°	ANDERSON	51
13	X	WTT-15-3424	FITTING, WELDED TEE, 15 DEGREE, 3-1/2" IPS MAIN TO 2-1/2" IPS TAP	ANDERSON	24
14	X	WTT-15-3434	FITTING, WELDED TEE, 15 DEGREE, 3-1/2" IPS MAIN TO 3-1/2" IPS TAP	ANDERSON	24
15	X	WTT2-15-3424	FITTING, WELDED VEE, 15 DEGREE, 3-1/2" IPS MAIN TO 2-1 /2" IPS VEE	ANDERSON	12
16	X	WTT2-15-3434	FITTING, WELDED VEE, 15 DEGREE, 3-1/2" IPS MAIN TO 3-1 /2" IPS VEE	ANDERSON	12
17	X	WCI-3434	FITTING, COUPLER, WELDED, INTERNAL, 3-1/2" IPS TO 3-1/2" IPS	ANDERSON	13
18	X	WLI45-3434	FITTING, COUPLER, WELDED, 45°, INTERNAL, 3-1/2" IPS TO 3-1/2" IPS	ANDERSON	6
19	X	WTTFR-30-60-D	FITTING, TEE, WELDED, 3"-6" IPS RUN TO 4" NEMA 4HP, INLINE PAD	ANDERSON	36
20	X	WEB34	FITTING, CORONA BELL, WELDED, INTERNAL FIT, 3-1/2" IPS	ANDERSON	39
41	X	E/INS-150-G	WILDLIFE PROTECTOR, SPLIT TUBING, GRAY, FOR 1272 AAC, 20 KV PHASE-GND	MIDSUN GROUP	10'
42	X	E/FTP-250G	WILDLIFE PROTECTOR, FUSING TAPE, GRAY, 2.5" WIDE, FOR EXPOSED CONNECTORS & W/ITEM 41 & 43	MIDSUN GROUP	AS REQ'D
43	X	E/BSC-350	WILDLIFE PROTECTOR, COVER FOR XFMR ARRESTERS	MIDSUN GROUP	3
44	X	E/BC-DBL-LEAD	WILDLIFE PROTECTOR, BUSHING COVER FOR TRANSFORMER	MIDSUN GROUP	3
61	X	NARCISSUS	CONDUCTOR, 1272 MCM AAC, 61 STRANDING	ALCOA	2500'
62	X	TERN	CONDUCTOR, 795 MCM ACSR 45/7 STRANDING, FOR HIGH VOLTAGE CONNECTIONS	ALCOA	500'
62	X	TERN	CONDUCTOR, 795 MCM ACSR 45/7 STRANDING, FOR BUS DAMPENING	ALCOA	2000'
80		2.5" - 6063-T6	CONDUCTOR, BUS, 2-1/2" IPS, SCHEDULE 40 ALUMINUM, 40' LENGTHS	ALCOA	200'
81		3.5" - 6063-T6	CONDUCTOR, BUS, 3-1/2" IPS, SCHEDULE 40 ALUMINUM, 40' LENGTHS	ALCOA	2520'
90	X	EVHS-D	HARDWARE SHIELDS, EHV, 4" NEMA 4HP (BOLT SHIELDS)	ANDERSON	230
91		HBS-XXX	STAINLESS STEEL BOLTS, 1/2" FOR ALUMINUM BUS CONNECTIONS, CONTRACTOR TO DETERMINE LENGTH	ANDERSON	AS REQ'D
92		BW500	STAINLESS STEEL BELLEVILLE WASHER, 1/2", 1.06" O.D.	ANDERSON	AS REQ'D
93		HNB500	SILICON BRONZE NUT, HIGH STRENGTH, 1/2"	ANDERSON	AS REQ'D
94		HFS5001	STAINLESS STEEL WASHER, 1/2", 1.13" O.D.	ANDERSON	AS REQ'D
96		PENETROX A	ELECTRICAL FILLER COMPOUND, NON-PETROLEUM BASED	BURNDY	AS REQ'D
200		4/0 COPPER	CONDUCTOR, 4/0 STRANDED SOFT DRAWN COPPER		14,000'
201		633400	GROUND ROD, 3/4" DIAMETER, 10' LONG, COPPER CLAD	ERICO	106
202		CR-34	GROUND ROD COUPLING, FOR CONNECTING MULTIPLE GROUND RODS OR DRIVE STUDS	ERICO	70
203		DS34	GROUND ROD DRIVING STUD	ERICO	20
205		GYR182Q	MOLD, GROUNDING CONNECTOR, EXOTHERMIC, 4/0 CABLE-3/4" GROUND ROD (USE 150 WELD)	ERICO	4
206		XBQ2Q2Q	MOLD, GROUNDING CONNECTOR, EXOTHERMIC, 4/0 CABLE - 4/0 CABLE CROSS (USE 250 WELD)	ERICO	25
207		TAC2Q2Q	MOLD, GROUNDING CONNECTOR, EXOTHERMIC, 4/0 CABLE - 4/0 CABLE TEE (USE 150 WELD)	ERICO	40
208		SSC2Q	MOLD, GROUNDING CONNECTOR, EXOTHERMIC, 4/0 CABLE - 4/0 CABLE SPLICE (USE 90 WELD)	ERICO	3
210		90	WELD METAL, 90 CARTRIDGE SIZE, FOR USE WITH ITEM 208	ERICO	40
211		150	WELD METAL, 150 CARTRIDGE SIZE, FOR USE WITH ITEMS 205 & 207	ERICO	400
212		250	WELD METAL, 250 CARTRIDGE SIZE, FOR USE WITH ITEM 206	ERICO	350
221		GC-141A-02	CONNECTOR, BRONZE, BOLTED, 1-4/0 COPPER TO FLAT SURFACE	ANDERSON	650
222		GC-143A-02	CONNECTOR, BRONZE, BOLTED, 2-4/0 COPPER TO FLAT SURFACE	ANDERSON	200
223		K3	CONNECTOR, BRONZE, BOLTED, 2 PARALLEL 4/0 COPPER	ANDERSON	150
224		K1	CONNECTOR, BRONZE, BOLTED, 2 PARALLEL #4 COPPER	ANDERSON	10
225		SWL-025-B	CONNECTOR, BRONZE, BOLTED, #4-4/0 COPPER TO NEMA 2HP	ANDERSON	80
226		C-4	CONNECTOR, BOLTED, 1-#4 SOLID COPPER TO TYPE A4 BARBED WIRE/FENCE FABRIC	ANDERSON	200
227		GC-111-5B	CONNECTOR, BOLTED, 1-#4 SOLID COPPER TO 1-5/8" FENCE TOP RAIL/GATE FRAME	ANDERSON	60
228		GC-110-82C	CONNECTOR, BOLTED, 2-4/0 STRANDED COPPER TO 2-1/2" FENCE LINE POST	ANDERSON	20
229		GC-110-102C	CONNECTOR, BOLTED, 2-4/0 STRANDED COPPER TO 3" FENCE CORNER POST	ANDERSON	4
230		GC-110-142C	CONNECTOR, BOLTED, 2-4/0 STRANDED COPPER TO 4" GATE POST	ANDERSON	4
231		GC-109-06	CONNECTOR, BOLTED, FLEXIBLE COPPER BRAID TO 2" GATE FRAME	ANDERSON	8
233		GB-100-3B	FLEXIBLE COPPER BRAID 24" LONG WITH TIN PLATED FERRULES EACH END	ANDERSON	8
240		#4 SD SOLID CU	CONDUCTOR, #4 SOLID SOFTDRAWN COPPER		500'
241		#6 SD SOLID CU	CONDUCTOR, #6 SOLID SOFTDRAWN COPPER		150'
242		3/8" EHS	CONDUCTOR, 7 WIRE, 3/8" EXTRA HIGH STRENGTH STEEL		500'
250		SWDE46N	DEADEND, BOLTED, STATIC WIRE, 3/8" EHS STEEL, QUADRANT STRAIN CLAMP	ANDERSON	8
251		YCS-04-90	Y-CLEVIS EYE, FOR STATIC WIRE DEADEND, 90°	ANDERSON	8

Item No.	OFM	Catalog Number	Description	Manufacturer	"Total Required"
271	X	804-LL8-400PE	FIBER OPTIC CABLE, MULTIMODE DUPLEX		400'
272	X	12048R101	FIBER OPTIC CABLE, MULTI-FIBER	SUPERIOR ESSEX	1460'
273	X	DF4X1C-XXXX	CONDUIT, INNERDUCT, 1" ORANGE CORROGATED W/TAPE	CARLON	1500'
280	X		CONTROL CABLE, (3) CONDUCTOR #12, 3/C-#12 SH		350'
281	X		CONTROL CABLE, (2) CONDUCTOR #10, 2/C-#10 SH		3600'
282	X		CONTROL CABLE, SHIELDED, (4) CONDUCTOR #10, 4/C-#10 SH		500'
283	X		CONTROL CABLE, SHIELDED, (9) CONDUCTOR #10, 9/C-#10 SH		5500'
284	X		CONTROL CABLE, SHIELDED, (12) CONDUCTOR #10, 12/C-#10 SH		5600'
285	X		CONTROL CABLE, (2) CONDUCTOR #6, 2/C-#6 SH		1500'
286	X		CONTROL CABLE, (3) CONDUCTOR #6, 3/C-#6 SH		2100'
287	X		POWER CABLE, (1) CONDUCTOR 500 MCM, 1/C-500		1000'
291			TERMINAL CONNECTORS, CONTROL CABLE, VARIOUS SIZES		1850
292			TERMINAL CONNECTORS, CONTROL CABLE, SHIELD		130
293			TERMINAL CONNECTORS, POWER CABLE, 500 MCM		18
294			CABLE MARKERS		1 LOT
300			CONDUIT, BELOW-GRADE, VARIOUS SIZES, SCHEDULE 40 PVC AND ASSOCIATED FITTINGS AND PULL WIRE		1 LOT
301			CONDUIT, STATION POWER RISERS, 90° ELBOW, 3-1/2" RIGID GALVANIZED STEEL, 40" MIN RADIUS		4
310			CONDUIT, ABOVE-GRADE, VARIOUS SIZES, RIGID GALVANIZED STEEL AND ASSOCIATED FITTINGS		1 LOT
311			CONDUIT, ABOVE-GRADE, VARIOUS SIZES, LIQUID-TIGHT FLEXIBLE AND ASSOCIATED FITTINGS		1 LOT
330			ANTI-CORROSION TAPE, FOR RIGID GALVANIZED STEEL INSTALLED BELOW GRADE		1 LOT
380	X		CABLE TRENCH ASSEMBLY	TRENWA	1 LOT
381	X		CABLE TRENCH GROUND CLAMPS	TRENWA	90
382			DRAIN TILE, 4" PERFORATED, HDPE, WITH COUPLINGS & ACCESSORIES AS NEEDED		630'
383			OUTLET, DRAIN TILE, 4", PREFABRICATED CMP, FLARED END, WITH RODENT GUARD		2
384			FENCE POST, MARKER FOR DRAIN TILE OUTLET		2
390			CONDUIT MARKER		9
400	X	FXL-56L-190-5K-W-U-Y-GR	FLOOD LIGHT, LED, 120-277 VAC, 187 WATT (400W MH EQUIVALENT)	HUBBELL	16
401	X	4024CM53	FLOOD LIGHT SLIP-FITTER, STEEL FOR 2" PIPE, 2 3/8" O.D. YOKE MOUNT	HUBBELL	16
402	X	6387	FLOOD LIGHT WALL BRACKET, 2" SLIP FITTER, GRAY	HOLOPHANE	16
500		FENCE	CHAIN-LINK FENCE SYSTEM		1184'
501		GATES	GATE, CHAIN-LINK DOUBLE GATE, 24' TOTAL WIDTH, WITH ONE PERSONNEL GATE		2

NOTES:
1. SEE PROJECT SPECIFICATIONS AND DETAIL DRAWINGS FOR FURTHER MATERIAL DETAILS AS NEEDED.
2. SUPPLIER SHALL BE RESPONSIBLE FOR PROVIDING OFM QUANTITIES AS REQUIRED TO COMPLETE THE PROJECT.
3. QUANTITIES OF CONTRACTOR-FURNISHED MATERIALS SHALL BE VERIFIED BY CONTRACTOR.
4. OWNER SHALL BE NOTIFIED OF ANY QUANTITIES THAT MAY BE SHOWN INCORRECTLY ON THIS DRAWING.

REGISTERED PROFESSIONAL ENGINEER — REG. NO. 10443 — PAUL D. KONECHNE — SOUTH DAKOTA

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly Registered Professional Engineer under the laws of the State of South Dakota.

By _____
Paul D. Konechne, P.E.

Registration Number 10443 Date: 01-18-19

DATE	DRAWN BY	NO.	APPROVED BY	REVISION DESCRIPTION
01-19	KLV	0	PJK	FOR CONSTRUCTION

BLACK HILLS ENERGY

WEST RAPID CITY SUBSTATION

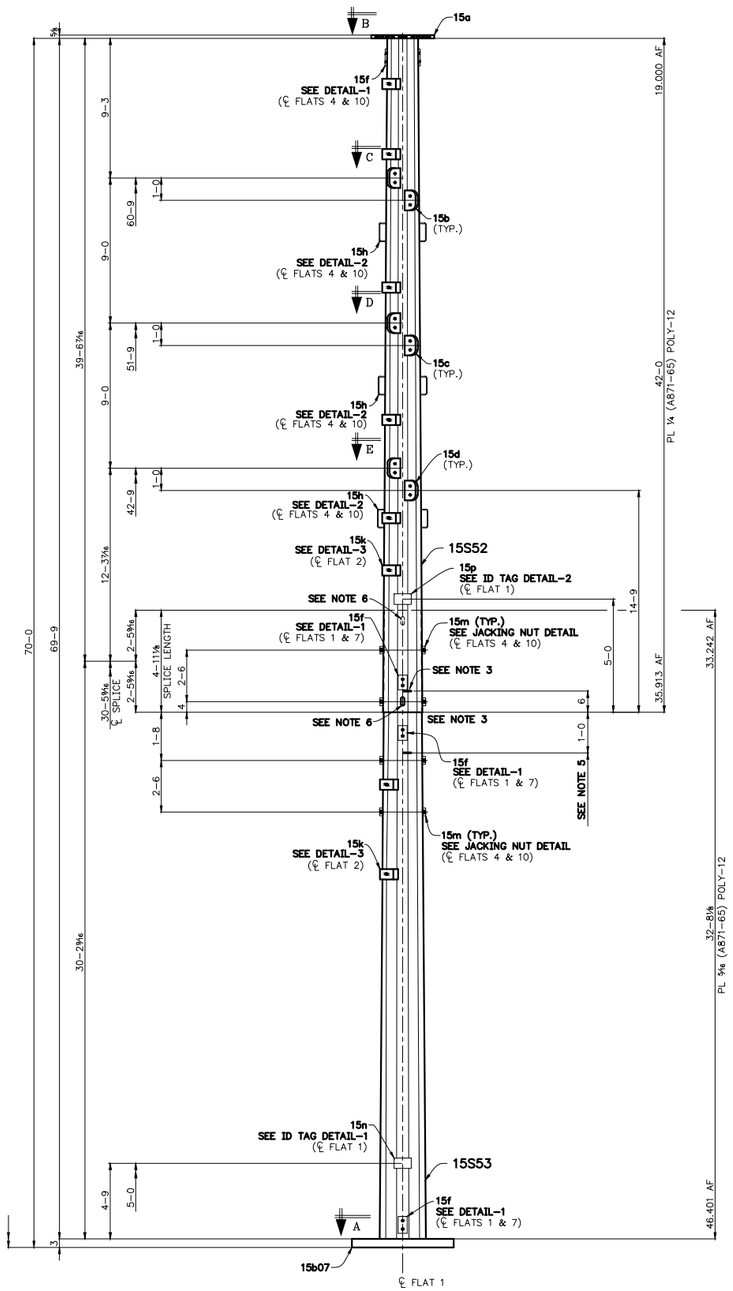
MATERIAL LIST

DRAWN BY KLV DATE 01-19 | APPROVED BY PJK DATE 01-19 | DWG NO. WRC-C-380 | REVISION 0

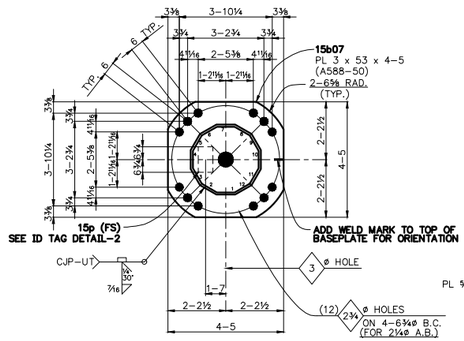
DGR ENGINEERING
ROCK RAPIDS, IOWA
(712) 472-2531

P:\04233115\DWG\WRC-C-380.DWG

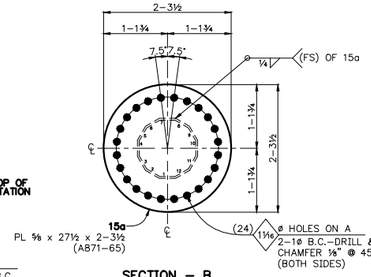
SHOP NOTE:
SEE HOLE DETAIL & SCHEDULE FOR HOLE SIZE AND LOCATIONS.



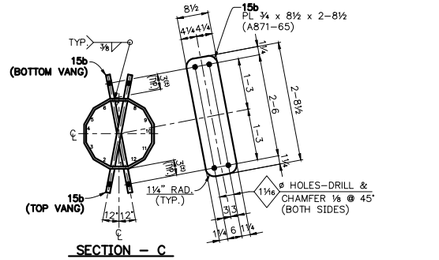
69KV TRANSMISSION POLE



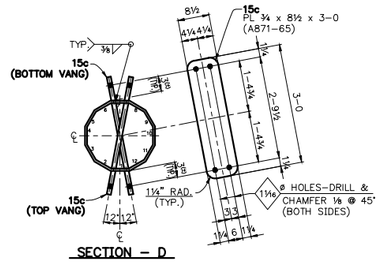
SECTION – A



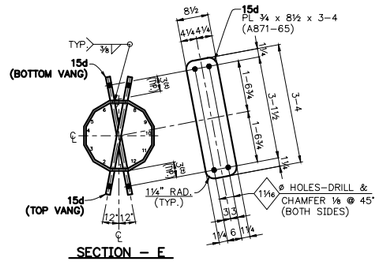
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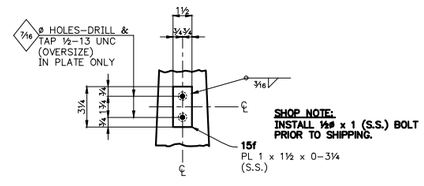
SECTION – C



SECTION – D



SECTION – E



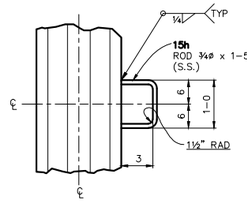
SHOP NOTE:
INSTALL ½ø x 1 (S.S.) BOLT PRIOR TO SHIPPING.

DETAIL – 1

GROUNDING SCHEDULE
DIM'S TO CENTER OF GROUND PLATE
SEE DETAIL-1

POLE – 15S52		POLE – 15S53
℄ OF FLATS 1 & 7	℄ OF FLATS 4 & 10	℄ OF FLATS 1 & 7
0–11	41–0	0–9
		26–10

ALL DIMENSIONS FROM BOTTOM OF SHAFT

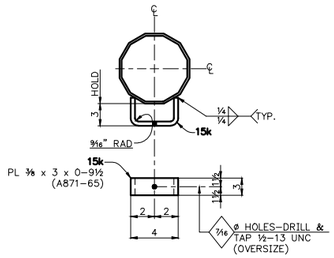


DETAIL – 2

GROUND LOOP SCHEDULE
DIM'S TO CENTER OF GROUND LOOP
SEE DETAIL-2

POLE – 15S52
℄ OF FLATS 4 & 10
12–6
21–6
30–6

ALL DIMENSIONS FROM BOTTOM OF SHAFT

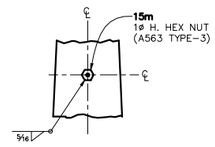


DETAIL – 3

OPGW SCHEDULE
DIM'S TO CENTER OF OPGW
SEE DETAIL-3

POLE – 15S52	POLE – 15S53
℄ OF FLAT 2	℄ OF FLAT 2
4–0	17–9
11–0	24–9
18–0	
25–0	
32–0	
39–0	

ALL DIMENSIONS FROM BOTTOM OF SHAFT



JACKING NUT DETAIL

MATERIAL REQ'D. FOR ASSEMBLY

MARK	QTY.	DESCRIPTION	BLACK WT.
15S52	ONE	POLY-12 POLE	3,666
15S53	ONE	POLY-12 POLE	6,807
		TOTAL BLACK WT.	10,473#

HARDWARE REQD. FOR ASSEMBLY

MARK	QTY.	DESCRIPTION
(1)	ONE	SEE ANCHOR BOLT CAGE DETAIL ON SHEET E29.

MATERIAL BILLED FOR ONE MAKE (ONE) TIME

GENERAL NOTES:

1. ALL WELDS SHALL BE IN ACCORDANCE WITH A.W.S. (D1.1.) UNLESS NOTED OTHERWISE.
   a.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL BE U.T. TESTED IN ACCORDANCE WITH AWS & ASNDT.
   b.) ALL MATERIAL WELDED WITH E80–SERIES, LOW HYDROGEN ELECTRODES.
   c.) ALL FILLET WELDS AT JOINT TERMINATIONS OR ABRUPT CHANGES IN WELD DIRECTION SHALL HAVE END RETURNS TO WRAP CORNERS AS GEOMETRY PERMITS. IF JOINT GEOMETRY DOES NOT PERMIT A FULL SIZE RETURN, A SEAL WELD SHALL BE PROVIDED WHERE ACCESSIBLE.
   d.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL USE 3/16" X 1 1/4", (A36) STEEL BACKING (GALVANIZED POLES); (A588–50) (NON–GALVANIZED), MINIMUM. BACKING BARS SHALL BE SPLICED ON SHAFT FLATS ONLY, WITH A C.J.P. GROOVE WELD. BACKING BARS SHALL BE SEAL WELDED ALL AROUND, WHEN ACCESSIBLE.
   e.) LONGITUDINAL SEAM WELDS SHALL ACHIEVE A MINIMUM OF 80% PENETRATION. LONGITUDINAL SEAM WELDS SHALL ACHIEVE 100% PENETRATION WITHIN A MINIMUM OF 6" FROM THE ENDS OF THE SHAFT AND THE FULL LENGTH OF THE FEMALE SECTION IN THE SLIP JOINT.
2. LONGITUDINAL SEAM WELDS IN FEMALE SECTION OF THE SLIP JOINT SHALL BE FULL PENETRATION WELDS.
3. FOR PROPER SHAFT ALIGNMENT FOR ASSEMBLY, A 6" HORIZONTAL WELD BEAD AND A MARK NUMBER ARE POSITIONED ON EACH SHAFT AT EACH SPLICE. THE 6" HORIZONTAL WELD BEADS ARE ON MATCHING CORNERS. THE MARK NUMBER IS ON AN ADJACENT FLAT. THE HORIZONTAL WELD BEAD CORNERS SHALL BE ALIGNED TOP TO BOTTOM OF THE POLE. MATCH NUMBERS SHALL BE MATCHED FOR EACH SPLICE.
4. FIELD ASSEMBLY HOLES (1⅛ø) WITH 1"ø H. HEX NUTS ARE LOCATED ON OPPOSING SECTION FLATS ABOVE AND BELOW SPLICES FOR JACKING SHAFTS TOGETHER.
5. THE LOWER WELD ORIENTATION MARK AT EACH SPLICE LOCATION SHALL BE TELESCOPED IN THE FIELD TO WITHIN 24" OF THE UPPER WELD ORIENTATION MARK. AFTER TELESCOPED, THE SECTIONS SHOULD SHOW NO FURTHER MOVEMENT AND THERE SHOULD BE ADEQUATE METAL–TO–METAL CONTACT ON ALL FLATS.
6. TWO SLOTS (1½ø x 2½") WILL BE PROVIDED AT THE SLIP FITTED END OF EACH SHAFT.
7. POLE TAPER = 0.402699 IN/FT
8. FIELD BOLT SHIPPING QUANTITIES WILL INCLUDE A MAXIMUM 5% OVERAGE FOR BOLTS 1"ø OR LESS. FIELD BOLTS OVER 1"ø WILL BE EXACT COUNT UNLESS NOTED OTHERWISE.
9. ALL HARDWARE NOTED WITH "PT" SHALL BE PRE–TENSIONED PER THE TURN–OF–NUT METHOD. ALL OTHER HARDWARE SHALL BE SNUG–TIGHT. SPARE SHIPPING QUANTITIES WILL INCLUDE THREE EXTRA ASSEMBLIES OF EACH BOLT TYPE DESIGNATED AS "PT" FOR FIELD VERIFICATION OF PRE–TENSIONING METHOD.
10. **POLE SHALL BE SWEEP BLASTED DULLED AFTER FABRICATION.**

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL, DO NOT GALVANIZE.

(STR. 2B–1) 19–9462PE28

DIS-TRAN Steel, LLC
P.O. BOX 5109•ALEXANDRIA, LA, 71307–5709
PHONE 318–448–0274•FAX 318–445–4454

WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

69KV TRANSMISSION POLE / ITEM – 19

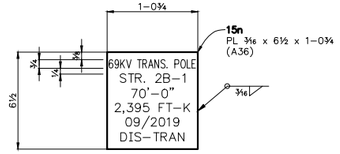
ERECTION ELEVATION, SECTIONS & DETAILS

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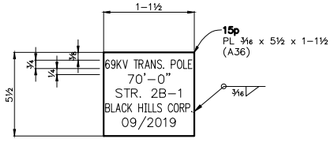
DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ

NOTICE TO ERECTOR
BACKCHARGES FOR CORRECTIVE WORK OR REPLACED MATERIALS WILL NOT BE ACCEPTED UNLESS EXPRESSLY AUTHORIZED BY DIS–TRAN BEFORE ANY SUCH COST ARE INCURRED.

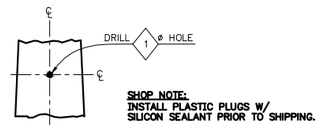
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1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19
2					
3					
4					
5					
6					
7					
8					



ID TAG DETAIL – 1



ID TAG DETAIL – 2



HOLE DETAIL

SHOP NOTE:
INSTALL PLASTIC PLUGS W/ SILICON SEALANT PRIOR TO SHIPPING.

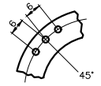
HOLE SCHEDULE DIM'S TO CENTER OF HOLES SEE HOLE DETAIL
POLE – 15S52
℄ OF FLATS 4 & 10
15–6
16–6
24–6
25–6
33–6
34–6

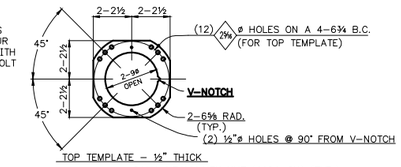
ALL DIMENSIONS FROM BOTTOM OF SHAFT

SPACE ANCHOR BOLTS 6" APART IN ALL FOUR QUADRANTS. START WITH THE FIRST ANCHOR BOLT ON THE 45° LINE AS SHOWN BELOW.

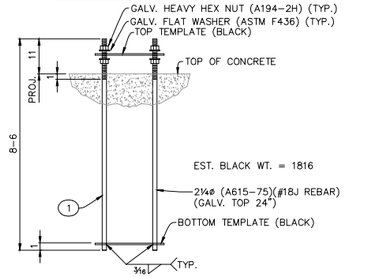


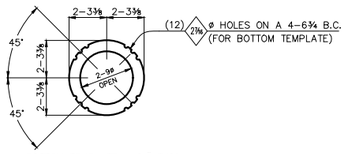
THEN LOCATE THE OTHER ANCHOR BOLTS 6" APART AS SHOWN BELOW.





TOP TEMPLATE – ½" THICK





BOTTOM TEMPLATE – ⅜" THICK

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL,
DO NOT GALVANIZE.

(STR. 2B–1) 19–9462PE29

NOTICE TO ERECTOR
BACKCHARGES FOR CORRECTIVE WORK OR REPLACED MATERIALS WILL NOT BE ACCEPTED UNLESS EXPRESSLY AUTHORIZED BY DIS–TRAN BEFORE ANY SUCH COST ARE INCURRED.

REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
4					
3					
2					
1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19

REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
8					
7					
6					
5					

DIS-TRAN Steel, LLC
P.O. BOX 5109•ALEXANDRIA, LA, 71307–5709
PHONE 318–448–0274•FAX 318–445–4454

WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

69KV TRANSMISSION POLE / ITEM – 19

SECTIONS & DETAILS (CONTINUED)

SCALE	DATE	JOB NUMBER	DRAWING NUMBER	REV. NO.
N.T.S.	07/12/19	19–9462P	E29	1

DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ

BLACK HILLS ENERGY

LANGE TO BEN FRENCH 69KV TRANSMISSION LINE

DRAWING LIST

DRAWING #	DRAWING DESCRIPTION
DL-01	DRAWING LIST
	ROUTE MAP
RM-01	ROUTE MAP
RM-04	ROUTE MAP
	PLAN AND PROFILE DRAWINGS
PP-01	STR LANGE – STR 8
PP-02	STR 39 – STR BF SUB
	STRUCTURE DETAILS
SD-01-1	SCHP-M2
SD-02-1	SCDE-69
SD-03-1	SCDE-69-2S
SD-04-1	TC-3PDE-ST
SD-05-1	DC-C3309-SDE
SD-06-1	TSZ-1
SD-07-1	TU-1, 1A, 1AA
SD-08-1	DT-01-69
	ASSEMBLY DETAILS
AD-01-1	T-4A,B,S, T-4D(S), T-4C
AD-02-1	T-4F, T-4FD, T-4FC
AD-03-1	T-FDL, T-FSC-1, T-FSC-2, T-FSC-3
AD-04-1	T-SP(1), T-BPD, T-PSD
AD-05-1	T-S4D, T-S4PD
AD-06-1	T-J4PD
AD-07-1	T-BDE6PD, T-SDE6PD, TM-EXT-15, T-BDE6D
AD-08-1	TM-9ST, TM-9SD, TM-9SSJ, TM-9
AD-09-1	TD-1, TD-2
AD-10-1	TG-26, TGS-1(A), TM-GM, TGS-2(A)
AD-11-1	TGS-OHG-1(A), TG-OHG-2(A), TA-P1, TA-2H, 3H, 5EXT
AD-12-1	TM-101 & TM-103, TP-A
AD-13-1	DPR-OPGW, DPR-795, DPR-EHS
AD-14-1	TM-SPS-2

DRAWING #	DRAWING DESCRIPTION
	LOAD AND DESIGN DETAILS
LD-13-1	STR 41, DESIGN DETAILS
LD-13-2	STR 41, DESIGN DETAILS
LD-13-3	STR 41, LOAD TREES
LD-13-4	STR 41, LOAD TREES
	GUYING DETAILS
TMG-01	STR 2C, STR 42C
	STAKING SHEETS
SS-01	STR SUB DE – STR BF SUB
	PHASING DIAGRAM
PH-01	PHASING DIAGRAM
	SAG TABLES 795 KCMIL 45/7 ACSR "TERN"
STC-01-1	STR SUB DE – STR 2C, STR 2C – STR 3, STR 41 – STR 42C, INITIAL
STC-02-1	STR 42C – STR 43C, FINAL
	SAG TABLES AFL CC-55/443 "DNO-4748" OPGW
STF-01-1	STR 41 – STR 42C, STR 42C – STR 43C, INITIAL
	SAG TABLES 3/8" 7 STRAND EHS
STS-01-1	STR SUB DE – STR 2C, STR 2C – STR 3, INITIAL
	MATERIAL LIST
ML-01-1	MATERIAL LIST
ML-01-2	MATERIAL LIST

1	REVISION
DESCRIPTION: MOVED STRUCTURE 41	
STATE NAME: DATE: REG. NO.:	
PROJECT #: 10114217	ISSUE DATE: 3/11/2020
PROJECT MANAGER: J. ELLSWORTH	
DESIGN ENGINEER: J. PANKRATZ	
DRAWN BY: Z. JANSEN	

2	REVISION
DESCRIPTION: RECORD DRAWINGS	
STATE NAME: DATE: REG. NO.:	
PROJECT #: 10114217	ISSUE DATE: 6/12/2020
PROJECT MANAGER: J. ELLSWORTH	
DESIGN ENGINEER: J. PANKRATZ	
DRAWN BY: G. NIKOLIC	

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

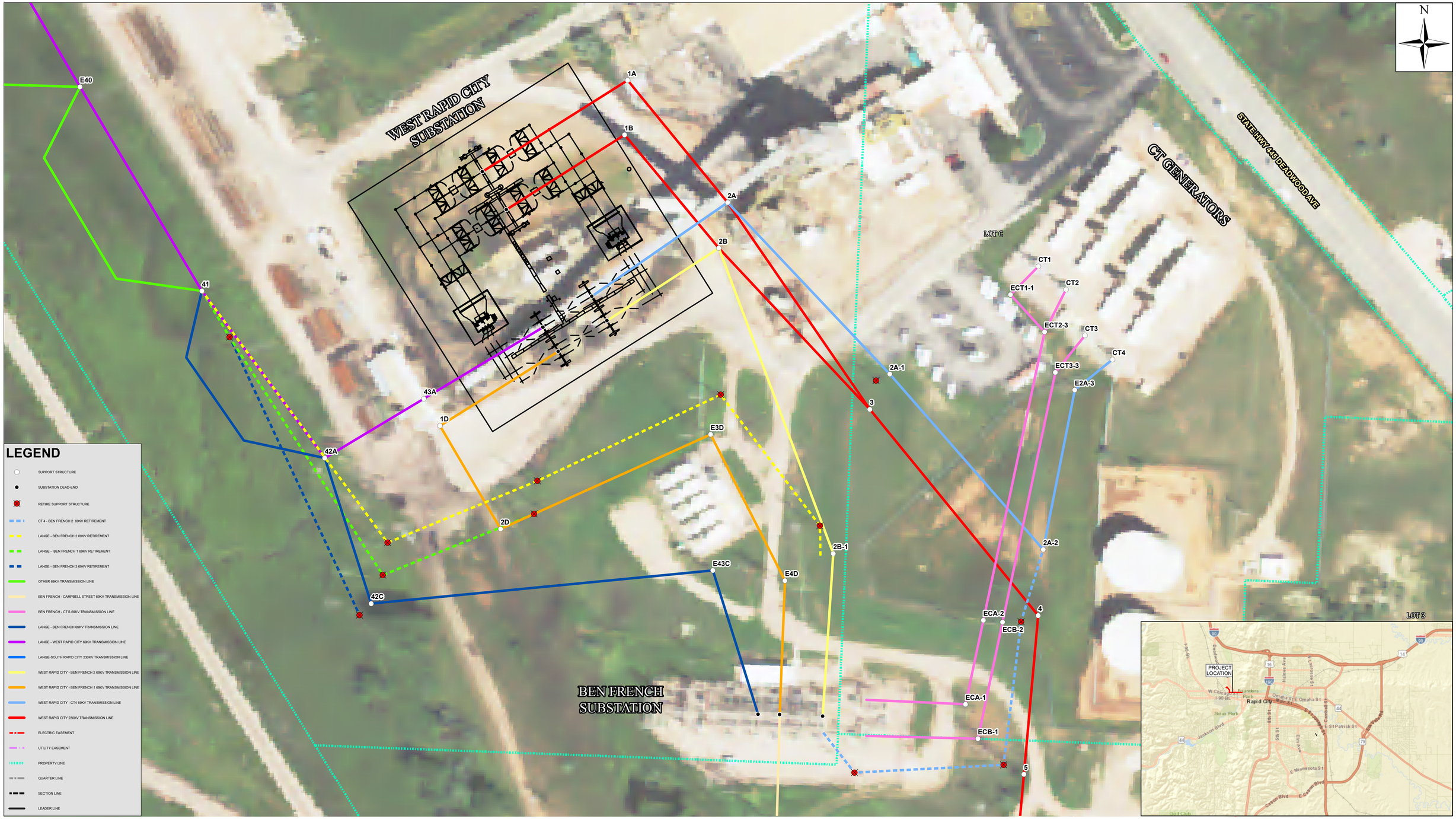
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - BEN FRENCH
69KV TRANSMISSION LINE

DRAWING LIST

0 1" 2"

FILENAME BHE-DL-01-01.DWG
SCALE NONE
SHEET DL-01



LEGEND

- SUPPORT STRUCTURE
- SUBSTATION DEAD-END
- RETIRE SUPPORT STRUCTURE
- CT 4 - BEN FRENCH 2 69KV RETIREMENT
- LANGE - BEN FRENCH 2 69KV RETIREMENT
- LANGE - BEN FRENCH 1 69KV RETIREMENT
- LANGE - BEN FRENCH 3 69KV RETIREMENT
- OTHER 69KV TRANSMISSION LINE
- BEN FRENCH - CAMPBELL STREET 69KV TRANSMISSION LINE
- BEN FRENCH - CT'S 69KV TRANSMISSION LINE
- LANGE - BEN FRENCH 69KV TRANSMISSION LINE
- LANGE - WEST RAPID CITY 69KV TRANSMISSION LINE
- LANGE-SOUTH RAPID CITY 230KV TRANSMISSION LINE
- WEST RAPID CITY - BEN FRENCH 2 69KV TRANSMISSION LINE
- WEST RAPID CITY - BEN FRENCH 1 69KV TRANSMISSION LINE
- WEST RAPID CITY - CT4 69KV TRANSMISSION LINE
- WEST RAPID CITY 230KV TRANSMISSION LINE
- ELECTRIC EASEMENT
- UTILITY EASEMENT
- PROPERTY LINE
- QUARTER LINE
- SECTION LINE
- LEADER LINE

Black Hills Energy
Improving life with energy

HDR

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	09/11/2019	ISSUE FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CADD TECHNICIAN	Z. JANSEN
GIS TECHNICIAN	S.GRIFFIN
PROJECT NUMBER	10114217

BLACK HILLS POWER
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
69KV TERMINATIONS

ROUTE MAP

0 20 40 80 Feet

FILENAME	West Rapid City 69kV Terminations 22x34
SCALE	1 inch = 50 feet

SHEET
RM-01



Black Hills Energy
Improving life with energy

HDR

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	09/11/2019	ISSUE FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CADD TECHNICIAN	Z. JANSEN
GIS TECHNICIAN	S.GRIFFIN
PROJECT NUMBER	10114217

BLACK HILLS POWER
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
69KV TERMINATIONS

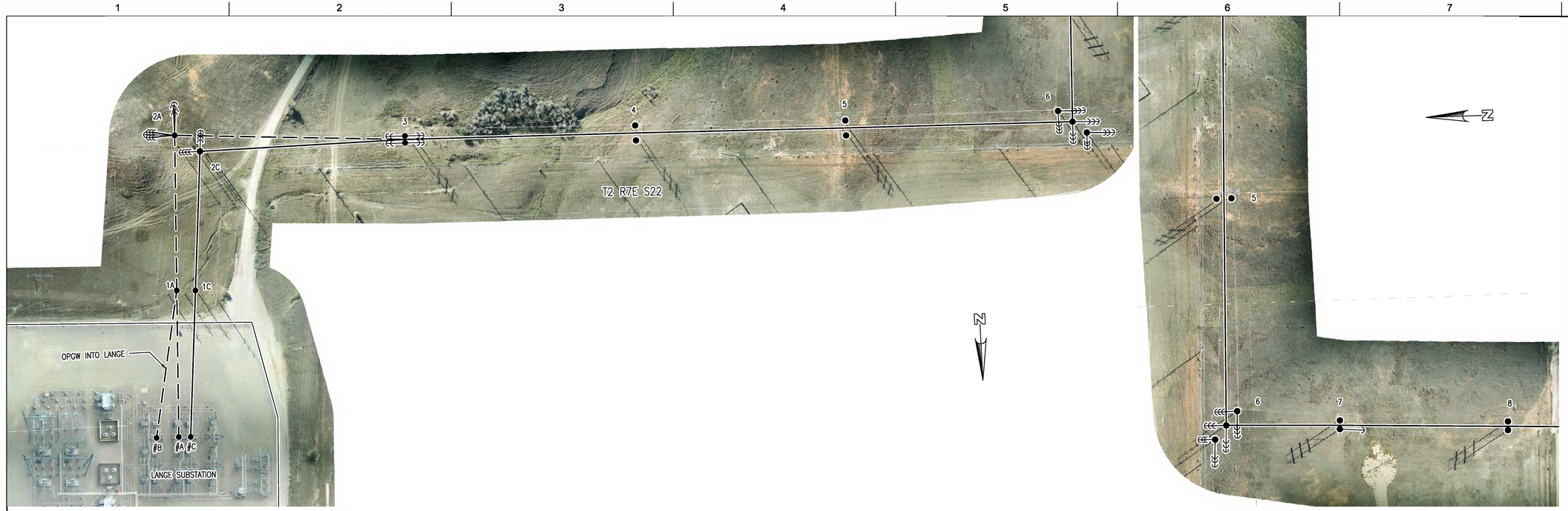
ROUTE MAP

0 50 100 200 Feet

FILENAME: West Rapid City 69kV Terminations 22x34

SCALE: 1 inch = 100 feet

SHEET
RM-04



PLAN NOTES:

- STRUCTURE
- ALIGNMENT
- ALIGNMENT OF ANOTHER LINE

NOTES:

1. [XXX] – EXISTING ASSEMBLY
2. *XXX – RETIREMENT ASSEMBLY
3. T[XXX] – TRANSFER UNIT ASSEMBLY
4. SHIELD WIRE SHOWN AT 60°F (CREEP)
5. CONDUCTOR SHOWN AT 212°F (MAX SAG)

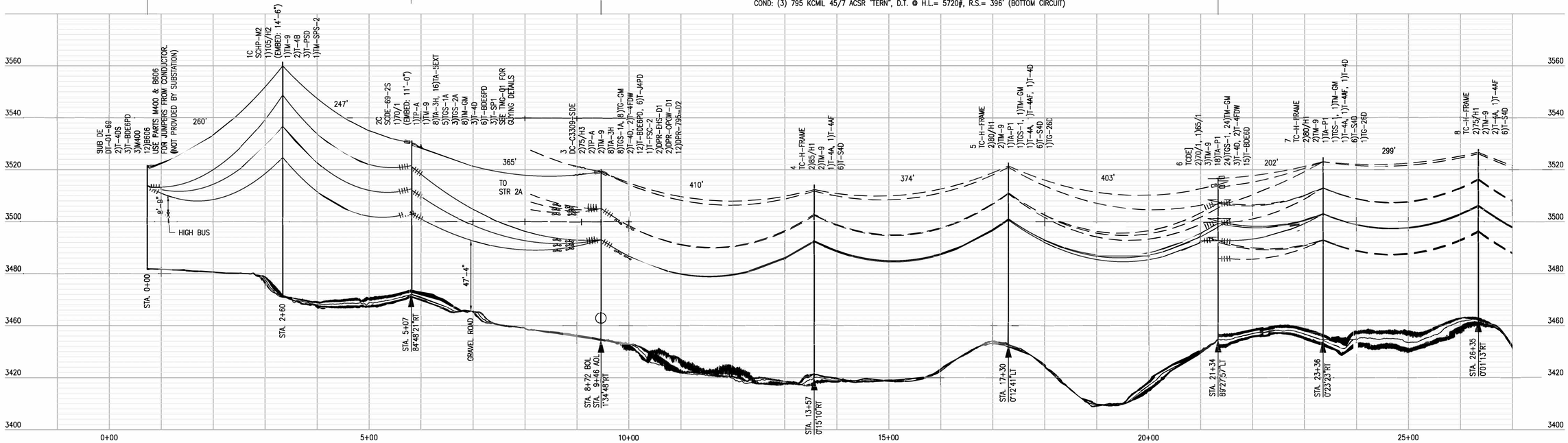
PROFILE NOTES:

- CONDUCTOR DAMPER
- SHIELD DAMPER
- OPGW SPLICE

SHIELD: (2) 3/8" 7 STRAND EHS, D.T. @ H.L.= 1500#, R.S.= 255'
COND: (3) 795 KCMIL 45/7 ACSR "TERN", D.T. @ H.L.= 2500#, R.S.= 255'

SHIELD: (1) 3/8" 7 STRAND EHS, D.T. @ H.L.= 2520#, R.S.= 365'
COND: (3) 795 KCMIL 45/7 ACSR "TERN", D.T. @ H.L.= 5815#, R.S.= 365'

SHIELD: (1) AFL CC-55/443 "DNO-4748" OPGW, D.T. @ H.L.= 2580#, R.S.= 388'
SHIELD: (1) 3/8" 7 STRAND HS, D.T. @ H.L.= 2615#, R.S.= 406'
COND: (3) 795 KCMIL 45/7 ACSR "TERN", D.T. @ H.L.= 5720#, R.S.= 396' (TOP CIRCUIT)
COND: (3) 795 KCMIL 45/7 ACSR "TERN", D.T. @ H.L.= 5720#, R.S.= 396' (BOTTOM CIRCUIT)



		PROJECT MANAGER	J. ELLSWORTH
		PROJECT ENGINEER	J. PANKRATZ
		DESIGN ENGINEER	J. PANKRATZ
		CAD TECHNICIAN	Z.JANSEN
2	6/12/2020	RECORD DRAWINGS	
0	9/11/2019	ISSUED FOR CONSTRUCTION	
ISSUE	DATE	DESCRIPTION	E. O. R. J. BRUNNER
			PROJECT NUMBER 10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - BEN FRENCH
69KV TRANSMISSION LINE

PLAN AND PROFILE

0 1" 2"

FILENAME BHE-PP-01-D-1.DWG
SCALE H:1"=100' V:1"=20'
SHEET PP-01



PLAN NOTES:

- STRUCTURE
- ALIGNMENT
- ALIGNMENT OF ANOTHER LINE

NOTES:

1. [XXX] – EXISTING ASSEMBLY
2. *XXX – RETIREMENT ASSEMBLY
3. T[XXX] – TRANSFER UNIT ASSEMBLY
4. SHIELD WIRE SHOWN AT 60°F (CREEP)
5. CONDUCTOR SHOWN AT 212°F (MAX SAG)

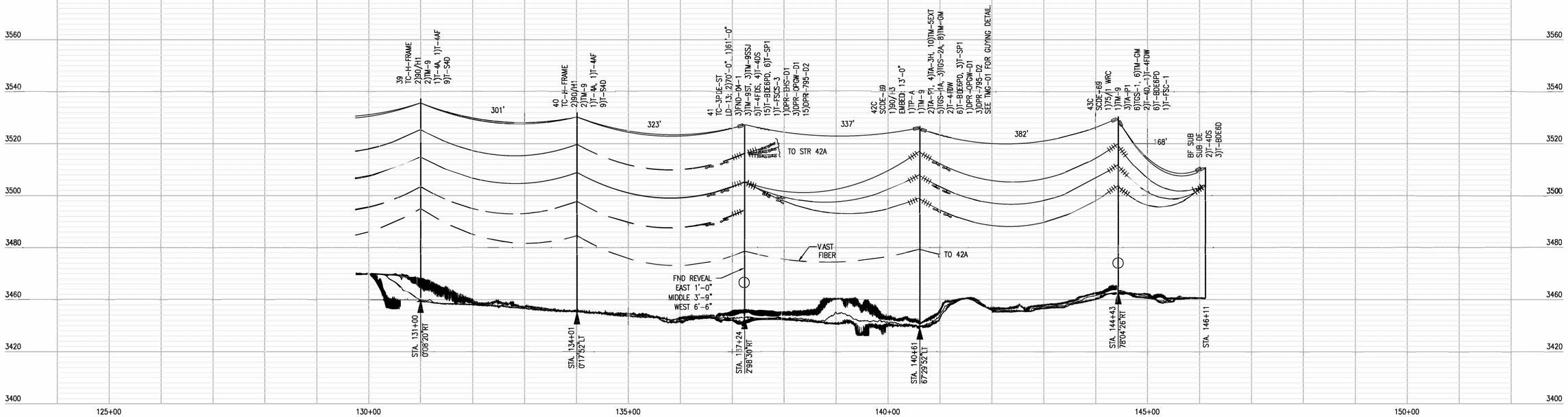
PROFILE NOTES:

- CONDUCTOR DAMPER
- SHIELD DAMPER
- OPGW SPLICE

SHIELD: (1) AFL CC-55/443 "DNO-4748" OPGW, D.T. @ H.L.= 2490#, R.S.= 392'
SHIELD: (1) 3/8" 7 STRAND HS, D.T. @ H.L.= 2460#, R.S.= 390'
COND: (3) 795 KCMIL 45/7 ACSR "TERN", D.T. @ H.L.= 6755#, R.S.= 390' (TOP CIRCUIT)
COND: (3) 795 KCMIL 45/7 ACSR "TERN", D.T. @ H.L.= 6870#, R.S.= 390' (MIDDLE CIRCUIT)
COND: (3) 795 KCMIL 45/7 ACSR "TERN", D.T. @ H.L.= 7130#, R.S.= 390' (BOTTOM CIRCUIT)

SHIELD: (1) AFL CC-55/443 "DNO-4748" OPGW, D.T. @ H.L.= 3095#, R.S.= 337'
COND: (3) 795 KCMIL 45/7 ACSR "TERN", D.T. @ H.L.= 7415#, R.S.= 337'
SHIELD: (1) AFL CC-55/443 "DNO-4748" OPGW, D.T. @ H.L.= 2565#, R.S.= 382'
COND: (3) 795 KCMIL 45/7 ACSR "TERN", D.T. @ H.L.= 4870#, R.S.= 382'

SHIELD: (1) 3/8" 7 STRAND HS, D.T. @ H.L.= 460#, R.S.= 168' (EAST)
SHIELD: (1) 3/8" 7 STRAND HS, D.T. @ H.L.= 475#, R.S.= 168' (WEST)
COND: (3) 795 KCMIL 45/7 ACSR "TERN", D.T. @ H.L.= 1145#, R.S.= 168'



ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	G. NIKOLIC
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

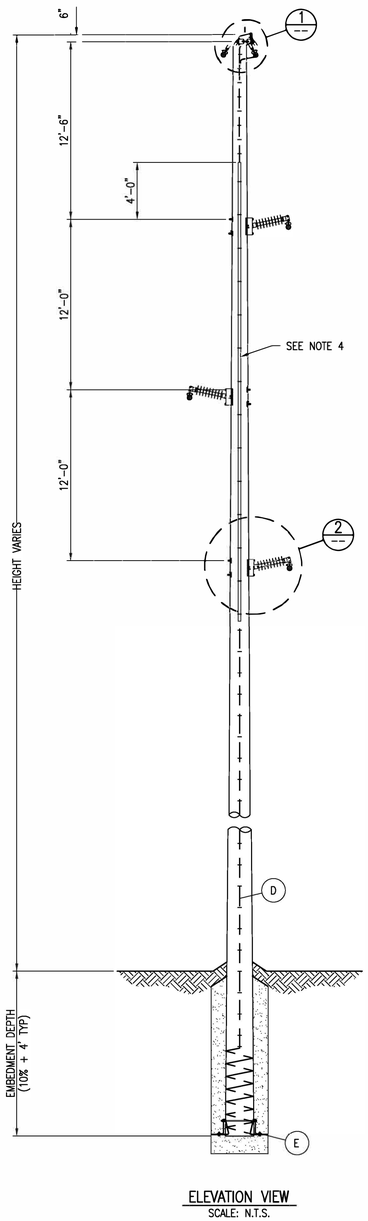
LANGE - BEN FRENCH
69KV TRANSMISSION LINE

PLAN AND PROFILE

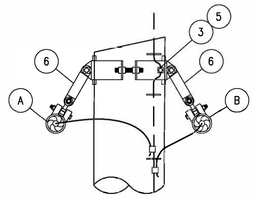
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FILENAME BHE-PP-01-D-1.DWG
SCALE H:1"=100' V:1"=20'

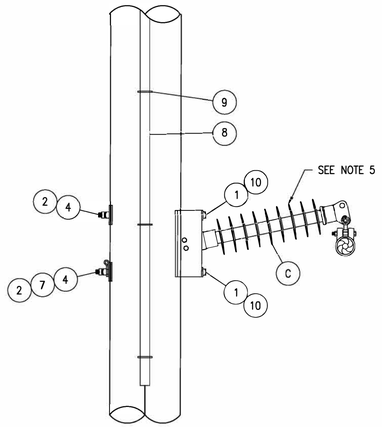
SHEET **PP-02**



ELEVATION VIEW
SCALE: N.T.S.



DETAIL 1
SHIELD
SCALE: N.T.S.



DETAIL 2
CONDUCTOR
SCALE: N.T.S.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	–	BOLT, MACHINE, 7/8" X REQ'D LENGTH	B270	HUGHES	–	6
1.1	20–7818	BOLT, MACHINE, 7/8" X 18"	B2718	HUGHES	B818–6	–
1.2	20–7820	BOLT, MACHINE, 7/8" X 20"	B2720	HUGHES	B820–6	–
1.3	20–7822	BOLT, MACHINE, 7/8" X 22"	B2722	HUGHES	B822–6	–
1.4	20–7824	BOLT, MACHINE, 7/8" X 24"	B2724	HUGHES	B824–6	–
2	22–7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	6
3	N.S.	3108 POLE BANDS, HEAVY DUTY, REQ'D POLE DIAMETER	–	HUGHES	–	1
3.1	18–1116	3108 POLE BANDS, HEAVY DUTY, 7"–10" POLE	F110	HUGHES	3108.5	–
3.2	18–1117	3108 POLE BANDS, HEAVY DUTY, 9"–12" POLE	F111	HUGHES	3108.6	–
4	22–4425	WASHER, SQ. CURVED, 4" X 1/4", 15/16" HOLE	W504	HUGHES	SCW4–80	6
5	46–2718	CLIP, BONDING, WITH 1/2" X 1 1/2" BOLT, 7/16" MAX. WIRE	P104	HUGHES	2718.55	1
6	14–3152	LINK, CONNECTING, 1/4" X 2" X 7 1/2", 15/16" HOLES, 24K LBS	F201	HUGHES	3152	4
7	N.S.	WASHER, SPRING, 15/16" HOLE	W207	HUGHES	2702.8	3
8	46–2503	MOULDING, GROUNDWIRE, 1–11/16" X 8'	P300	HUGHES	2503.8	4
9	46–2504	MOULDING STAPLES, 1–3/4" X 3–1/2"	P400	HUBBELL	C2050222	20
10	N.S.	WASHER, ROUND, 2" X 1/4", 15/16" HOLE	W410	HUGHES	RW2–80	6

TYPICAL ADDITIONAL ASSEMBLIES (CALLED OUT SEPARATELY)

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T–4B	OHSW SUSPENSION ASSEMBLY	1
B	T–4BF	OPGW SUSPENSION ASSEMBLY	1
C	T–PSD	69KV HORIZONTAL POST ASSEMBLY	3
D	TM–9	WOOD POLE GROUNDING	1
E	TP–A	POLE ANCHOR ASSEMBLY	1

TYPICAL BOLTS (QTY)*

ITEM NO.	POLE CLASS		
	2–1	H1–H2	H3–H4
1.1	4	2	–
1.2	2	2	2
1.3	–	2	2
1.4	–	–	2

*SEE NOTE 3

TYPICAL POLE BANDS (QTY)*

ITEM NO.	POLE CLASS		
	2–1	H1–H2	H3–H4
3.1	1	–	–
3.2	–	1	1

*SEE NOTE 3

NOTES:

1. DRILLED HOLES SHALL BE 1/16" GREATER THAN THE SPECIFIED BOLT DIAMETER.
2. FIELD DRILLED HOLES SHALL BE THOROUGHLY TREATED.
3. BOLT LENGTHS AND STATIC WIRE SUPPORT LENGTHS ARE ESTIMATED BASED ON STANDARD CLASS DOUGLAS FIR POLE DIMENSIONS. ACTUAL POLE DIAMETERS MAY VARY.
4. WOOD MOULDING SHALL BE STAPLED TO THE POLE WITH (5) STAPLES PER 8'–0" MOULDING STICK. FIRST STAPLES 6" FROM BOTH ENDS.
5. POLE GROUNDS, POLE ANCHORS AND STATIC/CONDUCTOR ASSEMBLIES ARE SEPARATE UNITS.

SHEET TITLE
TRANSMISSION STRUCTURE
69kV SINGLE CIRCUIT TANGENT W/ 2 SHIELDS
NON-TYPICAL

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: SCHP-M2

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

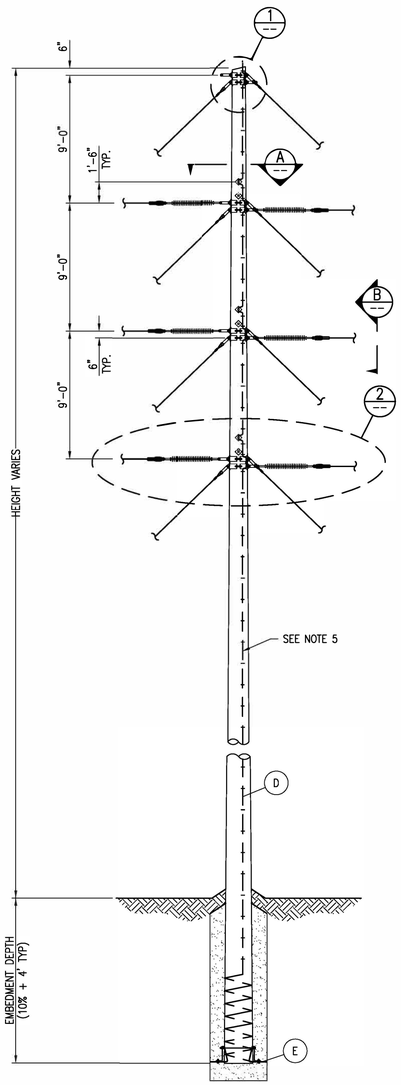
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - BEN FRENCH
69KV TRANSMISSION LINE

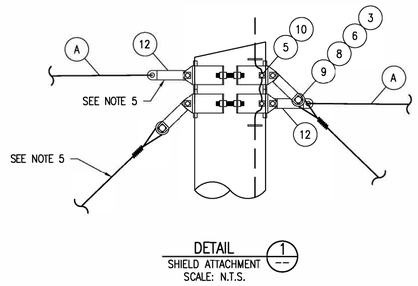
STRUCTURE DETAILS

0 1" 2"

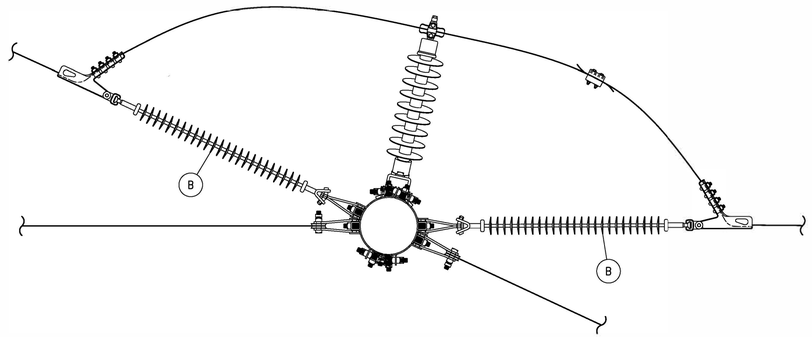
FILENAME: BHE–SD–01–D–1.DWG
SCALE: 3/16"=1'–0"
SHEET: **SD-01-1**



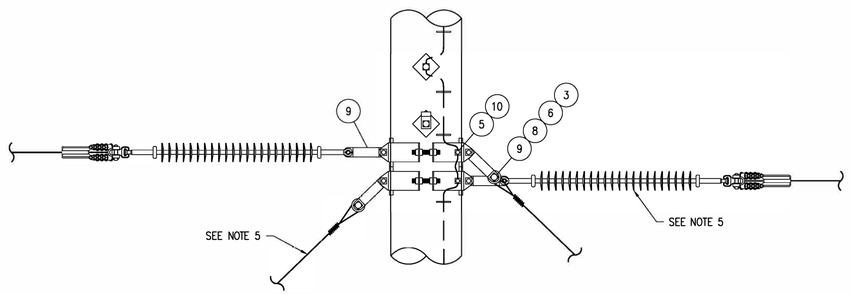
ELEVATION VIEW
SCALE: N.T.S.



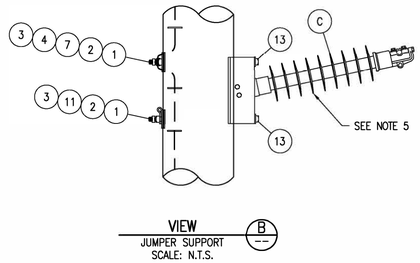
DETAIL 1
SHIELD ATTACHMENT
SCALE: N.T.S.



SECTION A
SCALE: N.T.S.



DETAIL 2
CONDUCTOR ATTACHMENT
SCALE: N.T.S.



VIEW B
JUMPER SUPPORT
SCALE: N.T.S.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY.
1	–	BOLT, MACHINE, 7/8" X REQ'D LENGTH	B270	HUGHES	–	6
1.1	20–7818	BOLT, MACHINE, 7/8" X 18"	B2718	HUGHES	B818–6	–
1.2	20–7820	BOLT, MACHINE, 7/8" X 20"	B2720	HUGHES	B820–6	–
1.3	20–7822	BOLT, MACHINE, 7/8" X 22"	B2722	HUGHES	B822–6	–
1.4	20–7824	BOLT, MACHINE, 7/8" X 24"	B2724	HUGHES	B824–6	–
2	22–4425	WASHER, SQ. CURVED, 4" X 1/4", 15/16" HOLE	W504	HUGHES	SCW4–80	6
3	22–7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	14
4	0407–0242	NUT, SQUARE, 7/8"	N107	HUGHES	N80	3
5	–	3108 POLE BANDS, HEAVY DUTY, REQ'D POLE DIAMETER	–	HUGHES	–	8
5.1	18–1116	3108 POLE BANDS, HEAVY DUTY, 7"–10" POLE	F110	HUGHES	3108.5	–
5.2	18–1117	3108 POLE BANDS, HEAVY DUTY, 9"–12" POLE	F111	HUGHES	3108.6	–
5.3	18–1118	3108 POLE BANDS, HEAVY DUTY, 11"–14" POLE	F112	HUGHES	3108.7	–
5.4	18–1119	3108 POLE BANDS, HEAVY DUTY, 13"–16" POLE	F113	HUGHES	3108.8	–
6	20–7803	BOLT, MACHINE, 7/8" X 3"	B273	HUGHES	B83–2	8
7	46–2728	CLIP, BONDING, FOR 7/8" DIA. BOLT, 5/16" MAX. WIRE	P207	HUGHES	2727.8	3
8	18–2808	GUY, ROLLER, 1 1/8" WR, 15/16" HOLE	G100	HUGHES	28082	8
9	14–3154	LINK, CONNECTING, 3/8" X 2" X 7 1/2", 15/16" HOLES, 38K LBS	F203	HUGHES	3154	28
10	46–2718	CLIP, BONDING, WITH 1/2" X 1 1/2" BOLT, 7/16" MAX. WIRE	P104	HUGHES	2718.55	8
11	N.S.	WASHER, SPRING, 15/16" HOLE	W207	HUGHES	2702.8	3
12	14–3152	LINK, CONNECTING, 1/4" X 2" X 7 1/2", 15/16" HOLES, 24K LBS	F201	HUGHES	3152	4
13	N.S.	WASHER, ROUND, 2" X 1/4", 15/16" HOLE	W410	HUGHES	RW2–80	6

TYPICAL ADDITIONAL ASSEMBLIES (CALLED OUT SEPARATELY)

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T–4D	OHSW DEADEND ASSEMBLY	2
	T–4FDW	OPGW DEADEND ASSEMBLY	
B	T–BDE6PD	CONDUCTOR DEADEND ASSEMBLY – POLYMER	6
	T–BDE6D	CONDUCTOR DEADEND ASSEMBLY – BELLS	
C	T–SP1	CONDUCTOR JUMPER ASSEMBLY	3
D	TM–9	WOOD POLE GROUNDING ASSEMBLY	1
E	TP–A	POLE ANCHOR ASSEMBLY	1

TYPICAL BOLTS (QTY)*

ITEM NO.	POLE CLASS		
	2–1	H1–H2	H3–H4
1.1	4	–	–
1.2	2	4	–
1.3	–	2	4
1.4	–	–	2

*SEE NOTE 3

TYPICAL POLE BANDS (QTY)*

ITEM NO.	POLE CLASS		
	2–1	H1–H2	H3–H4
5.1	2	–	–
5.2	4	2	2
5.3	2	4	2
5.4	–	2	4

*SEE NOTE 3

NOTES:

1. DRILLED HOLES SHALL BE 1/16" GREATER THAN THE SPECIFIED BOLT DIAMETER.
2. FIELD DRILLED HOLES SHALL BE THOROUGHLY TREATED.
3. BOLT LENGTHS AND POLE BAND DIAMETERS ARE ESTIMATED BASED ON STANDARD CLASS DOUGLAS FIR POLE DIMENSIONS. ACTUAL POLE DIAMETERS MAY VARY.
4. BOND ALL HARDWARE TO POLE GROUND UNIT.
5. POLE GROUND, GUYS, ANCHORS, POLE ANCHORS, JUMPER SUPPORT, AND STATIC/CONDUCTOR ASSEMBLIES ARE SEPARATE UNITS.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
69kV SINGLE CIRCUIT DEADEND
LIGHT TO HEAVY ANGLE WITH POST

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: SCDE-69

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

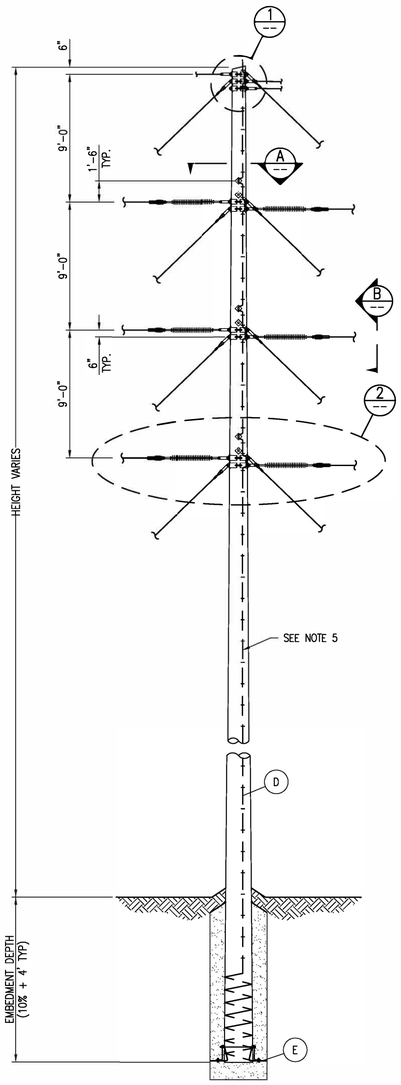
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - BEN FRENCH
69KV TRANSMISSION LINE

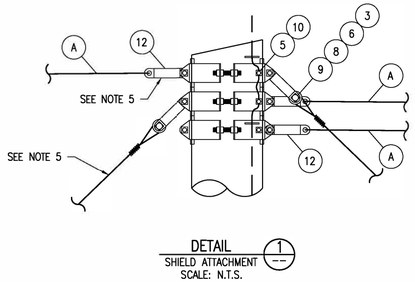
STRUCTURE DETAILS
69KV SINGLE CIRCUIT DEADEND

0 1" 2"

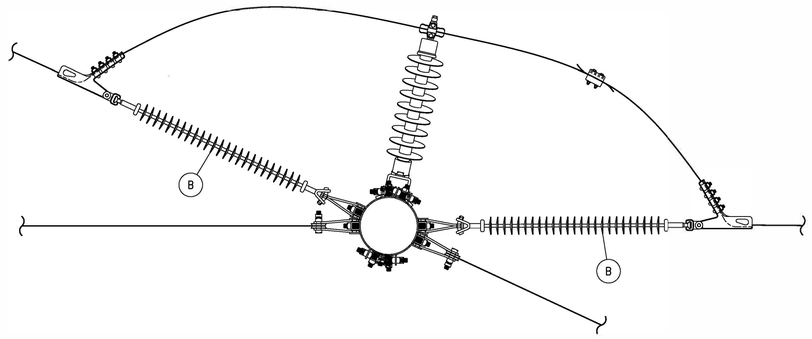
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SCALE: 3/16"=1'–0"
SHEET: SD-02-1



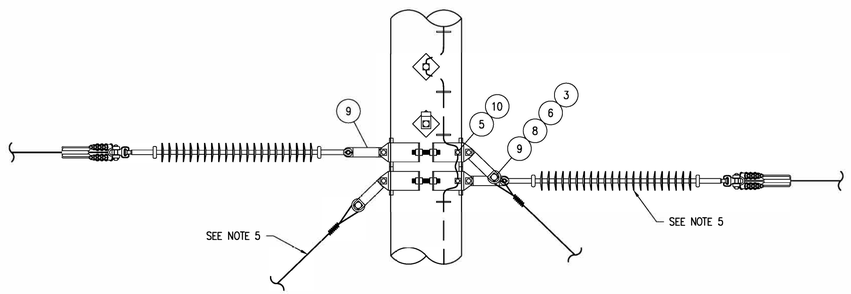
ELEVATION VIEW
SCALE: N.T.S.



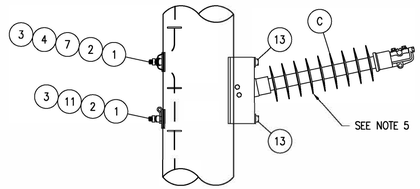
DETAIL 1
SHIELD ATTACHMENT
SCALE: N.T.S.



SECTION A
SCALE: N.T.S.



DETAIL 2
CONDUCTOR ATTACHMENT
SCALE: N.T.S.



VIEW B
JUMPER SUPPORT
SCALE: N.T.S.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY.
1	–	BOLT, MACHINE, 7/8" X REQ'D LENGTH	B270	HUGHES	–	6
1.1	20–7818	BOLT, MACHINE, 7/8" X 18"	B2718	HUGHES	B818–6	–
1.2	20–7820	BOLT, MACHINE, 7/8" X 20"	B2720	HUGHES	B820–6	–
1.3	20–7822	BOLT, MACHINE, 7/8" X 22"	B2722	HUGHES	B822–6	–
1.4	20–7824	BOLT, MACHINE, 7/8" X 24"	B2724	HUGHES	B824–6	–
2	22–4425	WASHER, SQ. CURVED, 4" X 1/4", 15/16" HOLE	W504	HUGHES	SCW4–80	6
3	22–7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	14
4	0407–0242	NUT, SQUARE, 7/8"	N107	HUGHES	N80	3
5	–	3108 POLE BANDS, HEAVY DUTY, REQ'D POLE DIAMETER	–	HUGHES	–	9
5.1	18–1116	3108 POLE BANDS, HEAVY DUTY, 7"–10" POLE	F110	HUGHES	3108.5	–
5.2	18–1117	3108 POLE BANDS, HEAVY DUTY, 9"–12" POLE	F111	HUGHES	3108.6	–
5.3	18–1118	3108 POLE BANDS, HEAVY DUTY, 11"–14" POLE	F112	HUGHES	3108.7	–
5.4	18–1119	3108 POLE BANDS, HEAVY DUTY, 13"–16" POLE	F113	HUGHES	3108.8	–
6	20–7803	BOLT, MACHINE, 7/8" X 3"	B273	HUGHES	B83–2	8
7	46–2728	CLIP, BONDING, FOR 7/8" DIA. BOLT, 5/16" MAX. WIRE	P207	HUGHES	2727.8	3
8	18–2808	GUY, ROLLER, 1 1/8" WR, 15/16" HOLE	G100	HUGHES	28082	8
9	14–3154	LINK, CONNECTING, 3/8" X 2" X 7 1/2", 15/16" HOLES, 38K LBS	F203	HUGHES	3154	28
10	46–2718	CLIP, BONDING, WITH 1/2" X 1 1/2" BOLT, 7/16" MAX. WIRE	P104	HUGHES	2718.55	9
11	N.S.	WASHER, SPRING, 15/16" HOLE	W207	HUGHES	2702.8	3
12	14–3152	LINK, CONNECTING, 1/4" X 2" X 7 1/2", 15/16" HOLES, 24K LBS	F201	HUGHES	3152	6
13	N.S.	WASHER, ROUND, 2" X 1/4", 15/16" HOLE	W410	HUGHES	RW2–80	6

TYPICAL ADDITIONAL ASSEMBLIES (CALLED OUT SEPARATELY)

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T–4D	OHSW DEADEND ASSEMBLY	3
	T–4FDW	OPGW DEADEND ASSEMBLY	
B	T–BDE6PD	CONDUCTOR DEADEND ASSEMBLY – POLYMER	6
	T–BDE6D	CONDUCTOR DEADEND ASSEMBLY – BELLS	
C	T–SP1	CONDUCTOR JUMPER ASSEMBLY	3
D	TM–9	WOOD POLE GROUNDING ASSEMBLY	1
E	TP–A	POLE ANCHOR ASSEMBLY	1

TYPICAL BOLTS (QTY)*

ITEM NO.	POLE CLASS		
	2–1	H1–H2	H3–H4
1.1	4	–	–
1.2	2	4	–
1.3	–	2	4
1.4	–	–	2

*SEE NOTE 3

TYPICAL POLE BANDS (QTY)*

ITEM NO.	POLE CLASS		
	2–1	H1–H2	H3–H4
5.1	3	–	–
5.2	4	3	3
5.3	2	4	2
5.4	–	2	4

*SEE NOTE 3

NOTES:

1. DRILLED HOLES SHALL BE 1/16" GREATER THAN THE SPECIFIED BOLT DIAMETER.
2. FIELD DRILLED HOLES SHALL BE THOROUGHLY TREATED.
3. BOLT LENGTHS AND POLE BAND DIAMETERS ARE ESTIMATED BASED ON STANDARD CLASS DOUGLAS FIR POLE DIMENSIONS. ACTUAL POLE DIAMETERS MAY VARY.
4. BOND ALL HARDWARE TO POLE GROUND UNIT.
5. POLE GROUND, GUYS, ANCHORS, POLE ANCHORS, JUMPER SUPPORT, AND STATIC/CONDUCTOR ASSEMBLIES ARE SEPARATE UNITS.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
69kV SINGLE CIRCUIT DEADEND W/ 2 SHIELDS ONE WAY
LIGHT TO HEAVY ANGLE WITH POST

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: SCDE-69-2S

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

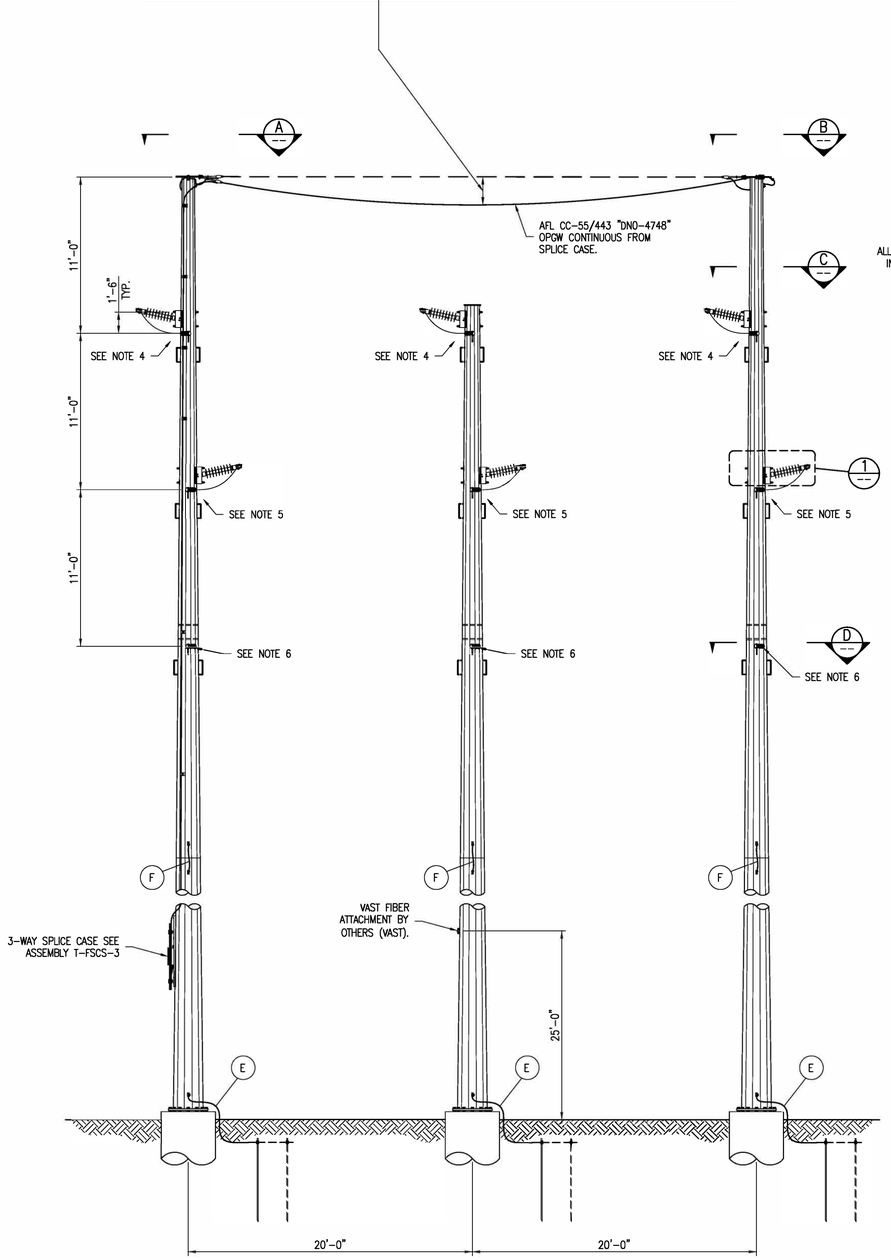
LANGE - BEN FRENCH
69KV TRANSMISSION LINE

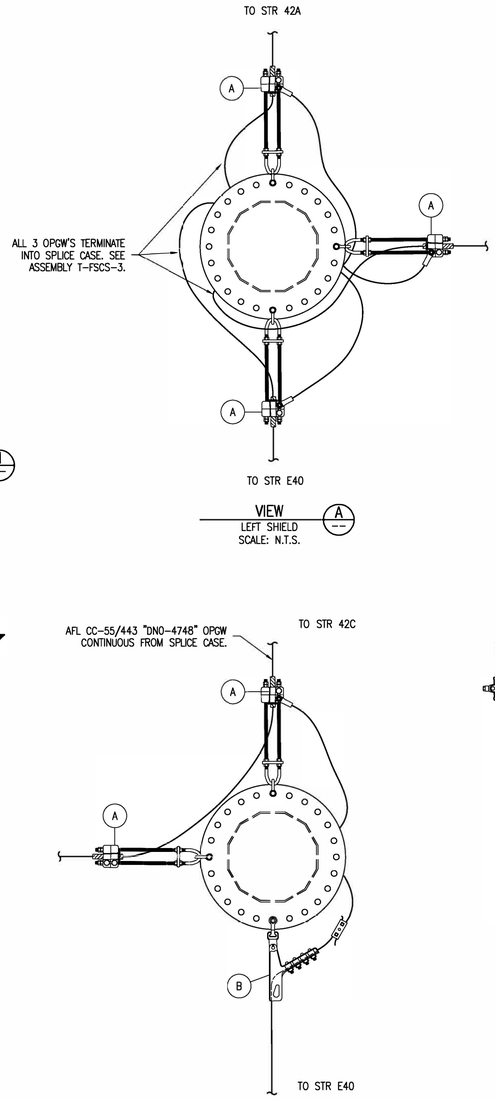
STRUCTURE DETAILS
69KV SINGLE CIRCUIT DEADEND
W/ 2 SHIELDS ONE WAY

0 1" 2"

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SCALE: 3/16"=1'–0"
SHEET: **SD-03-1**

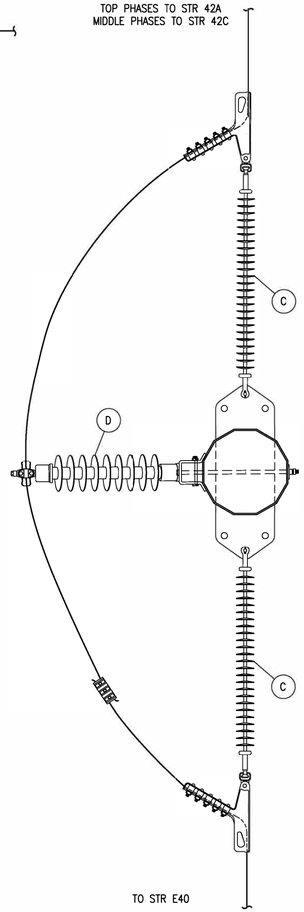
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SAG (FT)	0.65	0.66	0.68	0.70	0.72	0.74	0.75	0.77



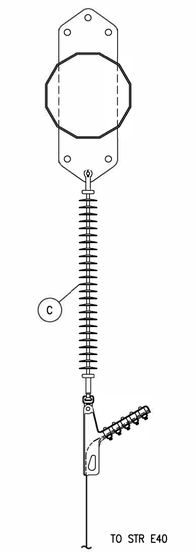


VIEW A
LEFT SHIELD
SCALE: N.T.S.

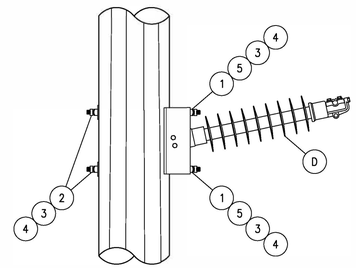
SECTION B
RIGHT SHIELD
SCALE: N.T.S.



SECTION C
TOP PHASES
MIDDLE PHASES
SCALE: N.T.S.



SECTION D
BOTTOM PHASE
SCALE: N.T.S.



DETAIL 1
JUMPER POST
SCALE: N.T.S.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY.
1	N.S.	ROD, FULL THREADED, 7/8" X 120", ASTM A307 GRADE B	D17120	PORTLAND BOLT	13919-10'	4
2	N.S.	WASHER, SQUARE, 4" X 1/4", 15/16" HOLE	W322	HUGHES	SCW4-80	12
3	47-0242	NUT, SQUARE, 7/8"	N107	HUGHES	N80	24
4	22-7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	24
5	N.S.	WASHER, ROUND, 2" X 1/4", 15/16" HOLE	W410	HUGHES	RW2-80	12

TYPICAL ADDITIONAL ASSEMBLIES (CALLED OUT SEPARATELY)

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T-4FDS	OPGW DEADEND ASSEMBLY - STEEL POLE	5
B	T-4DS	OHSW DEADEND ASSEMBLY - STEEL POLE	1
C	T-BDE6PD	CONDUCTOR DEADEND ASSEMBLY	15
D	T-SP1	CONDUCTOR JUMPER ASSEMBLY	6
E	TM-9ST	GROUNDING ASSEMBLY	3
F	TM-9SSJ	STEEL POLE SLIP JOINT GROUNDING	3

NOTES:
1. ONE (1) STICK OF 7/8" X 10'-0" THREADED ROD PER 1.5 INSULATOR ATTACHMENT. CUT TO LENGTH.
2. SEE LOAD AND DESIGN DRAWINGS FOR STEEL DESIGN DETAILS.
3. SEE STEEL POLE MANUFACTURING DRAWINGS FOR STEEL POLE DETAILS.
4. TOP PHASES ARE BEING RECONFIGURED TO THE LANGE – WEST RAPID CITY 69KV TRANSMISSION LINE. CONDUCTORS SPAN AHEAD ON LINE TO STR 42A.
5. MIDDLE PHASES ARE BEING RECONFIGURED TO THE LANGE – BEN FRENCH 2 69KV TRANSMISSION LINE. CONDUCTORS SPAN AHEAD ON LINE TO STR 42C.
6. BOTTOM PHASES ARE BEING RECONFIGURED AND TERMINATING ON THIS STRUCTURE. BHE WILL BE RETIRING THE BOTTOM 3 PHASES IN THE FUTURE.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
69kV TRIPLE CIRCUIT 3-POLE DEADEND - STEEL POLE
LIGHT TO HEAVY ANGLE WITH POST

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: TC-3PDE-ST

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

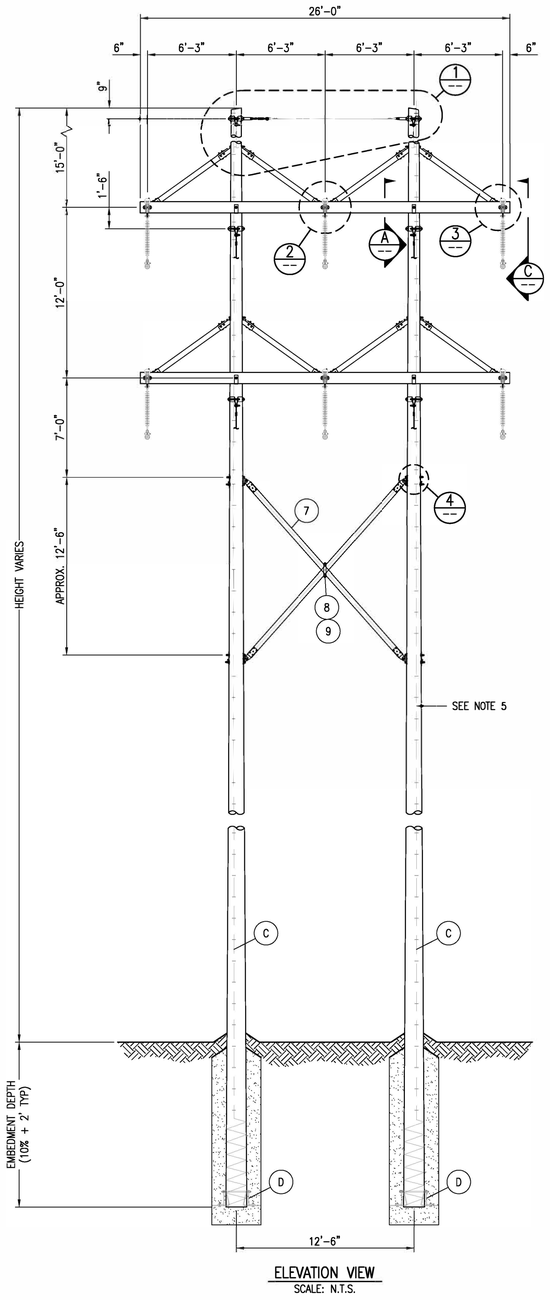
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - BEN FRENCH
69KV TRANSMISSION LINE

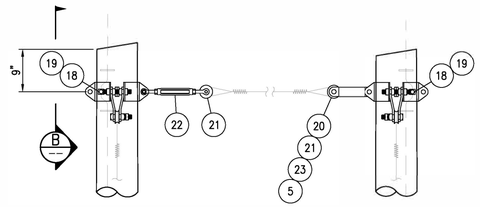
STRUCTURE DETAILS
69KV TRIPLE CIRCUIT 3-POLE
DEADEND - STEEL POLE
STR 39

0 1" 2"

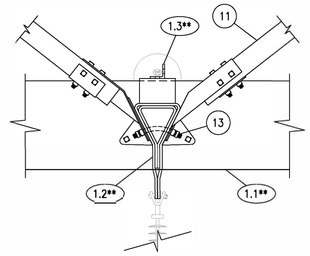
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SHEET: SD-04-1



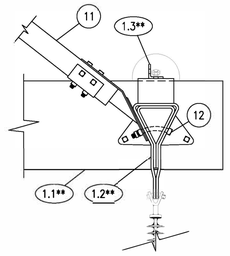
ELEVATION VIEW
SCALE: N.T.S.



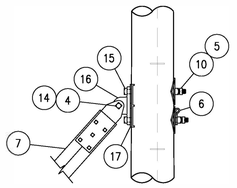
DETAIL (1)
SHIELD WITH VEE BRACE ATTACHMENT
SCALE: N.T.S.



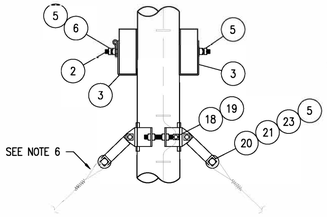
DETAIL (2)
ADJUSTABLE SPACER – MIDDLE PHASE
SCALE: N.T.S.



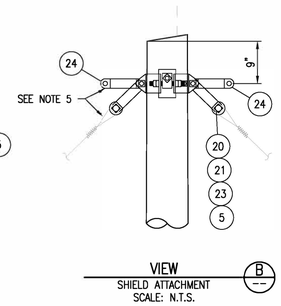
DETAIL (3)
ADJUSTABLE SPACER – END PHASE
SCALE: N.T.S.



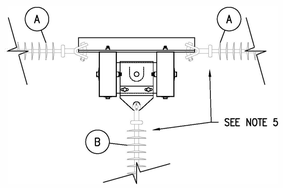
DETAIL (4)
X-BRACE CONNECTION
SCALE: N.T.S.



SECTION (A)
PHASE CROSSARM ATTACHMENT
SCALE: N.T.S.



VIEW (B)
SHIELD ATTACHMENT
SCALE: N.T.S.



VIEW (C)
CONDUCTOR ATTACHMENT
SCALE: N.T.S.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	CROSSARM ASSY. 5 5/8" X 7 1/2" X 26'-0"	X104	HUGHES	C3309.12A	2
1.1	–	CROSSARM, 5 5/8" X 7 1/2" X 26'-0"	–	HUGHES	–	4**
1.2	–	ADJUSTABLE SPACER ASSY.		HUGHES	3414.4PF-100	6**
1.3	–	AS2419.1A ANGLE, 3/8" X 3" X 3" X 24 1/2"		HUGHES	AS2419.1A	6**
2	N.S.	ROD, THREADED, DOUBLE END, 7/8" X REQ'D LENGTH, W/2 NUTS	D270	HUGHES	–	4
2.1	N.S.	ROD, THREADED, DOUBLE END, 7/8" X 28", W/2 NUTS	D2728	HUGHES	TR828-5	–
2.2	N.S.	ROD, THREADED, DOUBLE END, 7/8" X 30", W/2 NUTS	D2730	HUGHES	TR830-5	–
2.3	N.S.	ROD, THREADED, DOUBLE END, 7/8" X 32", W/2 NUTS	D2732	HUGHES	TR832-5	–
2.4	N.S.	ROD, THREADED, DOUBLE END, 7/8" X 34", W/2 NUTS	D2734	HUGHES	TR833-5	–
3	N.S.	POLE GAIN FITTING, 5 5/8" X 7 1/2" CROSSARM, 15/16" HOLE	V170	HUGHES	A783.1Y-15	8
4	N.S.	BOLT, MACHINE, 1" X 3 1/2"	B283.5	HUGHES	B103-1/2-2-1/2	4
5	22-7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	33
6	N.S.	WASHER, SPRING, 15/16" HOLE	W207	HUGHES	2702.8	12
7	N.S.	SET 2096-12-6 X-BRACE, 12'-6" POLE SPACING, 4 5/8 X 5 5/8	Y101	HUGHES	2096-12-6	1
8	N.S.	2840.1E CENTER CLAMP ROD	Y101A	HUGHES	2840.1E	2
9	N.S.	2087.4A CENTER CLAMP STRAP	Y101B	HUGHES	2087.4A	2
10	N.S.	WASHER, CURVED, 4" X 1/4", 15/16" HOLE	W602	HUGHES	CW80	8
11	N.S.	2025-BDV-86 VEE BRACE, 7'-2" CC HOLES, 6'-7" W.L., 37-1/2' & 52-1/2' FITTINGS	Y200	HUGHES	2025-BDV-86	8
12	N.S.	BOLT, BENT, 7/8" X 6"	E576	HUGHES	2722.1B-B	4
13	N.S.	BOLT, BENT STUD, 7/8" X 8"	E676	HUGHES	2722.1D-B	2
14	N.S.	NUT, LOCK, MF TYPE, 1"	N408	HUGHES	MF100	4
15	N.S.	BOLT, MACHINE, 7/8" X REQ'D LENGTH	B270	HUGHES	–	12
15.1	20-7814	BOLT, MACHINE, 7/8" X 14"	B2714	HUGHES	B814-6	–
15.2	20-7816	BOLT, MACHINE, 7/8" X 16"	B2716	HUGHES	B816-6	–
15.3	20-7818	BOLT, MACHINE, 7/8" X 18"	B2718	HUGHES	B818-6	–
15.4	20-7820	BOLT, MACHINE, 7/8" X 20"	B2720	HUGHES	B820-6	–
16	18-2817	TEE, DEAD END, 15/16" BOLT HOLE, 60K LBS	F900	HUGHES	2817-17	4
17	N.S.	GRID GAIN, 4 1/2" X 9" X 1/4", 31/32" HOLE, OUTER HOLES BONDED	V500	HUGHES	1260-AB2	4
18	N.S.	3108 POLE BANDS, HEAVY DUTY, REQ'D POLE DIAMETER	–	HUGHES	–	6
18.1	18-1116	3108 POLE BANDS, HEAVY DUTY, 7"-10" POLE	F110	HUGHES	3108.5	–
18.2	18-1117	3108 POLE BANDS, HEAVY DUTY, 9"-12" POLE	F111	HUGHES	3108.6	–
18.3	18-1118	3108 POLE BANDS, HEAVY DUTY, 11"-14" POLE	F112	HUGHES	3108.7	–
18.4	18-1119	3108 POLE BANDS, HEAVY DUTY, 13"-16" POLE	F113	HUGHES	3108.8	–
19	46-2718	CLIP, BONDING, WITH 1/2" X 1 1/2" BOLT, 7/16" MAX. WIRE	P104	HUGHES	2718.55	6
20	14-3154	LINK, CONNECTING, 3/8" X 2" X 7 1/2", 15/16" HOLES, 24K LBS	F203	HUGHES	3154	26
21	18-2808	GUY, ROLLER, 1 1/8" WR, 15/16" HOLE	G100	HUGHES	28082	14
22	N.S.	JAW & ROD END EYE TURNBUCKLE, 4/8" X 12"	H950	HUGHES	AS2545-D	1
23	20-7803	BOLT, MACHINE, 7/8" X 3"	B273	HUGHES	B83-2	13
24	14-3152	LINK, CONNECTING, 1/4" X 2" X 7 1/2", 15/16" HOLES, 24K LBS	F201	HUGHES	3152	8

TYPICAL ADDITIONAL ASSEMBLIES (CALLED OUT SEPARATELY)

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T-BDE6PD	CONDUCTOR BOLTED DEADEND – POLYMER	12
B	T-J4PD	JUMPER SUPPORT – POLYMER	6
C	TM-9	WOOD POLE GROUNDING ASSEMBLY	2
D	TP-A	POLE ANCHOR ASSEMBLY	2

TYPICAL THREADED ROD (QTY)*

ITEM NO.	POLE CLASS		
	2-1	H1-H2	H3-H4
2.1	2	–	–
2.2	2	2	–
2.3	–	2	2
2.4	–	–	2

*SEE NOTE 3

TYPICAL POLE BANDS (QTY)*

ITEM NO.	POLE CLASS		
	2-1	H1-H2	H3-H4
18.1	2	–	–
18.2	2	2	2
18.3	2	2	2
18.4	–	2	2

*SEE NOTE 3

SINGLE X TYPICAL BOLTS (QTY)*

ITEM NO.	POLE CLASS		
	2-1	H1-H2	H3-H4
15.1	6	2	–
15.2	4	4	2
15.3	2	6	4
15.4	–	–	6

*SEE NOTE 3

NOTES:

1. DRILLED HOLES SHALL BE 1/16" GREATER THAN THE SPECIFIED BOLT DIAMETER.
2. FIELD DRILLED HOLES SHALL BE THOROUGHLY TREATED.
3. POLE BANDS, BOLT LENGTHS AND THREADED ROD LENGTHS ARE ESTIMATED BASED ON STANDARD CLASS DOUGLAS FIR POLE DIMENSIONS. ACTUAL POLE DIAMETERS MAY VARY.
4. (**) IMPLIES ITEMS SUPPLIED BY ARM ASSEMBLY MANUFACTURER.
5. POLE GROUND, GUYS, ANCHORS, POLE ANCHORS, CROSS TIE, AND STATIC/CONDUCTOR ASSEMBLIES ARE SEPARATE UNITS.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
69KV DOUBLE CIRCUIT TANGENT DEADEND STRUCTURE

REFERENCE SHEET: **1 OF 1**
EXHIBIT NUMBER: **DC-C3309-SDE**

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
	J. PANKRATZ
	J. PANKRATZ
	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

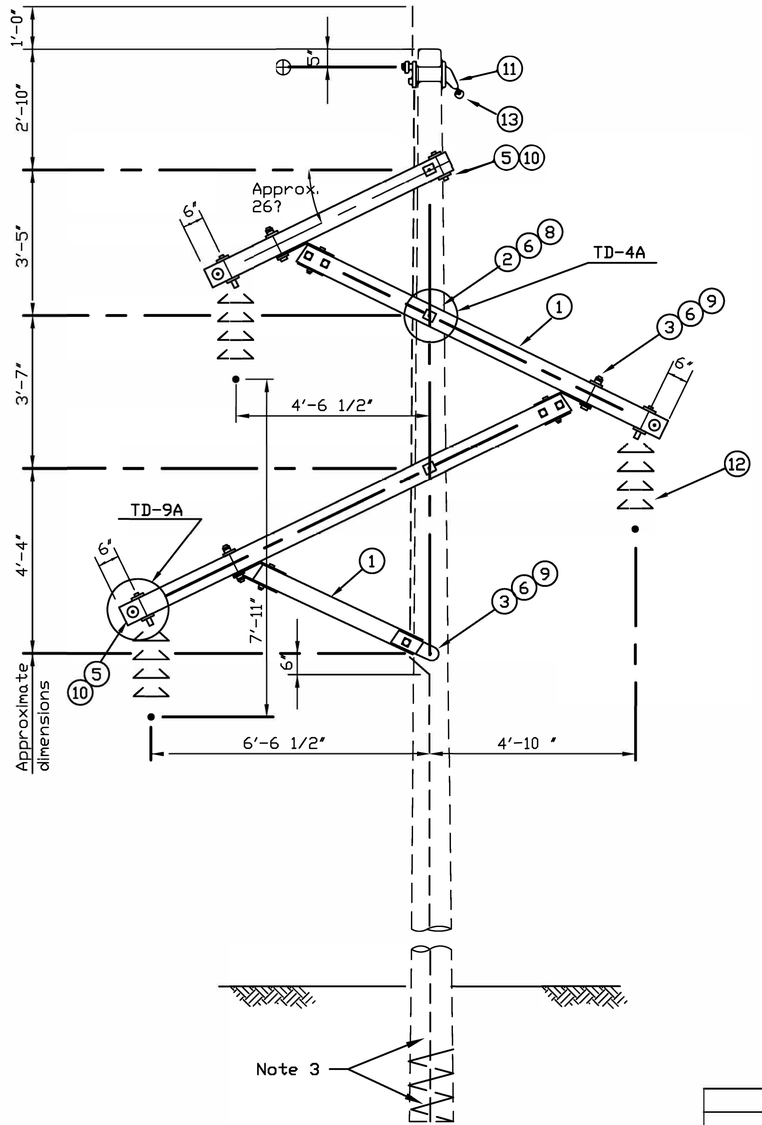
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - BEN FRENCH
69KV TRANSMISSION LINE

STRUCTURE DETAILS
69KV DC TANGENT DEADEND
STR 3

0 1" 2"

FILENAME: BHE-SD-05-D-1.DWG
SCALE: 3/16"=1'-0"
SHEET: **SD-05-1**



LIST OF MATERIALS

DWG. REF.	QTY.	DESCRIPTION	ITEM	DET.	CODE No.
1	1	X-Arm, Assembly, 3-5/8"x5-5/8", complete with brace and attaching hardware, fittings, and bolts			
2	3	3/4" Bolt, Machine, by req'd length			
3	4	5/8" Bolt, Machine, by req'd length			
4	3	5/8" Bolt, Shoulder Eye			
5	4	1/2" Bolt, Washer Head, w/Washer Nut			
6	10	Washer, Flat, 2-1/4"sq x3/16",13/16"h.			
7	3	Washer, Saddle, 13/16" hole			
8	6	3/4" Locknut, MF Type			
9	4	5/8" Locknut, MF Type			
10	4	1/2" Locknut, MF Type			
11	1	OHGW SUPPORT ASSEMBLY	–	TM-6__	
12	3	INSULATOR ASSEMBLY, TANGENT	–	TM-__A	
13	1	OHGW ASSEMBLY, TANGENT	–	TM-4__	

NOTES:

1. For other requirments, see REA specification T-5.
2. Drawing TE-1 gives guidance to subassembly alternatives.
3. The following materials are to be specified on the plan and profile drawings and staking sheets: POLES, POLE GROUNDING ASSEMBLY.

Reissued 03/98

TRANSMISSION LINE STRUCTURE

TANGENT WISHBONE–SINGLE ARM

(69 kV MAXIMUM)

NO.	REVISION	DATE
		Aug., 1986

TSZ–1

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - BEN FRENCH
69KV TRANSMISSION LINE

STRUCTURE DETAILS

0 1" 2"

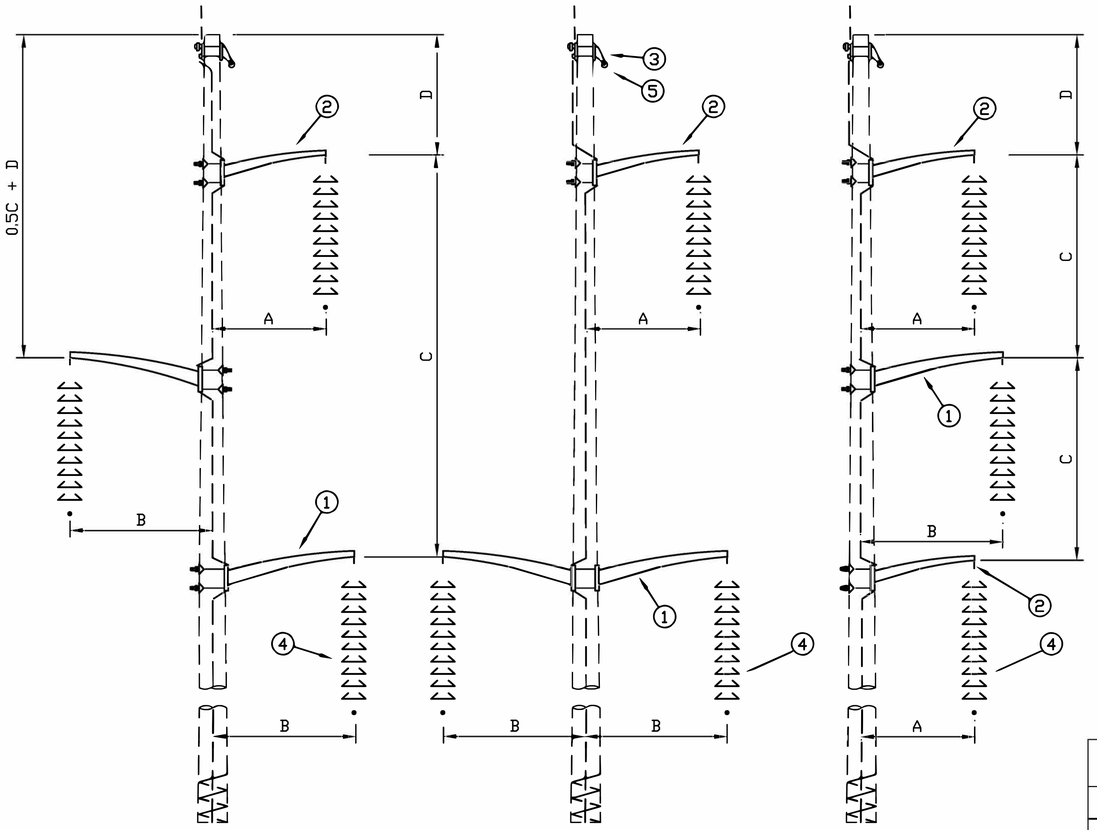
FILENAME BHE–SD–06–D–1.DWG

SCALE 3/16"=1'–0"

SHEET **SD-06-1**

	MINIMUM DIMENSIONS							
VOLTAGE	69 kv		115 kv		138 kv		161 kv	
A		4.0		6.0		7.0		8.0
B		5.0		7.0		8.0		9.0
C		7.0		9.0		10.0		12.0
D		4.5		6.5		7.5		9.0

	TU-		LIST OF MATERIALS			
DWG. REF.	1,1A	1AA	DESCRIPTION	ITEM	DET.	CODE No.
1	2	1	STEEL ARM ASS'Y_____Duty,___Ft.		TM-115_	
2	1	2	STEEL ARM ASS'Y_____Duty,___Ft.		TM-115_	
3	1	1	OHGW SUPPORT ASSEMBLY		TM-6__	
4	3	3	INSULATOR ASSEMBLY, TANGENT		TM-___	
5	1	1	OHGW ASSEMBLY, TANGENT		TM-4__	



NOTES:

1. For strength limitations and other assembly requirements, see REA Specification T-11.
2. Metal shims shall be used to adjust davit arms on uneven pole surfaces.
3. The following materials are to be specified on plan-profile drawings and staking sheets: POLES, POLE GROUNDING ASSEMBLY, AND ANY ADDITIONAL GROUNDING OR POLE FOUNDATION UNITS.

TRANSMISSION LINE STRUCTURE

STEEL UPSWEEP ARMS

(161 kv MAXIMUM)

Reissued 03/98

NO.	REVISION	DATE

Aug., 1986

TU-1,1A,1AA

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - BEN FRENCH
69KV TRANSMISSION LINE

STRUCTURE DETAILS

0 1" 2"

FILENAME BHE-SD-07-D-1.DWG

SCALE 3/16"=1'-0"

SHEET **SD-07-1**

LIST OF PARTS

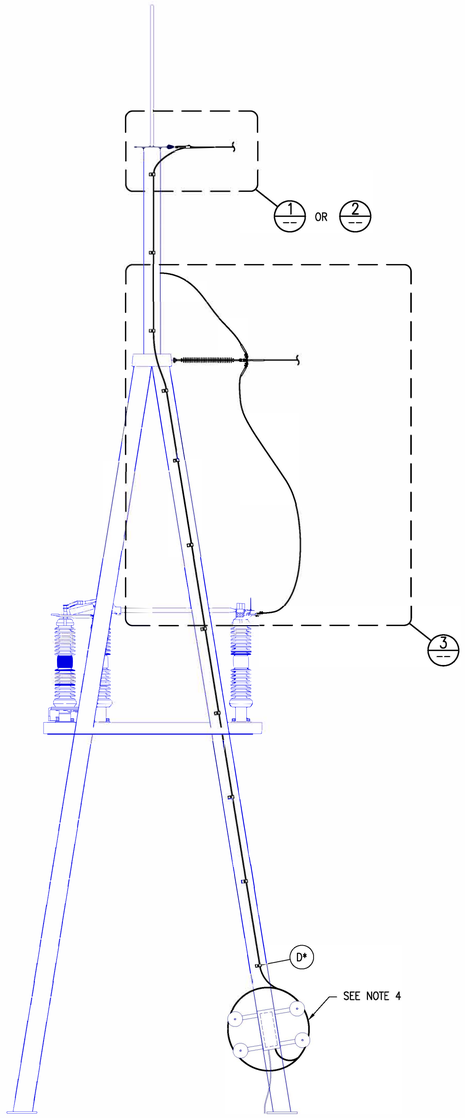
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	CLAMP, SINGLE BOLT, #4 STR CU TO 4/0 AWG STR. CU	Q551	HUBBELL	LC1602	1
2	N.S.	CLAMP, VISE TYPE, 3/8" EHS TO 4/0 AWG STR CU	Q552	HUBBELL	GA9040L55	1

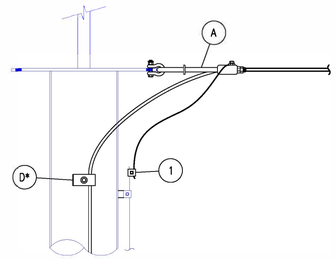
TYPICAL ADDITIONAL ASSEMBLIES (CALLED OUT SEPARATELY)

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T-4FDS	OPGW DEADEND ASSEMBLY - STEEL POLE	1
B	T-4D	OHSW DEADEND ASSEMBLY	1
C	T-SDE6PD	CONDUCTOR SUBSTATION DEADEND ASSEMBLY	3
D*	N/A	DOWNLEAD CLAMPS	AS REQ'D

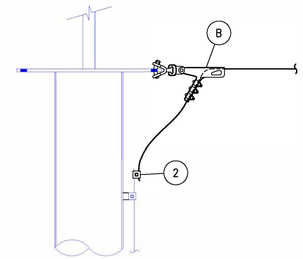
NOTES:

1. BLUE ASSEMBLIES ARE SUPPLIED AND INSTALLED BY THE SUBSTATION CONTRACTOR.
2. (*) ITEMS ARE SUPPLIED BY THE SUBSTATION CONTRACTOR AND INSTALLED BY THE TRANSMISSION CONTRACTOR.
3. MINIMUM BEND RADIUS FOR OPGW IS 9 INCHES.
4. COIL 50 FEET OF OPGW ON THE COIL BRACKET, CAP AND TAPE THE ENDS.
5. COORDINATE WITH SUBSTATION CONTRACTOR FOR PARTS SUPPLIED BY SUBSTATION.

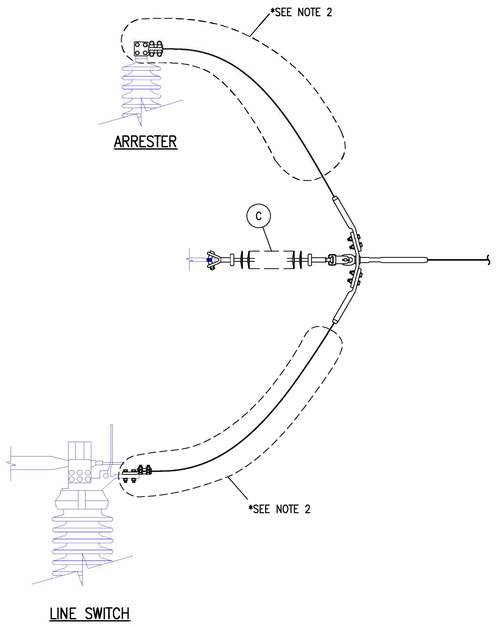




DETAIL 1
OPGW
SCALE: N.T.S.



DETAIL 2
OHSW
SCALE: N.T.S.



DETAIL 3
PHASE
SCALE: N.T.S.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
SUBSTATION DEADEND TOWER CONNECTION

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: DT-01-69

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - BEN FRENCH
69KV TRANSMISSION LINE

STRUCTURE DETAILS
SUBSTATION DEADEND TOWER CONNECTION

0 1" 2"

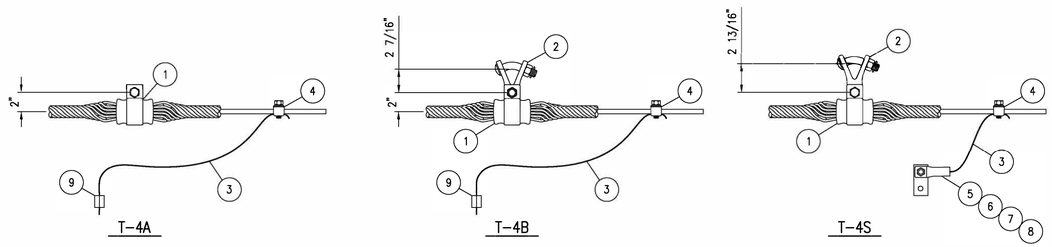
FILENAME: BHE-SD-08-D-1.DWG
SCALE: 3/16"=1'-0"
SHEET: **SD-08-1**

1 2 3 4 5 6 7 8

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4A QTY	T-4B QTY	T-4S QTY
1	40-7104	AGS SUSPENSION ASSY, 15K, 3/8" EHS	K400	PREFORMED	AGS-7104	1	1	1
2	48-5207	Y-CLEVIS - EYE, 90, 20K	H901	ANDERSON	YCS-05-90		1	1
3	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			2'	2'	6'
4	46-6810	CLAMP, SINGLE BOLT, VISE TYPE, 3/8" EHS TO #2 STR CU	Q550	HUBBELL	GA9020GLSS	1	1	1
5	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012			1
6	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207			1
7	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS			1
8	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD			1
9	36-0002	GROUND CLAMP, #2 STRANDED TO #4 SOLID	Q501	HOMAC	CC24	1	1	

*MAX. LINE ANGLE = 30°



OHSW SUSPENSION
3/8" EHS 7 STRAND GALV.

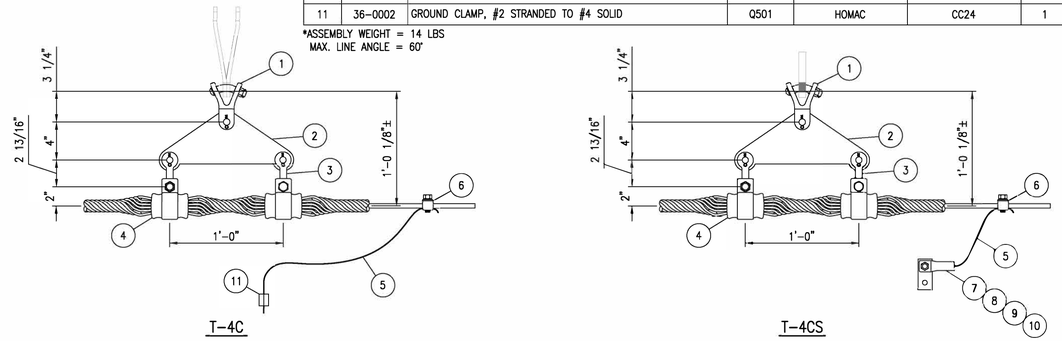
SHEET TITLE
TRANSMISSION ASSEMBLY
OHSW ATTACHMENT

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4A,B,S

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4C QTY	T-4CS QTY
1	48-5208	Y-CLEVIS, CLEVIS, 90, 3 1/4" LONG, 3/4" PIN, 30K	H801	HUBBELL	YCC3090	1	1
2	48-8510	AGS YOKE PLATE, 12" SPACING, 1/2" PLATE, 30K	H700	PREFORMED	YP-5907	1	1
3	48-5206	Y-CLEVIS, EYE, 20K	H900	ANDERSON	YCS-05	2	2
4	40-7804	AGS DOUBLE SUSPENSION ASSEMBLY, 15K, 3/8" EHS	K401	PREFORMED	AGS-7804	1	1
5	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			2'	6'
6	46-6810	CLAMP, SINGLE BOLT, VISE TYPE, 3/8" EHS TO #2 STR CU	Q550	HUBBELL	GA9020GLSS	1	1
7	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012		1
8	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207		1
9	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS		1
10	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD		1
11	36-0002	GROUND CLAMP, #2 STRANDED TO #4 SOLID	Q501	HOMAC	CC24	1	

*ASSEMBLY WEIGHT = 14 LBS
MAX. LINE ANGLE = 60°



OHSW DOUBLE SUSPENSION
3/8" EHS 7 STRAND GALV.

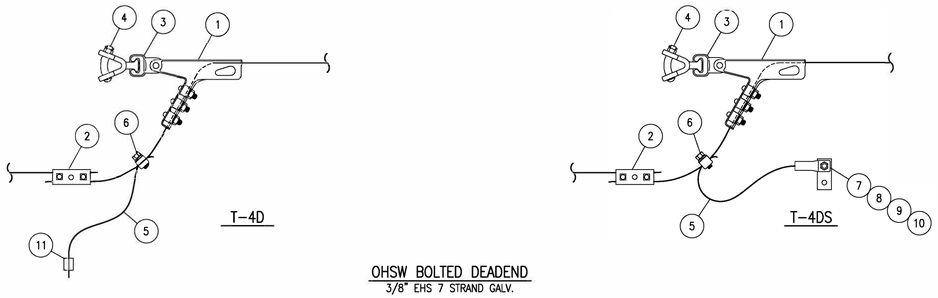
SHEET TITLE
TRANSMISSION ASSEMBLY
OHSW DOUBLE SUSPENSION

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4C

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4D QTY	T-4DS QTY
1	44-4053	STRAIN CLAMP, DE, 20K, 3/8" EHS	L300	HUBBELL	SWDE55N	1	1
2	18-5816	CLAMP, 3-BOLT, 6" LONG, 5/8" BOLT, 5/16" - 1/2" RANGE	Q100	MACLEAN	J931	1	1
3	N.S.	SOCKET EYE, 18K, 1/2" WIDTH, 11/16" HOLE, 2-1/16" LENGTH	H102	HUBBELL	SA04	1	1
4	48-3054	Y-CLEVIS BALL, 30K	H500	HUBBELL	YBC30	1	1
5	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			2'	6'
6	46-6810	CLAMP, SINGLE BOLT, VISE TYPE, 3/8" EHS TO #2 STR CU	Q550	HUBBELL	GA9020GLSS	1	1
7	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012		1
8	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207		1
9	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS		1
10	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD		1
11	36-0002	GROUND CLAMP, #2 STRANDED TO #4 SOLID	Q501	HOMAC	CC24	1	

*ONE ITEM (2) WILL BE REQUIRED FOR EVERY TWO ASSEMBLIES



OHSW BOLTED DEADEND
3/8" EHS 7 STRAND GALV.

SHEET TITLE
TRANSMISSION ASSEMBLY
OHSW DEADEND

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4D(S)

D C B A

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

Black Hills Energy
Improving life with energy

HDR

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - BEN FRENCH
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
OHSW ASSEMBLIES

0 1" 2"

FILENAME BHE-AD-01-D-1.DWG
SCALE N.T.S.

SHEET
AD-01-1

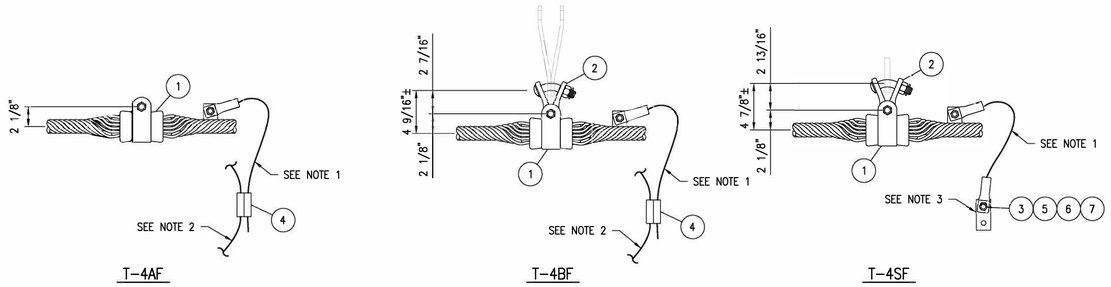
NOTES:

1. #4 STRANDED COPPER WITH CONNECTOR AND BOLTS. FURNISHED WITH ITEM 1.
2. WOOD POLE GROUND.
3. STEEL POLE NEMA PAD.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4AF QTY	T-4BF QTY	T-4SF QTY
1	N.S.	FIBERLIGN SUSPENSION ASSY, W/ GROUNDWIRE	J200	PREFORMED	4300104G	1	1	1
2	48-5207	Y-CLEVIS - EYE, 90, 20K	H901	ANDERSON	YCS-05-90		1	1
3	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012			1
4	N.S.	CONNECTOR, COMPRESSION #4 COPPER TO #4 COPPER	Q500	HOMAC	CC44	1	1	
5	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207			1
6	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS			1
7	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD			1

*MAX. LINE ANGLE = 30°



T-4AF T-4BF T-4SF

OPGW SUSPENSION
0.443" OPGW CABLE

SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW ATTACHMENT

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4F

NOTES:

1. #4 STRANDED COPPER WITH CONNECTOR AND BOLTS. FURNISHED WITH ITEM 1.
2. WOOD POLE GROUND.
3. STEEL POLE NEMA PAD.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4FDW QTY	T-4FDS QTY
1	N.S.	FIBER OPTIC DEADEND, 18" U-BOLT (48 FIBER), W/GROUNDWIRE	J300	PREFORMED	2801303G	1	1
2	N.S.	ANCHOR, SHACKLE, 3" LONG, 3/4" DIA., 7/8" DIA. PIN, 35K LBS	H602	HUGHES	2865-B3	1	1
3	N.S.	CONNECTOR, COMPRESSION #4 COPPER TO #4 COPPER	Q500	HOMAC	CC44	1	
4	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012		1
5	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207		1
6	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS		1
7	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD		1



T-4FDW T-4FDS

OPGW DEADEND
0.443" OPGW CABLE

SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW DEADEND

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4FD

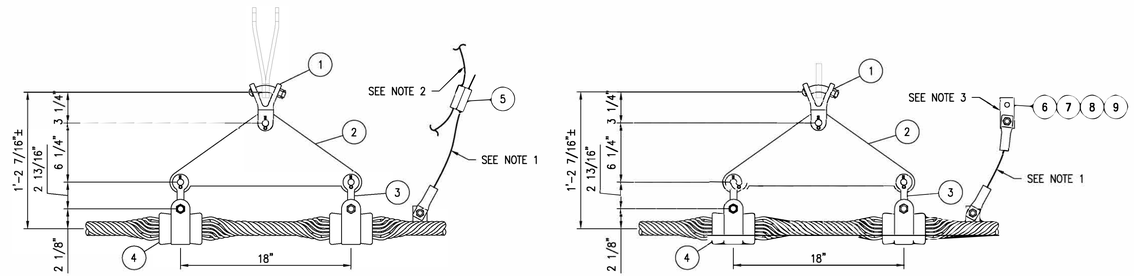
NOTES:

1. #4 STRANDED COPPER WITH CONNECTOR AND BOLTS. FURNISHED WITH ITEM 1.
2. WOOD POLE GROUND.
3. STEEL POLE NEMA PAD.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4FC QTY	T-4FCS QTY
1	48-5208	Y-CLEVIS, CLEVIS, 90, 3 1/4" LONG, 3/4" PIN, 30K	H801	HUBBELL	YCC3090	1	
2	48-8510	AGS YOKE PLATE, 18" SPACING, 1/2" PLATE, 30K	H702	HUGHES	AS2585-Z	1	1
3	48-5206	Y-CLEVIS, EYE, 20K	H900	ANDERSON	YCS-05	2	2
4	N.S.	FIBERLIGN DOUBLE SUSPENSION ASSY, W/ GROUNDWIRE	J201	PREFORMED	4300204G	1	1
5	N.S.	CONNECTOR, COMPRESSION #4 COPPER TO #4 COPPER	Q500	HOMAC	CC44	1	
6	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012		1
7	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207		1
8	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS		1
9	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD		1

*MAX. LINE ANGLE = 60°



T-4FC T-4FCS

OPGW DOUBLE SUSPENSION
0.433" OPGW CABLE

SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW DOUBLE SUSPENSION

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4FC

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - BEN FRENCH
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
OPGW ASSEMBLIES

0 1" 2"

FILENAME BHE-AD-02-D-1.DWG
SCALE N.T.S.

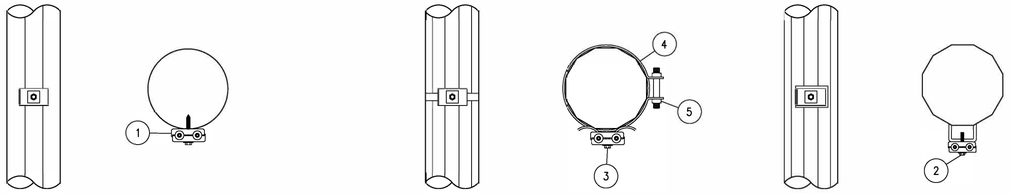
SHEET
AD-02-1

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-FDL-W QTY	T-FDL-S1 QTY	T-FDL-S2 QTY
1	N.S.	DOWNLEAD CUSHION KIT 0.443 OPGW W/ HARDWARE FOR WOOD POLE	J401	PREFORMED	8003041-H1	1	–	–
2	N.S.	DOWNLEAD CUSHION KIT, 0.443" OPGW W/ 1/2" -13 X 3" MOUNTING KIT	J403	PREFORMED	8003041-H3	–	–	1
3	N.S.	DOWNLEAD CUSHION KIT, 0.443" OPGW W/ BANDING BRACKET	J402	PREFORMED	8003041-B1	–	1	–
4	N.S.	BOLT-A-BAND, 3/4" X REQ'D LENGTH	J950	ALUMA-FORM	3/4-201-SSB-100	–	10'	–
5	N.S.	BUCKLE, BANDING, FOR 3/4" BANDING	J951	ALUMA-FORM	BAB-38	–	1	–

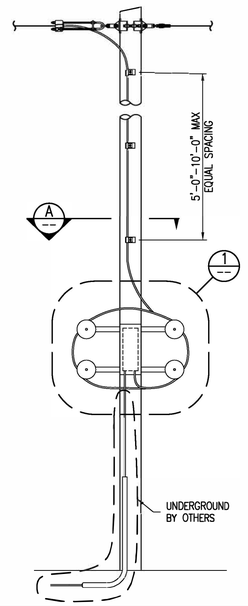
NOTES:

1. OPGW CONTINUOUS TO SPLICE BOX.
2. UNIT CONSISTS OF ONE DOWNLEAD CUSHION INSTALLED. SPECIFIC QUANTITY REQUIRED WILL VARY WITH STRUCTURE HEIGHT.



SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW DOWNLEAD

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-FDL

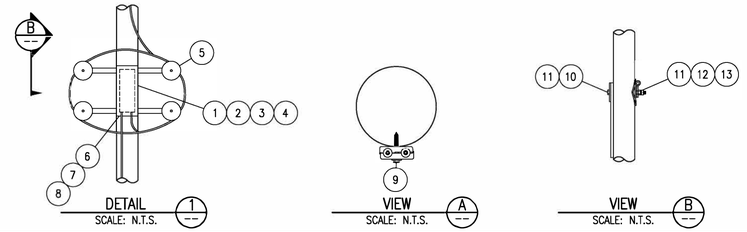


LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	6" X 22" COYOTE CLOSURE KIT W/ 6 PORT END PLATE	J510	PREFORMED	8006659	1
2	N.S.	SPLICE TRAY KIT, 36 COUNT TRAY	J600	PREFORMED	80805514	2
3	N.S.	VERTICAL MOUNTING BRACKET KIT	J502	PREFORMED	8003472	1
4	N.S.	COYOTE DEFENDER FOR 6"X 22" CLOSURE	J511	PREFORMED	8003492	1
5	N.S.	VERTICAL CABLE STORAGE ASSEMBLY	J501	PREFORMED	8003569	1
6	N.S.	CLOSURE END PLATE GROMMETS, 7/8" PORT, 0.443" OPGW	J700	PREFORMED	8003597	1
7	N.S.	FUTURE CABLE PORT KIT, 7/8" PORT	J720	PREFORMED	8003371	3
8	N.S.	GROMMET PLUG, 3/4" PORT, QTY 2	J730	PREFORMED	80806037	1
9	N.S.	DOWNLEAD CUSHION KIT 0.443 OPGW W/ HARDWARE FOR WOOD POLE	J401	PREFORMED	8003041-H1	10
10	N.S.	BOLT, MACHINE, 5/8" X REQ'D LENGTH	B250	HUGHES	–	2
11	N.S.	WASHER, SQUARE, 2" X 1/4", 11/16"	W304	HUGHES	SW2-60	4
12	N.S.	WASHER, SPRING, 11/16" HOLE	W205	HUGHES	2702.6	2
13	N.S.	NUT, LOCK, MF TYPE, 5/8"	N405	HUGHES	MF60	2

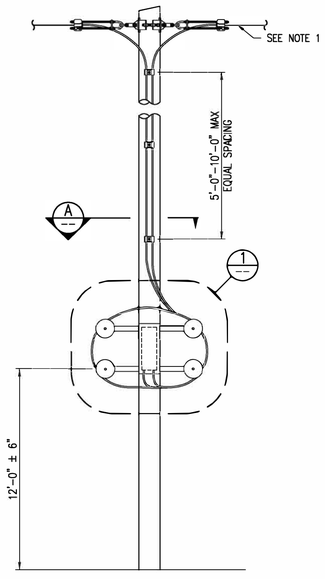
NOTES:

1. SEE T-FDL FOR MORE DETAIL.
2. OPGW CONTINUOUS TO SPLICE BOX.
3. COIL 50 FEET OF OPGW AROUND COIL BRACKET ON DOWNLEAD.



SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW SPLICE CASE - 1 OPGW
WOOD POLE

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-FSC-1

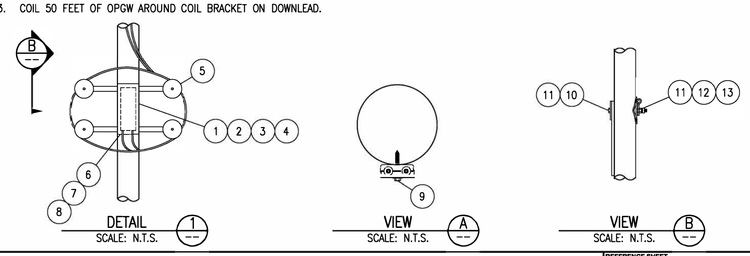


LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	6" X 22" COYOTE CLOSURE KIT W/ 6 PORT END PLATE	J510	PREFORMED	8006659	1
2	N.S.	SPLICE TRAY KIT, 36 COUNT TRAY	J600	PREFORMED	80805514	2
3	N.S.	VERTICAL MOUNTING BRACKET KIT	J502	PREFORMED	8003472	1
4	N.S.	COYOTE DEFENDER FOR 6"X 22" CLOSURE	J511	PREFORMED	8003492	1
5	N.S.	VERTICAL CABLE STORAGE ASSEMBLY	J501	PREFORMED	8003569	1
6	N.S.	CLOSURE END PLATE GROMMETS, 7/8" PORT, 0.443" OPGW	J700	PREFORMED	8003597	2
7	N.S.	FUTURE CABLE PORT KIT, 7/8" PORT	J720	PREFORMED	8003371	2
8	N.S.	GROMMET PLUG, 3/4" PORT, QTY 2	J730	PREFORMED	80806037	1
9	N.S.	DOWNLEAD CUSHION KIT 0.443 OPGW W/ HARDWARE FOR WOOD POLE	J401	PREFORMED	8003041-H1	10
10	N.S.	BOLT, MACHINE, 5/8" X REQ'D LENGTH	B250	HUGHES	–	2
11	N.S.	WASHER, SQUARE, 2" X 1/4", 11/16"	W304	HUGHES	SW2-60	4
12	N.S.	WASHER, SPRING, 11/16" HOLE	W205	HUGHES	2702.6	2
13	N.S.	NUT, LOCK, MF TYPE, 5/8"	N405	HUGHES	MF60	2

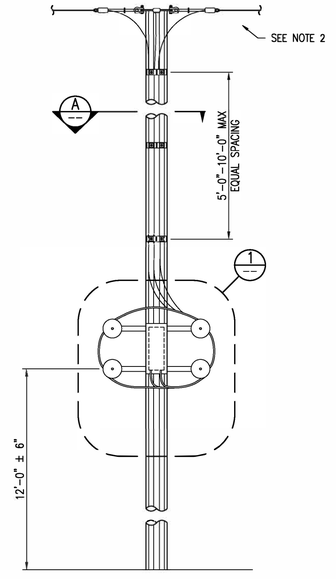
NOTES:

1. SEE T-FDL FOR MORE DETAIL.
2. OPGW CONTINUOUS TO SPLICE BOX.
3. COIL 50 FEET OF OPGW AROUND COIL BRACKET ON DOWNLEAD.



SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW SPLICE CASE - 2 OPGW
WOOD POLE

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-FSC-2

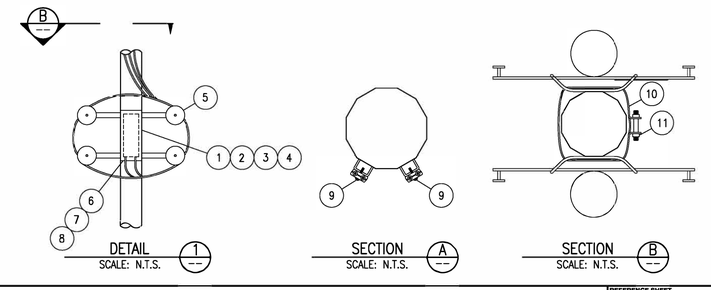


LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	6" X 22" COYOTE CLOSURE KIT W/ 6 PORT END PLATE	J510	PREFORMED	8006659	2
2	N.S.	SPLICE TRAY KIT, 36 COUNT TRAY	J600	PREFORMED	80805514	4
3	N.S.	VERTICAL MOUNTING BRACKET KIT	J502	PREFORMED	8003472	2
4	N.S.	COYOTE DEFENDER FOR 6"X 22" CLOSURE	J511	PREFORMED	8003492	2
5	N.S.	VERTICAL CABLE STORAGE ASSEMBLY	J501	PREFORMED	8003569	2
6	N.S.	CLOSURE END PLATE GROMMETS, 7/8" PORT, 0.443" OPGW	J700	PREFORMED	8003597	4
7	N.S.	FUTURE CABLE PORT KIT, 7/8" PORT	J720	PREFORMED	8003371	4
8	N.S.	GROMMET PLUG, 3/4" PORT, QTY 2	J730	PREFORMED	80806037	2
9	N.S.	DOWNLEAD CUSHION KIT, 0.443 OPGW W/ 1/2"-13 X 3" MOUNTING KIT	J403	PREFORMED	8003041-H3	28
10	N.S.	BOLT-A-BAND, 3/4" X REQ'D LENGTH	J950	ALUMA-FORM	3/4-201-SSB-100	60'
11	N.S.	BUCKLE, BANDING, FOR 3/4" BANDING	J951	ALUMA-FORM	BAB-38	2

NOTES:

1. OPGW CONTINUOUS TO SPLICE BOX.
2. COIL 50 FEET OF OPGW AROUND COIL BRACKET ON DOWNLEAD.



SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW SPLICE CASE - 3 OPGW
STEEL POLE

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-FSCS-3

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - BEN FRENCH
69KV TRANSMISSION LINE

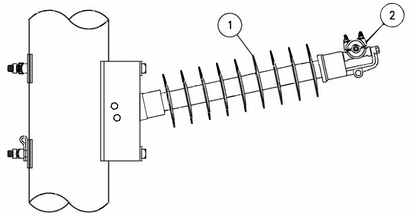
ASSEMBLY DETAILS
OPGW SPLICE DETAILS

0 1" 2"

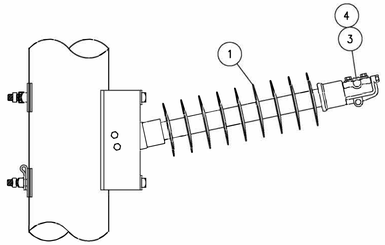
FILENAME BHE-AD-03-D-1.DWG
SCALE N.T.S.
SHEET **AD-03-1**

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-SP QTY	T-SP1 QTY
1	N.S.	INSULATOR, HORIZONTAL POST, CLAMPTOP, 69KV	I250	HUBBELL	P250043S1020	1	1
2	N.S.	AGS SUPPORT ASSEMBLY, 795 KCMIL 45/7 ACSR "TERN"	K350	PREFORMED	AGS-5227	1	–
3	48-7020	CLAMP, TRUNNION, 795 KCMIL 45/7 ACSR "TERN", 2,800 LBS	K300	HUBBELL	TSC150	–	1
4	N.S.	INHIBITOR, RUST (NO-OX-ID), 1 PT CAN, GRADE "A"	O102	SANCHEM INC	NO-OX-ID "A" SPECIAL	–	0.06



CONDUCTOR SUPPORT T-SP
795 ACSR-45/7 "TERN"



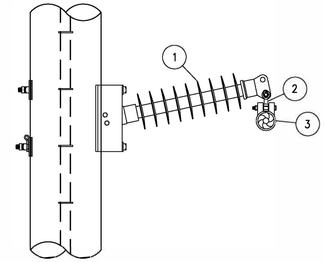
JUMPER SUPPORT T-SP1
795 ACSR-45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
69kV HORIZONTAL CLAMPTOP
795 ACSR - 45/7 "TERN"

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-SP(1)

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	INSULATOR, HORIZONTAL POST, DROP TONGUE, 69KV	I220	HUBBELL	P250043S0020	1
2	48-3053	Y-CLEVIS, EYE, 90, 40K	H902	HUBBELL	YCS-06-90-40	1
3	40-5114	AGS SUPSENSION ASSEMBLY, 25K, 795 ACSR-45/7 "TERN"	K500	PREFORMED	AGS-5128	1



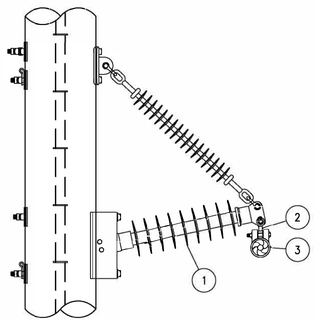
69kV HORIZONTAL POST
795 ACSR-45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
69kV HORIZONTAL POST
795 ACSR - 45/7 "TERN"

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-PSD

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	INSULATOR, HORIZONTAL BRACED POST ASSEMBLY, 69KV	I200	HUBBELL	BLP043G12000	1
2	48-3053	Y-CLEVIS, EYE, 90, 40K	H902	HUBBELL	YCS-06-90-40	1
3	40-5114	AGS SUPSENSION ASSEMBLY, 25K, 795 ACSR-45/7 "TERN"	K500	PREFORMED	AGS-5128	1



69kV BRACED POST ASSEMBLY
795 ACSR-45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
69kV BRACED POST ASSEMBLY
795 ACSR - 45/7 "TERN"

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-BPD

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

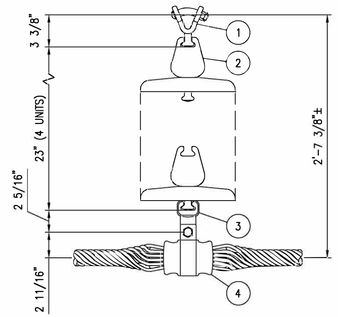
LANGE - BEN FRENCH
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
POST INSULATOR ASSEMBLIES
795 KCMIL 45/7 ACSR "TERN"

0 1" 2"

FILENAME BHE-AD-04-D-1.DWG
SCALE N.T.S.
SHEET **AD-04-1**

LIST OF MATERIALS						
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48-3054	Y-CLEVIS, BALL, 30K	H500	HUBBELL	YBC30	1
2	48-0027	GLASS INSULATOR, 22K LB, M&E, ANSI CL 52-3, 10" X 5 3/4"	I100	SEDIVER	N100/146	4
3	42-7020	AGS SOCKET EYE, 25K	H100	PREFORMED	SE-5154	1
4	40-5114	AGS SUSPENSION ASSY., 25K, 795 ACSR 45/7 "TERN"	K500	PREFORMED	AGS-5128	1

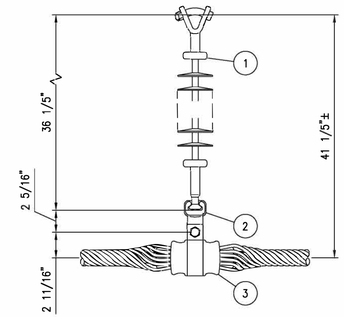


CONDUCTOR SUSPENSION
795 ACSR-45/7 "TERN"
MAX. LINE ANGLE = 30°

SHEET TITLE
TRANSMISSION ASSEMBLY
CONDUCTOR SUSPENSION ATTACHMENT
PORCELAIN

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-S4D

LIST OF MATERIALS						
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48-6924	INSULATOR, SUSPENSION, Y-CLEVIS BALL, 36.2" LENGTH, 25K	I110	MACLEAN	S14080025MXAL015	1
2	42-7020	AGS SOCKET EYE, 25K	H100	PREFORMED	SE-5154	1
3	40-5114	AGS SUSPENSION ASSY., 25K, 795 ACSR 45/7 "TERN"	K500	PREFORMED	AGS-5128	1



CONDUCTOR SUSPENSION
795 ACSR-45/7 "TERN"
MAX. LINE ANGLE = 30°

SHEET TITLE
TRANSMISSION ASSEMBLY
CONDUCTOR SUSPENSION ATTACHMENT
POLYMER

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-S4PD

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - BEN FRENCH
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
SUSPENSION INSULATOR ASSEMBLIES
795 KCMIL 45/7 ACSR "TERN"

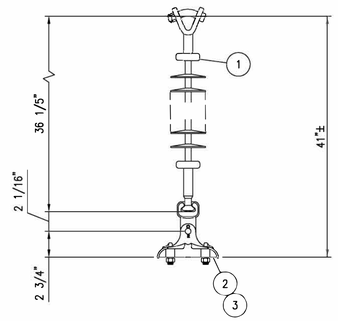
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FILENAME BHE-AD-05-D-1.DWG
SCALE N.T.S.

SHEET
AD-05-1

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48-6924	INSULATOR, SUSPENSION, Y-CLEVIS BALL, 36.2" LENGTH, 25K	I110	MACLEAN	S14080025MXAL015	1
2	42-0118	SUSPENSION CLAMP W/ SOCKET, 25K	K102	HUBBELL	HAS-118-S	1
3	N.S.	INHIBITOR, RUST (NO-OX-ID), 1 PT CAN, GRADE "A"	0102	SANCHEM INC	NO-OX-ID "A" SPECIAL	0.06



JUMPER SUPPORT
795 ACSR-45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
JUMPER SUPPORT
POLYMER

REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
T-J4PD

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - BEN FRENCH
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
JUMPER INSULATOR ASSEMBLIES
795 KCMIL 45/7 ACSR "TERN"

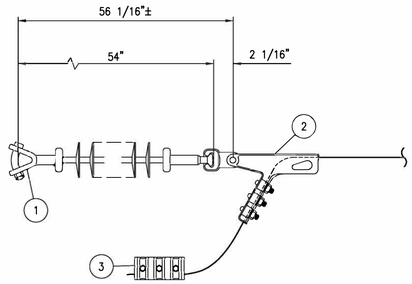
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FILENAME BHE-AD-06-D-1.DWG
SCALE N.T.S.

SHEET
AD-06-1

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48-6927	INSULATOR, DEADEND, Y-CLEVIS BALL, 54" LENGTH, 25K	I300	MACLEAN	S14080042MXAL027	1
2	42-1120	STRAIN CLAMP, DEADEND W/ SOCKET-EYE, 30K, 0.50 - 1.20 RANGE	L101	HUBBELL	SD112S	1
3	42-0483	PARALLEL GROOVE CONNECTOR, 0.743 - 1.152 RANGE	Q601	AFL	483.3P	1

*ONE ITEM (3) WILL BE REQUIRED FOR EVERY TWO ASSEMBLIES

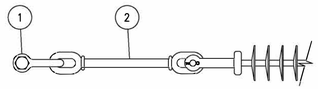


CONDUCTOR BOLTED DEADEND
795 ACSR-45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
CONDUCTOR BOLTED DEADEND
POLYMER

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-BDE6PD

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	ANCHOR SHACKLE, 3.5" LONG, 7/8" DIA, 3/4" PIN, 60K LBS	H603	HUBBELL	AS50BNK	1
2	N.S.	HOT LINK EXTENSION, CHAIN EYE - CHAIN EYE, 15" LONG, 30K LBS	H400	HUBBELL	H003015	1



TM-EXT-15
15" EXTENSION LINK

SHEET TITLE
TRANSMISSION ASSEMBLY
15" EXTENSION LINK

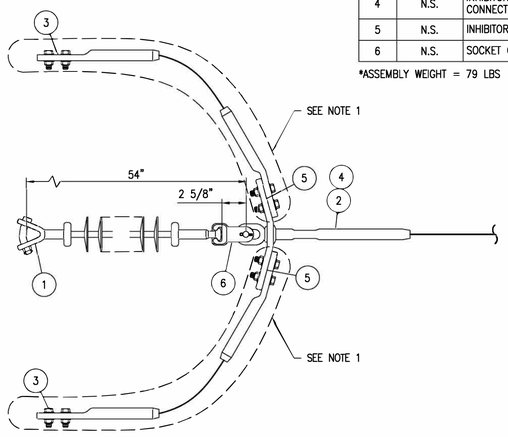
REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TM-EXT-15

NOTE:

1. JUMPERS AND TERMINALS SUPPLIED BY SUBSTATION, INSTALLED BY TRANSMISSION. SEE WEST RAPID CITY SUBSTATION REFERENCE SHEETS IN APPENDIX.

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48-6927	INSULATOR, DEADEND, Y-CLEVIS BALL, 54" LENGTH, 25K	I300	MACLEAN	S14080042MXAL027	1
2	42-8230	COMPRESSION DEADEND ASSY, DOUBLE TONGUE, W/ 15' TERMINAL "TERN"	L502	AFL	VED-123	1
3	N.S.	BOLT, NUT, BELLEVILLE, FLAT, STAINLESS STEEL ASSEMBLY	B606	CMC	SBA20-50	8
4	N.S.	INHIBITOR, FILLER COMPOUND, GRITTED, COMPRESSION CONNECTIONS, 8 oz.	O100	HUBBELL	VSG8B	1.5
5	N.S.	INHIBITOR, FILLER COMPOUND, NON-GRITTED, PAD TO PAD, 8 OZ	O101	HUBBELL	VS8B	0.6
6	N.S.	SOCKET CLEVIS, 30K	H200	HUBBELL	SC30	1

*ASSEMBLY WEIGHT = 79 LBS



CONDUCTOR SUBSTATION DEADEND
795 ACSR-45/7 "TERN"

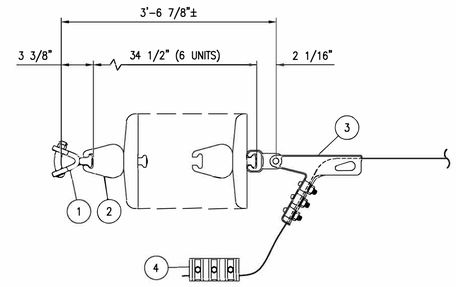
SHEET TITLE
TRANSMISSION ASSEMBLY
CONDUCTOR SUBSTATION DEADEND
POLYMER

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-SDE6PD

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48-3054	Y-CLEVIS, BALL, 30K	H500	HUBBELL	YBC30	1
2	N.S.	GLASS INSULATOR, 30K LB, M&E, ANSI CL 52-5, 10" X 5 3/4"	I102	SEDIVER	N14/146	6
3	42-1120	STRAIN CLAMP, DEADEND W/ SOCKET-EYE, 30K, 0.50 - 1.20 RANGE	L101	HUBBELL	SD112S	1
4	42-0483	PARALLEL GROOVE CONNECTOR, 0.743 - 1.152 RANGE	Q601	AFL	483.3P	1

*ONE ITEM (4) WILL BE REQUIRED FOR EVERY TWO ASSEMBLIES

ASSEMBLY WEIGHT = 75 LBS



CONDUCTOR BOLTED DEADEND
795 ACSR-45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
CONDUCTOR BOLTED DEADEND

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-BDE6D

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - BEN FRENCH
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
DEADEND INSULATOR ASSEMBLIES
795 KCMIL 45/7 ACSR "TERN"

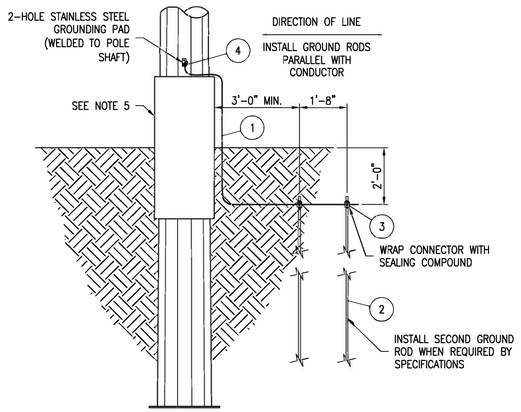
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FILENAME BHE-AD-07-D-1.DWG
SCALE N.T.S.

SHEET
AD-07-1

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			10'
2	46-0588	ROD, GROUND, 5/8" X 8'-0", COPPERCLAD	P500	GALVAN	6260G13	1
3	46-0058	CLAMP, GROUND ROD, 0.128 TO 0.460 RANGE, 5/8" ROD	P701	CHANCE	C2030344	1
4	N.S.	CLAMP, VISE TYPE, LIGHTNING ARRESTOR GROUND, #2 STRANDED	P820	HUBBELL	GC207	1



STEEL POLE GROUNDING DETAIL
SCALE: N.T.S.

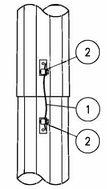
SPECIFICATIONS FOR DRIVEN GROUND ROD INSTALLATION:

1. INSTALL 8'-0" OF GROUND ROD AND TEST THE RESISTANCE LEVEL. WHEN RESISTANCE IS 25Ω OR LESS, NO ADDITIONAL STEPS ARE NEEDED.
2. IF RESISTANCE IS 25Ω OR GREATER, INSTALL AN ADDITIONAL 8'-0" OF GROUND ROD AS SHOWN:
   - TEST RESISTANCE WITH 1ST ROD CONNECTED TO 2ND ROD WITH #2 CU FOR COMBINED PARALLEL RESISTANCE VALUE. RECORD RESISTANCE VALUE.
3. AFTER DRIVING TWO (2) GROUND RODS AS NOTED ABOVE AND THE COMBINED RESISTANCE IS 25Ω OR GREATER, THE ELECTRICAL ENGINEERING DEPARTMENT SHOULD BE CONSULTED FOR FURTHER ACTION.
4. BOND STATIC WIRE TO POLE GROUND, USE FARGO CONNECTOR (ITEM #5).
5. GROUNDING THE SAME FOR STEEL POLE ON CONCRETE PIER FOUNDATIONS.

SHEET TITLE: **TRANSMISSION ASSEMBLY STEEL POLE GROUNDING**
REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: TM-9ST

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			4'
2	N.S.	CLAMP, VISE TYPE, LIGHTNING ARRESTOR GROUND, #2 STRANDED	P820	HUBBELL	GC207	2

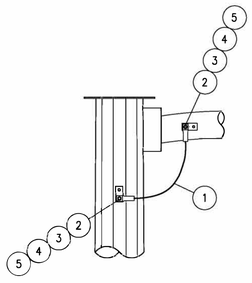


TM-9SSJ
SLIP JOINT
SCALE: N.T.S.

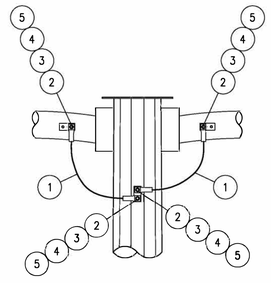
SHEET TITLE: **TRANSMISSION ASSEMBLY STEEL POLE SLIP JOINT GROUNDING**
REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: TM-9SSJ

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	9SD-1	9SD-2
1	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			5'	10'
2	N.S.	COMPRESSION TERMINAL, COPPER, #6 – 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012	2	4
3	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207	2	4
4	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS	2	4
5	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD	2	4

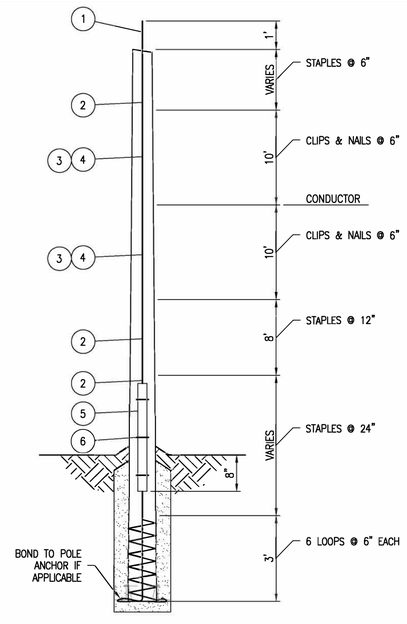


TM-9SD-1
SINGLE DAVIT GROUNDING
SCALE: N.T.S.



TM-9SD-2
DOUBLE DAVIT GROUNDING
SCALE: N.T.S.

SHEET TITLE: **TRANSMISSION ASSEMBLY STEEL POLE DAVIT ARM GROUNDING**
REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: TM-9SD



LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	36-4000	GROUNDWIRE, #4CU SD, 40% CONDUCTIVITY	C901			125'
2	46-7494	STAPLE, CUT (SLASH) 1 1/2" X 3/8" CU-COATED, BARBED	P600	MACLEAN	J7682	50
3	46-7460	NAIL, 10D, CU-COATED	P150	MACLEAN	J7260	40
4	46-2729	CLIP, CU-COATED	P151	KEARNEY	5730-1	40
5	46-2503	WOOD MOULDING, 1-11/16" X 8'	P300	HUGHES	2503.8	1
6	46-2504	MOULDING STAPLES, 1-3/4" X 3-1/2"	P400	HUBBELL	C2050222	3

NOTES:

1. BOND ALL POLE HARDWARE TO POLE GROUND. USE BONDING CLIP.
2. ON 230/69kV CONSTRUCTION, BOND ALL 69kV HARDWARE.
3. GROUND WIRE SHALL BE INSTALLED FOR THE FULL LENGTH OF EACH POLE, ACROSS THE BOTTOM, AND BACK UP IN WRAP TURNS AS SHOWN. STAPLE THE WRAPS AT EACH INTERSECTION OF THE DOWNLEAD, AND EVERY 12" FOR THE LENGTH OF THE WRAPS.
4. THIS UNIT INCLUDES THE MEASURE AND RECORDING OF EACH POLE'S FOOTING RESISTANCE, AFTER POLE SETTING IS COMPLETED AND BEFORE INSTALLING THE OHSW.
5. FOR FOOTING RESISTANCES GREATER THAN 15 OHMS, GROUNDING CONNECTIONS SHALL BE USED TO BOND TOGETHER THE GROUND WIRES OF EACH POLE AND GUY ANCHORS IF APPLICABLE.
6. IF THE FOOTING RESISTANCE READS GREATER THAN 15 OHMS AFTER INSTALLATION PROCEDURES PER NOTE 5, CONTRACTOR SHALL NOTIFY THE ENGINEER FOR FURTHER GROUNDING INSTRUCTIONS.
7. BOND STATIC WIRE TO POLE GROUND, USE FARGO CONNECTOR. (ITEM #5)
8. SEE INDIVIDUAL STRUCTURE DRAWINGS FOR REMAINING DIMENSIONS.

SHEET TITLE: **TRANSMISSION ASSEMBLY WOOD POLE GROUNDING**
REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: TM-9

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - BEN FRENCH
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
GROUNDING ASSEMBLIES

0 1" 2"

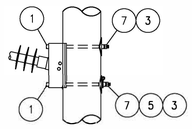
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SCALE: N.T.S.
SHEET: AD-08-1

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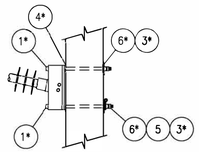
LIST OF MATERIAL

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	1A	1B	1C	1D
1	N.S.	BOLT, MACHINE, 7/8" X REQ'D LENGTH	B270			2	2*	2	–
2	N.S.	ROD, FULL THREADED, 7/8" X REQ'D LENGTH, W/ 4 NUTS	D170			–	–	–	2
3	22–7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	2	2*	2	4
4	N.S.	POLE SHIM, GAIN BASE TO FLAT	V400	N/A	N/A	–	1*	–	–
5	N.S.	WASHER, SPRING, 15/16" HOLE	W207	HUGHES	2702.8	1	1	–	–
6	N.S.	WASHER, SQUARE, 4" X 1/4", 15/16" HOLE	W322	HUGHES	SW4–80	–	2*	2	2
7	22–4425	WASHER, SQ. CURVED, 4" X 1/4", 15/16" HOLE	W504	HUGHES	SCW4–80	2	–	–	–

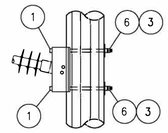
(*) DENOTES MATERIAL SUPPLIED BY LAMINATED POLE MANUFACTURER



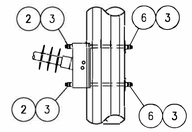
TD–1A
ROUND WOOD POLE ASSEMBLY
SCALE: N.T.S.



TD–1B
LAMINATED POLE ASSEMBLY
SCALE: N.T.S.



TD–1C
STEEL POLE ASSEMBLY
SCALE: N.T.S.



TD–1D
LARGE STEEL POLE ASSEMBLY
SCALE: N.T.S.

NOTES:

1. STRENGTH LIMITATIONS OF 7/8" BOLTS.
   A. SINGLE SHEAR THROUGH THREADS 17,270 LBS.
   B. SINGLE SHEAR THROUGH SHAFT 24,350 LBS.
   C. MINIMUM TENSILE STRENGTH 25,400 LBS.

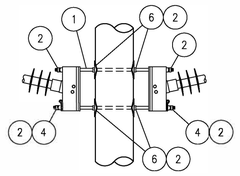
SHEET TITLE
TRANSMISSION ASSEMBLY
SINGLE INSULATOR BASE TO POLE ASSEMBLY

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TD-1

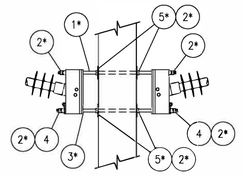
LIST OF MATERIAL

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	2A	2B	2C
1	N.S.	ROD, FULL THREADED, 7/8" X REQ'D LENGTH, W/ 4 NUTS	D170			2	2*	2
2	22–7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	8	8*	8
3	N.S.	POLE SHIM, GAIN BASE TO FLAT	V400	N/A	N/A	–	2*	–
4	N.S.	WASHER, SPRING, 15/16" HOLE	W207	HUGHES	2702.8	2	2	–
5	N.S.	WASHER, SQUARE, 4" X 1/4", 15/16" HOLE	W322	HUGHES	SW4–80	–	4*	4
6	22–4425	WASHER, SQ. CURVED, 4" X 1/4", 15/16" HOLE	W504	HUGHES	SCW4–80	4	–	–

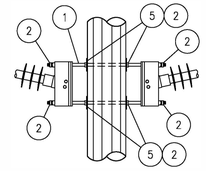
(*) DENOTES MATERIAL SUPPLIED BY LAMINATED POLE MANUFACTURER



TD–2A
ROUND WOOD POLE ASSEMBLY
SCALE: N.T.S.



TD–2B
LAMINATED POLE ASSEMBLY
SCALE: N.T.S.



TD–2C
STEEL POLE ASSEMBLY
SCALE: N.T.S.

NOTES:

1. STRENGTH LIMITATIONS OF 7/8" BOLTS.
   A. SINGLE SHEAR THROUGH THREADS 17,270 LBS.
   B. SINGLE SHEAR THROUGH SHAFT 24,350 LBS.
   C. MINIMUM TENSILE STRENGTH 25,400 LBS.

SHEET TITLE
TRANSMISSION ASSEMBLY
DOUBLE INSULATOR BASE TO POLE ASSEMBLY

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TD-2

D C B A

Black Hills Energy
Improving life with energy

HDR

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - BEN FRENCH
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
INSULATOR BASE TO POLE ASSEMBLIES

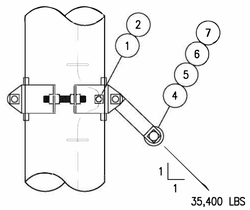
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FILENAME BHE–AD–09–D–1.DWG
SCALE N.T.S.

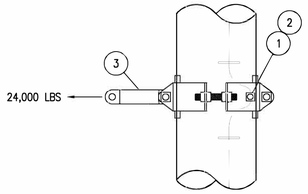
SHEET
AD-09-1

LIST OF MATERIALS

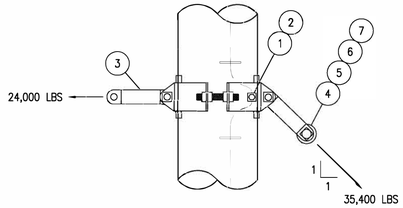
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	TG-26B QTY	TG-26C QTY	TG-26D QTY	TG-26E QTY
1	N.S.	POLE BAND ASSY. HEAVY DUTY, REQ'D POLE DIAMETER	–	HUGHES	–	1	1	1	1
1.1	18-1116	POLE BANDS, HEAVY DUTY, 7"-10" POLE	F110	HUGHES	3108.5	–	–	–	–
1.2	18-1117	POLE BANDS, HEAVY DUTY, 9"-12" POLE	F111	HUGHES	3108.6	–	–	–	–
1.3	18-1118	POLE BANDS, HEAVY DUTY, 11"-14" POLE	F112	HUGHES	3108.7	–	–	–	–
1.4	18-1119	POLE BANDS, HEAVY DUTY, 13"-16" POLE	F113	HUGHES	3108.8	–	–	–	–
2	46-2718	CLIP, BONDING, WITH 1/2" X 1 1/2" BOLT, 7/16" MAX. WIRE	P104	HUGHES	2718.55	1	1	1	1
3	14-3152	LINK, CONNECTING, 1/4" X 2" X 7 1/2", 15/16" HOLES, 24K LBS	F201	HUGHES	3152	–	2	2	–
4	14-3154	LINK, CONNECTING, 3/8" X 2" X 7 1/2", 15/16" HOLES, 38K LBS	F203	HUGHES	3154	2	–	2	4
5	18-2808	GUY, ROLLER, 1 1/8" WR, 15/16" HOLE	G100	HUGHES	28082	1	–	1	2
6	20-7803	MACHINE BOLT, 7/8" X 3"	B273	HUGHES	B83-2	1	–	1	2
7	22-7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	1	–	1	2



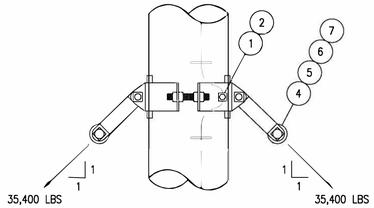
TG-26B



TG-26C



TG-26D



TG-26E

NOTES:

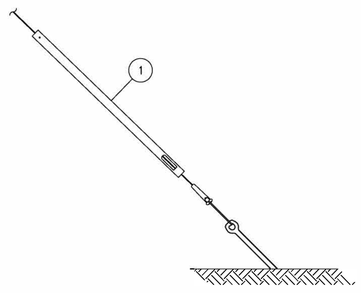
1. THE INDICATED LOADS ARE DESIGN MAXIMUMS.
2. FOR GUY SLOPES MORE THAN 1V TO 1H, THE MAXIMUM VERTICAL CAPACITY SHOULD NOT EXCEED 25,000 LBS.
3. WHEN TWO GUY ATTACHMENTS ARE NEEDED. THE ADDITIONAL POLE BAND SHALL BE 6' BELOW THE FIRST ONE.

SHEET TITLE
TRANSMISSION ASSEMBLY
POLE BAND ASSEMBLIES

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TG-26

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	GUY, GUARD, 2" X 8'-0", FULL ROUND, YELLOW	G400	MACLEAN	J1493Y	1



GUY MARKER

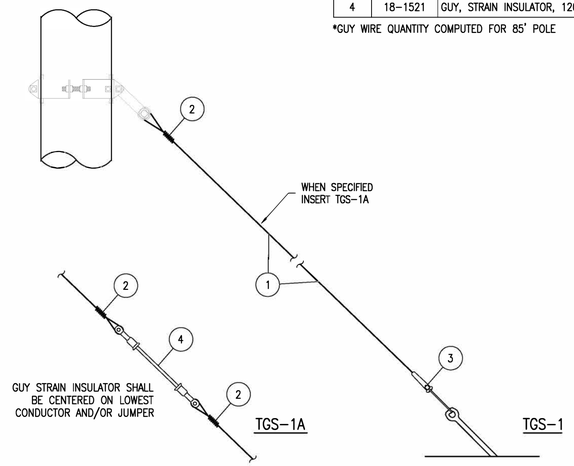
SHEET TITLE
TRANSMISSION ASSEMBLY
GUY MARKER

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TM-GM

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	TGS-1 QTY	TGS-1A QTY
1	18-7167	WIRE, GALVANIZED, 7 STEEL STRAND, 7/16" EHS	C801	–	–	110'	110'
2	18-7168	GUY DEADEND GRIP, FOR 7/16" EHS	G601	PREFORMED	GDE-1108	1	3
3	18-0716	GUY, STRANDVISE, 7/16" EHS, SHORT BAIL	G902	MACLEAN	5203	1	1
4	18-1521	GUY, STRAIN INSULATOR, 120" LONG, 21K LBS, ROLLER, ROLLER	G200	HUGHES	CF694-120R2	–	1

*GUY WIRE QUANTITY COMPUTED FOR 85' POLE



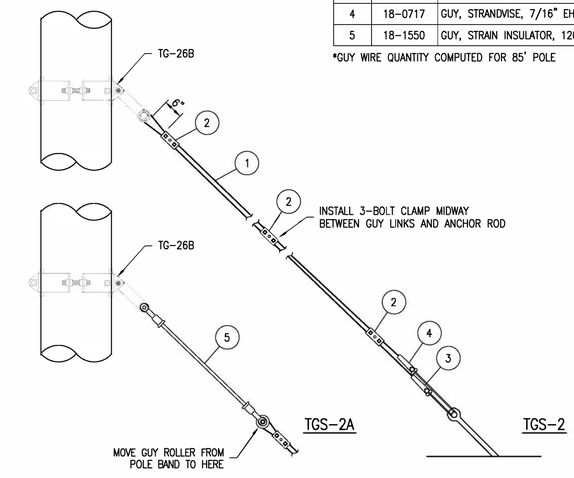
SHEET TITLE
TRANSMISSION ASSEMBLY
SINGLE GUY ASSEMBLIES
7/16" EHS

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TGS-1(A)

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	TGS-2 QTY	TGS-2A QTY
1	18-7167	WIRE, GALVANIZED, 7 STEEL STRAND, 7/16" EHS	C801	–	–	220'	220'
2	18-5816	CLAMP, 3-BOLT, 6" LONG, 5/8" BOLT, 5/16" – 1/2" RANGE	Q100	MACLEAN	J931	3	3
3	18-0716	GUY, STRANDVISE, 7/16" EHS, SHORT BAIL	G902	MACLEAN	5203	1	1
4	18-0717	GUY, STRANDVISE, 7/16" EHS, LONG BAIL	G903	MACLEAN	5203L	1	1
5	18-1550	GUY, STRAIN INSULATOR, 120" LONG, 50K LBS	G201	MACLEAN	GCC50-120-SC	–	1

*GUY WIRE QUANTITY COMPUTED FOR 85' POLE



SHEET TITLE
TRANSMISSION ASSEMBLY
DOUBLE GUY ASSEMBLY
7/16" EHS

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TGS-2(A)

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - BEN FRENCH
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
GUY AND ANCHOR ASSEMBLIES

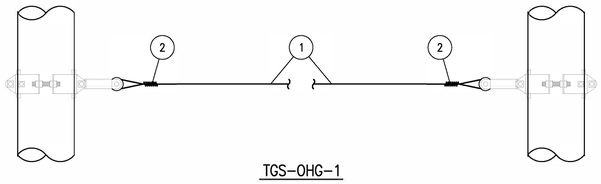
0 1" 2"

FILENAME BHE-AD-10-D-1.DWG
SCALE N.T.S.

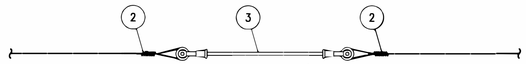
SHEET
AD-10-1

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	TGS–OHG–1	TGS–OHG–1A
1	18–7167	WIRE, GALVANIZED, 7 STEEL STRAND, 7/16" EHS	C801	–	–	150'	150'
2	18–7168	GUY DEADEND GRIP, FOR 7/16" EHS	G601	PREFORMED	GDE–1108	2	4
3	N.S.	GUY, STRAIN INSULATOR, 120" LONG, 21K LBS, ROLLER, ROLLER	G200	HUGHES	CF694–120R2	–	1



TGS–OHG–1



TGS–OHG–1A

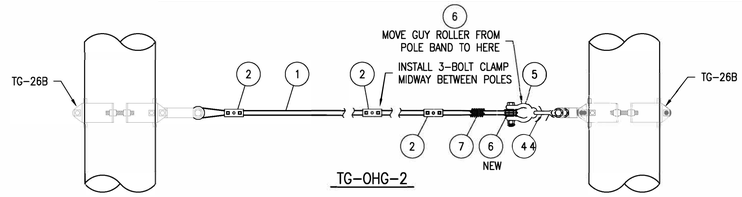
POSITION THE GUY STRAIN INSULATOR SUCH THAT THE LOWER END OF THE INSULATOR WOULD BE NO LESS THAN 10'–0" FROM THE GROUND IN AN EVENT OF BROKEN GUY WIRE

SHEET TITLE
TRANSMISSION ASSEMBLY
SINGLE OVERHEAD GUY ASSEMBLY

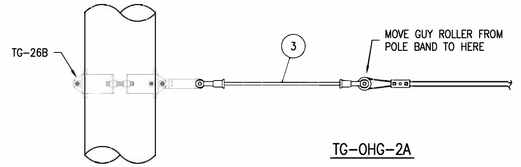
REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TGS-OHG-1(A)

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	TG–OHG–2	TG–OHG–2A
1	18–7167	7/16" EH.S. STEEL 7–STRAND GUY WIRE	C801	–	–	300'	300'
2	18–5816	CLAMP, 3–BOLT, 6" LONG, 5/8" BOLT, 5/16" – 1/2" RANGE	Q100	MACLEAN	J931	3	3
3	18–1550	GUY, STRAIN INSULATOR, 120" LONG, 50K LBS	G201	MACLEAN	GCC50–120–SC	–	1
4	N.S.	ANCHOR, SHACKLE, 3.5" LONG, 7/8" DIA., 3/4" DIA. PIN, 60K	H603	HUBBELL	AS50BNK	1	1
5	N.S.	ANCHOR, SHACKLE, 3.5" LONG, 1 7/16" WIDE, 7/8" DIA., 7/8" DIA. PIN, 72K	H604	HUBBELL	AS60875BNK	1	1
6	18–2808	GUY, ROLLER, 1 1/8" WR, 15/16" HOLE	G100	HUGHES	28082	1	1
7	18–7168	GUY DEADEND GRIP, FOR 7/16" EHS	G601	PREFORMED	GDE–1108	2	2



TG–OHG–2



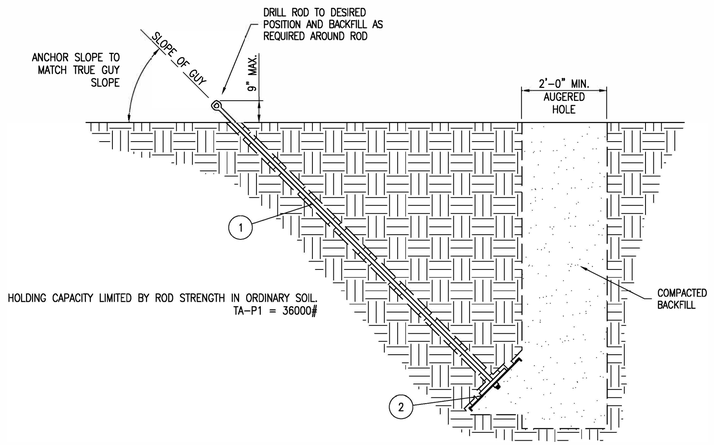
TG–OHG–2A

SHEET TITLE
TRANSMISSION ASSEMBLY
DOUBLE OVERHEAD GUY ASSEMBLY

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TG-OHG-2(A)

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	TA–P1 QTY
1	18–1102	ROD, ANCHOR, TWIN EYE 1" X 10', 36K	A100	MACLEAN	J7540	1
2	18–1024	ANCHOR, CROSS–PLATE TYPE, 400 IN BEARING AREA, 1" ROD	A200	MACLEAN	J3524	1



SHEET TITLE
TRANSMISSION ASSEMBLY
PLATE ANCHOR
AUGERED

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TA-P1

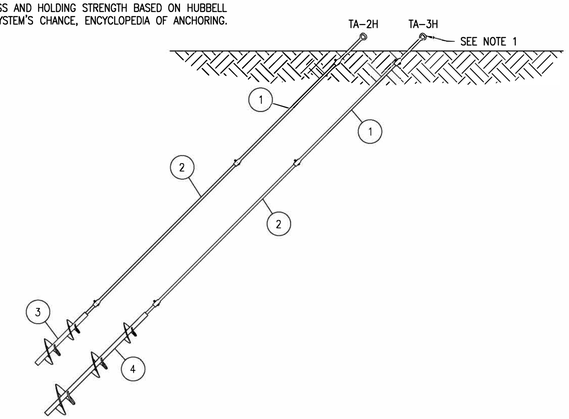
NOTES:

1. TRIPLE EYE GUY ADAPTER INCLUDED WITH ANCHOR ASSEMBLY.
2. CONTINUE TO DRIVE THE ANCHOR AND ADD EXTENSIONS UNTIL THE DESIRED TORQUE IS REACHED AND MAINTAINED FOR A MINIMUM OF THREE FEET OR THREE TIMES THE DIAMETER OF THE LARGEST HELIX.
3. A MINIMUM INSTALLATION OF THREE TIMES THE DIAMETER OF THE LARGEST HELIX (BELOW THE FREEZE/ THAW LINE) IS REQUIRED. THIS DEPTH SHOULD EQUAL OR EXCEED FIVE TIMES THE DIAMETER OF THE LARGEST HELIX FROM THE TOP SURFACE OF THE SOIL VERTICALLY.
4. MINIMUM INSTALL TORQUE IS 3,500 FT–LBS.
5. MAXIMUM INSTALLATION TORQUE IS 5,500 FT–LBS OR 1.5 TWISTS.
6. TYPICAL WORKING TORQUE IS 5,500 FT. LBS. FOR 1 1/2" SQUARE SHAFT ANCHORS.
7. SOIL CLASS AND HOLDING STRENGTH BASED ON HUBBELL POWER SYSTEM'S CHANCE, ENCYCLOPEDIA OF ANCHORING.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	TA–2H QTY	TA–3H QTY	TA–5EXT QTY
1	N.S.	ANCHOR, EXTENSION, 1 1/2" SQ. SHAFT 5'–0"	A110	CHANCE	12656	–	–	AS REQ'D
2	N.S.	ANCHOR, EXTENSION, 1 1/2" SQ. SHAFT 7'–0"	A111	CHANCE	12657	1	1	–
3	N.S.	ANCHOR, 1 1/2" SQ. SHAFT, 8" AND 10" HELIX W/ TRIPLEYE ADAPTER	A202	CHANCE	12654–3AE	1	–	–
4	N.S.	ANCHOR, 1 1/2" SQ. SHAFT, 8", 10" AND 12" HELIX W/ TRIPLEYE ADAPTER	A210	CHANCE	12654–3AEJ	–	1	–

HELIX COMBINATION	SOIL ANCHOR HOLDING STRENGTH (LBS.) VS. SOIL CLASS					
	CLASS 7	CLASS 6	CLASS 5	CLASS 4	CLASS 3	CLASS 2
8"–10"	19,000	23,000	27,000	32,000	36,000	41,000
8"–10"–12"	26,000	32,000	39,000	46,000	51,000	58,000



SHEET TITLE
TRANSMISSION ASSEMBLY
POWER INSTALLED SCREW ANCHORS

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TA-2H, 3H, 5EXT

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - BEN FRENCH
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
GUY AND ANCHOR ASSEMBLIES

0 1" 2"

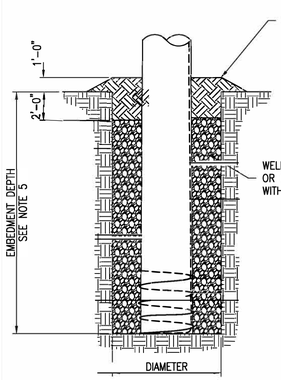
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SCALE N.T.S.

SHEET
AD-11-1

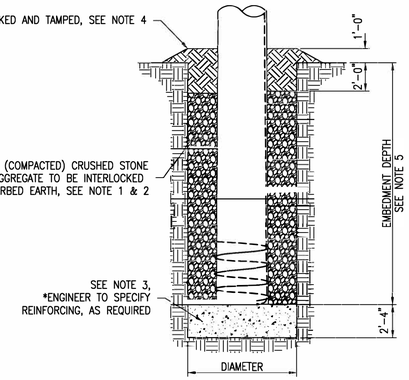
POLE STABILITY FOUNDATION
IMPORTED GRANULAR BACKFILL

POLE HT.–CL.	EMBEDMENT DEPTH (FT)	DIAMETER (FT)	POLE WIDTH (IN)	POLE WEIGHT (LB)	APPROX. QTY. CUBIC YDS. (10% + 4 FT)
60–1	10	4.0*	18.0	–	3.2
70–1	11	4.0*	18.9	–	3.6
80–H1	12	4.0*	20.9	–	3.8
90–H2	13	4.0*	23.2	–	4.0
100–H2	14	4.0*	24.0	–	4.2

(*) HOLE DIAMTER AS NEEDED TO TAMP ALL THE WAY AROUND THE POLE.



TM–101
IMPORTED BACKFILL
SCALE: N.T.S.



TM–103
IMPORTED BACKFILL AND BEARING REINFORCEMENT
SCALE: N.T.S.

GRADATION FOR IMPORTED GRANULAR BACKFILL	
SIZE OF GRAVEL OR CRUSHED STONE	SIZE OF MESH (IN)
100% BY WEIGHT TO PASS 1" SCREEN	1.00
60%–90% BY WEIGHT TO PASS 1/2" SCREEN	0.500
40%–60% BY WEIGHT TO PASS NO. 4 SCREEN	0.187
25%–50% BY WEIGHT TO PASS NO. 8 SCREEN	0.0937
20%–40% BY WEIGHT TO PASS NO. 16 SCREEN	0.0469
15%–30% BY WEIGHT TO PASS NO. 40 SCREEN	0.0165

IMPORTANT

EACH POLE SHALL BE BACKFILLED FROM BOTTOM TO TOP BY ONE LABORER SHOVELING FILL AND TWO OTHERS USING PNEUMATIC TAMPERS.

NOTES:

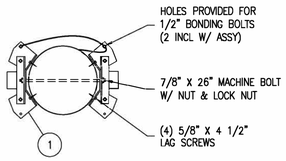
1. GRADATION FOR IMPORTED BACKFILL IS SHOWN IN THE TABLE. THE AGGREGATE SHALL BE WELL MIXED IN A STOCK PILE, AND PNEUMATICALLY PLACED AND TAMPED IN 6–INCH LIFTS.
2. THE SPECIFICATION FOR AGGREGATE GIVEN IN THE TABLE IS MINIMUM. IN AREAS WHERE SMALLER FINES ARE AVAILABLE AT COMPARABLE COST, IT IS RECOMMENDED THAT THE ENGINEER SPECIFY SMALLER FINES.
3. CONCRETE SHALL BE 2000 PSI HIGH EARLY STRENGTH CONCRETE. IT SHALL BE DEPOSITED IN A MANNER WHICH WILL PREVENT SEGREGATION OF THE AGGREGATE AND CEMENT. CARE SHOULD BE TAKEN TO AVOID GETTING DIRT MIXED WITH THE CONCRETE. THE POLE SHALL NOT BE SET UNTIL THE CONCRETE BEARING BASE HAS ATTAINED SUFFICIENT STRENGTH TO SUPPORT THE POLE. DURING THE PLACEMENT OF POLE, AVOID BUMPING CONCRETE BASE.
4. WELL TAMPED NATIVE BACKFILL SHOULD BE PLACED AROUND THE POLE AS SHOWN.
5. SEE STRUCTURE DRAWINGS FOR EMBEDMENT DEPTHS.

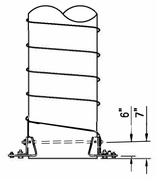
SHEET TITLE
TRANSMISSION ASSEMBLY
POLE STABILITY FOUNDATION

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TM-101 & TM-103

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	18–1895	ANCHOR ASSEMBLY WITH BOLTS; PAIR	F300	HUGHES	A–1895–2	1





SHEET TITLE
TRANSMISSION ASSEMBLY
POLE ANCHOR ASSEMBLY

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TP-A

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

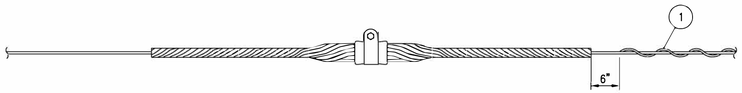
LANGE - BEN FRENCH
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
POLE STABILITY ASSEMBLIES

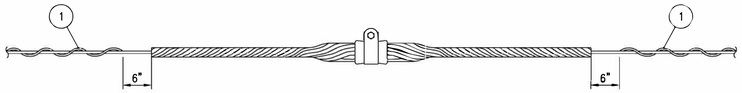
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SCALE N.T.S.
SHEET **AD-12-1**

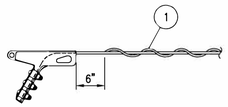
LIST OF MATERIALS								
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T1 QTY	2T1 QTY	D1 QTY
1	N.S.	SPIRAL VIBRATION DAMPER, 0.327" – 0.461" RANGE	S110	PREFORMED	5050104	1	2	1



DPR–EHS–T1



DPR–EHS–2T1



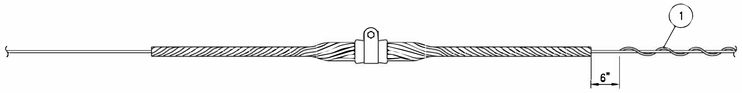
DPR–EHS–D1

SHEET TITLE
TRANSMISSION ASSEMBLY
DAMPER - 3/8" EHS

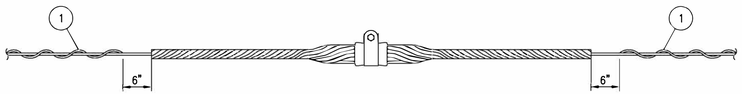
REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
DPR-EHS

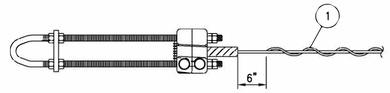
LIST OF MATERIALS								
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T1 QTY	2T1 QTY	D1 QTY
1	N.S.	SPIRAL VIBRATION DAMPER, 0.327" – 0.461" RANGE	S110	PREFORMED	5050104	1	2	1



DPR–OPGW–T1



DPR–OPGW–2T1



DPR–OPGW–D1

SHEET TITLE
TRANSMISSION ASSEMBLY
DAMPER - OPGW

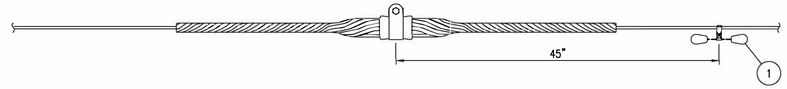
REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
DPR-OPGW

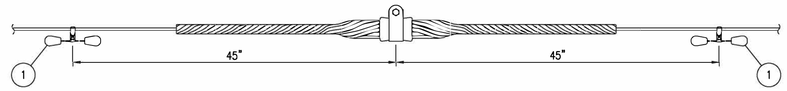
LIST OF MATERIALS								
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T1 QTY	2T1 QTY	D1 QTY	D2 QTY
1	N.S.	DAMPER, DOGBONE, 795 ACSR	S150	HUBBELL	60710–12	1	2	1	2

NOTES:

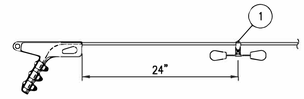
1. FIRST DAMPER AT SUSPENSION SPAN ENDS SHALL BE LOCATED FROM CENTER OF DAMPER CLAMP TO THE SUSPENSION SUPPORT PER REFERENCED DIMENSION.
2. THE ORIENTATION OF THE WEIGHTS ALONG THE CONDUCTOR IS OPTIONAL. (I.E. WHETHER THE LARGE WEIGHT IS TOWARD THE TOWER OR TOWARD THE SPAN. ORIENT THE DAMPER FOR EASY ACCESS TO THE BOLT AND TO OBTAIN VISUAL ASSURANCE OF POSITIVE CONDUCTOR SEATING.
3. FOLLOW MANUFACTURER'S INSTALLATION INSTRUCTIONS IN DELIVERY BOX.
4. SEE SAG TABLES FOR INSTALLATION DIRECTION ON THE LINE.



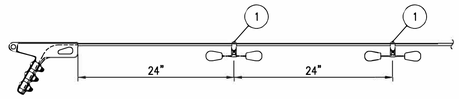
DPR–795–T1



DPR–795–2T1



DPR–795–D1



DPR–795–D2

SHEET TITLE
TRANSMISSION ASSEMBLY
DAMPER - 795 ACSR

REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
DPR-795

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - BEN FRENCH
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
DAMPER ASSEMBLIES

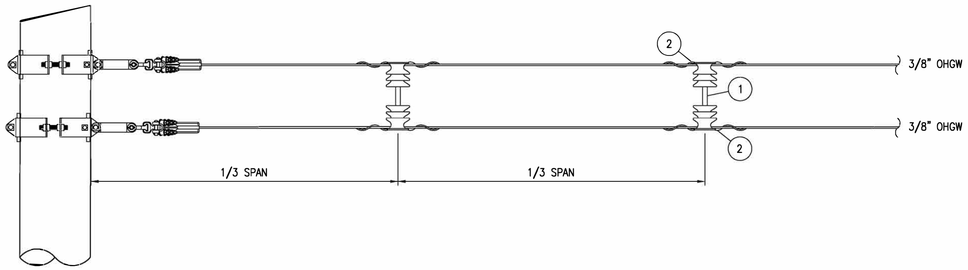
0 1" 2"

FILENAME BHE–AD–13–D–1.DWG
SCALE N.T.S.

SHEET
AD-13-1

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	PHASE SPACER, 1'-6" LONG, 15KV	I400	HUGHES	CF800-18C	2
2	N.S.	WRAPLOCK TIE, C-NECK, 0.36" CONDUCTOR	M601	PREFORMED	WTC-0109	4



SHEET TITLE
TRANSMISSION ASSEMBLY
SHIELD PHASE SPACER

REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
TM-SPS-2

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

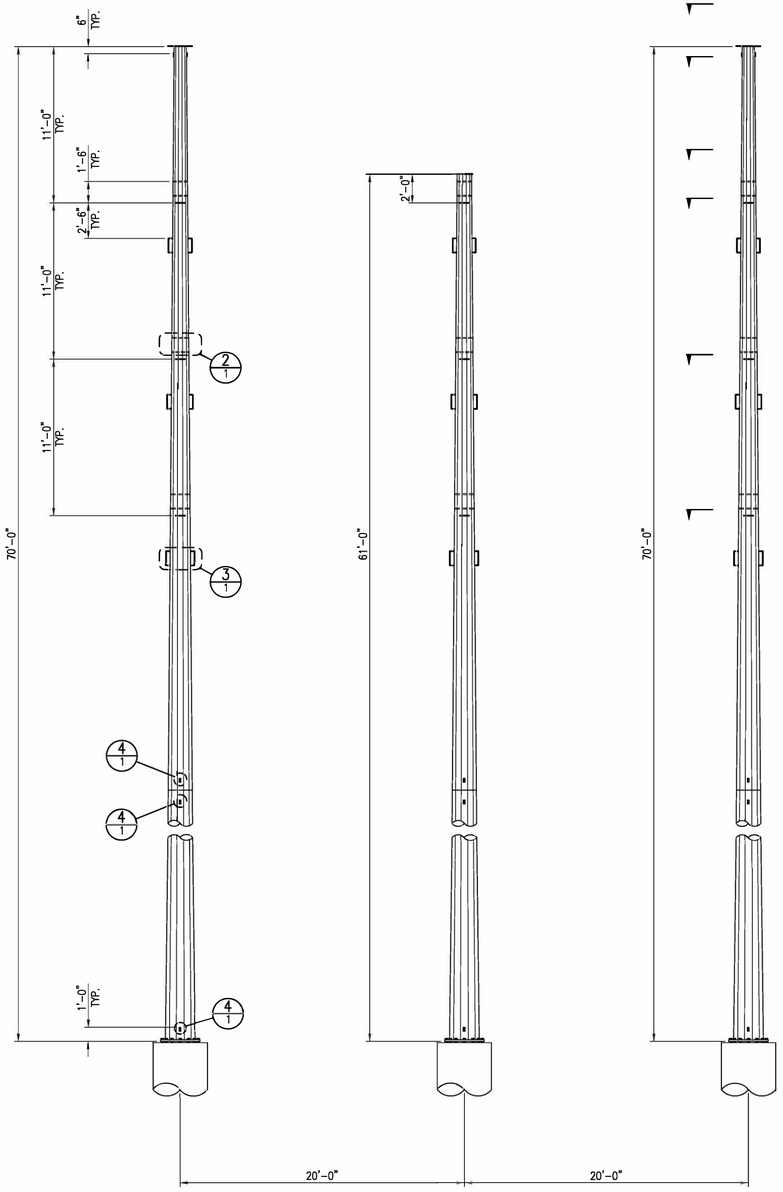
LANGE - BEN FRENCH
69KV TRANSMISSION LINE

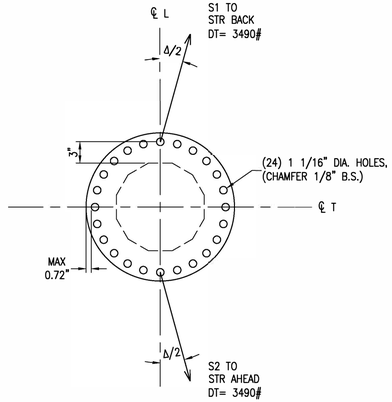
ASSEMBLY DETAILS
SPACER ASSEMBLIES

0 1" 2"

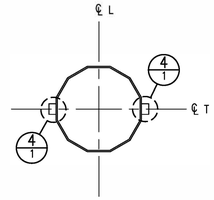
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SCALE N.T.S.

SHEET
AD-14-1

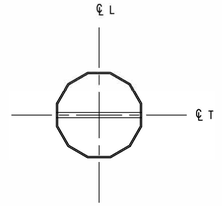




VIEW A 1
SHIELD ORIENTATION
SCALE: N.T.S.



SECTION B 1
SHIELD NEMA PAD ORIENTATION
SCALE: N.T.S.



SECTION C 1
JUMPER POST ORIENTATION
SCALE: N.T.S.

GENERAL NOTES

MAXIMUM SHIELD WIRE VANG THICKNESS = 3/4"
MAXIMUM CONDUCTOR VANG THICKNESS = 1"
LOAD TREE VALUES ARE ULTIMATE, INCLUDE OVERLOAD FACTORS, AND ARE SHOWN IN POUNDS.

DESIGN CRITERIA

(S1) SHIELD WIRE IS AFL CC-55/443 "DNO-4748" OPGW, MAXIMUM TENSION AT NESC HEAVY LOADING: 3490# R.S.= 450'
(S2) SHIELD WIRE IS AFL CC-55/443 "DNO-4748" OPGW, MAXIMUM TENSION AT NESC HEAVY LOADING: 3490# R.S.= 450'
(C1) CONDUCTOR IS 795 KCMIL 45/7 ACSR "TERN" MAXIMUM TENSION AT NESC HEAVY LOADING: 7840# R.S.= 450'
(C2) CONDUCTOR IS 795 KCMIL 45/7 ACSR "TERN" MAXIMUM TENSION AT NESC HEAVY LOADING: 7840# R.S.= 450'

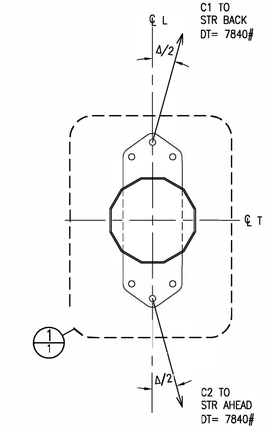
WIND SPAN: 500'
WEIGHT SPAN: 800' AT NESC HEAVY LOADING
HEIGHT OF STR: 70'-0"
DESIGN MAXIMUM ANGLE (Δ): 10°00'00"

SPECIFICATIONS

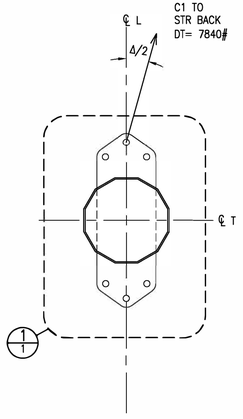
1. POLES TO BE DESIGNED PER SECTION 33 71 16.23 TUBULAR STEEL POLES SPECIFICATIONS.
2. ALL STEEL TO BE WEATHERING STEEL.
3. POLES TO HAVE EITHER SLIP JOINTS OR BOLTED FLANGE TYPE SPLICES, WHICHEVER IS MORE COST EFFECTIVE.
   A. IF SLIP JOINTS ARE USED, INSTALL GROUND PADS (DETAIL 4) ABOVE AND BELOW THE SLIP JOINT.
4. STRUCTURES SHALL BE DESIGNED ASSUMING DRILLED PIER TYPE FOUNDATION.
5. THE CIRCLED LOADINGS SHOWN IN LOAD TREES CONVEY THE ADDITIONAL VERTICAL LOAD THAT WILL BE APPLIED TO THE STRUCTURE BY LINE PERSONNEL DURING CONSTRUCTION AND MAINTENANCE OPERATIONS.
   A. IT IS REQUIRED THAT ALL CONDUCTOR ATTACHMENT SUPPORTS BE DESIGNED TO MEET THIS REQUIREMENT. HOWEVER, AS THE LOADING WILL BE APPLIED TO ONLY ONE PHASE AT ANY GIVEN TIME, THE SHAFT MAY BE DESIGNED FOR ITS APPLICATION AT A SINGLE CONTROLLING PHASE LOCATION TO BE DETERMINED BY THE STEEL MANUFACTURER.
6. SEE DETAIL 5 SHEET 2 FOR OPGW DOWNLEAD DETAILS.

DEFLECTION

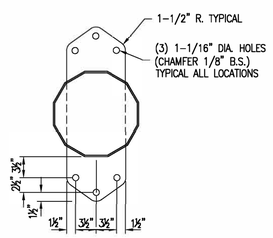
SEE TUBULAR STEEL POLE SPECIFICATION FOR DEFLECTION OF THE SHAFT UNDER LOAD CASE V.



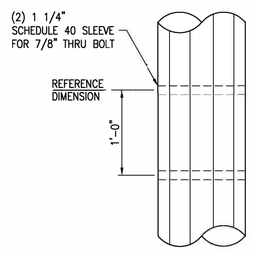
SECTION D 1
TOP AND MIDDLE CONDUCTOR ORIENTATION
SCALE: N.T.S.



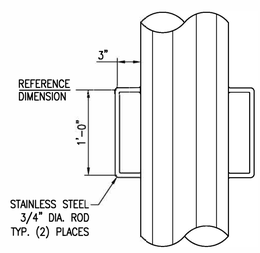
SECTION E 1
BOTTOM CONDUCTOR ORIENTATION
SCALE: N.T.S.



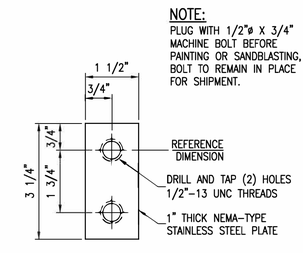
DETAIL 1 1
CONDUCTOR VANGS
SCALE: N.T.S.



DETAIL 2 1
JUMPER POST ATTACHMENT
SCALE: N.T.S.



DETAIL 3 1
GROUNDING LOOP
SCALE: N.T.S.



DETAIL 4 1
GROUNDING PAD
SCALE: N.T.S.

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
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PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

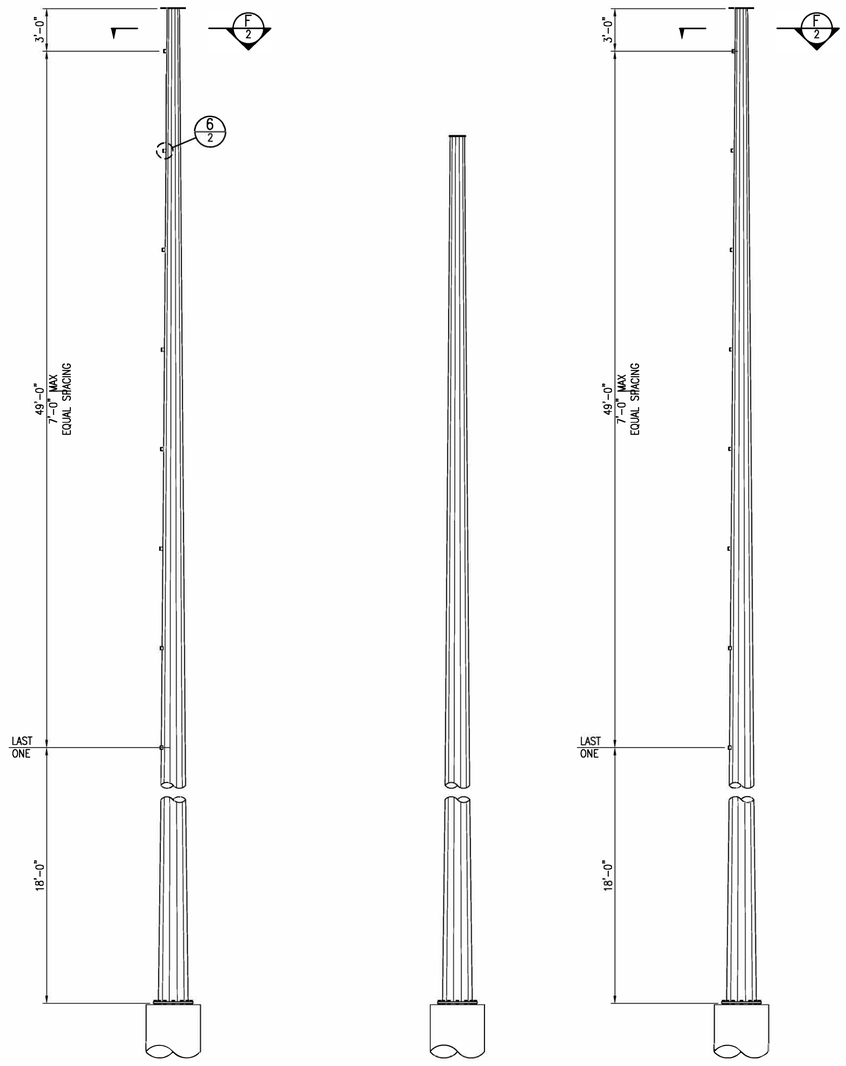
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
LANGE - BEN FRENCH
69KV TRANSMISSION LINE

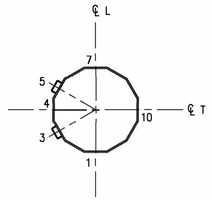
LOAD & DESIGN DETAIL
TC-3PDE-ST
STR 41

0 1" 2"

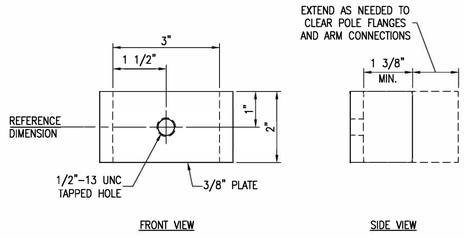
FILENAME BHE-LD-13-D-1.DWG
SCALE 3/16"=1'-0"
SHEET LD-13-1



DETAIL 5/2
OPGW DOWNLEADS
SCALE: N.T.S.



SECTION F/2
OPGW DOWNLEAD
ORIENTATION
SCALE: N.T.S.



SECTION 6/2
OPGW DOWNLEAD
BRACKET
SCALE: N.T.S.

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

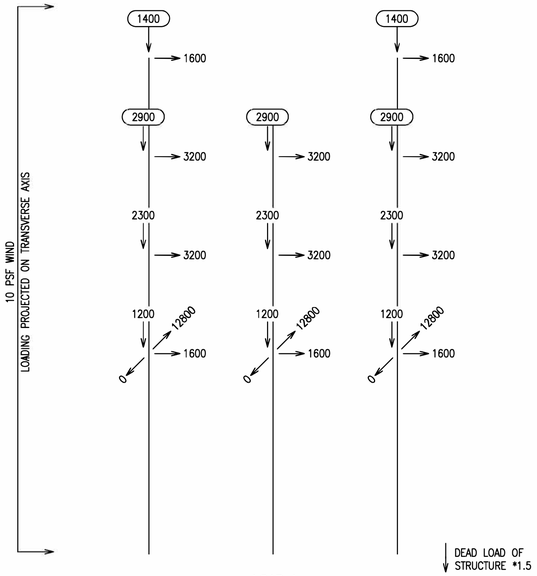
LANGE - WEST RAPID CITY
LANGE - BEN FRENCH
69KV TRANSMISSION LINE

LOAD & DESIGN DETAIL
TC-3PDE-ST
STR 41

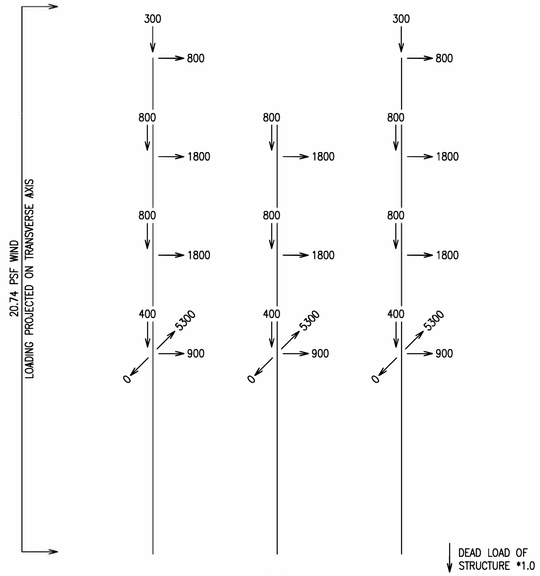
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FILENAME BHE–LD–13–D–2.DWG
SCALE 3/16"=1'–0"

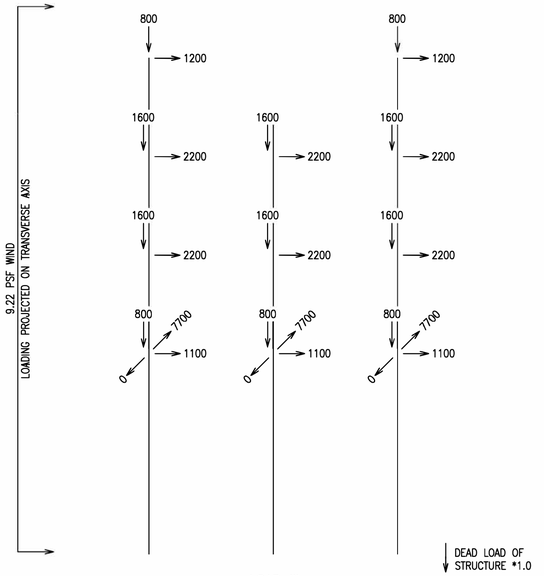
SHEET **LD-13-2**



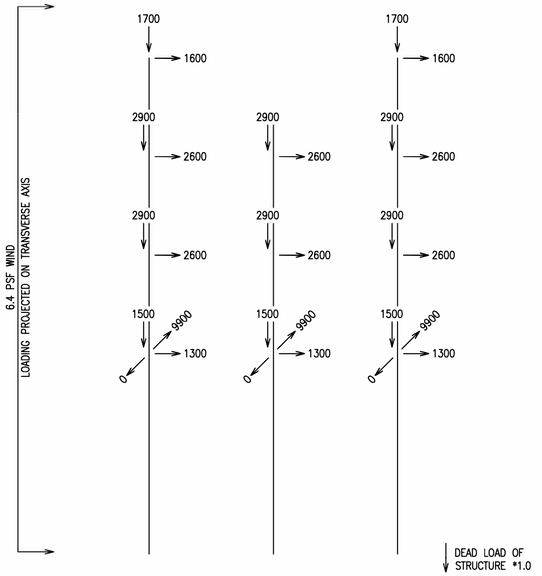
LOAD I
NESC HEAVY LOADING – RULE 250B
ALL WIRES INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 4 PSF WIND @ 0°F



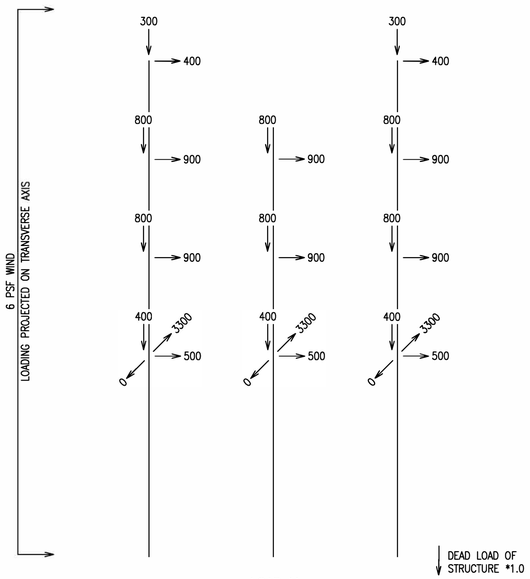
LOAD II
NESC EXTREME HIGH WIND – RULE 250C
ALL WIRES INTACT
NO ICE, 20.74 PSF WIND @ 60°F



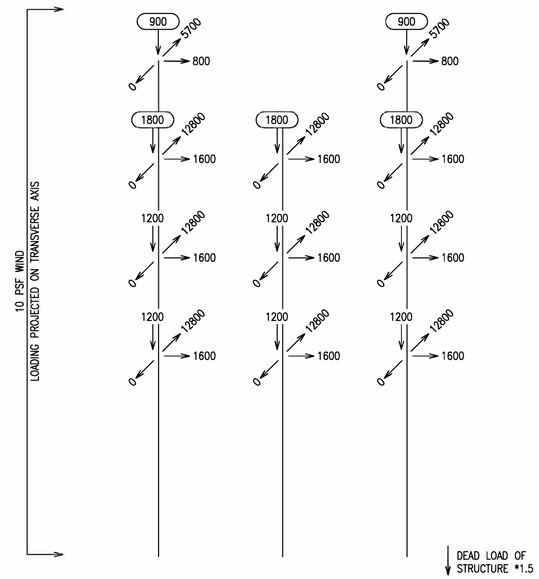
LOAD III
NESC CONCURRENT ICE/WIND – RULE 250D
ALL WIRES INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 9.22 PSF WIND @ 15°F



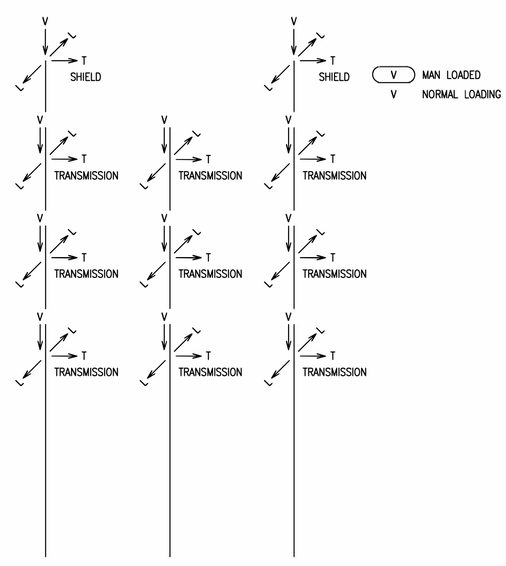
LOAD IV
BHE CONCURRENT ICE/WIND
ALL WIRES INTACT
1.0" RADIAL ICE @ 57 LBS/FT³, 6.4 PSF WIND @ 0°F



LOAD V
DEFLECTION LIMIT
ALL WIRES INTACT
NO ICE, 6 PSF WIND @ 60°F



LOAD VI
TERMINAL
BACK SPAN INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 4 PSF WIND @ 0°F



TYPICAL

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

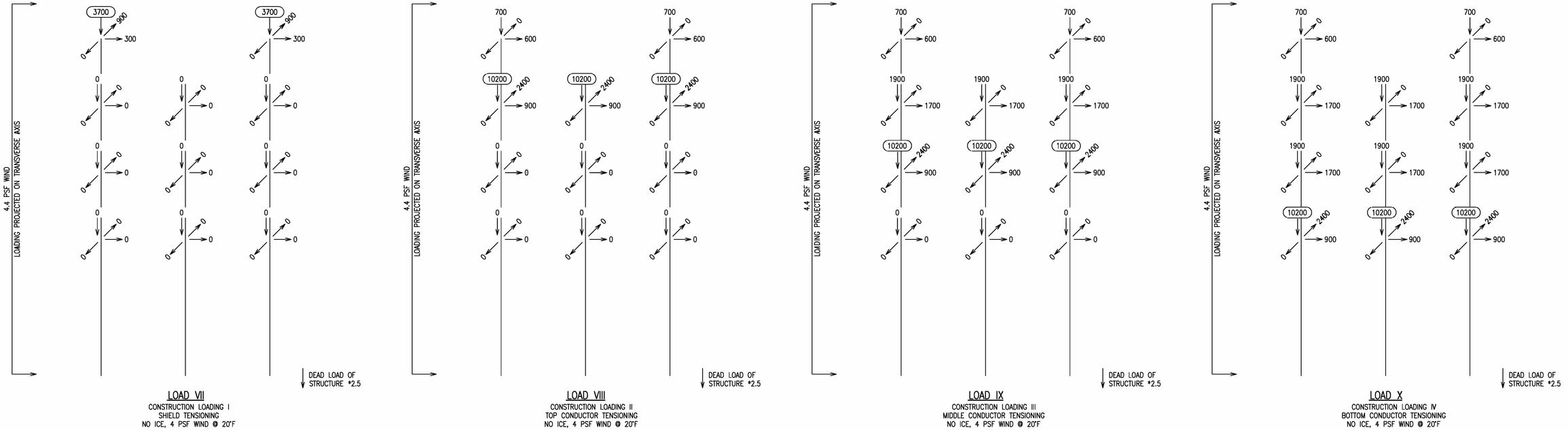
LANGE - WEST RAPID CITY
LANGE - BEN FRENCH
69KV TRANSMISSION LINE

LOAD & DESIGN DETAIL
TC-3PDE-ST
STR 41

0 1" 2"

FILENAME BHE-LD-13-D-3.DWG
SCALE 3/16"=1'-0"

SHEET
LD-13-3



ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
LANGE - BEN FRENCH
69KV TRANSMISSION LINE

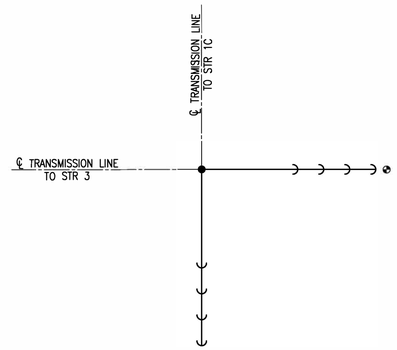
LOAD & DESIGN DETAIL
TC-3PDE-ST
STR 41

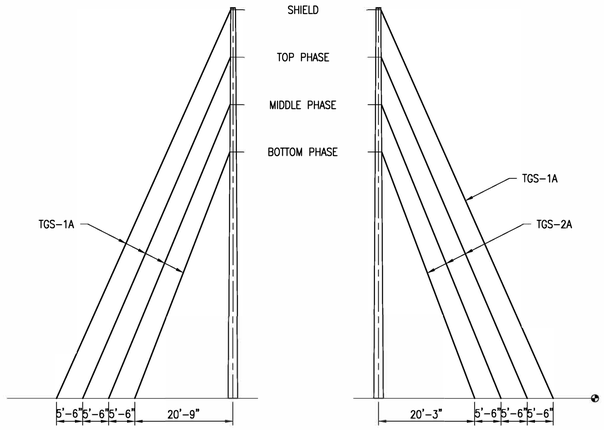
0 1" 2"

FILENAME BHE-LD-13-D-4.DWG
SCALE 3/16"=1'-0"

SHEET
LD-13-4

NOTES:
1. ALL ANCHORS ARE TA-3H.



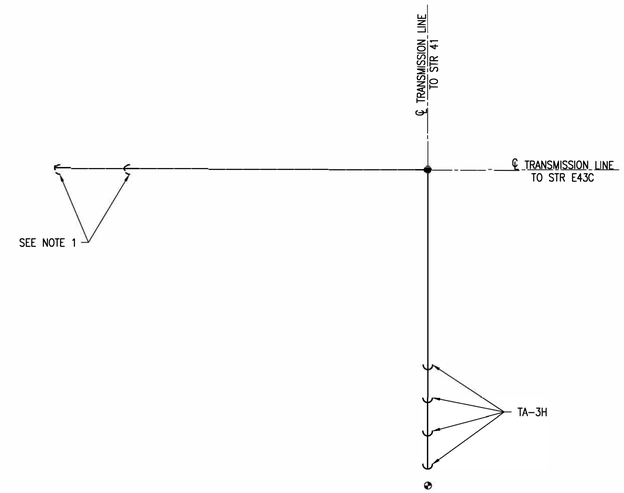


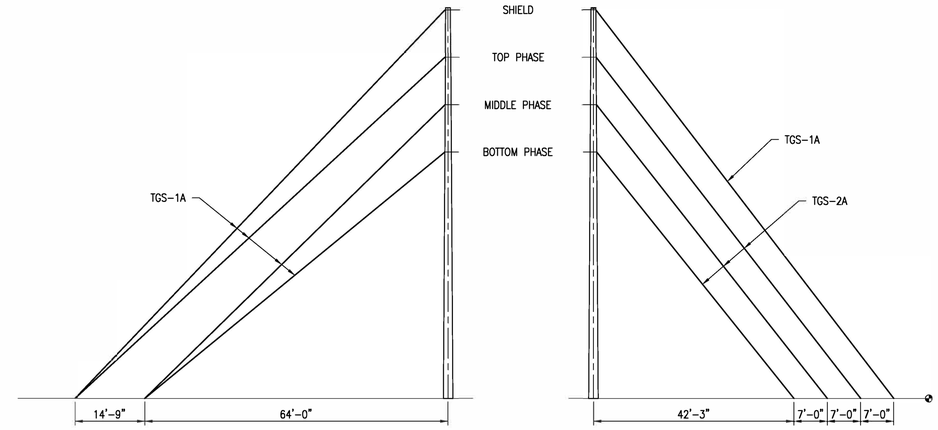
SHEET TITLE
GUYING ARRANGEMENT
STRUCTURE 2C

REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
GD-STR2C

NOTES:
1. EXISTING TA-P1 ANCHORS. ANCHORS SHALL BE TESTED TO 50% OF THEIR ULTIMATE RATING CAPACITY. ALL MATERIAL AND LABOR REQUIRED FOR TESTING OF THE ANCHORS SHALL BE FURNISHED BY THE CONTRACTOR AND INCLUDED IN THE UNIT COSTS FOR TESTING ANCHORS.
ANCHORS SHALL BE HELD AT THE FOLLOWING TENSION FOR 1 MINUTE:
TA-P1.....18,000 LBS





SHEET TITLE
GUYING ARRANGEMENT
STRUCTURE 42C

REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
GD-STR42C

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z.JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - BEN FRENCH
69KV TRANSMISSION LINE

GUYING DETAIL

0 1" 2"

FILENAME BHE-TMG-01-D-1.DWG
SCALE NONE

SHEET
TMG-01

STRUCTURE DATA												TRANSMISSION ASSEMBLIES							COMMENTS
STR. #	STATION (FT)	AHEAD SPAN	LINE ANGLE				STR TYPE	POLE H&C	FND	FND REVEAL	GROUND	ANCHORS	GUYS	SHIELD ASSEMBLIES	CONDUCTOR ASSEMBLIES	OPGW SPLICE	DAMPERS	MISC.	
SUB DE	0+00	260					DT-01-69							2)T-4DS	3)T-BDE6PD	SPLICE BY SUBSTATION		3)M400, 12)B606	USE PARTS M400 & B606 FOR JUMPERS FROM CONDUCTOR DEADENDS (NOT PROVIDED BY SUBSTATION).
1C	2+60	247					SCHP-M2	1)105/H2	EMBED: 14'-6"		1)TM-9			2)T-4B	3)T-PSD			1)TM-SPS-2	
2C	5+07	365	84°	48'	21"	RT	SCDE-69-2S	1)70/1	EMBED: 11'-0" 1)TP-A		1)TM-9	8)TA-3H, 16)TA-5EXT	5)TGS-1A, 3)TGS-2A, 8)TM-GM	3)T-4D	6)T-BDE6PD, 3)T-SP1				SEE TMG-01 FOR GUYING DETAIL. TA-5EXT ANCHOR EXTENTIONS INSTELLED 3 PER ANCHOR WEST, 1 PER ANCHOR EAST.
3	8+72 BOL 9+46 AOL	410	1°	34'	48"	RT	DC-C3309-SDE	2)75/H3	2)TP-A		2)TM-9	8)TA-3H	8)TGS-1A, 8)TM-GM	2)T-4D, 2)T-4FDW	12)T-BDE6PD, 6)T-J4PD	1)T-FSC-2	2)DPR-EHS-D1, 2)DPR-OPGW-D1, 12)DPR-795-D2		STR INSTALLED ON LANGE-WEST RAPID CITY 69KV PACKAGE.
4	13+57	374		15'	10"	RT	TC-H-FRAME	2)85/H1			2)TM-9			1)T-4A, 1)T-4AF	6)T-S4D				
40	134+01	323		17'	52"	LT	TC-H-FRAME	2)90/H1			2)TM-9			1)T-4A, 1)T-4AF	6)T-S4D				
41	137+24	337	2°	48'	30"	RT	TC-3PDE-ST	LD-13: 2)70'-0", 1)60'-0"	3)FND-04-1	EAST: 1'-0" MIDDLE: 3'-9" WEST: 6'-6"	3)TM-9ST, 3)TM-9SSJ			5)T-4FDS, 4)T-4DS	15)T-BDE6PD, 6)T-SP	1)T-FSCS-3	1)DPR-EHS-D1, 3)DPR-OPGW-D1, 15)DPR-795-D2		THIRD (3) OPGW SPANS ACROSS AS OVERHEAD STRUCTURE TIE AND CONTINUES ON LANGE-BEN FRENCH 3 LINE. STR INSTALLED ON LANGE-WEST RAPID CITY 69KV PACKAGE
42C	140+61	382	67°	29'	52"	LT	SCDE-69	1)90/H3	EMBED: 13'-0" 1)TP-A		1)TM-9	2)TA-P1, 4)TA-3H, 10)TA-5EXT	5)TGS-1A, 3)TGS-2A, 8)TM-GM	2)T-4FDW	6)T-BDE6PD, 3)T-SP1		1)DPR-OPGW-D1, 3)DPR-795-D2		SEE TMG-01 FOR GUYING DETAIL. TA-5EXT ANCHOR EXTENSTIONS INSTALLED: 3-2-3-2 WEST.
43C	144+43	168	78°	04'	26"	RT	SCDE-69	1)75/1 WRC			1)TM-9	3)TA-P1	6)TGS-1, 6)TM-GM	1)T-4FDW, 2)T-4D	6)T-BDE6PD	1)T-FSC-1			OPGW TERMINATES HERE FOR FUTURE USE.
BF 3	146+11						SUB DE							2)T-4DS	3)T-BDE6D				

NOTES:

XXX NEW

[XXX] EXISTING

*XXX RETIRE

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - BEN FRENCH
69KV TRANSMISSION LINE

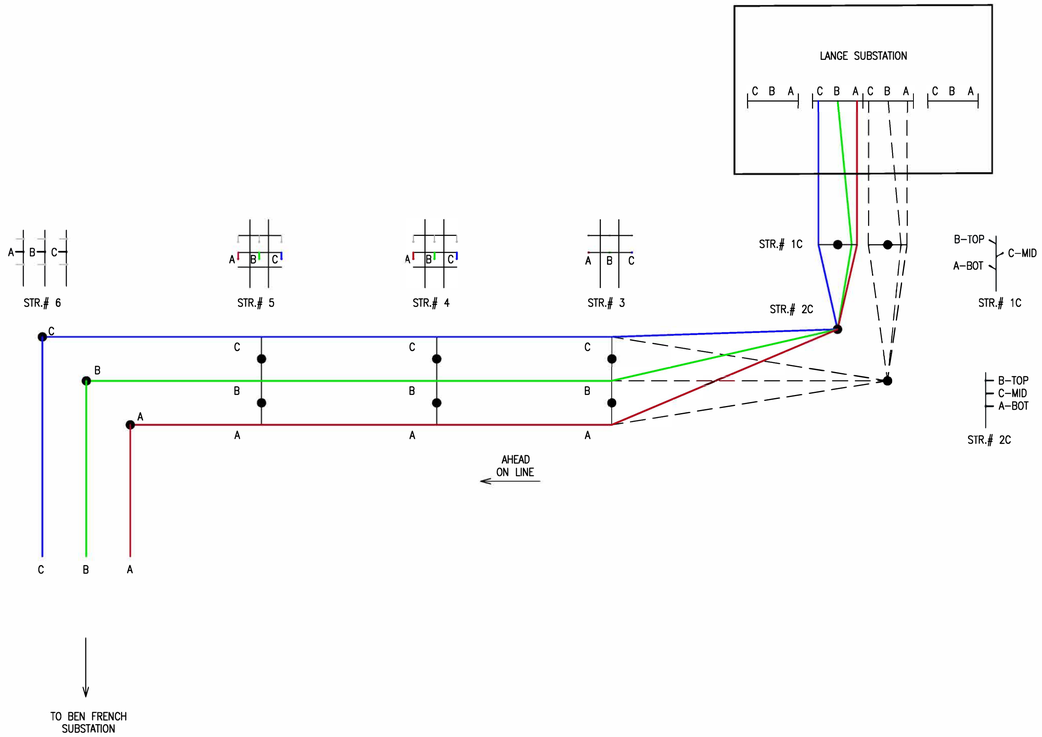
STAKING SHEETS

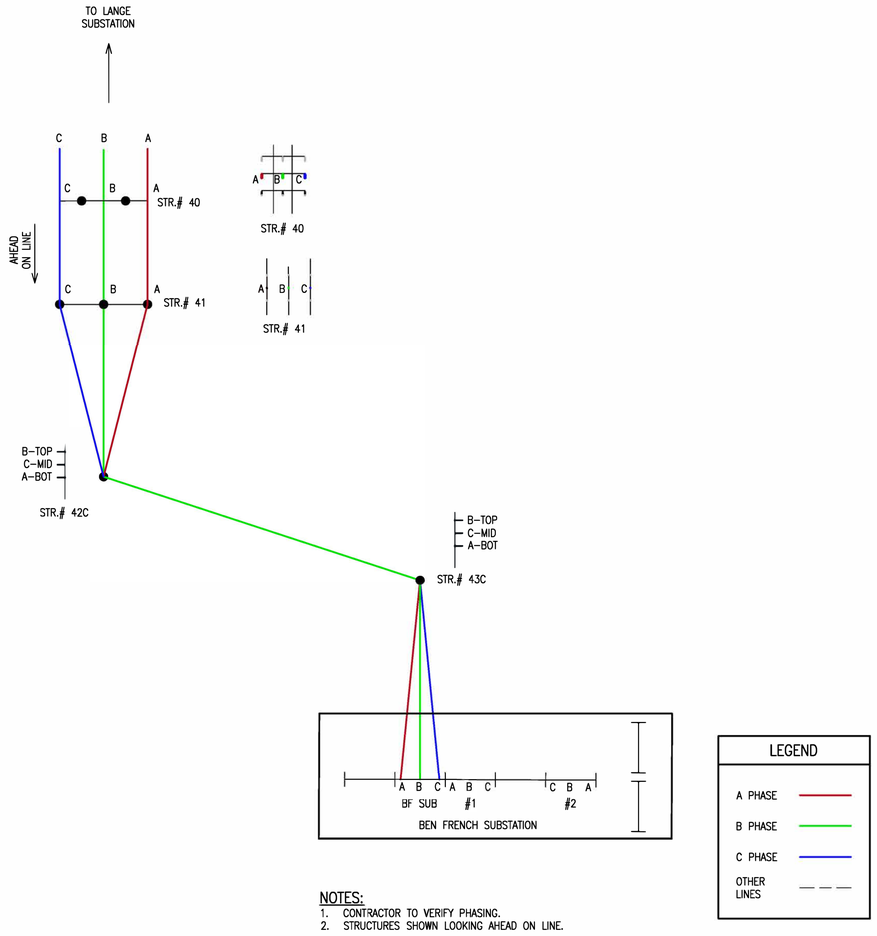
0 1" 2"

FILENAME BHE-SS-01-D-1.DWG

SCALE NONE

SHEET **SS-01**





NOTES:
1. CONTRACTOR TO VERIFY PHASING.
2. STRUCTURES SHOWN LOOKING AHEAD ON LINE.

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
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CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
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BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - BEN FRENCH
69KV TRANSMISSION LINE

PHASING DIAGRAM

0 1" 2"

FILENAME BHE–PH–01–D–1.DWG
SCALE N.T.S.

SHEET **PH-01**

INITIAL SAG TABLE			795 KCMIL 45/7 ACSR "TERN" 2500# @ NESC HEAVY LOADING														SUB DE to 2C													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
SUB DE	255	260	7.13	7.36	7.58	7.80	8.00	8.19	8.38	8.56	8.74	8.91	9.09	9.26	9.42	9.59	9.75	7.99	8.12	8.24	8.35	8.46	8.56	8.66	8.75	8.84	8.93	9.02	9.10	9.18	9.26	9.34	
1C		247	6.39	6.59	6.79	6.98	7.16	7.33	7.50	7.66	7.83	7.98	8.13	8.29	8.43	8.58	8.73	7.56	7.68	7.79	7.90	8.00	8.10	8.19	8.28	8.37	8.45	8.53	8.61	8.69	8.76	8.84	
SUB-PHASE TENS. LBS			1076	1042	1012	984	959	937	916	897	878	862	845	830	815	801	788																SUBTOTAL DAMPERS NEEDED:0

INITIAL SAG TABLE			795 KCMIL 45/7 ACSR "TERN" 5815# @ NESC HEAVY LOADING														2C to 3													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
2C	365	365	3.78	4.11	4.47	4.84	5.22	5.60	5.97	6.34	6.71	7.06	7.40	7.74	8.06	8.38	8.70	5.81	6.06	6.32	6.58	6.84	7.08	7.31	7.53	7.74	7.95	8.14	8.32	8.49	8.66	8.82	
3																																	3)DPR-795-D2 BOL, 3)DPR-795-D2 AOL
SUB-PHASE TENS. LBS			3939	3617	3325	3071	2847	2655	2489	2344	2218	2107	2010	1922	1845	1775	1711																SUBTOTAL DAMPERS NEEDED:12

INITIAL SAG TABLE			795 KCMIL 45/7 ACSR "TERN" 7415# @ NESC HEAVY LOADING														41 to 42C													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
41	337	337	1.87	2.00	2.16	2.35	2.56	2.80	3.08	3.39	3.71	4.06	4.43	4.78	5.15	5.50	5.85	4.09	4.23	4.40	4.58	4.78	5.01	5.25	5.50	5.76	6.03	6.29	6.54	6.78	7.01	7.23	3)DPR-795-D2 BOL, 3)DPR-795-D2 AOL
SUB-PHASE TENS. LBS			6754	6298	5839	5377	4930	4500	4097	3726	3397	3104	2851	2637	2452	2294	2158																SUBTOTAL DAMPERS NEEDED:12

ISSUE	DATE	DESCRIPTION
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PROJECT MANAGER	J. ELLSWORTH
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DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - BEN FRENCH
69KV TRANSMISSION LINE

INITIAL SAG TABLES

795 KCMIL 45/7 ACSR "TERN"

0 1" 2"

FILENAME BHE-STC-01-D-1.DWG

SCALE NONE

SHEET **STC-01-1**

FINAL SAG TABLE			795 KCMIL 45/7 ACSR "TERN" 4870# @ NESC HEAVY LOADING														42C to 43C													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
42C	382	382	6.86	7.23	7.59	7.94	8.28	8.61	8.94	9.25	9.56	9.86	10.16	10.44	10.73	11.00	11.28	7.83	8.04	8.24	8.43	8.61	8.78	8.94	9.10	9.25	9.39	9.53	9.66	9.80	9.92	10.04	3)DPR-795-D2 AOL
SUB-PHASE TENS. LBS			2373	2251	2145	2050	1965	1890	1821	1759	1702	1650	1602	1559	1517	1480	1444																SUBTOTAL DAMPERS NEEDED:6

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
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PROJECT MANAGER	J. ELLSWORTH
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DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - BEN FRENCH
69KV TRANSMISSION LINE

FINAL SAG TABLES

795 KCMIL 45/7 ACSR "TERN"

0 1" 2"

FILENAME BHE-STC-02-D-1.DWG

SCALE NONE

SHEET **STC-02-1**

INITIAL SAG TABLE			AFL CC-55/443 "DNO-4748" OPGW 3095# @ NESC HEAVY LOADING														41 to 42C												
			SAG FT														3RD WAVE TIME SEC.												
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
41	337	337	1.96	2.08	2.21	2.35	2.50	2.67	2.85	3.04	3.24	3.45	3.67	3.90	4.13	4.37	4.60	4.19	4.31	4.44	4.58	4.73	4.89	5.05	5.21	5.38	5.55	5.73	5.91	6.08	6.25	6.42	1)DPR-OPGW-D1 AOL
SUB-PHASE TENS. LBS			2082	1962	1849	1738	1632	1530	1433	1345	1261	1184	1111	1047	988	935	887																SUBTOTAL DAMPERS NEEDED:1

INITIAL SAG TABLE			AFL CC-55/443 "DNO-4748" OPGW 2565# @ NESC HEAVY LOADING														42C to 43C												
			SAG FT														3RD WAVE TIME SEC.												
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
42C	382	382	5.25	5.51	5.77	6.04	6.30	6.56	6.81	7.06	7.31	7.55	7.79	8.03	8.26	8.49	8.72	6.85	7.02	7.18	7.35	7.51	7.66	7.80	7.95	8.09	8.22	8.35	8.48	8.60	8.72	8.83	1)DPR-OPGW-D1 AOL
SUB-PHASE TENS. LBS			1011	963	920	879	843	810	780	752	726	703	681	661	642	625	609																SUBTOTAL DAMPERS NEEDED:1

ISSUE	DATE	DESCRIPTION
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PROJECT MANAGER	J. ELLSWORTH
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DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - BEN FRENCH
69KV TRANSMISSION LINE

INITIAL SAG TABLES

AFL CC-55/443 "DNO-4748" OPGW

0 1" 2"

FILENAME BHE-STF-01-D-1.DWG

SCALE NONE

SHEET **STF-01-1**

INITIAL SAG TABLE			3/8" 7 STRAND EHS 1500# @ NESC HEAVY LOADING														SUB DE to 2C													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
SUB DE	255	260	5.54	5.69	5.82	5.96	6.09	6.22	6.35	6.47	6.60	6.72	6.85	6.97	7.08	7.20	7.31	7.04	7.13	7.22	7.30	7.38	7.46	7.54	7.61	7.68	7.75	7.82	7.89	7.96	8.03	8.09	
1C		247	4.95	5.08	5.20	5.32	5.44	5.56	5.67	5.78	5.89	6.01	6.11	6.22	6.33	6.43	6.53	6.66	6.74	6.82	6.90	6.97	7.05	7.12	7.19	7.26	7.33	7.40	7.46	7.52	7.58	7.64	
SUB-PHASE TENS. LBS			424	413	404	394	386	378	370	363	356	350	343	337	332	327	321																SUBTOTAL DAMPERS NEEDED:0

INITIAL SAG TABLE			3/8" 7 STRAND EHS 2520# @ NESC HEAVY LOADING														2C to 3													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
2C	365	365	4.35	4.56	4.76	4.97	5.17	5.38	5.58	5.78	5.98	6.19	6.38	6.58	6.77	6.96	7.15	6.24	6.38	6.52	6.66	6.80	6.93	7.07	7.19	7.32	7.44	7.56	7.67	7.78	7.89	8.00	
3																																	1)DPR-EHS-D1 BOL & 1)DPR-EHS-D1 AOL
SUB-PHASE TENS. LBS			1041	995	952	913	877	843	812	784	757	732	710	688	669	651	634																SUBTOTAL DAMPERS NEEDED:2

D

C

B

A

Black Hills Energy
Improving life with energy

HDR

ISSUE	DATE	DESCRIPTION
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BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - BEN FRENCH
69KV TRANSMISSION LINE

INITIAL SAG TABLES

3/8" 7 STRAND EHS

0 1" 2"

FILENAME: BHE-STS-01-D-1.DWG
SCALE: NONE

SHEET: **STS-01-1**

ITEM NO.	QTY	DESCRIPTION	MANUFACTURER	MANUFACTURER PART #	CLIENT #	SCHP-M2	SCDE-69	SCDE-69-2S	DT-01-69	T-4B	T-4D	T-4DS	T-4FDW	T-FSC-1	T-SP1	T-PSD	T-BDEBPD	TM-9	TGS-1A	TGS-2A	TA-3H	TA-SEXT	TM-GM	TM-SPS-2	TP-A	DPR-DPGW-01	DPR-795-D2	3/8" EHS	DNO-4748	795-ACSR	8606	M400	EXTRA
				Lange-Ben French 3 - QTY:		1	1	1	1	2	3	2	3	1	6	3	15	3	10	6	12	26	16	1	2	1	3	1500	1000	4000	12	3	1
A110	26	ANCHOR, EXTENSION, 1 1/2" SQ. SHAFT 5'-0"	CHANCE	12656	N.S.																	1											
A111	12	ANCHOR, EXTENSION, 1 1/2" SQ. SHAFT 7'-0"	CHANCE	12657	N.S.																1												
A210	12	ANCHOR, 1 1/2" SQ. SHAFT, 8", 10", AND 12" HELIX W/ TRIPLEYE ADAPTER	CHANCE	12654-3AEJ	N.S.																1												
B2526	2	BOLT, MACHINE, 5/8" X 26"	HUGHES	B626-6	N.S.								2																				
B273	16	BOLT, MACHINE, 7/8" X 3"	HUGHES	B83-2	20-7803		8	8																									
B2718	2	BOLT, MACHINE, 7/8" X 18"	HUGHES	B818-6	20-7818	2																											
B2720	2	BOLT, MACHINE, 7/8" X 20"	HUGHES	B820-6	20-7820	2																											
B2722	10	BOLT, MACHINE, 7/8" X 22"	HUGHES	B822-6	20-7822	2	4	4																									
B2724	4	BOLT, MACHINE, 7/8" X 24"	HUGHES	B824-6	20-7824		2	2																									
B603	2	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	BURNDY	50 FWSS	N.S.							1																					
B605	2	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	BURNDY	50 SWSSMD	N.S.							1																					
B606	12	BOLT, NUT, BELLEVILLE, FLAT, STAINLESS STEEL, ASSEMBLY	CMC	SBA20-50	N.S.																										1		
B614	2	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	FASTENAL	70207	N.S.							1																					
C107	4000	CONDUCTOR, 795 KCMIL ACSR, 45/7 "TERN"	SOUTHWIRE		N.S.																									1			
C800	1500	WIRE, GALVANIZED, 7 STEEL STRAND, 3/8" EHS	MITCHELL		N.S.																							1					
C801	2420	WIRE, GALVANIZED, 7 STEEL STRAND, 7/16" EHS	MITCHELL		18-7167														110	220													
C901	375	WIRE, COPPER, #4 SOLID, 40% CONDUCTIVITY	SOUTHWIRE		36-4000													125															
C902	22	WIRE, COPPER, #2 STRANDED, CLASS B	SOUTHWIRE		N.S.					2	2	6																					
F111	6	3108.6 POLE BANDS, HEAVY DUTY, 9"-12" POLE	HUGHES	3108.6	18-1117	1	2	3																									
F112	4	3108.7 POLE BANDS, HEAVY DUTY, 11"-14" POLE	HUGHES	3108.7	18-1118		2	2																									
F113	8	3108.8 POLE BANDS, HEAVY DUTY, 13"-16" POLE	HUGHES	3108.8	18-1119		4	4																									
F201	14	LINK, CONNECTING, 1/4" X 2" X 7 1/2", 15/16" HOLES, 24K LBS	HUGHES	3152	14-3152	4	4	6																									
F203	56	LINK, CONNECTING, 3/8" X 2" X 7 1/2", 15/16" HOLES, 38K LBS	HUGHES	3154	14-3154		28	28																									
F300	2	ANCHOR ASSEMBLY WITH BOLTS, PAIR	HUGHES	A1895-2	N.S.																			1									
G100	16	GUY, ROLLER, 1 1/8" WR, 15/16" HOLE	HUGHES	28082	18-2808		8	8																									
G200	10	GUY, STRAIN INSULATOR, 120" LONG, 21K LBS, ROLLER, ROLLER	HUGHES	CF694-120R2	18-1521														1														
G201	6	GUY, STRAIN INSULATOR, 120" LONG, 50K LBS	MACLEAN	GCC50-120-SC	18-1550															1													
G400	16	GUY, GUARD, 2" X 8'-0", FULL ROUND, YELLOW	MacLEAN	J1493Y	N.S.																		1										
G601	30	GUY DEADEND GRIP, FOR 7/16" EHS	PREFORMED	GDE-1108	18-7168														3														
G902	16	GUY, STRANDVISE, 7/16" EHS, SHORT BAIL	MacLEAN	5203	18-0716														1	1													
G903	6	GUY, STRANDVISE, 7/16" EHS, LONG BAIL	MacLEAN	5203L	18-0717															1													
H102	5	SOCKET EYE, 18K, 1/2" WIDTH, 11/16" HOLE, 2-1/16" LENGTH	HUBBELL	SA04	N.S.						1	1																					
H200	0	SOCKET CLEVIS, 30K	HUBBELL	SC30	N.S.																												
H500	5	Y-CLEVIS BALL, 30K	HUBBELL	YBC30	48-3054						1	1																					
H602	3	ANCHOR, SHACKLE, 3" LONG, 3/4" DIA., 7/8" DIA. PIN, 35K LBS	HUGHES	2865-B3	N.S.								1																				
H901	2	Y-CLEVIS, EYE, 90, 20K	ANDERSON	YCS-05-90	48-5207					1																							
H902	3	Y-CLEVIS, EYE, 90, 40K	HUBBELL	YCS-06-90-40	48-3053											1																	
I220	3	INSULATOR, HORIZONTAL POST, DROP TONGUE, 69KV	HUBBELL	P250043S0020	48-1007											1																	
I250	6	INSULATOR, HORIZONTAL POST, CLAMPTOP, 69KV	HUBBELL	P250043S1020	N.S.										1																		
I300	15	INSULATOR, DEADEND, Y-CLEVIS BALL, 54" LENGTH, 25K LBS	MACLEAN	S14080042MXAL027	48-6927												1																
I400	2	PHASE SPACER, 1'-6" LONG, 15KV	HUGHES	CF800-18C	N.S.																			2									
J100	1000	AFL CC-55/443 "DNO-4748" OPGW	AFL	DNO-4748	N.S.																								1				
J300	3	FIBER OPTIC DEADEND, 18" U-BOLT (48 FIBER), W/ GROUND WIRE	PREFORMED	2801303G	N.S.								1																				
J401	10	DOWNLEAD CUSHION KIT 0.443 OPGW W/ HARDWARE FOR WOOD POLE	PREFORMED	8663041-H1	N.S.									10																			
J501	1	VERTICAL CABLE STORAGE ASSEMBLY	PREFORMED	8003569	N.S.									1																			
J502	1	VERTICAL MOUNTING BRACKET KIT	PREFORMED	8003472	N.S.									1																			
J510	1	6" X 22" COYOTE CLOSURE KIT W/ 6 PORT END PLATE	PREFORMED	8006659	N.S.									1																			
J511	1	COYOTE DEFENDER FOR 6" X 22" CLOSURE	PREFORMED	8003492	N.S.									1																			
J600	2	SPLICE TRAY KIT, 36 COUNT TRAY	PREFORMED	80805514	N.S.									2																			
J700	1	CLOSURE END PLATE GROMMETS, 7/8" PORT, 0.443" OPGW	PREFORMED	8003597	N.S.									1																			
J720	3	FUTURE CABLE PORT KIT, 7/8" PORT	PREFORMED	8003371	N.S.									3																			
J730	1	GROMMET PLUG, 3/4" PORT, QTY 2	PREFORMED	80806037	N.S.									1																			
K300	6	CLAMP, TRUNNION, 795 KCMIL 45/7 ACSR "TERN", 2,800 LBS	HUBBELL	TSC150	48-7020										1																		
K400	2	AGS SUSPENSION ASSEMBLY, 15K, 3/8" EHS	PREFORMED	AGS-7104	40-7104					1																							
K500	3	AGS SUSPENSION ASSEMBLY, 25K, 795 ACSR-45/7 "TERN"	PREFORMED	AGS-5128	40-5114											1																	
L101	15	STRAIN CLAMP, DEADEND W/ SOCKET-EYE, 30K, 0.50 - 1.20 RANGE	HUBBELL	SD-112-S	42-1120												1																
L300	5	STRAIN CLAMP, DE, 20K, 3/8" EHS	HUBBELL	SWDE55N	44-4053						1	1																					
L502	0	COMPRESSION DEADEND ASSY, DOUBLE TONGUE, W/ 15' TERMINAL "TERN"	AFL	VED-123	42-8230																												
M400	3	COMPRESSION TERMINAL, STRAIGHT, 4-HOLE, 795 TERN	ALCOA	TS-12	N.S.																											1	
M500	2	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	HUBBELL	VHCL1012	N.S.							1																					
M601	4	WRAPLOCK TIE, C-NECK, 0.36" CONDUCTOR	PREFORMED	WTC-0109	N.S.																			4									
N107	6	NUT, SQUARE, 7/8"	HUGHES	N80	47-0242		3	3																									
N405	2	NUT, LOCK, MF TYPE, 5/8"	HUGHES	MF60	N.S.									2																			
N407	34	NUT, LOCK, MF TYPE, 7/8"	HUGHES	MF80	22-7856	6	14	14																									

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - BEN FRENCH
69KV TRANSMISSION LINE

MATERIAL LIST

0 1" 2"

FILENAME BHE-ML-01-D-1.DWG
SCALE NONE
SHEET ML-01-1

						SCHP-M2	SCDE-69	SCDE-69-2S	DT-01-69	T-4B	T-4D	T-4DS	T-4FDW	T-FSC-1	T-SP1	T-PSD	T-BDEBPD	TM-9	TGS-1A	TGS-2A	TA-3H	TA-SEXT	TM-GM	TM-SPS-2	TP-A	DPR-DPGW-01	DPR-795-D2	3/8" EHS	DNO-4/7/8	795 ACSR	8636	MA90	EXTRA
				Lange-Ben French 3 - QTY:		1	1	1	1	2	3	2	3	1	6	3	15	3	10	6	12	26	16	1	2	1	3	1500	1000	4000	12	3	1
ITEM NO.	QTY	DESCRIPTION	MANUFACTURER	MANUFACTURER PART #	CLIENT #																												
O100	0	INHIBITOR, FILLER COMPOUND, GRITTED, COMPRESSION CONNECTIONS, 8 oz.	HUBBELL	VS68B	N.S.																												
O101	0	INHIBITOR, FILLER COMPOUND, NON-GRITTED, PAD TO PAD, 8 OZ	HUBBELL	VS8B	N.S.																												
O102	0.36	INHIBITOR, RUST (NO-OX-ID), 1 PT CAN, GRADE "A"	SANCHEM INC	NO-OX-ID "A" SPECIAL	N.S.										0.06																		
P104	18	CLIP, BONDING, WITH 1/2" X 1 1/2" BOLT, 7/16" MAX. WIRE	HUGHES	2718.55	46-2718	1	8	9																									
P150	120	NAIL, 10D, CU-COATED	MACLEAN	J7260	46-7460													40															
P151	120	CLIP, CU-COATED	KEARNEY	5730-1	46-2729													40															
P207	6	CLIP, BONDING, FOR 7/8" DIA. BOLT, 5/16" MAX. WIRE	HUGHES	2727.8	46-2728		3	3																									
P300	7	WOOD MOULDING, 1-11/16" X 8'-0"	HUGHES	2503.8	46-2503	4												1															
P400	29	MOULDING, STAPLES, 3 1/2" X 1 3/4"	HUBBELL	C25050222	46-2504	20												3															
P600	150	STAPLES, CUT (SLASH), 1 1/2" X 3/8", COPPER COATED, BARBED	MACLEAN	J7682	46-7494													50															
Q100	23	CLAMP, 3-BOLT, 6" LONG, 5/8" BOLT, 5/16" - 1/2" RANGE	MACLEAN	J931	18-5816						1	1								3													
Q500	3	CONNECTOR, COMPRESSION #4 COPPER TO #4 COPPER	HOMAC	CC44	N.S.								1																				
Q501	5	GROUND CLAMP, #2 STRANDED TO #4 SOLID	HOMAC	CC24	36-0002					1	1																						
Q550	7	CLAMP, SINGLE BOLT, VISE TYPE, 3/8" EHS TO #2 STR CU	HUBBELL	GA9020GLSS	46-6810					1	1	1																					
Q551	1	CLAMP, SINGLE BOLT, #4 STR CU TO 4/0 AWG STR. CU	HUBBELL	LC1602	N.S.				1																								
Q552	1	CLAMP, VISE TYPE, 3/8 EHS TO 4/0 AWG STR CU	HUBBELL	GA9040L55	N.S.				1																								
Q601	15	PARALLEL GROOVE CONNECTOR, 0.743 - 1.152 RANGE	AFL	483.3A	42-0483												1																
S110	1	SPIRAL VIBRATION DAMPER, 0.327" - 0.461" RANGE	PREFORMED	5050104	N.S.																					1							
S150	6	DAMPER, DOG BONE, 795 ACSR	HUBBELL	60710-12	N.S.																						2						
W205	2	WASHER, SPRING, 11/16" HOLE	HUGHES	2702.6	N.S.								2																				
W207	9	WASHER, SPRING, 15/16" HOLE	HUGHES	2702.8	N.S.	3	3	3																									
W304	4	WASHER, SQUARE, 2" X 1/4", 11/16" HOLE	HUGHES	SW2-60	N.S.								4																				
W410	18	WASHER, ROUND, 2" X 1/4", 15/16" HOLE	HUGHES	RW2-80	N.S.	6	6	6																									
W504	18	WASHER, SQ. CURVED, 4" X 1/4", 15/16" HOLE	HUGHES	SCW4-80	22-4425	6	6	6																									

Black Hills Energy
Improving life with energy

HDR

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
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DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - BEN FRENCH
69KV TRANSMISSION LINE

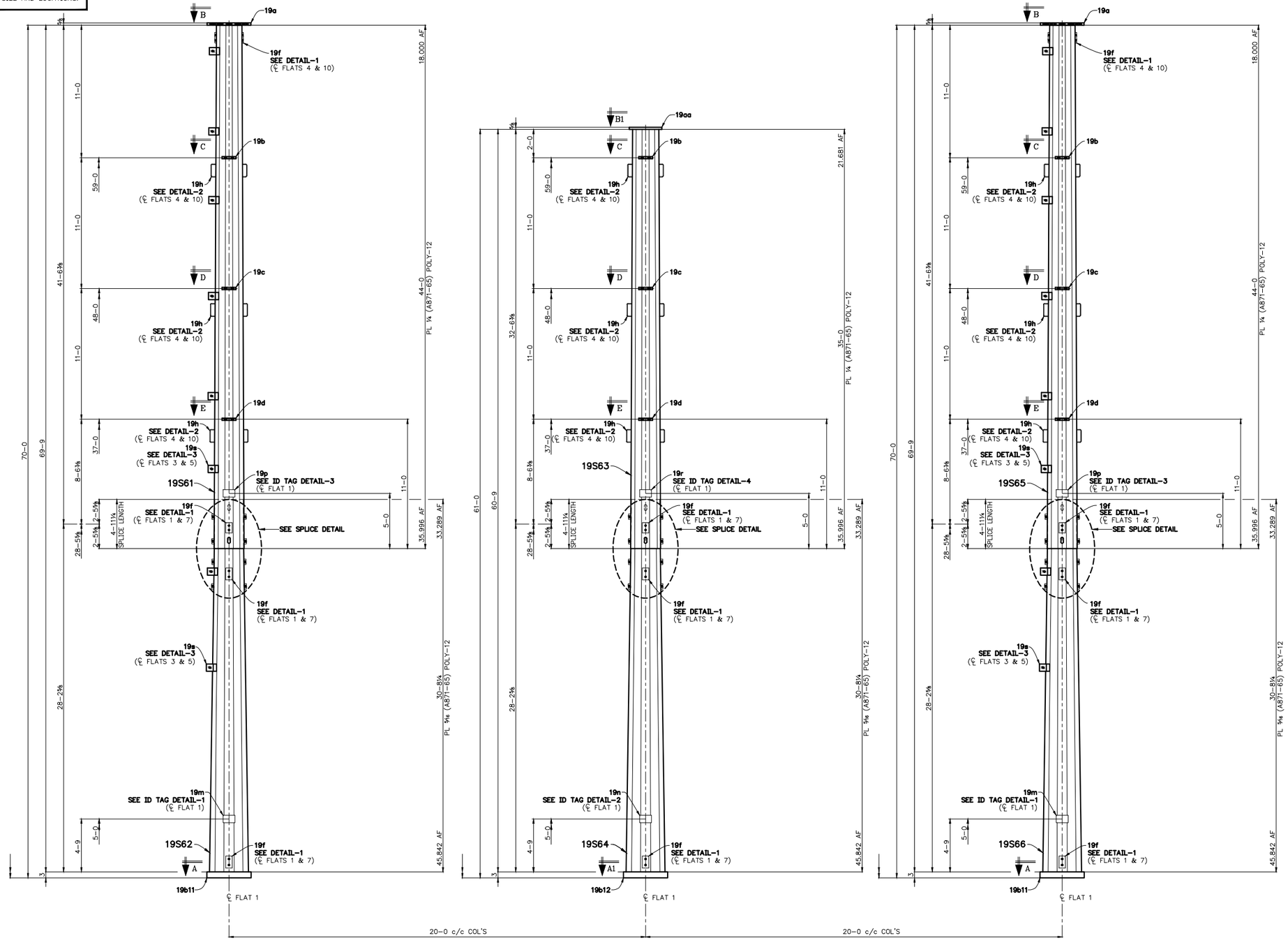
MATERIAL LIST

0 1" 2"

FILENAME BHE-ML-01-D-2.DWG
SCALE NONE

SHEET
ML-01-2

SHOP NOTE:
SEE HOLE DETAIL & SCHEDULE FOR HOLE SIZE AND LOCATIONS.



69KV 3-POLE DEADEND STRUCTURE

MATERIAL REQ'D. FOR ASSEMBLY			
MARK	QTY.	DESCRIPTION	BLACK WT.
19S61	ONE	POLY-12 POLE	3,732
19S62	ONE	POLY-12 POLE	6,172
19S63	ONE	POLY-12 POLE	3,205
19S64	ONE	POLY-12 POLE	6,159
19S65	ONE	POLY-12 POLE	3,732
19S66	ONE	POLY-12 POLE	6,172
		TOTAL BLACK WT.	29,172#

HARDWARE REQD. FOR ASSEMBLY		
MARK	QTY.	DESCRIPTION
(1)	ONE	SEE ANCHOR BOLT CAGE DETAIL ON SHEET E38x.

MATERIAL BILLED FOR ONE MAKE (ONE) TIME

GENERAL NOTES:

1. ALL WELDS SHALL BE IN ACCORDANCE WITH A.W.S. (D1.1.) UNLESS NOTED OTHERWISE.
   a.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL BE U.T. TESTED IN ACCORDANCE WITH AWS & ASNDT.
   b.) ALL MATERIAL WELDED WITH E80-SERIES, LOW HYDROGEN ELECTRODES.
   c.) ALL FILLET WELDS AT JOINT TERMINATIONS OR ABRUPT CHANGES IN WELD DIRECTION SHALL HAVE END RETURNS TO WRAP CORNERS AS GEOMETRY PERMITS. IF JOINT GEOMETRY DOES NOT PERMIT A FULL SIZE RETURN, A SEAL WELD SHALL BE PROVIDED WHERE ACCESSIBLE.
   d.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL USE 3/16" X 1 1/4", (A36) STEEL BACKING (GALVANIZED POLES); (A588-50) (NON-GALVANIZED), MINIMUM. BACKING BARS SHALL BE SPLICED ON SHAFT FLATS ONLY, WITH A C.J.P. GROOVE WELD. BACKING BARS SHALL BE SEAL WELDED ALL AROUND, WHEN ACCESSIBLE.
   e.) LONGITUDINAL SEAM WELDS SHALL ACHIEVE A MINIMUM OF 80% PENETRATION. LONGITUDINAL SEAM WELDS SHALL ACHIEVE 100% PENETRATION WITHIN A MINIMUM OF 6" FROM THE ENDS OF THE SHAFT AND THE FULL LENGTH OF THE FEMALE SECTION IN THE SLIP JOINT.
2. LONGITUDINAL SEAM WELDS IN FEMALE SECTION OF THE SLIP JOINT SHALL BE FULL PENETRATION WELDS.
3. FOR PROPER SHAFT ALIGNMENT FOR ASSEMBLY, A 6" HORIZONTAL WELD BEAD AND A MARK NUMBER ARE POSITIONED ON EACH SHAFT AT EACH SPLICE. THE 6" HORIZONTAL WELD BEADS ARE ON MATCHING CORNERS. THE MARK NUMBER IS ON AN ADJACENT FLAT. THE HORIZONTAL WELD BEAD CORNERS SHALL BE ALIGNED TOP TO BOTTOM OF THE POLE. MATCH NUMBERS SHALL BE MATCHED FOR EACH SPLICE.
4. FIELD ASSEMBLY HOLES (1⅛ø) WITH 1"ø H. HEX NUTS ARE LOCATED ON OPPOSING SECTION FLATS ABOVE AND BELOW SPLICES FOR JACKING SHAFTS TOGETHER.
5. THE LOWER WELD ORIENTATION MARK AT EACH SPLICE LOCATION SHALL BE TELESCOPED IN THE FIELD TO WITHIN 24" OF THE UPPER WELD ORIENTATION MARK. AFTER TELESCOPED, THE SECTIONS SHOULD SHOW NO FURTHER MOVEMENT AND THERE SHOULD BE ADEQUATE METAL-TO-METAL CONTACT ON ALL FLATS.
6. TWO SLOTS (1⅛ø x 2½") WILL BE PROVIDED AT THE SLIP FITTED END OF EACH SHAFT.
7. POLE TAPER = 0.409000 IN/FT (INNER & OUTER POLES)
8. FIELD BOLT SHIPPING QUANTITIES WILL INCLUDE A MAXIMUM 5% OVERAGE FOR BOLTS 1"ø OR LESS. FIELD BOLTS OVER 1"ø WILL BE EXACT COUNT UNLESS NOTED OTHERWISE.
9. ALL HARDWARE NOTED WITH "PT" SHALL BE PRE-TENSIONED PER THE TURN-OF-NUT METHOD. ALL OTHER HARDWARE SHALL BE SNUG-TIGHT. SPARE SHIPPING QUANTITIES WILL INCLUDE THREE EXTRA ASSEMBLIES OF EACH BOLT TYPE DESIGNATED AS "PT" FOR FIELD VERIFICATION OF PRE-TENSIONING METHOD.
10. **POLE SHALL BE SWEEP BLASTED DULLED AFTER FABRICATION.**

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL, DO NOT GALVANIZE.

(STR. 41) 19-9462PE37

NOTICE TO ERECTOR
BACKCHARGES FOR CORRECTIVE WORK OR REPLACED MATERIALS WILL NOT BE ACCEPTED UNLESS EXPRESSLY AUTHORIZED BY DIS-TRAN BEFORE ANY SUCH COST ARE INCURRED.

REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
4					
3					
2					
1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19
8					
7					
6					
5					

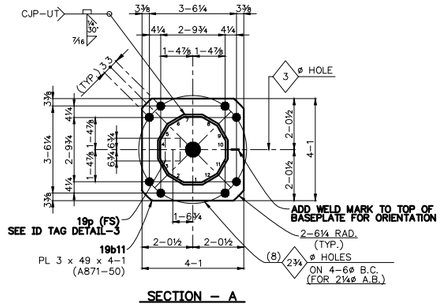
DIS-TRAN Steel, LLC
P.O. BOX 5109•ALEXANDRIA, LA, 71307-5709
PHONE 318-448-0274•FAX 318-445-4454

WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

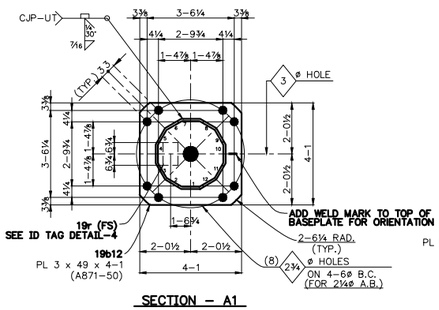
69KV 3-POLE DEADEND STRUCTURE / ITEM - 24
ERECTION ELEVATION, SECTIONS & DETAILS

SCALE	DATE	JOB NUMBER	DRAWING NUMBER	REV. NO.
N.T.S.	07/12/19	19-9462P	E37	1

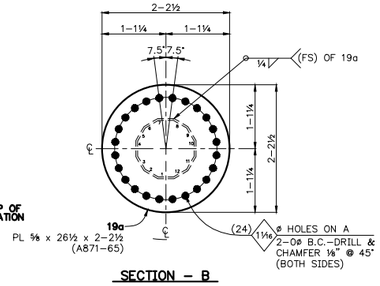
DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ



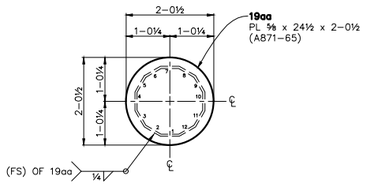
SECTION – A



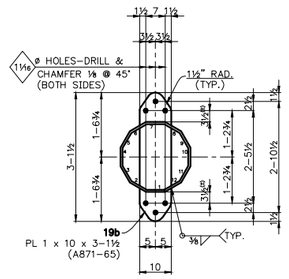
SECTION – A1



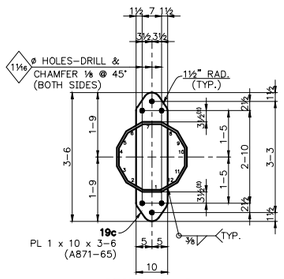
SECTION – B



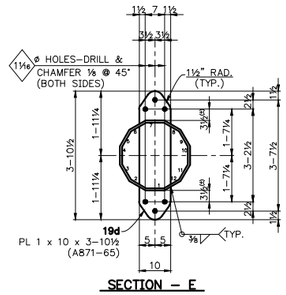
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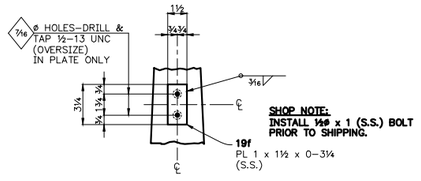
SECTION – C



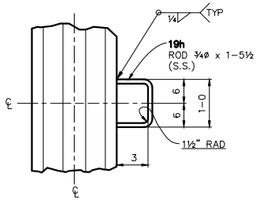
SECTION – D



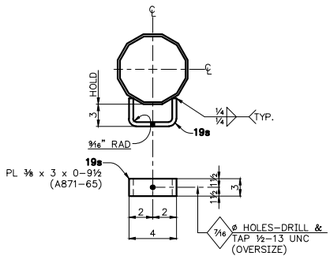
SECTION – E



DETAIL – 1



DETAIL – 2



DETAIL – 3

GROUNDING SCHEDULE
DIM'S TO CENTER OF GROUND PLATE
SEE DETAIL–1

POLES – 19S61 & 19S65		POLES – 19S62, 19S64 & 19S66	POLE – 19S63
℄ OF FLATS 1 & 7	℄ OF FLATS 4 & 10	℄ OF FLATS 1 & 7	℄ OF FLATS 1 & 7
0–11	43–6	0–9	0–11
		24–10	

ALL DIMENSIONS FROM BOTTOM OF SHAFT

GROUND LOOP SCHEDULE
DIM'S TO CENTER OF GROUND LOOP
SEE DETAIL–2

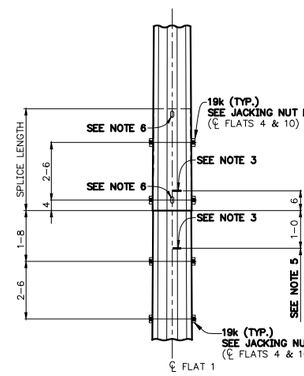
POLES – 19S61, 19S63 & 19S65
℄ OF FLATS 4 & 10
8–0
19–0
30–0

ALL DIMENSIONS FROM BOTTOM OF SHAFT

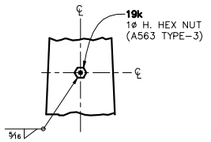
OPGW SCHEDULE
DIM'S TO CENTER OF OPGW
SEE DETAIL–3

POLES – 19S61 & 19S65	POLES – 19S62 & 19S66
℄ OF FLATS 3 & 5	℄ OF FLATS 3 & 5
6–0	17–9
13–0	24–9
20–0	
27–0	
34–0	
41–0	

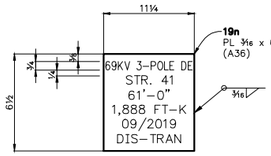
ALL DIMENSIONS FROM BOTTOM OF SHAFT



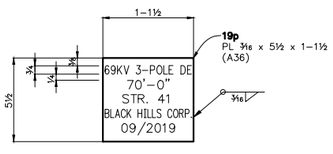
SPLICE DETAIL
(DETAIL–1 REMOVED FOR CLARITY)



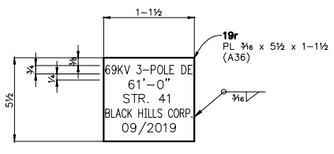
JACKING NUT DETAIL



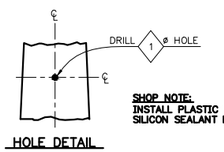
ID TAG DETAIL – 2



ID TAG DETAIL – 3



ID TAG DETAIL – 4



HOLE DETAIL

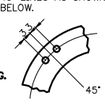
SHOP NOTE:
INSTALL PLASTIC PLUGS W/ SILICON SEALANT PRIOR TO SHIPPING.

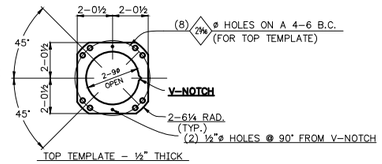
HOLE SCHEDULE
DIM'S TO CENTER OF HOLES
SEE HOLE DETAIL

POLES – 19S61, 19S63 & 19S65
℄ OF FLATS 4 & 10
11–6
12–6
22–6
23–6
33–6
34–6

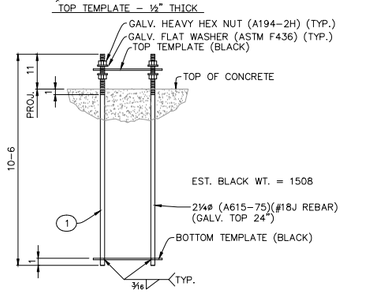
ALL DIMENSIONS FROM BOTTOM OF SHAFT

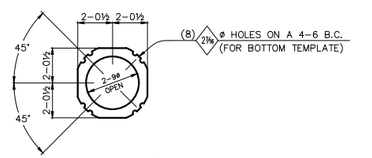
SPACE ANCHOR BOLTS 6" APART IN ALL FOUR QUADRANTS. LOCATE TWO A–BOLTS IN EACH QUADRANT SPLIT ON THE 45° LINES AS SHOWN BELOW.



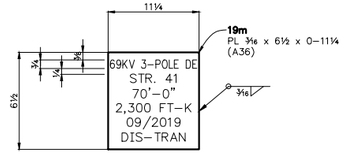


TOP TEMPLATE – ½" THICK





BOTTOM TEMPLATE – ⅜" THICK



ID TAG DETAIL – 1

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL, DO NOT GALVANIZE.

(STR. 41) 19–9462PE38

DIS-TRAN Steel, LLC
P.O. BOX 5109 • ALEXANDRIA, LA, 71307–5709
PHONE 318–448–0274 • FAX 318–445–4454

WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

69KV 3–POLE DEADEND STRUCTURE / ITEM – 24
SECTIONS & DETAILS (CONTINUED)

SCALE	DATE	JOB NUMBER	DRAWING NUMBER	REV. NO.
N.T.S.	07/12/19	19–9462P	E38x	1

DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ

NOTICE TO ERECTOR
BACKCHARGES FOR CORRECTIVE WORK OR REPLACED MATERIALS WILL NOT BE ACCEPTED UNLESS EXPRESSLY AUTHORIZED BY DIS–TRAN BEFORE ANY SUCH COST ARE INCURRED.

REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
4					
3					
2					
1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19

REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
8					
7					
6					
5					

BLACK HILLS ENERGY

LANGE TO WEST RAPID CITY 69KV TRANSMISSION LINE

DRAWING LIST

DRAWING #	DRAWING DESCRIPTION
DL-01	DRAWING LIST
	ROUTE MAP
RM-01	ROUTE MAP
RM-04	ROUTE MAP
	PLAN AND PROFILE DRAWINGS
PP-01	STR LANGE – STR 8
PP-02	STR 39 – STR WEST RAPID CITY
	STRUCTURE DETAILS
SD-01-1	SCHP-M2
SD-02-1	SCHPRC-M1
SD-03-1	SCDE-69
SD-04-1	SCDE-69-2S
SD-05-1	SCDE-ST-M1
SD-06-1	TC-3PDE-ST
SD-07-1	DC-C3309-SDE
SD-08-1	TU-1, 1A, 1AA
SD-09-1	DT-01-69
SD-10-1	TSZ-1
	ASSEMBLY DETAILS
AD-01-1	T-4A,B,S, T-4D(S), T-4C
AD-02-1	T-4F, T-4FD, T-4FC
AD-03-1	T-FDL, T-FSC-1, T-FSC-2, T-FSC-3
AD-04-1	T-SP(1), T-BPD, T-PSD
AD-05-1	T-S4D, T-S4PD
AD-06-1	T-J4PD
AD-07-1	T-BDE6PD, T-SDE6PD, TM-EXT-15, T-BDE6D
AD-08-1	TM-9ST, TM-9SD, TM-9SSJ, TM-9
AD-09-1	TD-1, TD-2
AD-10-1	TG-26, TGS-1(A), TM-GM, TGS-2(A)
AD-11-1	TGS-OHG-1(A), TG-OHG-2(A), TA-P1, TA-2H, 3H, 5EXT
AD-12-1	TM-101 & TM-103, TP-A
AD-13-1	DPR-OPGW, DPR-795, DPR-EHS
AD-14-1	TM-SPS-1

DRAWING #	DRAWING DESCRIPTION
	LOAD & DESIGN DETAILS
LD-12-1	STR 42A, DESIGN DETAILS
LD-12-2	STR 42A, LOAD TREES
LD-13-1	STR 41, DESIGN DETAILS
LD-13-2	STR 41, LOAD TREES
LD-13-3	STR 41, DESIGN DETAILS
LD-13-4	STR 41, LOAD TREES
	GUYING DETAILS
TMG-01	STR 2A, STR 3
	FOUNDATION DETAILS
FND-04-1	STR 41, STR 42A
	STAKING SHEETS
SS-01	STR SUB DE – STR SUB DE
	PHASING DIAGRAM
PH-01	PHASING DIAGRAM
	SAG TABLES 795 KCMIL 45/7 ACSR "TERN"
STC-01-1	STR SUB DE – STR 2A, STR 2A – STR 3, STR 41 – STR 42A, STR 42A – STR SUB DE, INITIAL
	SAG TABLES AFL CC-55/443 "DNO-4748" OPGW
STF-01-1	STR SUB DE – STR 2A, STR 2A – STR 3, STR 41 – STR 42A, STR 42A – STR SUB DE, INITIAL
	SAG TABLES 3/8" 7 STRAND EHS
STS-01-1	STR SUB DE – STR 2A, STR 42A – STR SUB DE, INITIAL
	MATERIAL LIST
ML-01-1	MATERIAL LIST
ML-01-2	MATERIAL LIST

DRAWING #	DRAWING DESCRIPTION
	APPENDIX
	WEST RAPID CITY SUBSTATION REFERENCE DRAWINGS
WRC-C-101	GENERAL ARRANGEMENT
WRC-C-305	SECTION G AND H
WRC-C-320	BUS CONNECTION DETAILS
WRC-C-321	BUS CONNECTION DETAILS
WRC-C-380	MATERIAL LIST

1	REVISION
DESCRIPTION: MOVED STRUCTURE 41	
STATE NAME: DATE: REG. NO.:	
PROJECT #: 10114217	ISSUE DATE: 3/11/2020
PROJECT MANAGER: J. ELLSWORTH	
DESIGN ENGINEER: J. PANKRATZ	
DRAWN BY: Z. JANSEN	

2	REVISION
DESCRIPTION: RECORD DRAWINGS	
STATE NAME: DATE: REG. NO.:	
PROJECT #: 10114217	ISSUE DATE: 6/12/2020
PROJECT MANAGER: J. ELLSWORTH	
DESIGN ENGINEER: J. PANKRATZ	
DRAWN BY: G. NIKOLIC	

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	G. NIKOLIC
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

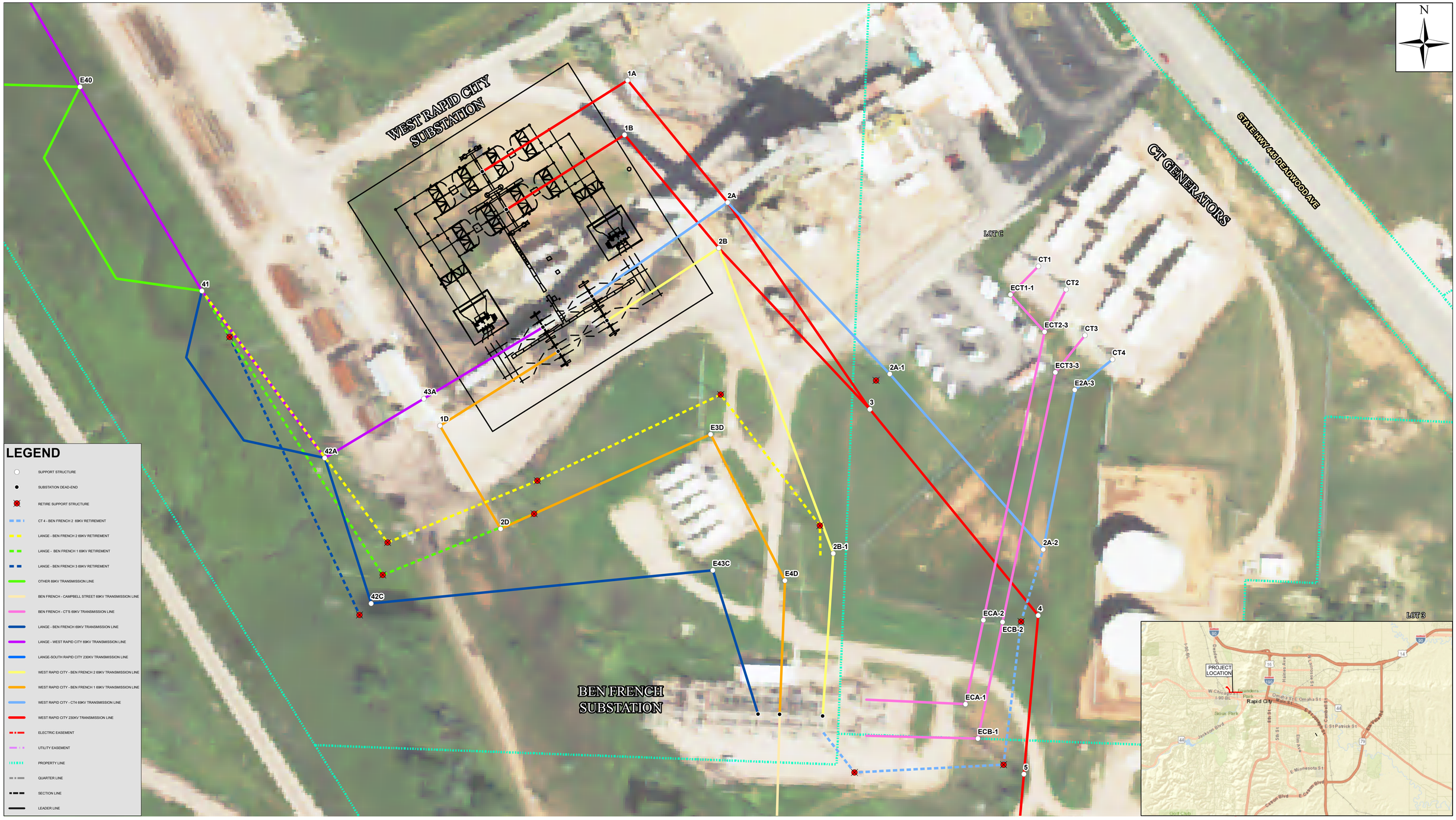
LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

DRAWING LIST

0 1" 2"

FILENAME BHE-DL-01-01.DWG
SCALE NONE

SHEET **DL-01**



LEGEND

- SUPPORT STRUCTURE
- SUBSTATION DEAD-END
- RETIRE SUPPORT STRUCTURE
- CT 4 - BEN FRENCH 2 69KV RETIREMENT
- LANGE - BEN FRENCH 2 69KV RETIREMENT
- LANGE - BEN FRENCH 1 69KV RETIREMENT
- LANGE - BEN FRENCH 3 69KV RETIREMENT
- OTHER 69KV TRANSMISSION LINE
- BEN FRENCH - CAMPBELL STREET 69KV TRANSMISSION LINE
- BEN FRENCH - CT'S 69KV TRANSMISSION LINE
- LANGE - BEN FRENCH 69KV TRANSMISSION LINE
- LANGE - WEST RAPID CITY 69KV TRANSMISSION LINE
- LANGE-SOUTH RAPID CITY 230KV TRANSMISSION LINE
- WEST RAPID CITY - BEN FRENCH 2 69KV TRANSMISSION LINE
- WEST RAPID CITY - BEN FRENCH 1 69KV TRANSMISSION LINE
- WEST RAPID CITY - CT4 69KV TRANSMISSION LINE
- WEST RAPID CITY 230KV TRANSMISSION LINE
- ELECTRIC EASEMENT
- UTILITY EASEMENT
- PROPERTY LINE
- QUARTER LINE
- SECTION LINE
- LEADER LINE

Black Hills Energy
Improving life with energy

HDR

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	09/11/2019	ISSUE FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CADD TECHNICIAN	Z. JANSEN
GIS TECHNICIAN	S.GRIFFIN
PROJECT NUMBER	10114217

BLACK HILLS POWER
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
69KV TERMINATIONS

ROUTE MAP

0 20 40 80 Feet

FILENAME: West Rapid City 69kV Terminations 22x34

SCALE: 1 inch = 50 feet

SHEET: RM-01

N

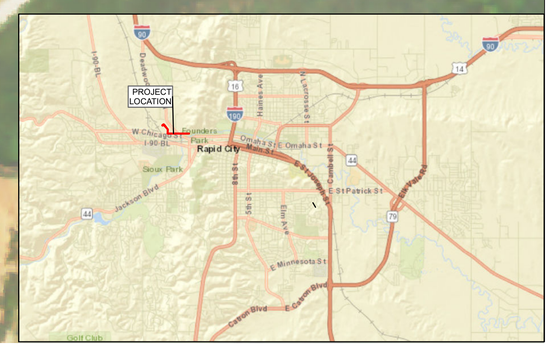
LANGE SUBSTATION

1C
1A
2C
2A
3
E4
E5
E6
E7
E8
E9
E10

LANGE RANCH RD

TATANKA RD

HARNEY DR



LEGEND

- SUPPORT STRUCTURE
- SUBSTATION DEAD-END
- RETIRE SUPPORT STRUCTURE
- CT 4 - BEN FRENCH 2 69KV RETIREMENT
- LANGE - BEN FRENCH 2 69KV RETIREMENT
- LANGE - BEN FRENCH 1 69KV RETIREMENT
- LANGE - BEN FRENCH 3 69KV RETIREMENT
- OTHER 69KV TRANSMISSION LINE
- BEN FRENCH - CAMPBELL STREET 69KV TRANSMISSION LINE
- BEN FRENCH - CTS 69KV TRANSMISSION LINE
- LANGE - BEN FRENCH 69KV TRANSMISSION LINE
- LANGE - WEST RAPID CITY 69KV TRANSMISSION LINE
- LANGE-SOUTH RAPID CITY 230KV TRANSMISSION LINE
- WEST RAPID CITY - BEN FRENCH 2 69KV TRANSMISSION LINE
- WEST RAPID CITY - BEN FRENCH 1 69KV TRANSMISSION LINE
- WEST RAPID CITY - CT4 69KV TRANSMISSION LINE
- WEST RAPID CITY 230KV TRANSMISSION LINE
- ELECTRIC EASEMENT
- UTILITY EASEMENT
- PROPERTY LINE
- QUARTER LINE
- SECTION LINE
- LEADER LINE

Black Hills Energy
Improving life with energy

HDR

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	09/11/2019	ISSUE FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CADD TECHNICIAN	Z. JANSEN
GIS TECHNICIAN	S.GRIFFIN
PROJECT NUMBER	10114217

BLACK HILLS POWER
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
69KV TERMINATIONS

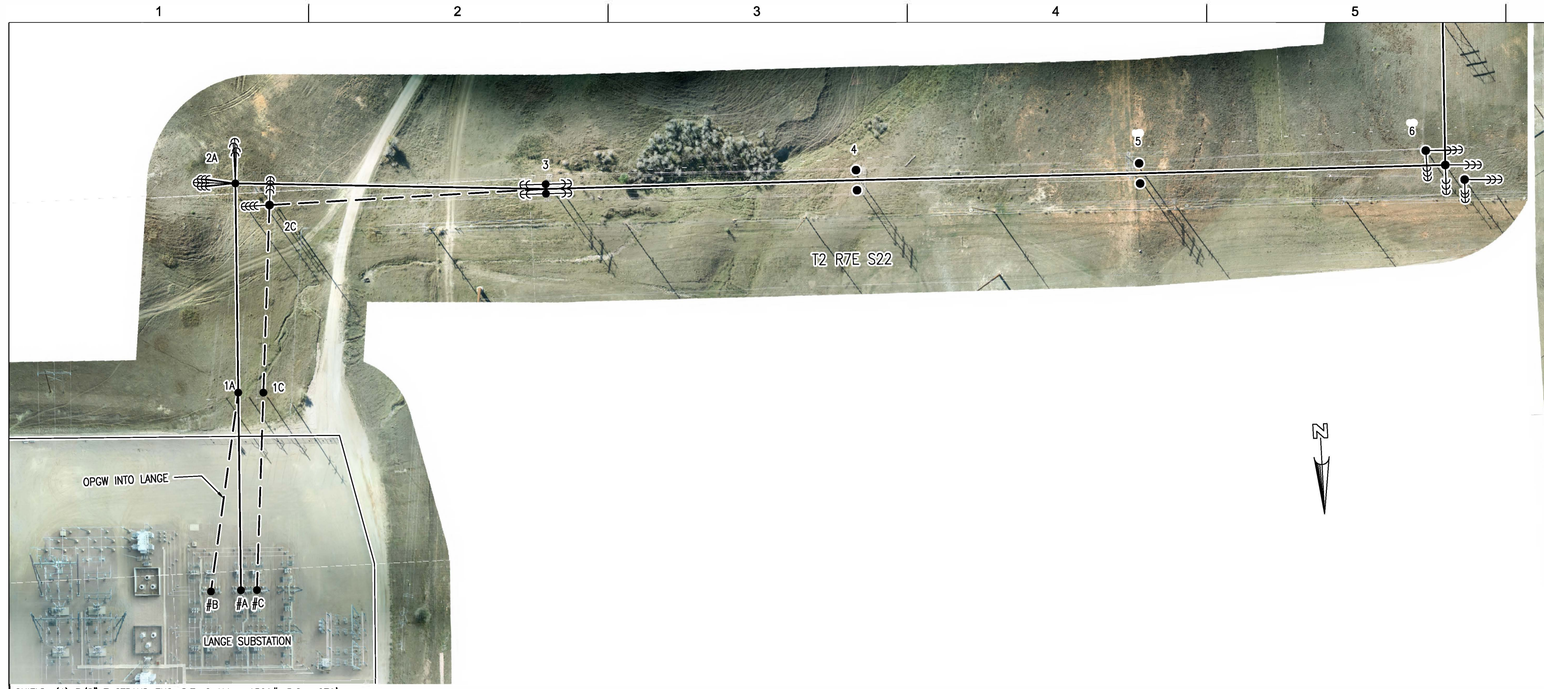
ROUTE MAP

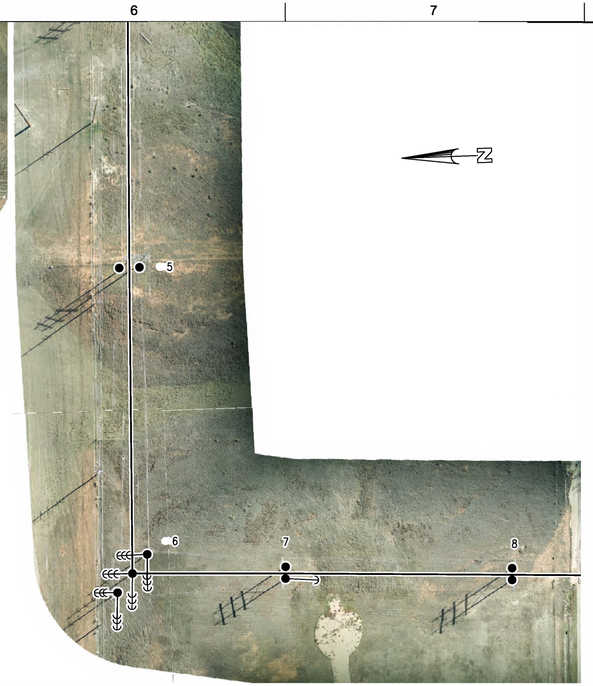
0 50 100 200 Feet

FILENAME: West Rapid City 69kV Terminations 22x34

SCALE: 1 inch = 100 feet

SHEET
RM-04





PLAN NOTES:

- STRUCTURE
- ALIGNMENT
- ALIGNMENT OF ANOTHER LINE

NOTES:

1. [XXX] – EXISTING ASSEMBLY
2. *XXX – RETIREMENT ASSEMBLY
3. T[XXX] – TRANSFER UNIT ASSEMBLY
4. SHIELD WIRE SHOWN AT 60°F (CREEP)
5. CONDUCTOR SHOWN AT 212°F (MAX SAG)

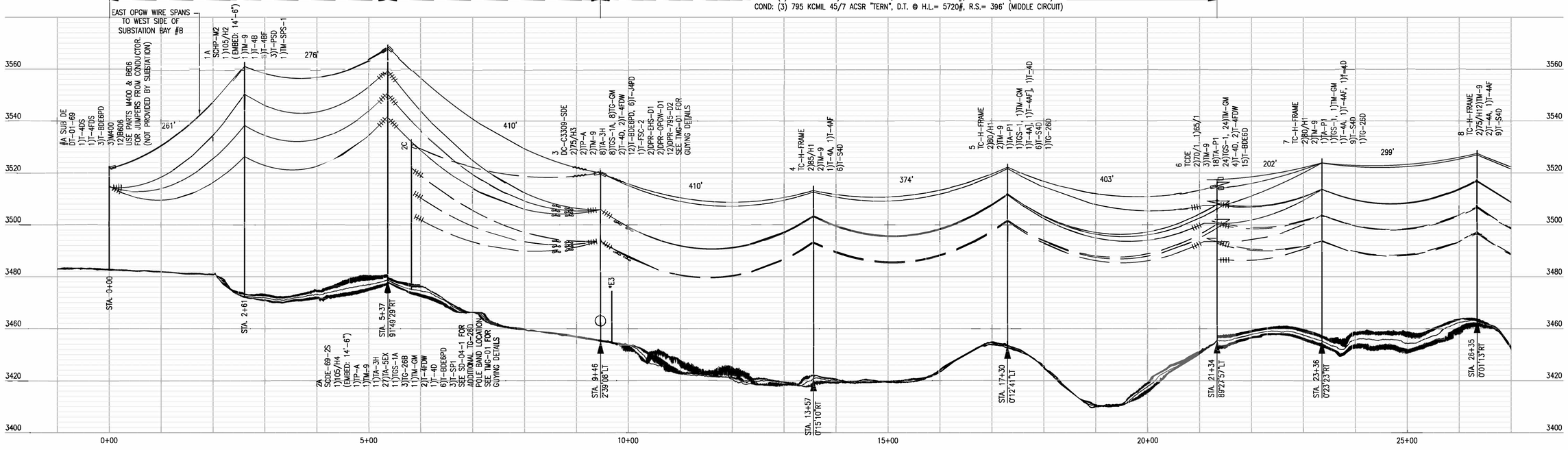
PROFILE NOTES:

- CONDUCTOR DAMPER
- SHIELD DAMPER
- OPGW SPLICE

SHIELD: (1) 3/8" 7 STRAND EHS, D.T. @ H.L.= 1500#, R.S.= 270'
SHIELD: (1) AFL CC-55/443 "DNO-4748" OPGW, D.T. @ H.L.= 1590#, R.S.= 270'
COND: (3) 795 KCMIL 45/7 ACSR "TERN", D.T. @ H.L.= 2500#, R.S.= 270'

SHIELD: (1) AFL CC-55/443 "DNO-4748" OPGW, D.T. @ H.L.= 2645#, R.S.= 410'
COND: (3) 795 KCMIL 45/7 ACSR "TERN", D.T. @ H.L.= 5760#, R.S.= 410'

SHIELD: (1) AFL CC-55/443 "DNO-4748" OPGW, D.T. @ H.L.= 2580#, R.S.= 388'
SHIELD: (1) 3/8" 7 STRAND HS, D.T. @ H.L.= 2615#, R.S.= 406'
COND: (3) 795 KCMIL 45/7 ACSR "TERN", D.T. @ H.L.= 5720#, R.S.= 396' (TOP CIRCUIT)
COND: (3) 795 KCMIL 45/7 ACSR "TERN", D.T. @ H.L.= 5720#, R.S.= 396' (MIDDLE CIRCUIT)



ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
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DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z.JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

PLAN AND PROFILE

0 1" 2"

FILENAME BHE-PP-01-D-1.DWG
SCALE H:1"=100' V:1"=20'

SHEET **PP-01**



PLAN NOTES:

- ● STRUCTURE
- —— ALIGNMENT
- — — ALIGNMENT OF ANOTHER LINE

NOTES:

1. [XXX] – EXISTING ASSEMBLY
2. *XXX – RETIREMENT ASSEMBLY
3. T[XXX] – TRANSFER UNIT ASSEMBLY
4. SHIELD WIRE SHOWN AT 60°F (CREEP)
5. CONDUCTOR SHOWN AT 212°F (MAX SAG)
6. THIRD (3) OPGW SPANS ACROSS STR AS OVERHEAD TIE AND CONTINUES ON LANGE – BEN FRENCH 3 LINE.

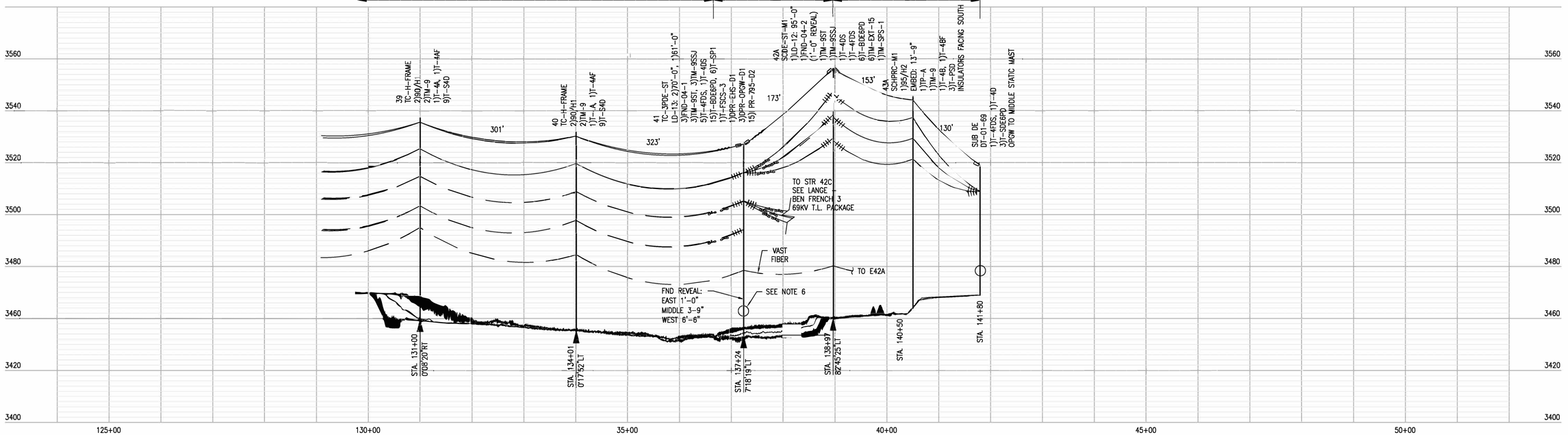
PROFILE NOTES:

- CONDUCTOR DAMPER
- SHIELD DAMPER
- OPGW SPLICE

SHIELD: (1) AFL CC-55/443 "DNO-4748" OPGW, D.T. @ H.L.= 2490#, R.S.= 392'
SHIELD: (1) 3/8" 7 STRAND HS, D.T. @ H.L.= 2460#, R.S.= 390'
COND: (3) 795 KCMIL 45/7 ACSR "TERN", D.T. @ H.L.= 6755#, R.S.= 390' (TOP CIRCUIT)
COND: (3) 795 KCMIL 45/7 ACSR "TERN", D.T. @ H.L.= 6870#, R.S.= 390' (MIDDLE CIRCUIT)
COND: (3) 795 KCMIL 45/7 ACSR "TERN", D.T. @ H.L.= 7130#, R.S.= 390' (BOTTOM CIRCUIT)

SHIELD: (1) AFL CC-55/443 "DNO-4748" OPGW, D.T. @ H.L.= 2345#, R.S.= 173'
COND: (3) 795 KCMIL 45/7 ACSR "TERN", D.T. @ H.L.= 6515#, R.S.= 173'

SHIELD: (1) AFL CC-55/443 "DNO-4748" OPGW, D.T. @ H.L.= 1500#, R.S.= 140'
SHIELD: (1) 3/8" 7 STRAND EHS, D.T. @ H.L.= 1375#, R.S.= 140'
COND: (3) 795 KCMIL 45/7 ACSR "TERN", D.T. @ H.L.= 2500#, R.S.= 140'



ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
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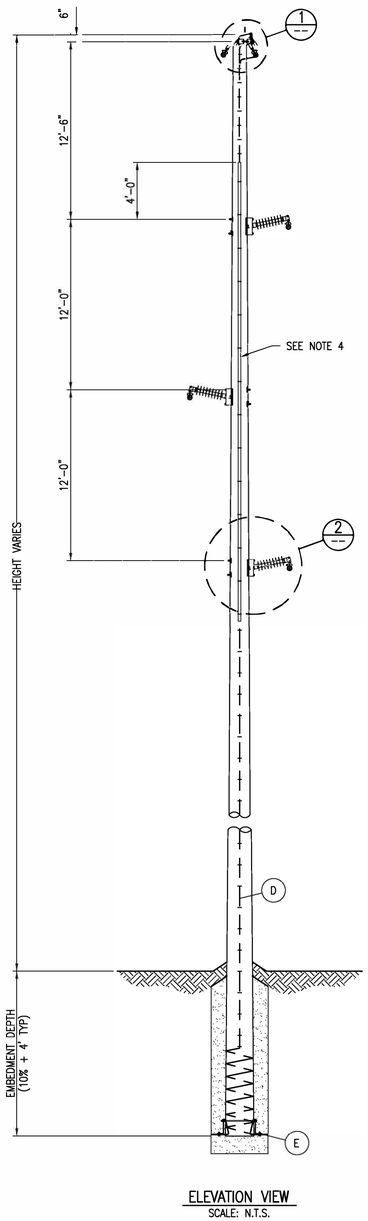
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

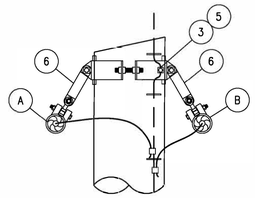
PLAN AND PROFILE

0 1" 2"

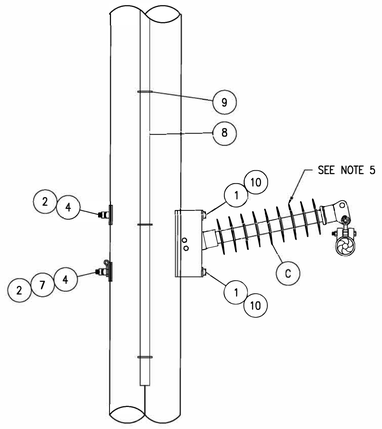
FILENAME BHE-PP-01-D-1.DWG
SCALE H:1"=100' V:1"=20'
SHEET PP-02



ELEVATION VIEW
SCALE: N.T.S.



DETAIL 1
SHIELD
SCALE: N.T.S.



DETAIL 2
CONDUCTOR
SCALE: N.T.S.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	–	BOLT, MACHINE, 7/8" X REQ'D LENGTH	B270	HUGHES	–	6
1.1	20–7818	BOLT, MACHINE, 7/8" X 18"	B2718	HUGHES	B818–6	–
1.2	20–7820	BOLT, MACHINE, 7/8" X 20"	B2720	HUGHES	B820–6	–
1.3	20–7822	BOLT, MACHINE, 7/8" X 22"	B2722	HUGHES	B822–6	–
1.4	20–7824	BOLT, MACHINE, 7/8" X 24"	B2724	HUGHES	B824–6	–
2	22–7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	6
3	N.S.	3108 POLE BANDS, HEAVY DUTY, REQ'D POLE DIAMETER	–	HUGHES	–	1
3.1	18–1116	3108 POLE BANDS, HEAVY DUTY, 7"–10" POLE	F110	HUGHES	3108.5	–
3.2	18–1117	3108 POLE BANDS, HEAVY DUTY, 9"–12" POLE	F111	HUGHES	3108.6	–
4	22–4425	WASHER, SQ. CURVED, 4" X 1/4", 15/16" HOLE	W504	HUGHES	SCW4–80	6
5	46–2718	CLIP, BONDING, WITH 1/2" X 1 1/2" BOLT, 7/16" MAX. WIRE	P104	HUGHES	2718.55	1
6	14–3152	LINK, CONNECTING, 1/4" X 2" X 7 1/2", 15/16" HOLES, 24K LBS	F201	HUGHES	3152	4
7	N.S.	WASHER, SPRING, 15/16" HOLE	W207	HUGHES	2702.8	3
8	46–2503	MOULDING, GROUNDWIRE, 1–11/16" X 8'	P300	HUGHES	2503.8	4
9	46–2504	MOULDING STAPLES, 1–3/4" X 3–1/2"	P400	HUBBELL	C2050222	20
10	N.S.	WASHER, ROUND, 2" X 1/4", 15/16" HOLE	W410	HUGHES	RW2–80	6

TYPICAL ADDITIONAL ASSEMBLIES (CALLED OUT SEPARATELY)

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T–4B	OHSW SUSPENSION ASSEMBLY	1
B	T–4BF	OPGW SUSPENSION ASSEMBLY	1
C	T–PSD	69KV HORIZONTAL POST ASSEMBLY	3
D	TM–9	WOOD POLE GROUNDING	1
E	TP–A	POLE ANCHOR ASSEMBLY	1

TYPICAL BOLTS (QTY)*

ITEM NO.	POLE CLASS		
	2–1	H1–H2	H3–H4
1.1	4	2	–
1.2	2	2	2
1.3	–	2	2
1.4	–	–	2

*SEE NOTE 3

TYPICAL POLE BANDS (QTY)*

ITEM NO.	POLE CLASS		
	2–1	H1–H2	H3–H4
3.1	1	–	–
3.2	–	1	1

*SEE NOTE 3

NOTES:

1. DRILLED HOLES SHALL BE 1/16" GREATER THAN THE SPECIFIED BOLT DIAMETER.
2. FIELD DRILLED HOLES SHALL BE THOROUGHLY TREATED.
3. BOLT LENGTHS AND STATIC WIRE SUPPORT LENGTHS ARE ESTIMATED BASED ON STANDARD CLASS DOUGLAS FIR POLE DIMENSIONS. ACTUAL POLE DIAMETERS MAY VARY.
4. WOOD MOULDING SHALL BE STAPLED TO THE POLE WITH (5) STAPLES PER 8'–0" MOULDING STICK. FIRST STAPLES 6" FROM BOTH ENDS.
5. POLE GROUNDS, POLE ANCHORS AND STATIC/CONDUCTOR ASSEMBLIES ARE SEPARATE UNITS.

SHEET TITLE
TRANSMISSION STRUCTURE
69kV SINGLE CIRCUIT TANGENT W/ 2 SHIELDS
NON-TYPICAL

REFERENCE SHEET: **1 OF 1**
EXHIBIT NUMBER: **SCHP-M2**

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

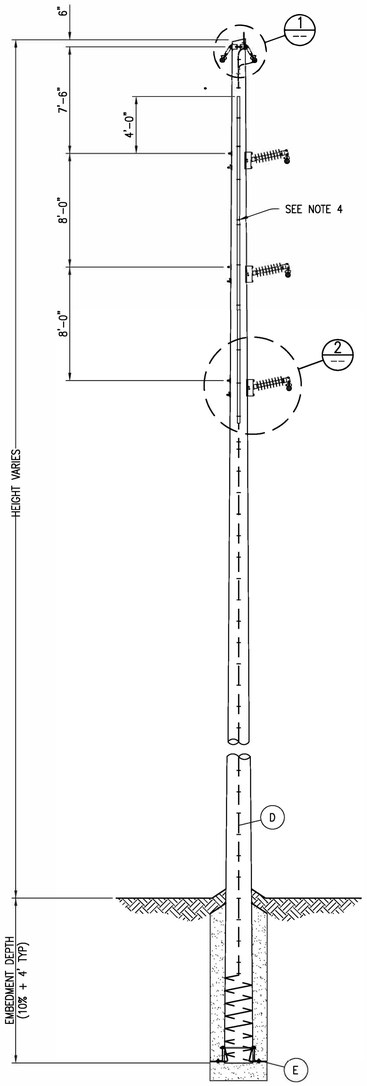
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

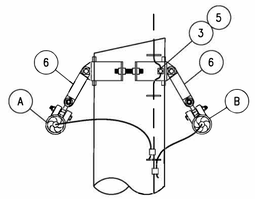
STRUCTURE DETAILS

0 1" 2"

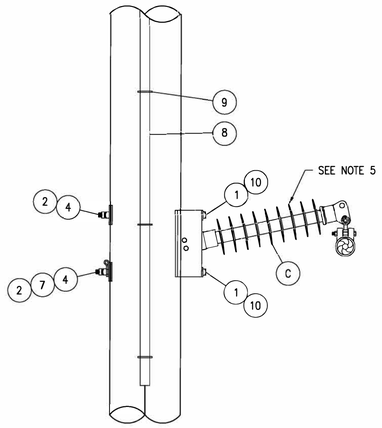
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SCALE: 3/16"=1'–0"
SHEET: **SD-01-1**



ELEVATION VIEW
SCALE: N.T.S.



DETAIL 1 SHIELD
SCALE: N.T.S.



DETAIL 2 CONDUCTOR
SCALE: N.T.S.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	–	BOLT, MACHINE, 7/8" X REQ'D LENGTH	B270	HUGHES	–	6
1.1	20–7818	BOLT, MACHINE, 7/8" X 18"	B2718	HUGHES	B818–6	–
1.2	20–7820	BOLT, MACHINE, 7/8" X 20"	B2720	HUGHES	B820–6	–
1.3	20–7822	BOLT, MACHINE, 7/8" X 22"	B2722	HUGHES	B822–6	–
1.4	20–7824	BOLT, MACHINE, 7/8" X 24"	B2724	HUGHES	B824–6	–
2	22–7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	6
3	N.S.	3108 POLE BANDS, HEAVY DUTY, REQ'D POLE DIAMETER	–	HUGHES	–	1
3.1	18–1116	3108 POLE BANDS, HEAVY DUTY, 7"–10" POLE	F110	HUGHES	3108.5	–
3.2	18–1117	3108 POLE BANDS, HEAVY DUTY, 9"–12" POLE	F111	HUGHES	3108.6	–
4	22–4425	WASHER, SQ. CURVED, 4" X 1/4", 15/16" HOLE	W504	HUGHES	SCW4–80	6
5	46–2718	CLIP, BONDING, WITH 1/2" X 1 1/2" BOLT, 7/16" MAX. WIRE	P104	HUGHES	2718.55	1
6	14–3152	LINK, CONNECTING, 1/4" X 2" X 7 1/2", 15/16" HOLES, 24K LBS	F201	HUGHES	3152	4
7	N.S.	WASHER, SPRING, 15/16" HOLE	W207	HUGHES	2702.8	3
8	46–2503	MOULDING, GROUNDWIRE, 1–11/16" X 8'	P300	HUGHES	2503.8	3
9	46–2504	MOULDING STAPLES, 1–3/4" X 3–1/2"	P400	HUBBELL	C2050222	15
10	N.S.	WASHER, ROUND, 2" X 1/4", 15/16" HOLE	W410	HUGHES	RW2–80	6

TYPICAL ADDITIONAL ASSEMBLIES (CALLED OUT SEPARATELY)

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T–4B	OHSW SUSPENSION ASSEMBLY	1
B	T–4BF	OPGW SUSPENSION ASSEMBLY	1
C	T–PSD	69KV HORIZONTAL POST ASSEMBLY	3
D	TM–9	WOOD POLE GROUNDING	1
E	TP–A	POLE ANCHOR ASSEMBLY	1

TYPICAL BOLTS (QTY)*

ITEM NO.	POLE CLASS		
	2–1	H1–H2	H3–H4
1.1	4	2	–
1.2	2	2	2
1.3	–	2	2
1.4	–	–	2

*SEE NOTE 3

TYPICAL POLE BANDS (QTY)*

ITEM NO.	POLE CLASS		
	2–1	H1–H2	H3–H4
3.1	1	–	–
3.2	–	1	1

*SEE NOTE 3

NOTES:

1. DRILLED HOLES SHALL BE 1/16" GREATER THAN THE SPECIFIED BOLT DIAMETER.
2. FIELD DRILLED HOLES SHALL BE THOROUGHLY TREATED.
3. BOLT LENGTHS AND STATIC WIRE SUPPORT LENGTHS ARE ESTIMATED BASED ON STANDARD CLASS DOUGLAS FIR POLE DIMENSIONS. ACTUAL POLE DIAMETERS MAY VARY.
4. WOOD MOULDING SHALL BE STAPLED TO THE POLE WITH (5) STAPLES PER 8'–0" MOULDING STICK. FIRST STAPLES 6" FROM BOTH ENDS.
5. POLE GROUNDS, POLE ANCHORS AND STATIC/CONDUCTOR ASSEMBLIES ARE SEPARATE UNITS.

SHEET TITLE
TRANSMISSION STRUCTURE
69kV SINGLE CIRCUIT RUNNING CORNER
NON-TYPICAL

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: SCHPRC-M1

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

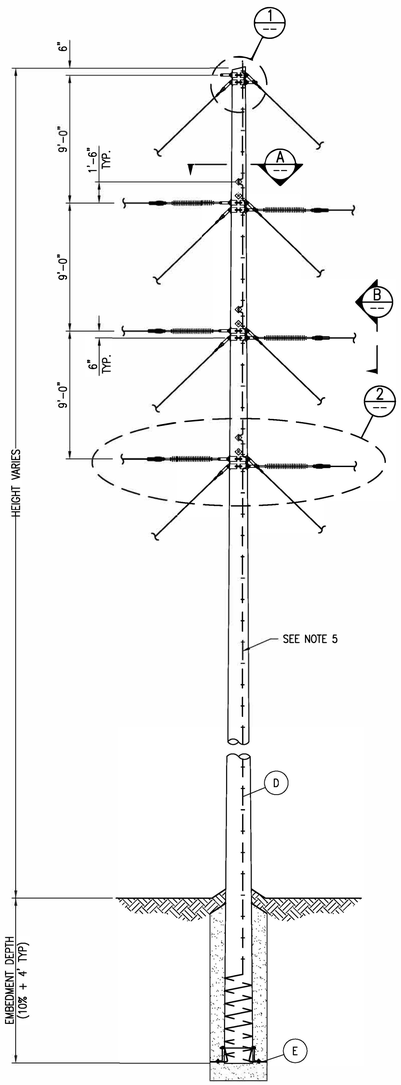
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

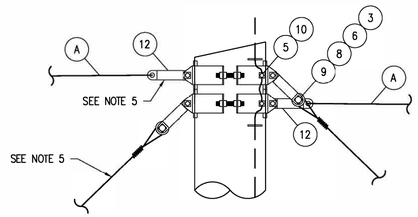
STRUCTURE DETAILS

0 1" 2"

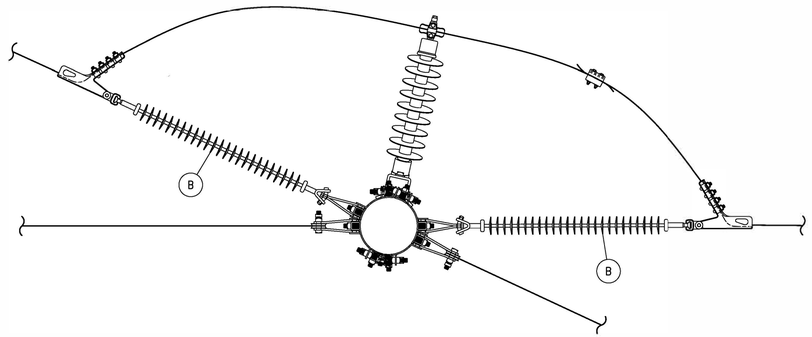
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SHEET: **SD-02-1**



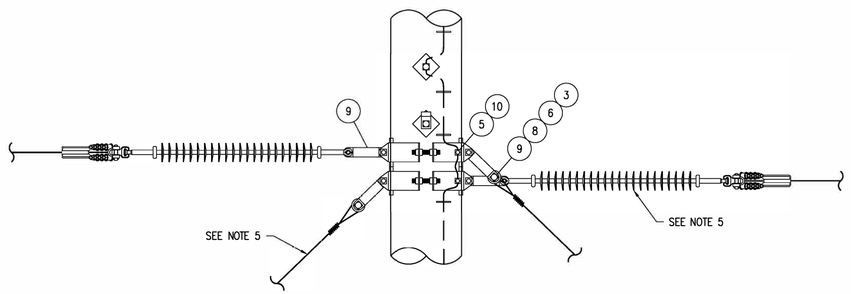
ELEVATION VIEW
SCALE: N.T.S.



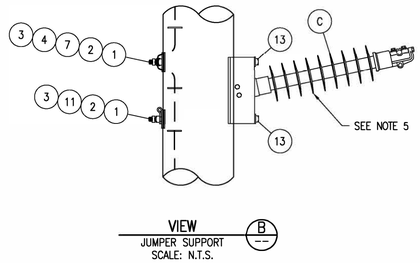
DETAIL 1
SHIELD ATTACHMENT
SCALE: N.T.S.



SECTION A
SCALE: N.T.S.



DETAIL 2
CONDUCTOR ATTACHMENT
SCALE: N.T.S.



VIEW B
JUMPER SUPPORT
SCALE: N.T.S.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY.
1	–	BOLT, MACHINE, 7/8" X REQ'D LENGTH	B270	HUGHES	–	6
1.1	20–7818	BOLT, MACHINE, 7/8" X 18"	B2718	HUGHES	B818–6	–
1.2	20–7820	BOLT, MACHINE, 7/8" X 20"	B2720	HUGHES	B820–6	–
1.3	20–7822	BOLT, MACHINE, 7/8" X 22"	B2722	HUGHES	B822–6	–
1.4	20–7824	BOLT, MACHINE, 7/8" X 24"	B2724	HUGHES	B824–6	–
2	22–4425	WASHER, SQ. CURVED, 4" X 1/4", 15/16" HOLE	W504	HUGHES	SCW4–80	6
3	22–7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	14
4	0407–0242	NUT, SQUARE, 7/8"	N107	HUGHES	N80	3
5	–	3108 POLE BANDS, HEAVY DUTY, REQ'D POLE DIAMETER	–	HUGHES	–	8
5.1	18–1116	3108 POLE BANDS, HEAVY DUTY, 7"–10" POLE	F110	HUGHES	3108.5	–
5.2	18–1117	3108 POLE BANDS, HEAVY DUTY, 9"–12" POLE	F111	HUGHES	3108.6	–
5.3	18–1118	3108 POLE BANDS, HEAVY DUTY, 11"–14" POLE	F112	HUGHES	3108.7	–
5.4	18–1119	3108 POLE BANDS, HEAVY DUTY, 13"–16" POLE	F113	HUGHES	3108.8	–
6	20–7803	BOLT, MACHINE, 7/8" X 3"	B273	HUGHES	B83–2	8
7	46–2728	CLIP, BONDING, FOR 7/8" DIA. BOLT, 5/16" MAX. WIRE	P207	HUGHES	2727.8	3
8	18–2808	GUY, ROLLER, 1 1/8" WR, 15/16" HOLE	G100	HUGHES	28082	8
9	14–3154	LINK, CONNECTING, 3/8" X 2" X 7 1/2", 15/16" HOLES, 38K LBS	F203	HUGHES	3154	28
10	46–2718	CLIP, BONDING, WITH 1/2" X 1 1/2" BOLT, 7/16" MAX. WIRE	P104	HUGHES	2718.55	8
11	N.S.	WASHER, SPRING, 15/16" HOLE	W207	HUGHES	2702.8	3
12	14–3152	LINK, CONNECTING, 1/4" X 2" X 7 1/2", 15/16" HOLES, 24K LBS	F201	HUGHES	3152	4
13	N.S.	WASHER, ROUND, 2" X 1/4", 15/16" HOLE	W410	HUGHES	RW2–80	6

TYPICAL ADDITIONAL ASSEMBLIES (CALLED OUT SEPARATELY)

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T–4D	OHSW DEADEND ASSEMBLY	2
	T–4FDW	OPGW DEADEND ASSEMBLY	
B	T–BDE6PD	CONDUCTOR DEADEND ASSEMBLY – POLYMER	6
	T–BDE6D	CONDUCTOR DEADEND ASSEMBLY – BELLS	
C	T–SP1	CONDUCTOR JUMPER ASSEMBLY	3
D	TM–9	WOOD POLE GROUNDING ASSEMBLY	1
E	TP–A	POLE ANCHOR ASSEMBLY	1

TYPICAL BOLTS (QTY)*

ITEM NO.	POLE CLASS		
	2–1	H1–H2	H3–H4
1.1	4	–	–
1.2	2	4	–
1.3	–	2	4
1.4	–	–	2

*SEE NOTE 3

TYPICAL POLE BANDS (QTY)*

ITEM NO.	POLE CLASS		
	2–1	H1–H2	H3–H4
5.1	2	–	–
5.2	4	2	2
5.3	2	4	2
5.4	–	2	4

*SEE NOTE 3

NOTES:

1. DRILLED HOLES SHALL BE 1/16" GREATER THAN THE SPECIFIED BOLT DIAMETER.
2. FIELD DRILLED HOLES SHALL BE THOROUGHLY TREATED.
3. BOLT LENGTHS AND POLE BAND DIAMETERS ARE ESTIMATED BASED ON STANDARD CLASS DOUGLAS FIR POLE DIMENSIONS. ACTUAL POLE DIAMETERS MAY VARY.
4. BOND ALL HARDWARE TO POLE GROUND UNIT.
5. POLE GROUND, GUYS, ANCHORS, POLE ANCHORS, JUMPER SUPPORT, AND STATIC/CONDUCTOR ASSEMBLIES ARE SEPARATE UNITS.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
69kV SINGLE CIRCUIT DEADEND
LIGHT TO HEAVY ANGLE WITH POST

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: SCDE-69

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

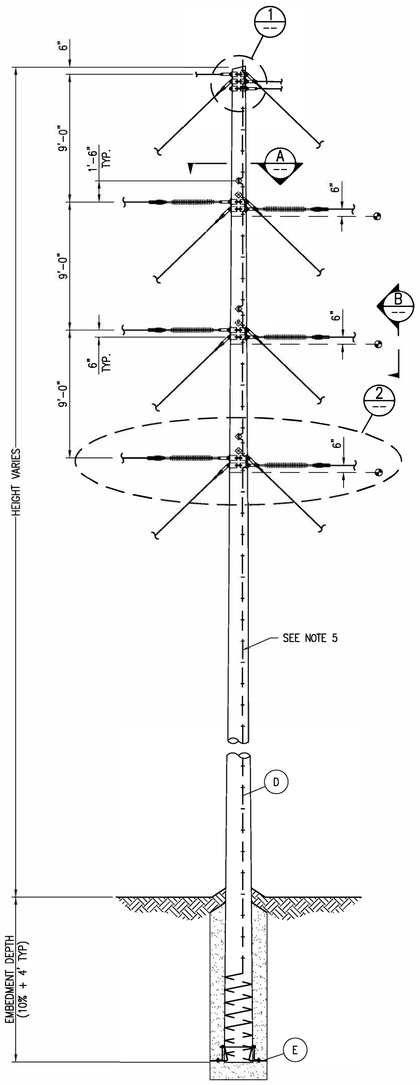
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

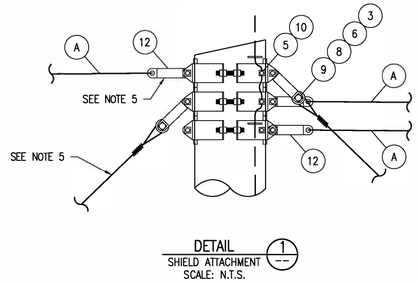
STRUCTURE DETAILS
69KV SINGLE CIRCUIT DEADEND

0 1" 2"

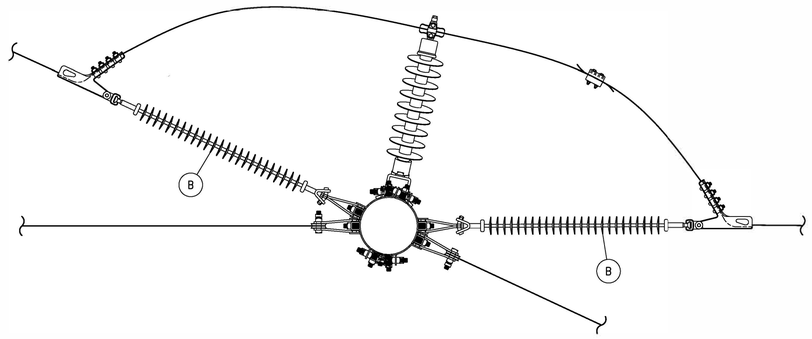
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SHEET: SD-03-1



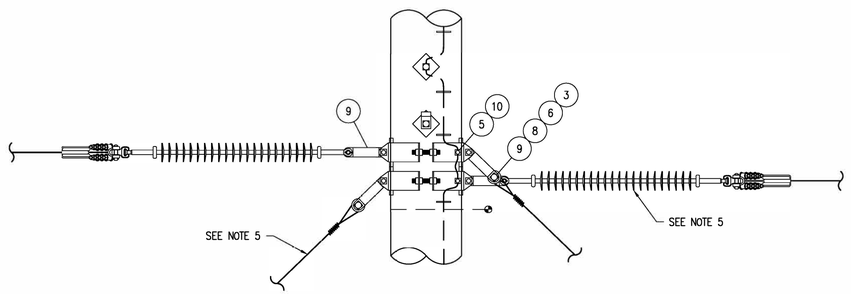
ELEVATION VIEW
SCALE: N.T.S.



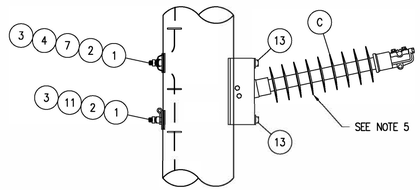
DETAIL 1
SHIELD ATTACHMENT
SCALE: N.T.S.



SECTION A
SCALE: N.T.S.



DETAIL 2
CONDUCTOR ATTACHMENT
SCALE: N.T.S.



VIEW B
JUMPER SUPPORT
SCALE: N.T.S.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY.
1	–	BOLT, MACHINE, 7/8" X REQ'D LENGTH	B270	HUGHES	–	6
1.1	20–7818	BOLT, MACHINE, 7/8" X 18"	B2718	HUGHES	B818–6	–
1.2	20–7820	BOLT, MACHINE, 7/8" X 20"	B2720	HUGHES	B820–6	–
1.3	20–7822	BOLT, MACHINE, 7/8" X 22"	B2722	HUGHES	B822–6	–
1.4	20–7824	BOLT, MACHINE, 7/8" X 24"	B2724	HUGHES	B824–6	–
2	22–4425	WASHER, SQ. CURVED, 4" X 1/4", 15/16" HOLE	W504	HUGHES	SCW4–80	6
3	22–7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	14
4	0407–0242	NUT, SQUARE, 7/8"	N107	HUGHES	N80	3
5	–	3108 POLE BANDS, HEAVY DUTY, REQ'D POLE DIAMETER	–	HUGHES	–	9
5.1	18–1116	3108 POLE BANDS, HEAVY DUTY, 7"–10" POLE	F110	HUGHES	3108.5	–
5.2	18–1117	3108 POLE BANDS, HEAVY DUTY, 9"–12" POLE	F111	HUGHES	3108.6	–
5.3	18–1118	3108 POLE BANDS, HEAVY DUTY, 11"–14" POLE	F112	HUGHES	3108.7	–
5.4	18–1119	3108 POLE BANDS, HEAVY DUTY, 13"–16" POLE	F113	HUGHES	3108.8	–
6	20–7803	BOLT, MACHINE, 7/8" X 3"	B273	HUGHES	B83–2	8
7	46–2728	CLIP, BONDING, FOR 7/8" DIA. BOLT, 5/16" MAX. WIRE	P207	HUGHES	2727.8	3
8	18–2808	GUY, ROLLER, 1 1/8" WR, 15/16" HOLE	G100	HUGHES	28082	8
9	14–3154	LINK, CONNECTING, 3/8" X 2" X 7 1/2", 15/16" HOLES, 38K LBS	F203	HUGHES	3154	28
10	46–2718	CLIP, BONDING, WITH 1/2" X 1 1/2" BOLT, 7/16" MAX. WIRE	P104	HUGHES	2718.55	9
11	N.S.	WASHER, SPRING, 15/16" HOLE	W207	HUGHES	2702.8	3
12	14–3152	LINK, CONNECTING, 1/4" X 2" X 7 1/2", 15/16" HOLES, 24K LBS	F201	HUGHES	3152	6
13	N.S.	WASHER, ROUND, 2" X 1/4", 15/16" HOLE	W410	HUGHES	RW2–80	6

TYPICAL ADDITIONAL ASSEMBLIES (CALLED OUT SEPARATELY)

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T–4D	OHSW DEADEND ASSEMBLY	3
	T–4FDW	OPGW DEADEND ASSEMBLY	
B	T–BDE6PD	CONDUCTOR DEADEND ASSEMBLY – POLYMER	6
	T–BDE6D	CONDUCTOR DEADEND ASSEMBLY – BELLS	
C	T–SP1	CONDUCTOR JUMPER ASSEMBLY	3
D	TM–9	WOOD POLE GROUNDING ASSEMBLY	1
E	TP–A	POLE ANCHOR ASSEMBLY	1

TYPICAL BOLTS (QTY)*

ITEM NO.	POLE CLASS		
	2–1	H1–H2	H3–H4
1.1	4	–	–
1.2	2	4	–
1.3	–	2	4
1.4	–	–	2

*SEE NOTE 3

TYPICAL POLE BANDS (QTY)*

ITEM NO.	POLE CLASS		
	2–1	H1–H2	H3–H4
5.1	3	–	–
5.2	4	3	3
5.3	2	4	2
5.4	–	2	4

*SEE NOTE 3

NOTES:

1. DRILLED HOLES SHALL BE 1/16" GREATER THAN THE SPECIFIED BOLT DIAMETER.
2. FIELD DRILLED HOLES SHALL BE THOROUGHLY TREATED.
3. BOLT LENGTHS AND POLE BAND DIAMETERS ARE ESTIMATED BASED ON STANDARD CLASS DOUGLAS FIR POLE DIMENSIONS. ACTUAL POLE DIAMETERS MAY VARY.
4. BOND ALL HARDWARE TO POLE GROUND UNIT.
5. POLE GROUND, GUYS, ANCHORS, POLE ANCHORS, JUMPER SUPPORT, AND STATIC/CONDUCTOR ASSEMBLIES ARE SEPARATE UNITS.
6. (⊘) IMPLIES LOCATION OF ADDITIONAL TG–26B POLE BANDS ON STR 2A.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
69kV SINGLE CIRCUIT DEADEND W/ 2 SHIELDS ONE WAY
LIGHT TO HEAVY ANGLE WITH POST

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: SCDE-69-2S

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

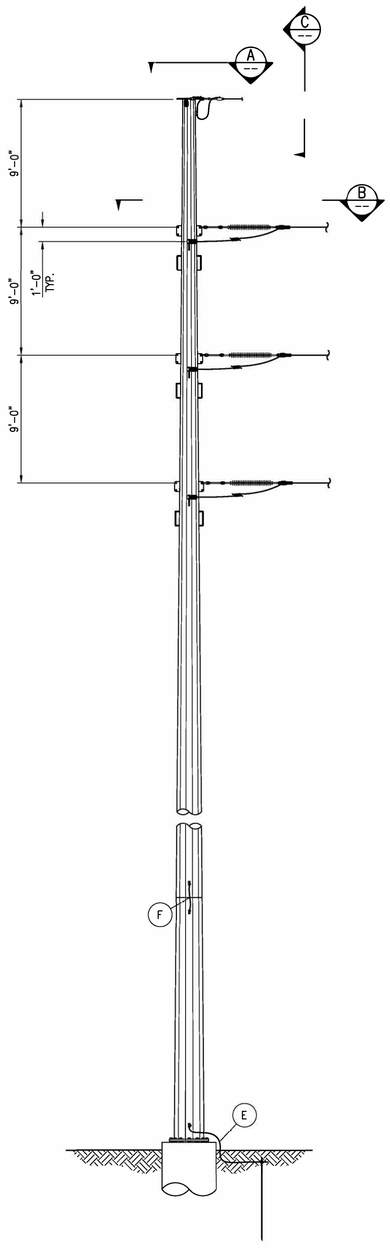
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

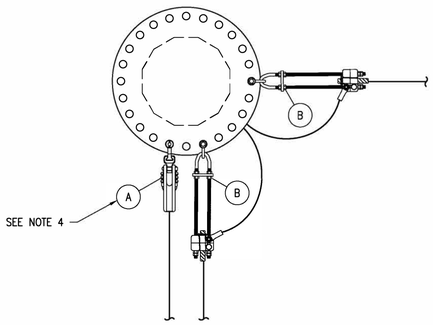
LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

STRUCTURE DETAILS
69KV SINGLE CIRCUIT DEADEND
W/ 2 SHIELDS ONE WAY

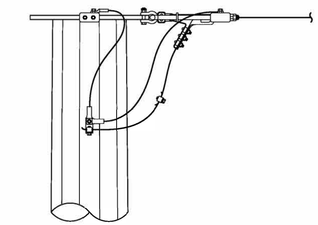
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SHEET: **SD-04-1**

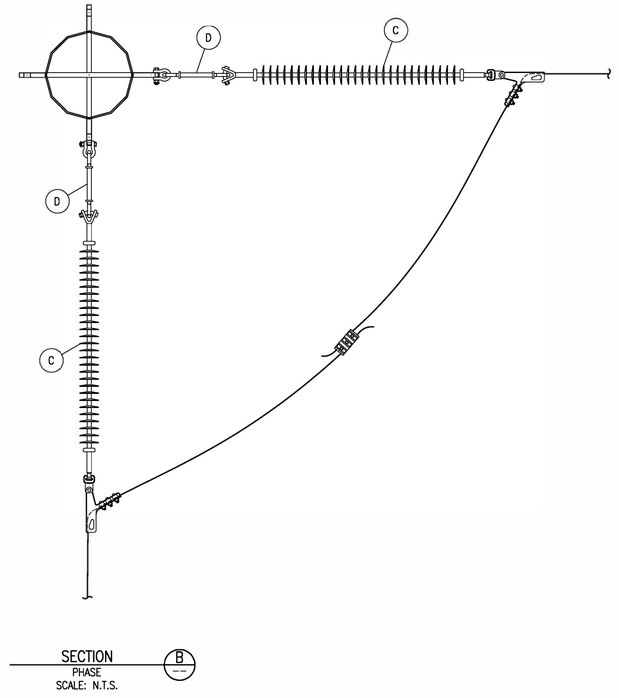




VIEW A
SHIELD
SCALE: N.T.S.



VIEW C
SHIELD GROUNDING
SCALE: N.T.S.



SECTION B
PHASE
SCALE: N.T.S.

LIST OF ASSEMBLIES (CALLED OUT SEPARATELY)			
ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T-4DS	OHSW DEADEND ASSEMBLY - STEEL POLE	1
B	T-4FDS	OPGW DEADEND ASSEMBLY - STEEL POLE	2
C	T-BDE6PD	CONDUCTOR DEADEND ASSEMBLY	6
D	TM-EXT-15	EXTENSION LINK ASSEMBLY	6
E	TM-9ST	STEEL POLE GROUNDING ASSEMBLY	1
F	TM-9SSJ	STEEL POLE SLIP JOINT GROUNDING	1

NOTES:
1. SEE LOAD AND DESIGN DRAWINGS FOR STEEL DESIGN DETAILS.
2. SEE STEEL POLE MANUFACTURING DRAWINGS FOR STEEL POLE DETAILS.
3. STATIC/CONDUCTOR AND POLE GROUND ASSEMBLIES ARE SEPARATE UNITS.
4. STR 2B DOES NOT HAVE A ADDITIONAL T-4DS OHGW ASSEMBLY.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
69KV SINGLE CIRCUIT DEADEND ON STEEL POLE
NON-TYPICAL

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: SCDE-ST-M1

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

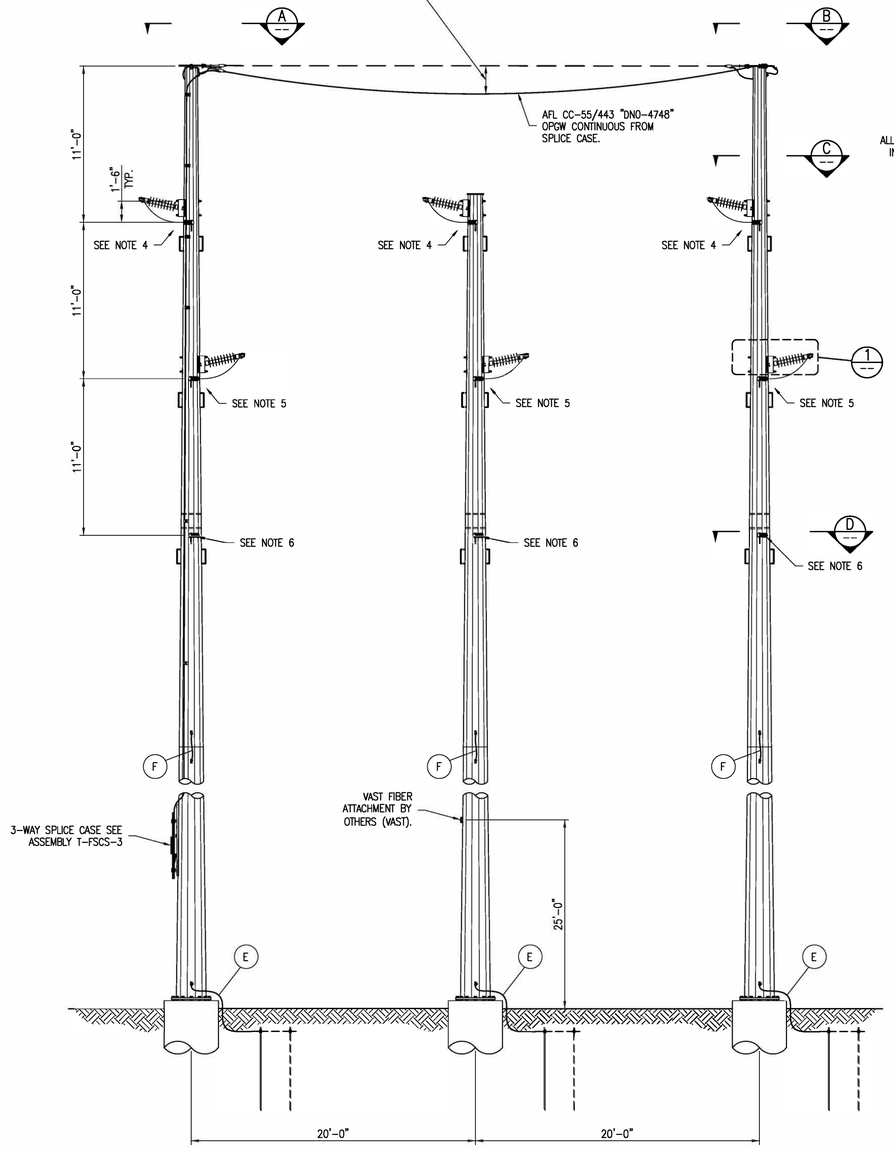
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

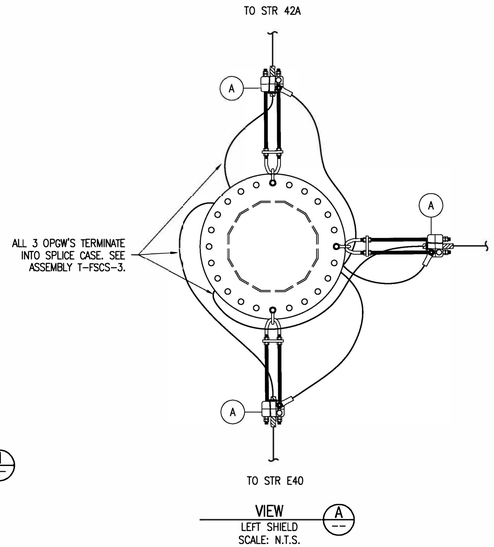
LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

STRUCTURE DETAILS

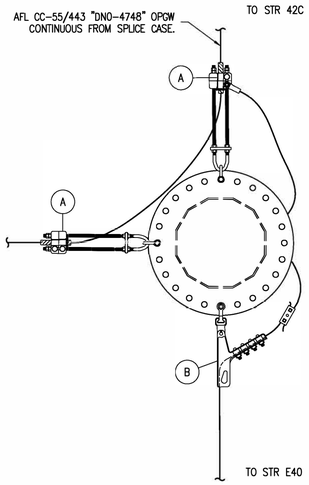
0 1" 2"
FILENAME: BHE-SD-05-D-1.DWG
SCALE: 3/16"=1'-0"
SHEET: **SD-05-1**

	−20°F	0°F	20°F	40°F	60°F	80°F	100°F	120°F
SAG (FT)	0.65	0.66	0.68	0.70	0.72	0.74	0.75	0.77

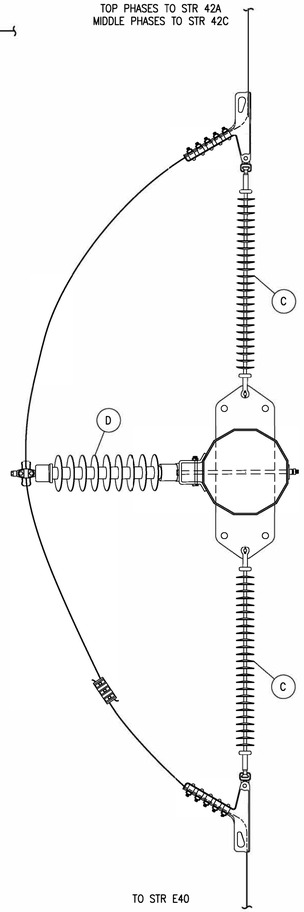




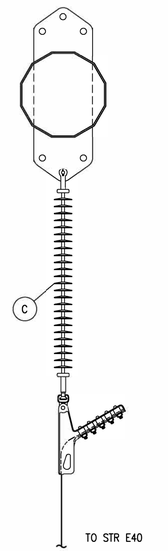
VIEW A
LEFT SHIELD
SCALE: N.T.S.



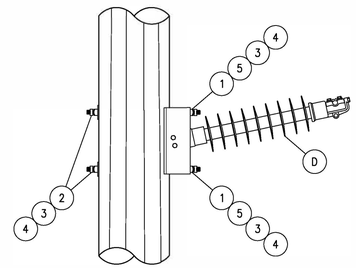
SECTION B
RIGHT SHIELD
SCALE: N.T.S.



SECTION C
TOP PHASES
MIDDLE PHASES
SCALE: N.T.S.



SECTION D
BOTTOM PHASE
SCALE: N.T.S.



DETAIL 1
JUMPER POST
SCALE: N.T.S.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY.
1	N.S.	ROD, FULL THREADED, 7/8" X 120", ASTM A307 GRADE B	D17120	PORTLAND BOLT	13919-10'	4
2	N.S.	WASHER, SQUARE, 4" X 1/4", 15/16" HOLE	W322	HUGHES	SCW4-80	12
3	47-0242	NUT, SQUARE, 7/8"	N107	HUGHES	N80	24
4	22-7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	24
5	N.S.	WASHER, ROUND, 2" X 1/4", 15/16" HOLE	W410	HUGHES	RW2-80	12

TYPICAL ADDITIONAL ASSEMBLIES (CALLED OUT SEPARATELY)

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T-4FDS	OPGW DEADEND ASSEMBLY – STEEL POLE	5
B	T-4DS	OHSW DEADEND ASSEMBLY – STEEL POLE	1
C	T-BDE6PD	CONDUCTOR DEADEND ASSEMBLY	15
D	T-SP1	CONDUCTOR JUMPER ASSEMBLY	6
E	TM-9ST	GROUNDING ASSEMBLY	3
F	TM-9SSJ	STEEL POLE SLIP JOINT GROUNDING	3

NOTES:
1. ONE (1) STICK OF 7/8" X 10'-0" THREADED ROD PER 1.5 INSULATOR ATTACHMENT. CUT TO LENGTH.
2. SEE LOAD AND DESIGN DRAWINGS FOR STEEL DESIGN DETAILS.
3. SEE STEEL POLE MANUFACTURING DRAWINGS FOR STEEL POLE DETAILS.
4. TOP PHASES ARE BEING RECONFIGURED TO THE LANGE – WEST RAPID CITY 69KV TRANSMISSION LINE. CONDUCTORS SPAN AHEAD ON LINE TO STR 42A.
5. MIDDLE PHASES ARE BEING RECONFIGURED TO THE LANGE – BEN FRENCH 2 69KV TRANSMISSION LINE. CONDUCTORS SPAN AHEAD ON LINE TO STR 42C.
6. BOTTOM PHASES ARE BEING RECONFIGURED AND TERMINATING ON THIS STRUCTURE. BHE WILL BE RETIRING THE BOTTOM 3 PHASES IN THE FUTURE.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
69kV TRIPLE CIRCUIT 3-POLE DEADEND - STEEL POLE
LIGHT TO HEAVY ANGLE WITH POST

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: TC-3PDE-ST

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

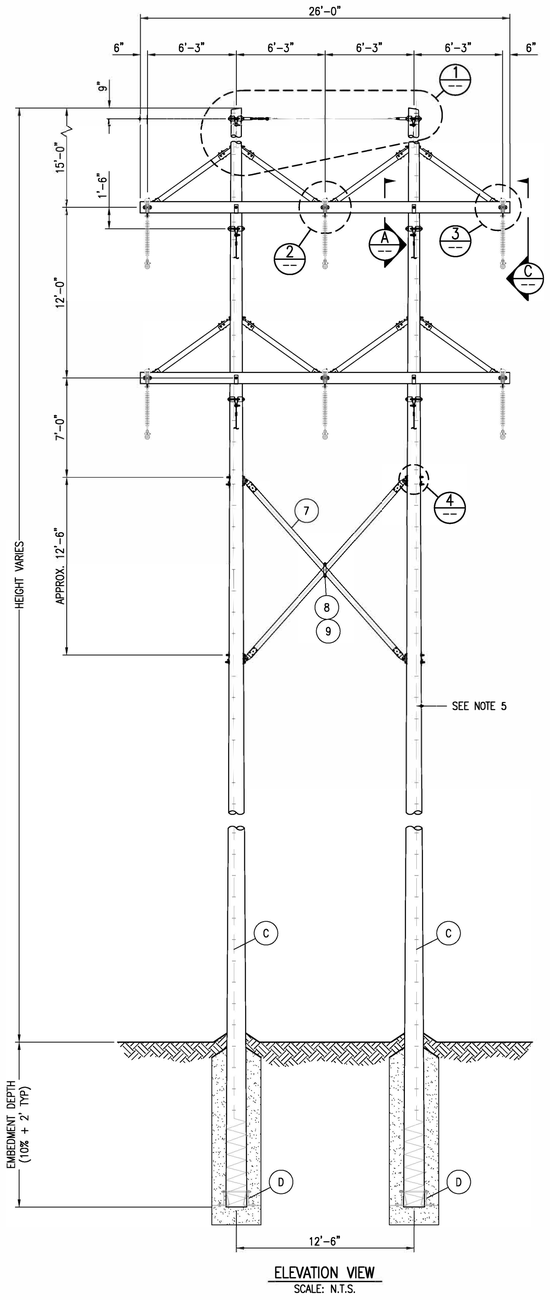
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

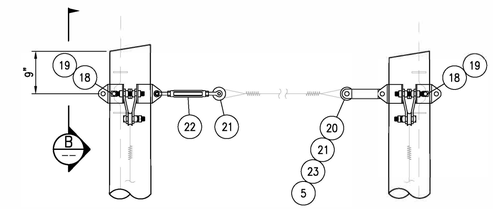
STRUCTURE DETAILS
69KV TRIPLE CIRCUIT 3-POLE
DEADEND - STEEL POLE
STR 41

0 1" 2"

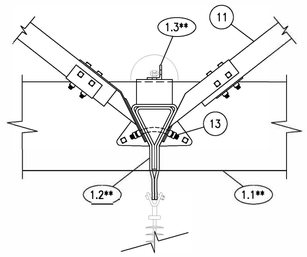
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SCALE: 3/16"=1'-0"
SHEET: SD-06-1



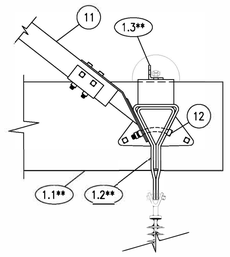
ELEVATION VIEW
SCALE: N.T.S.



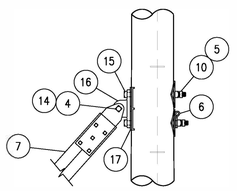
DETAIL (1)
SHIELD WITH VEE BRACE ATTACHMENT
SCALE: N.T.S.



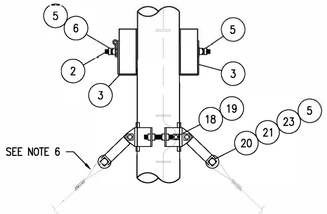
DETAIL (2)
ADJUSTABLE SPACER – MIDDLE PHASE
SCALE: N.T.S.



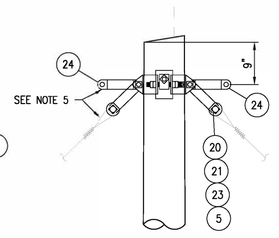
DETAIL (3)
ADJUSTABLE SPACER – END PHASE
SCALE: N.T.S.



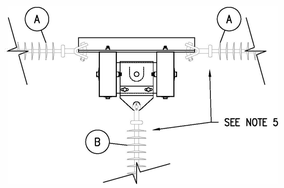
DETAIL (4)
X-BRACE CONNECTION
SCALE: N.T.S.



SECTION (A)
PHASE CROSSARM ATTACHMENT
SCALE: N.T.S.



VIEW (B)
SHIELD ATTACHMENT
SCALE: N.T.S.



VIEW (C)
CONDUCTOR ATTACHMENT
SCALE: N.T.S.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	CROSSARM ASSY. 5 5/8" X 7 1/2" X 26'-0"	X104	HUGHES	C3309.12A	2
1.1	–	CROSSARM, 5 5/8" X 7 1/2" X 26'-0"	–	HUGHES	–	4**
1.2	–	ADJUSTABLE SPACER ASSY.		HUGHES	3414.4PF-100	6**
1.3	–	AS2419.1A ANGLE, 3/8" X 3" X 3" X 24 1/2"		HUGHES	AS2419.1A	6**
2	N.S.	ROD, THREADED, DOUBLE END, 7/8" X REQ'D LENGTH, W/2 NUTS	D270	HUGHES	–	4
2.1	N.S.	ROD, THREADED, DOUBLE END, 7/8" X 28", W/2 NUTS	D2728	HUGHES	TR828-5	–
2.2	N.S.	ROD, THREADED, DOUBLE END, 7/8" X 30", W/2 NUTS	D2730	HUGHES	TR830-5	–
2.3	N.S.	ROD, THREADED, DOUBLE END, 7/8" X 32", W/2 NUTS	D2732	HUGHES	TR832-5	–
2.4	N.S.	ROD, THREADED, DOUBLE END, 7/8" X 34", W/2 NUTS	D2734	HUGHES	TR833-5	–
3	N.S.	POLE GAIN FITTING, 5 5/8" X 7 1/2" CROSSARM, 15/16" HOLE	V170	HUGHES	A783.1Y-15	8
4	N.S.	BOLT, MACHINE, 1" X 3 1/2"	B283.5	HUGHES	B103-1/2-2-1/2	4
5	22-7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	33
6	N.S.	WASHER, SPRING, 15/16" HOLE	W207	HUGHES	2702.8	12
7	N.S.	SET 2096-12-6 X-BRACE, 12'-6" POLE SPACING, 4 5/8 X 5 5/8	Y101	HUGHES	2096-12-6	1
8	N.S.	2840.1E CENTER CLAMP ROD	Y101A	HUGHES	2840.1E	2
9	N.S.	2087.4A CENTER CLAMP STRAP	Y101B	HUGHES	2087.4A	2
10	N.S.	WASHER, CURVED, 4" X 1/4", 15/16" HOLE	W602	HUGHES	CW80	8
11	N.S.	2025-BDV-86 VEE BRACE, 7'-2" CC HOLES, 6'-7" W.L., 37-1/2' & 52-1/2' FITTINGS	Y200	HUGHES	2025-BDV-86	8
12	N.S.	BOLT, BENT, 7/8" X 6"	E576	HUGHES	2722.1B-B	4
13	N.S.	BOLT, BENT STUD, 7/8" X 8"	E676	HUGHES	2722.1D-B	2
14	N.S.	NUT, LOCK, MF TYPE, 1"	N408	HUGHES	MF100	4
15	N.S.	BOLT, MACHINE, 7/8" X REQ'D LENGTH	B270	HUGHES	–	12
15.1	20-7814	BOLT, MACHINE, 7/8" X 14"	B2714	HUGHES	B814-6	–
15.2	20-7816	BOLT, MACHINE, 7/8" X 16"	B2716	HUGHES	B816-6	–
15.3	20-7818	BOLT, MACHINE, 7/8" X 18"	B2718	HUGHES	B818-6	–
15.4	20-7820	BOLT, MACHINE, 7/8" X 20"	B2720	HUGHES	B820-6	–
16	18-2817	TEE, DEAD END, 15/16" BOLT HOLE, 60K LBS	F900	HUGHES	2817-17	4
17	N.S.	GRID GAIN, 4 1/2" X 9" X 1/4", 31/32" HOLE, OUTER HOLES BONDED	V500	HUGHES	1260-AB2	4
18	N.S.	3108 POLE BANDS, HEAVY DUTY, REQ'D POLE DIAMETER	–	HUGHES	–	6
18.1	18-1116	3108 POLE BANDS, HEAVY DUTY, 7"-10" POLE	F110	HUGHES	3108.5	–
18.2	18-1117	3108 POLE BANDS, HEAVY DUTY, 9"-12" POLE	F111	HUGHES	3108.6	–
18.3	18-1118	3108 POLE BANDS, HEAVY DUTY, 11"-14" POLE	F112	HUGHES	3108.7	–
18.4	18-1119	3108 POLE BANDS, HEAVY DUTY, 13"-16" POLE	F113	HUGHES	3108.8	–
19	46-2718	CLIP, BONDING, WITH 1/2" X 1 1/2" BOLT, 7/16" MAX. WIRE	P104	HUGHES	2718.55	6
20	14-3154	LINK, CONNECTING, 3/8" X 2" X 7 1/2", 15/16" HOLES, 24K LBS	F203	HUGHES	3154	26
21	18-2808	GUY, ROLLER, 1 1/8" WR, 15/16" HOLE	G100	HUGHES	28082	14
22	N.S.	JAW & ROD END EYE TURNBUCKLE, 4/8" X 12"	H950	HUGHES	AS2545-D	1
23	20-7803	BOLT, MACHINE, 7/8" X 3"	B273	HUGHES	B83-2	13
24	14-3152	LINK, CONNECTING, 1/4" X 2" X 7 1/2", 15/16" HOLES, 24K LBS	F201	HUGHES	3152	8

TYPICAL ADDITIONAL ASSEMBLIES (CALLED OUT SEPARATELY)

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T-BDE6PD	CONDUCTOR BOLTED DEADEND – POLYMER	12
B	T-J4PD	JUMPER SUPPORT – POLYMER	6
C	TM-9	WOOD POLE GROUNDING ASSEMBLY	2
D	TP-A	POLE ANCHOR ASSEMBLY	2

TYPICAL THREADED ROD (QTY)*

ITEM NO.	POLE CLASS		
	2-1	H1-H2	H3-H4
2.1	2	–	–
2.2	2	2	–
2.3	–	2	2
2.4	–	–	2

*SEE NOTE 3

TYPICAL POLE BANDS (QTY)*

ITEM NO.	POLE CLASS		
	2-1	H1-H2	H3-H4
18.1	2	–	–
18.2	2	2	2
18.3	2	2	2
18.4	–	2	2

*SEE NOTE 3

SINGLE X TYPICAL BOLTS (QTY)*

ITEM NO.	POLE CLASS		
	2-1	H1-H2	H3-H4
15.1	6	2	–
15.2	4	4	2
15.3	2	6	4
15.4	–	–	6

*SEE NOTE 3

NOTES:

1. DRILLED HOLES SHALL BE 1/16" GREATER THAN THE SPECIFIED BOLT DIAMETER.
2. FIELD DRILLED HOLES SHALL BE THOROUGHLY TREATED.
3. POLE BANDS, BOLT LENGTHS AND THREADED ROD LENGTHS ARE ESTIMATED BASED ON STANDARD CLASS DOUGLAS FIR POLE DIMENSIONS. ACTUAL POLE DIAMETERS MAY VARY.
4. (**) IMPLIES ITEMS SUPPLIED BY ARM ASSEMBLY MANUFACTURER.
5. POLE GROUND, GUYS, ANCHORS, POLE ANCHORS, CROSS TIE, AND STATIC/CONDUCTOR ASSEMBLIES ARE SEPARATE UNITS.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
69KV DOUBLE CIRCUIT TANGENT DEADEND STRUCTURE

REFERENCE SHEET: **1 OF 1**
EXHIBIT NUMBER: **DC-C3309-SDE**

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
	J. PANKRATZ
	J. PANKRATZ
	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

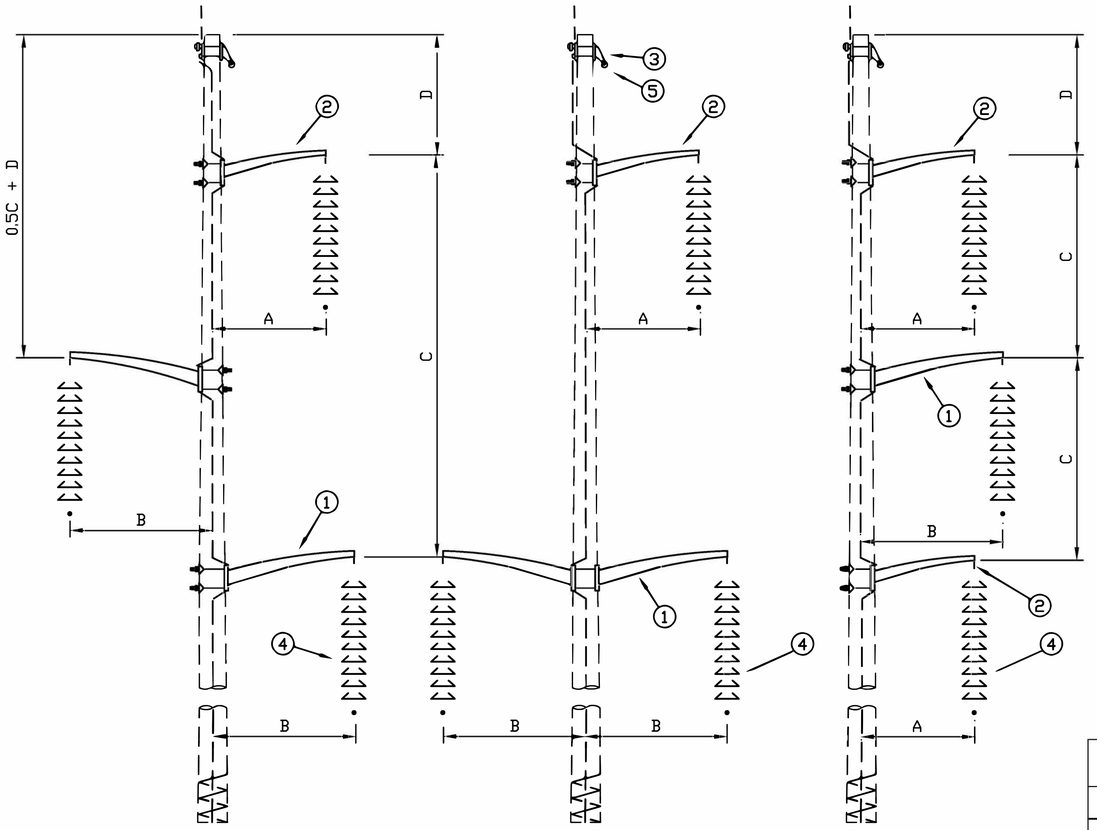
STRUCTURE DETAILS
69KV DC TANGENT DEADEND
STR 3

0 1" 2"

FILENAME: BHE-SD-07-D-1.DWG
SCALE: 3/16"=1'-0"
SHEET: **SD-07-1**

MINIMUM DIMENSIONS								
VOLTAGE	69 kv		115 kv		138 kv		161 kv	
A		4.0		6.0		7.0		8.0
B		5.0		7.0		8.0		9.0
C		7.0		9.0		10.0		12.0
D		4.5		6.5		7.5		9.0

LIST OF MATERIALS						
DWG. REF.	TU- 1,1A	TU- 1AA	DESCRIPTION	ITEM	DET.	CODE No.
1	2	1	STEEL ARM ASS'Y_____Duty,___Ft.		TM-115_	
2	1	2	STEEL ARM ASS'Y_____Duty,___Ft.		TM-115_	
3	1	1	OHGW SUPPORT ASSEMBLY		TM-6__	
4	3	3	INSULATOR ASSEMBLY, TANGENT		TM-___	
5	1	1	OHGW ASSEMBLY, TANGENT		TM-4__	



NOTES:

1. For strength limitations and other assembly requirements, see REA Specification T-11.
2. Metal shims shall be used to adjust davit arms on uneven pole surfaces.
3. The following materials are to be specified on plan-profile drawings and staking sheets: POLES, POLE GROUNDING ASSEMBLY, AND ANY ADDITIONAL GROUNDING OR POLE FOUNDATION UNITS.

TRANSMISSION LINE STRUCTURE

STEEL UPSWEEP ARMS

(161 kv MAXIMUM)

Reissued 03/98

NO.	REVISION	DATE

Aug., 1986

TU-1,1A,1AA

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

STRUCTURE DETAILS

0 1" 2"

FILENAME BHE-SD-08-D-1.DWG

SCALE 3/16"=1'-0"

SHEET **SD-08-1**

LIST OF PARTS

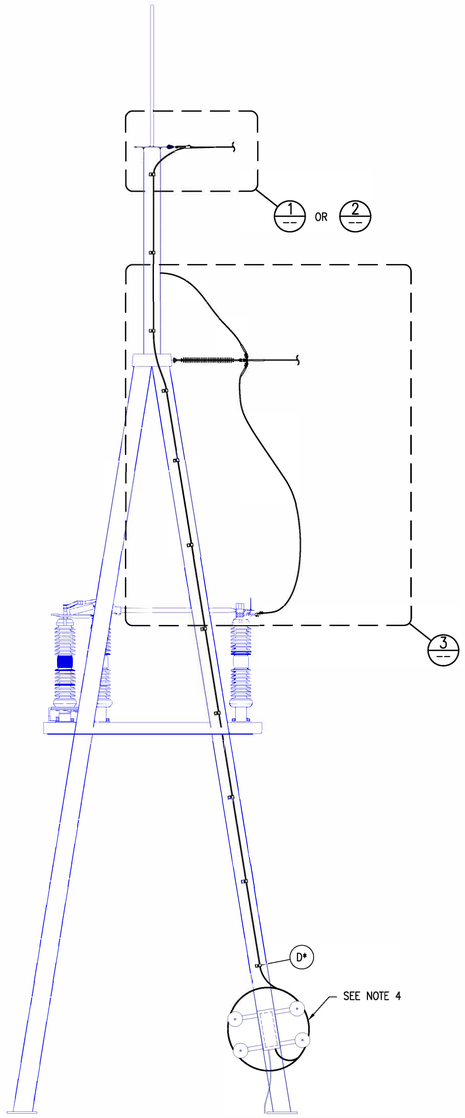
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	CLAMP, SINGLE BOLT, #4 STR CU TO 4/0 AWG STR. CU	Q551	HUBBELL	LC1602	1
2	N.S.	CLAMP, VISE TYPE, 3/8" EHS TO 4/0 AWG STR CU	Q552	HUBBELL	GA9040L55	1

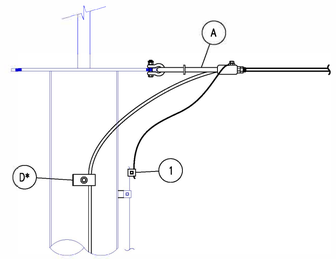
TYPICAL ADDITIONAL ASSEMBLIES (CALLED OUT SEPARATELY)

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T-4FDS	OPGW DEADEND ASSEMBLY - STEEL POLE	1
B	T-4D	OHSW DEADEND ASSEMBLY	1
C	T-SDE6PD	CONDUCTOR SUBSTATION DEADEND ASSEMBLY	3
D*	N/A	DOWNLEAD CLAMPS	AS REQ'D

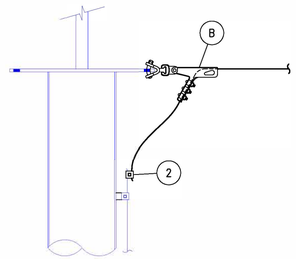
NOTES:

1. BLUE ASSEMBLIES ARE SUPPLIED AND INSTALLED BY THE SUBSTATION CONTRACTOR.
2. (*) ITEMS ARE SUPPLIED BY THE SUBSTATION CONTRACTOR AND INSTALLED BY THE TRANSMISSION CONTRACTOR.
3. MINIMUM BEND RADIUS FOR OPGW IS 9 INCHES.
4. COIL 50 FEET OF OPGW ON THE COIL BRACKET, CAP AND TAPE THE ENDS.
5. COORDINATE WITH SUBSTATION CONTRACTOR FOR PARTS SUPPLIED BY SUBSTATION.

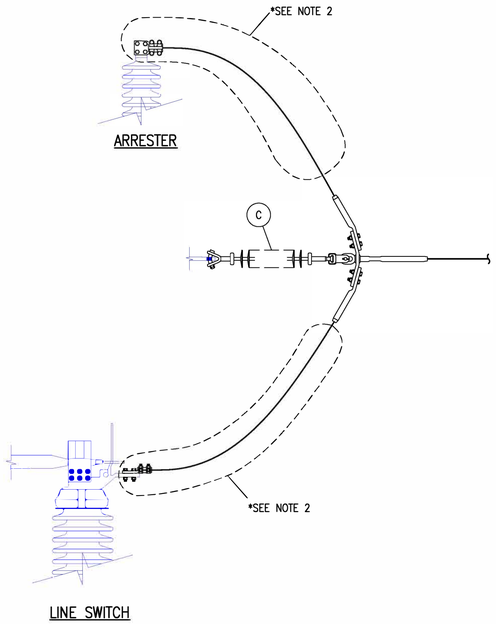




DETAIL 1
OPGW
SCALE: N.T.S.



DETAIL 2
OHSW
SCALE: N.T.S.



DETAIL 3
PHASE
SCALE: N.T.S.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
SUBSTATION DEADEND TOWER CONNECTION

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: DT-01-69

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z.JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

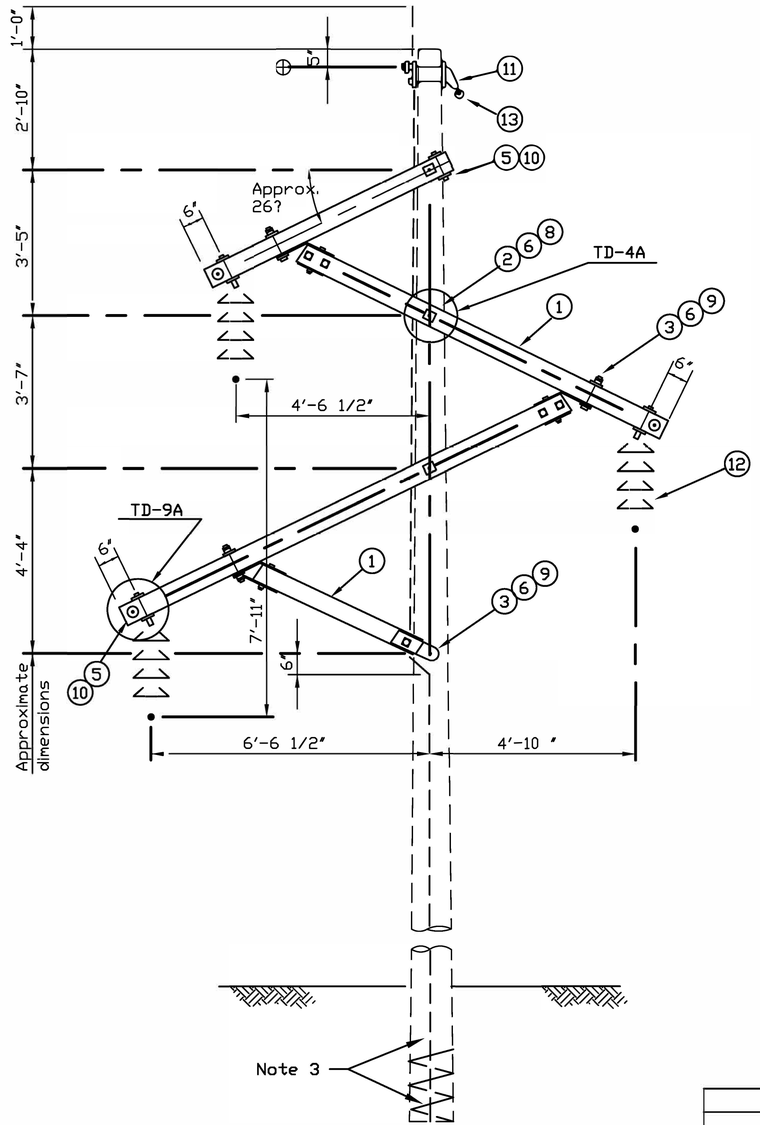
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

STRUCTURE DETAILS
SUBSTATION DEADEND TOWER CONNECTION

0 1" 2"

FILENAME: BHE-SD-09-D-1.DWG
SCALE: 3/16"=1'-0"
SHEET: **SD-09-1**



LIST OF MATERIALS

DWG. REF.	QTY.	DESCRIPTION	ITEM	DET.	CODE No.
1	1	X-Arm, Assembly, 3-5/8"x5-5/8", complete with brace and attaching hardware, fittings, and bolts			
2	3	3/4" Bolt, Machine, by req'd length			
3	4	5/8" Bolt, Machine, by req'd length	gz		
4	3	5/8" Bolt, Shoulder Eye			
5	4	1/2" Bolt, Washer Head, w/Washer Nut			
6	10	Washer, Flat, 2-1/4"sq x3/16",13/16"h.			
7	3	Washer, Saddle, 13/16" hole			
8	6	3/4" Locknut, MF Type			
9	4	5/8" Locknut, MF Type			
10	4	1/2" Locknut, MF Type			
11	1	OHGW SUPPORT ASSEMBLY	–	TM-6__	
12	3	INSULATOR ASSEMBLY, TANGENT	–	TM-__A	
13	1	OHGW ASSEMBLY, TANGENT	–	TM-4__	

NOTES:

1. For other requirments, see REA specification T-5.
2. Drawing TE-1 gives guidance to subassembly alternatives.
3. The following materials are to be specified on the plan and profile drawings and staking sheets: POLES, POLE GROUNDING ASSEMBLY.

Reissued 03/98

TRANSMISSION LINE STRUCTURE

TANGENT WISHBONE–SINGLE ARM

(69 kV MAXIMUM)

NO.	REVISION	DATE

Aug., 1986

TSZ–1

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

STRUCTURE DETAILS

0 1" 2"

FILENAME BHE–SD–10–D–1.DWG

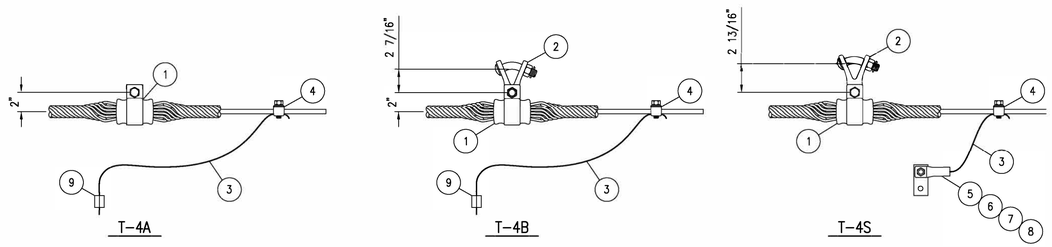
SCALE 3/16"=1'–0"

SHEET **SD-10-1**

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4A QTY	T-4B QTY	T-4S QTY
1	40-7104	AGS SUSPENSION ASSY, 15K, 3/8" EHS	K400	PREFORMED	AGS-7104	1	1	1
2	48-5207	Y-CLEVIS - EYE, 90, 20K	H901	ANDERSON	YCS-05-90		1	1
3	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			2'	2'	6'
4	46-6810	CLAMP, SINGLE BOLT, VISE TYPE, 3/8" EHS TO #2 STR CU	Q550	HUBBELL	GA9020GLSS	1	1	1
5	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012			1
6	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207			1
7	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS			1
8	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD			1
9	36-0002	GROUND CLAMP, #2 STRANDED TO #4 SOLID	Q501	HOMAC	CC24	1	1	

*MAX. LINE ANGLE = 30°



OHSW SUSPENSION
3/8" EHS 7 STRAND GALV.

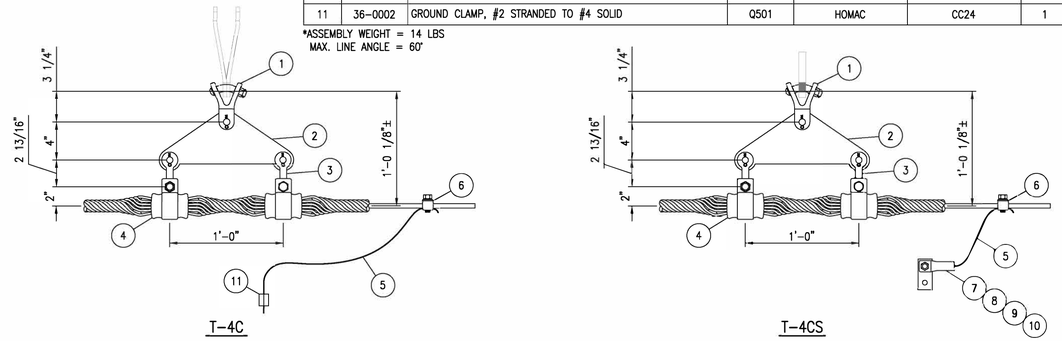
SHEET TITLE
TRANSMISSION ASSEMBLY
OHSW ATTACHMENT

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4A,B,S

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4C QTY	T-4CS QTY
1	48-5208	Y-CLEVIS, CLEVIS, 90, 3 1/4" LONG, 3/4" PIN, 30K	H801	HUBBELL	YCC3090	1	1
2	48-8510	AGS YOKE PLATE, 12" SPACING, 1/2" PLATE, 30K	H700	PREFORMED	YP-5907	1	1
3	48-5206	Y-CLEVIS, EYE, 20K	H900	ANDERSON	YCS-05	2	2
4	40-7804	AGS DOUBLE SUSPENSION ASSEMBLY, 15K, 3/8" EHS	K401	PREFORMED	AGS-7804	1	1
5	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			2'	6'
6	46-6810	CLAMP, SINGLE BOLT, VISE TYPE, 3/8" EHS TO #2 STR CU	Q550	HUBBELL	GA9020GLSS	1	1
7	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012		1
8	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207		1
9	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS		1
10	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD		1
11	36-0002	GROUND CLAMP, #2 STRANDED TO #4 SOLID	Q501	HOMAC	CC24	1	

*ASSEMBLY WEIGHT = 14 LBS
MAX. LINE ANGLE = 60°



OHSW DOUBLE SUSPENSION
3/8" EHS 7 STRAND GALV.

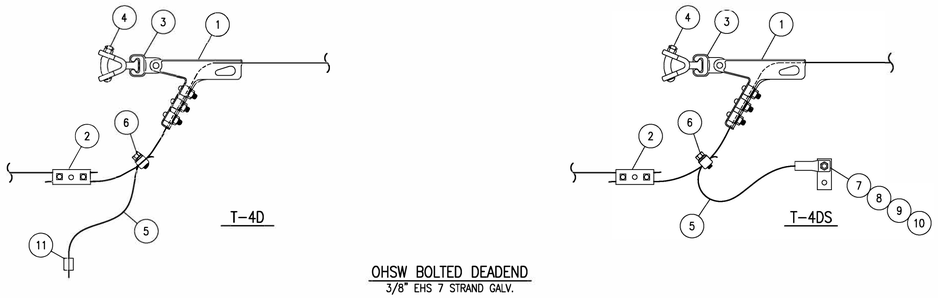
SHEET TITLE
TRANSMISSION ASSEMBLY
OHSW DOUBLE SUSPENSION

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4C

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4D QTY	T-4DS QTY
1	44-4053	STRAIN CLAMP, DE, 20K, 3/8" EHS	L300	HUBBELL	SWDE55N	1	1
2	18-5816	CLAMP, 3-BOLT, 6" LONG, 5/8" BOLT, 5/16" - 1/2" RANGE	Q100	MACLEAN	J931	1	1
3	N.S.	SOCKET EYE, 18K, 1/2" WIDTH, 11/16" HOLE, 2-1/16" LENGTH	H102	HUBBELL	SA04	1	1
4	48-3054	Y-CLEVIS BALL, 30K	H500	HUBBELL	YBC30	1	1
5	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			2'	6'
6	46-6810	CLAMP, SINGLE BOLT, VISE TYPE, 3/8" EHS TO #2 STR CU	Q550	HUBBELL	GA9020GLSS	1	1
7	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012		1
8	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207		1
9	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS		1
10	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD		1
11	36-0002	GROUND CLAMP, #2 STRANDED TO #4 SOLID	Q501	HOMAC	CC24	1	

*ONE ITEM (2) WILL BE REQUIRED FOR EVERY TWO ASSEMBLIES



OHSW BOLTED DEADEND
3/8" EHS 7 STRAND GALV.

SHEET TITLE
TRANSMISSION ASSEMBLY
OHSW DEADEND

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4D(S)

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
OHSW ASSEMBLIES

0 1" 2"

FILENAME BHE-AD-01-D-1.DWG
SCALE N.T.S.

SHEET
AD-01-1

1 | 2 | 3 | 4 | 5 | 6 | 7 | 8

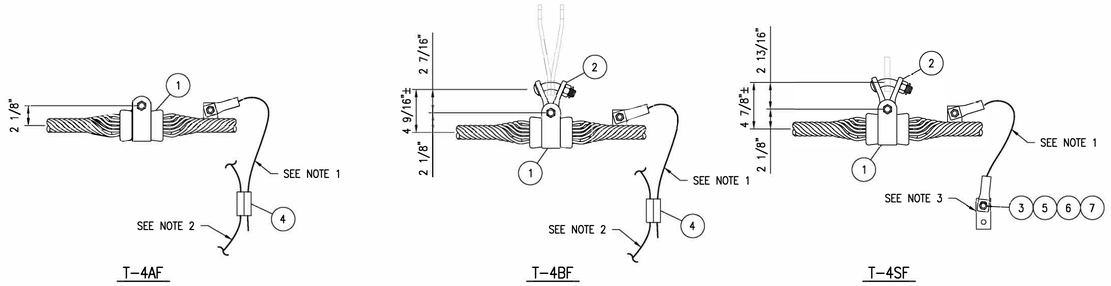
NOTES:

1. #4 STRANDED COPPER WITH CONNECTOR AND BOLTS. FURNISHED WITH ITEM 1.
2. WOOD POLE GROUND.
3. STEEL POLE NEMA PAD.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4AF QTY	T-4BF QTY	T-4SF QTY
1	N.S.	FIBERLIGN SUSPENSION ASSY, W/ GROUNDWIRE	J200	PREFORMED	4300104G	1	1	1
2	48-5207	Y-CLEVIS - EYE, 90, 20K	H901	ANDERSON	YCS-05-90		1	1
3	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012			1
4	N.S.	CONNECTOR, COMPRESSION #4 COPPER TO #4 COPPER	Q500	HOMAC	CC44	1	1	
5	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207			1
6	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS			1
7	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD			1

*MAX. LINE ANGLE = 30°



T-4AF T-4BF T-4SF

OPGW SUSPENSION
0.443" OPGW CABLE

SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW ATTACHMENT

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4F

NOTES:

1. #4 STRANDED COPPER WITH CONNECTOR AND BOLTS. FURNISHED WITH ITEM 1.
2. WOOD POLE GROUND.
3. STEEL POLE NEMA PAD.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4FDW QTY	T-4FDS QTY
1	N.S.	FIBER OPTIC DEADEND, 18" U-BOLT (48 FIBER), W/GROUNDWIRE	J300	PREFORMED	2801303G	1	1
2	N.S.	ANCHOR, SHACKLE, 3" LONG, 3/4" DIA., 7/8" DIA. PIN, 35K LBS	H602	HUGHES	2865-B3	1	1
3	N.S.	CONNECTOR, COMPRESSION #4 COPPER TO #4 COPPER	Q500	HOMAC	CC44	1	
4	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012		1
5	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207		1
6	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS		1
7	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD		1



T-4FDW T-4FDS

OPGW DEADEND
0.443" OPGW CABLE

SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW DEADEND

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4FD

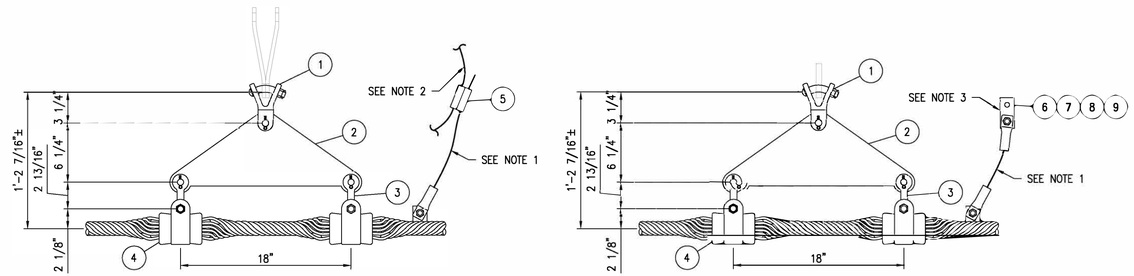
NOTES:

1. #4 STRANDED COPPER WITH CONNECTOR AND BOLTS. FURNISHED WITH ITEM 1.
2. WOOD POLE GROUND.
3. STEEL POLE NEMA PAD.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4FC QTY	T-4FCS QTY
1	48-5208	Y-CLEVIS, CLEVIS, 90, 3 1/4" LONG, 3/4" PIN, 30K	H801	HUBBELL	YCC3090	1	
2	48-8510	AGS YOKE PLATE, 18" SPACING, 1/2" PLATE, 30K	H702	HUGHES	AS2585-Z	1	1
3	48-5206	Y-CLEVIS, EYE, 20K	H900	ANDERSON	YCS-05	2	2
4	N.S.	FIBERLIGN DOUBLE SUSPENSION ASSY, W/ GROUNDWIRE	J201	PREFORMED	4300204G	1	1
5	N.S.	CONNECTOR, COMPRESSION #4 COPPER TO #4 COPPER	Q500	HOMAC	CC44	1	
6	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012		1
7	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207		1
8	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS		1
9	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD		1

*MAX. LINE ANGLE = 60°



T-4FC T-4FCS

OPGW DOUBLE SUSPENSION
0.433" OPGW CABLE

SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW DOUBLE SUSPENSION

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4FC

D C B A

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
OPGW ASSEMBLIES

0 1" 2"

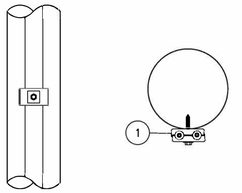
FILENAME BHE-AD-02-D-1.DWG
SCALE N.T.S.
SHEET **AD-02-1**

LIST OF MATERIALS

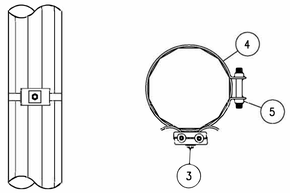
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-FDL-W QTY	T-FDL-S1 QTY	T-FDL-S2 QTY
1	N.S.	DOWNLEAD CUSHION KIT 0.443 OPGW W/ HARDWARE FOR WOOD POLE	J401	PREFORMED	8003041-H1	1	–	–
2	N.S.	DOWNLEAD CUSHION KIT, 0.443" OPGW W/ 1/2" -13 X 3" MOUNTING KIT	J403	PREFORMED	8003041-H3	–	–	1
3	N.S.	DOWNLEAD CUSHION KIT, 0.443" OPGW W/ BANDING BRACKET	J402	PREFORMED	8003041-B1	–	1	–
4	N.S.	BOLT-A-BAND, 3/4" X REQ'D LENGTH	J950	ALUMA-FORM	3/4-201-SSB-100	–	10'	–
5	N.S.	BUCKLE, BANDING, FOR 3/4" BANDING	J951	ALUMA-FORM	BAB-38	–	1	–

NOTES:

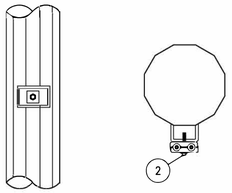
1. OPGW CONTINUOUS TO SPLICE BOX.
2. UNIT CONSISTS OF ONE DOWNLEAD CUSHION INSTALLED. SPECIFIC QUANTITY REQUIRED WILL VARY WITH STRUCTURE HEIGHT.



T-FDL-W
WOOD POLE



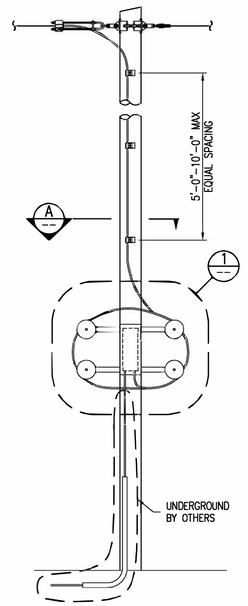
T-FDL-S1
STEEL POLE-BANDED



T-FDL-S2
STEEL POLE - BOLTED

SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW DOWNLEAD

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-FDL

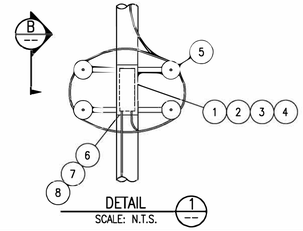


LIST OF MATERIALS

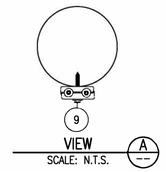
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	6" X 22" COYOTE CLOSURE KIT W/ 6 PORT END PLATE	J510	PREFORMED	8006659	1
2	N.S.	SPLICE TRAY KIT, 36 COUNT TRAY	J600	PREFORMED	80805514	2
3	N.S.	VERTICAL MOUNTING BRACKET KIT	J502	PREFORMED	8003472	1
4	N.S.	COYOTE DEFENDER FOR 6"X 22" CLOSURE	J511	PREFORMED	8003492	1
5	N.S.	VERTICAL CABLE STORAGE ASSEMBLY	J501	PREFORMED	8003569	1
6	N.S.	CLOSURE END PLATE GROMMETS, 7/8" PORT, 0.443" OPGW	J700	PREFORMED	8003597	1
7	N.S.	FUTURE CABLE PORT KIT, 7/8" PORT	J720	PREFORMED	8003371	3
8	N.S.	GROMMET PLUG, 3/4" PORT, QTY 2	J730	PREFORMED	80806037	1
9	N.S.	DOWNLEAD CUSHION KIT 0.443 OPGW W/ HARDWARE FOR WOOD POLE	J401	PREFORMED	8003041-H1	10
10	N.S.	BOLT, MACHINE, 5/8" X REQ'D LENGTH	B250	HUGHES	–	2
11	N.S.	WASHER, SQUARE, 2" X 1/4", 11/16"	W304	HUGHES	SW2-60	4
12	N.S.	WASHER, SPRING, 11/16" HOLE	W205	HUGHES	2702.6	2
13	N.S.	NUT, LOCK, MF TYPE, 5/8"	N405	HUGHES	MF60	2

NOTES:

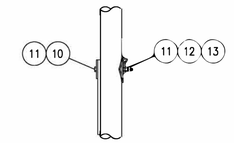
1. SEE T-FDL FOR MORE DETAIL.
2. OPGW CONTINUOUS TO SPLICE BOX.
3. COIL 50 FEET OF OPGW AROUND COIL BRACKET ON DOWNLEAD.



DETAIL 1 — SCALE: N.T.S.



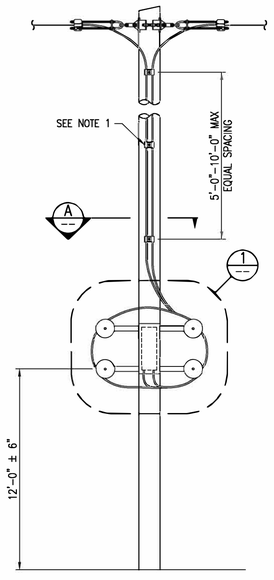
VIEW A — SCALE: N.T.S.



VIEW B — SCALE: N.T.S.

SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW SPLICE CASE - 1 OPGW
WOOD POLE

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-FSC-1

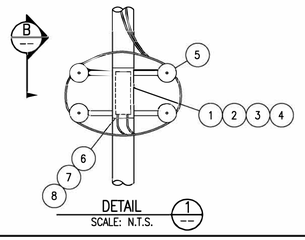


LIST OF MATERIALS

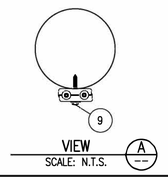
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	6" X 22" COYOTE CLOSURE KIT W/ 6 PORT END PLATE	J510	PREFORMED	8006659	1
2	N.S.	SPLICE TRAY KIT, 36 COUNT TRAY	J600	PREFORMED	80805514	2
3	N.S.	VERTICAL MOUNTING BRACKET KIT	J502	PREFORMED	8003472	1
4	N.S.	COYOTE DEFENDER FOR 6"X 22" CLOSURE	J511	PREFORMED	8003492	1
5	N.S.	VERTICAL CABLE STORAGE ASSEMBLY	J501	PREFORMED	8003569	1
6	N.S.	CLOSURE END PLATE GROMMETS, 7/8" PORT, 0.443" OPGW	J700	PREFORMED	8003597	2
7	N.S.	FUTURE CABLE PORT KIT, 7/8" PORT	J720	PREFORMED	8003371	2
8	N.S.	GROMMET PLUG, 3/4" PORT, QTY 2	J730	PREFORMED	80806037	1
9	N.S.	DOWNLEAD CUSHION KIT 0.443 OPGW W/ HARDWARE FOR WOOD POLE	J401	PREFORMED	8003041-H1	10
10	N.S.	BOLT, MACHINE, 5/8" X REQ'D LENGTH	B250	HUGHES	–	2
11	N.S.	WASHER, SQUARE, 2" X 1/4", 11/16"	W304	HUGHES	SW2-60	4
12	N.S.	WASHER, SPRING, 11/16" HOLE	W205	HUGHES	2702.6	2
13	N.S.	NUT, LOCK, MF TYPE, 5/8"	N405	HUGHES	MF60	2

NOTES:

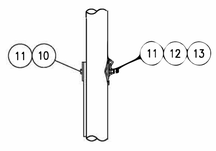
1. SEE T-FDL FOR MORE DETAIL.
2. OPGW CONTINUOUS TO SPLICE BOX.
3. COIL 50 FEET OF OPGW AROUND COIL BRACKET ON DOWNLEAD.



DETAIL 1 — SCALE: N.T.S.



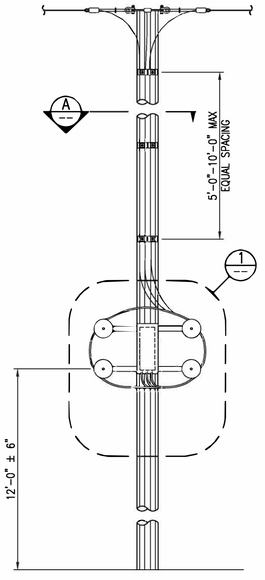
VIEW A — SCALE: N.T.S.



VIEW B — SCALE: N.T.S.

SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW SPLICE CASE - 2 OPGW
WOOD POLE

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-FSC-2

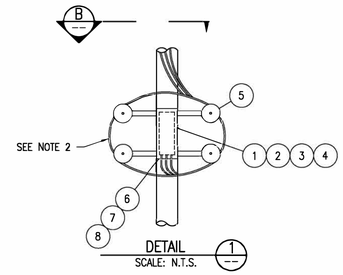


LIST OF MATERIALS

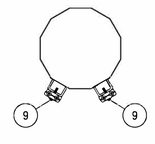
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	6" X 22" COYOTE CLOSURE KIT W/ 6 PORT END PLATE	J510	PREFORMED	8006659	1
2	N.S.	SPLICE TRAY KIT, 36 COUNT TRAY	J600	PREFORMED	80805514	4
3	N.S.	VERTICAL MOUNTING BRACKET KIT	J502	PREFORMED	8003472	1
4	N.S.	COYOTE DEFENDER FOR 6"X 22" CLOSURE	J511	PREFORMED	8003492	1
5	N.S.	VERTICAL CABLE STORAGE ASSEMBLY	J501	PREFORMED	8003569	1
6	N.S.	CLOSURE END PLATE GROMMETS, 7/8" PORT, 0.443" OPGW	J700	PREFORMED	8003597	3
7	N.S.	FUTURE CABLE PORT KIT, 7/8" PORT	J720	PREFORMED	8003371	1
8	N.S.	GROMMET PLUG, 3/4" PORT, QTY 2	J730	PREFORMED	80806037	1
9	N.S.	DOWNLEAD CUSHION KIT, 0.443 OPGW W/ 1/2"-13 X 3" MOUNTING KIT	J403	PREFORMED	8003041-H3	28
10	N.S.	BOLT-A-BAND, 3/4" X REQ'D LENGTH	J950	ALUMA-FORM	3/4-201-SSB-100	60'
11	N.S.	BUCKLE, BANDING, FOR 3/4" BANDING	J951	ALUMA-FORM	BAB-38	2

NOTES:

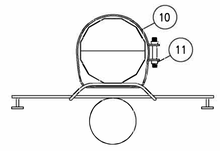
1. OPGW CONTINUOUS TO SPLICE BOX.
2. COIL 50 FEET OF OPGW AROUND COIL BRACKET ON DOWNLEAD.



DETAIL 1 — SCALE: N.T.S.



SECTION A — SCALE: N.T.S.



SECTION B — SCALE: N.T.S.

SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW SPLICE CASE - 3 OPGW
STEEL POLE

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-FSCS-3

2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION
ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
OPGW SPLICE DETAILS

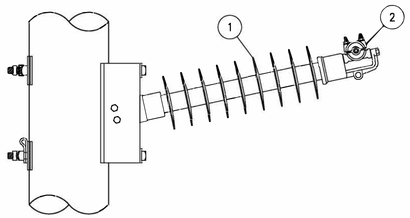
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FILENAME BHE-AD-03-D-1.DWG
SCALE N.T.S.

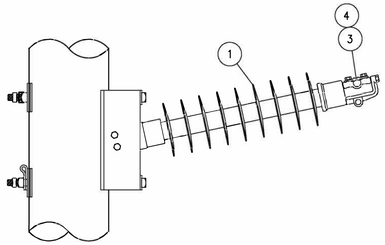
SHEET **AD-03-1**

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-SP QTY	T-SP1 QTY
1	N.S.	INSULATOR, HORIZONTAL POST, CLAMPTOP, 69KV	I250	HUBBELL	P250043S1020	1	1
2	N.S.	AGS SUPPORT ASSEMBLY, 795 KCMIL 45/7 ACSR "TERN"	K350	PREFORMED	AGS-5227	1	–
3	48-7020	CLAMP, TRUNNION, 795 KCMIL 45/7 ACSR "TERN", 2,800 LBS	K300	HUBBELL	TSC150	–	1
4	N.S.	INHIBITOR, RUST (NO-OX-ID), 1 PT CAN, GRADE "A"	O102	SANCHEM INC	NO-OX-ID "A" SPECIAL	–	0.06



CONDUCTOR SUPPORT T-SP
795 ACSR-45/7 "TERN"



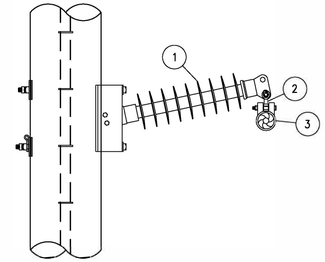
JUMPER SUPPORT T-SP1
795 ACSR-45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
69kV HORIZONTAL CLAMPTOP
795 ACSR - 45/7 "TERN"

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-SP(1)

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	INSULATOR, HORIZONTAL POST, DROP TONGUE, 69KV	I220	HUBBELL	P250043S0020	1
2	48-3053	Y-CLEVIS, EYE, 90, 40K	H902	HUBBELL	YCS-06-90-40	1
3	40-5114	AGS SUPSENSION ASSEMBLY, 25K, 795 ACSR-45/7 "TERN"	K500	PREFORMED	AGS-5128	1



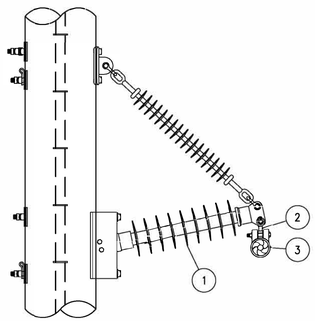
69kV HORIZONTAL POST
795 ACSR-45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
69kV HORIZONTAL POST
795 ACSR - 45/7 "TERN"

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-PSD

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	INSULATOR, HORIZONTAL BRACED POST ASSEMBLY, 69KV	I200	HUBBELL	BLP043G12000	1
2	48-3053	Y-CLEVIS, EYE, 90, 40K	H902	HUBBELL	YCS-06-90-40	1
3	40-5114	AGS SUPSENSION ASSEMBLY, 25K, 795 ACSR-45/7 "TERN"	K500	PREFORMED	AGS-5128	1



69kV BRACED POST ASSEMBLY
795 ACSR-45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
69kV BRACED POST ASSEMBLY
795 ACSR - 45/7 "TERN"

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-BPD

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

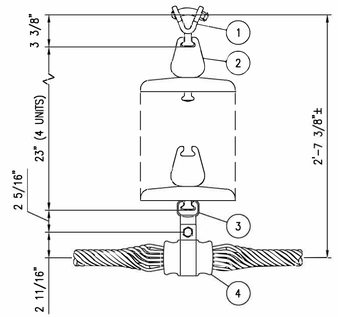
ASSEMBLY DETAILS
POST INSULATOR ASSEMBLIES
795 KCMIL 45/7 ACSR "TERN"

0 1" 2"

FILENAME BHE-AD-04-D-1.DWG
SCALE N.T.S.

SHEET
AD-04-1

LIST OF MATERIALS						
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48-3054	Y-CLEVIS, BALL, 30K	H500	HUBBELL	YBC30	1
2	48-0027	GLASS INSULATOR, 22K LB, M&E, ANSI CL 52-3, 10" X 5 3/4"	I100	SEDIVER	N100/146	4
3	42-7020	AGS SOCKET EYE, 25K	H100	PREFORMED	SE-5154	1
4	40-5114	AGS SUSPENSION ASSY., 25K, 795 ACSR 45/7 "TERN"	K500	PREFORMED	AGS-5128	1

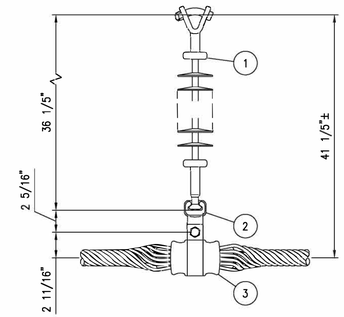


CONDUCTOR SUSPENSION
795 ACSR-45/7 "TERN"
MAX. LINE ANGLE = 30°

SHEET TITLE
TRANSMISSION ASSEMBLY
CONDUCTOR SUSPENSION ATTACHMENT
PORCELAIN

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-S4D

LIST OF MATERIALS						
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48-6924	INSULATOR, SUSPENSION, Y-CLEVIS BALL, 36.2" LENGTH, 25K	I110	MACLEAN	S14080025MXAL015	1
2	42-7020	AGS SOCKET EYE, 25K	H100	PREFORMED	SE-5154	1
3	40-5114	AGS SUSPENSION ASSY., 25K, 795 ACSR 45/7 "TERN"	K500	PREFORMED	AGS-5128	1



CONDUCTOR SUSPENSION
795 ACSR-45/7 "TERN"
MAX. LINE ANGLE = 30°

SHEET TITLE
TRANSMISSION ASSEMBLY
CONDUCTOR SUSPENSION ATTACHMENT
POLYMER

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-S4PD

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
SUSPENSION INSULATOR ASSEMBLIES
795 KCMIL 45/7 ACSR "TERN"

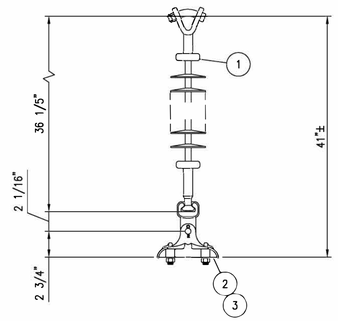
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FILENAME BHE-AD-05-D-1.DWG
SCALE N.T.S.

SHEET
AD-05-1

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48-6924	INSULATOR, SUSPENSION, Y-CLEVIS BALL, 36.2" LENGTH, 25K	I110	MACLEAN	S14080025MXAL015	1
2	42-0118	SUSPENSION CLAMP W/ SOCKET, 25K	K102	HUBBELL	HAS-118-S	1
3	N.S.	INHIBITOR, RUST (NO-OX-ID), 1 PT CAN, GRADE "A"	O102	SANCHEM INC	NO-OX-ID "A" SPECIAL	0.06



JUMPER SUPPORT
795 ACSR-45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
JUMPER SUPPORT
POLYMER

REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
T-J4PD

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
JUMPER INSULATOR ASSEMBLIES
795 KCMIL 45/7 ACSR "TERN"

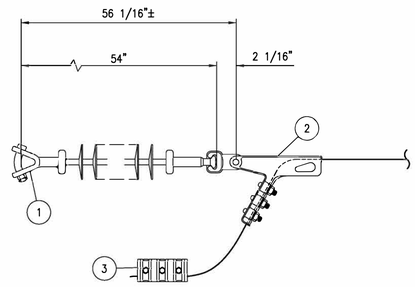
0 1" 2"

FILENAME BHE-AD-06-D-1.DWG
SCALE N.T.S.

SHEET
AD-06-1

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48-6927	INSULATOR, DEADEND, Y-CLEVIS BALL, 54" LENGTH, 25K	I300	MACLEAN	S140800042MXAL027	1
2	42-1120	STRAIN CLAMP, DEADEND W/ SOCKET-EYE, 30K, 0.50 - 1.20 RANGE	L101	HUBBELL	SD112S	1
3	42-0483	PARALLEL GROOVE CONNECTOR, 0.743 - 1.152 RANGE	Q601	AFL	483.3P	1

*ONE ITEM (3) WILL BE REQUIRED FOR EVERY TWO ASSEMBLIES

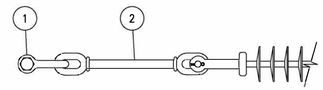


CONDUCTOR BOLTED DEADEND
795 ACSR-45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
CONDUCTOR BOLTED DEADEND
POLYMER

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-BDE6PD

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	ANCHOR SHACKLE, 3.5" LONG, 7/8" DIA, 3/4" PIN, 60K LBS	H603	HUBBELL	AS50BNK	1
2	N.S.	HOT LINK EXTENSION, CHAIN EYE - CHAIN EYE, 15" LONG, 30K LBS	H400	HUBBELL	H003015	1



TM-EXT-15
15" EXTENSION LINK

SHEET TITLE
TRANSMISSION ASSEMBLY
15" EXTENSION LINK

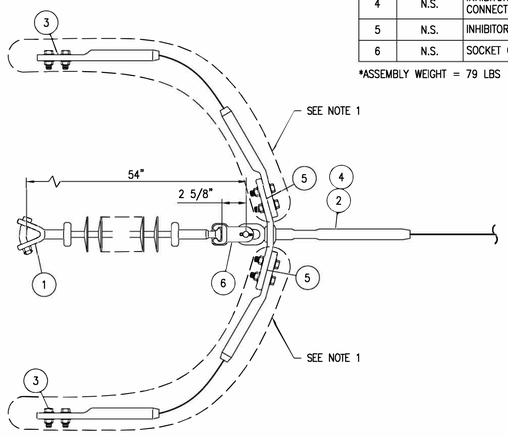
REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TM-EXT-15

NOTE:

1. JUMPERS AND TERMINALS SUPPLIED BY SUBSTATION, INSTALLED BY TRANSMISSION. SEE WEST RAPID CITY SUBSTATION REFERENCE SHEETS IN APPENDIX.

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48-6927	INSULATOR, DEADEND, Y-CLEVIS BALL, 54" LENGTH, 25K	I300	MACLEAN	S140800042MXAL027	1
2	42-8230	COMPRESSION DEADEND ASSY, DOUBLE TONGUE, W/ 15' TERMINAL "TERN"	L502	AFL	VED-123	1
3	N.S.	BOLT, NUT, BELLEVILLE, FLAT, STAINLESS STEEL ASSEMBLY	B606	CMC	SBA20-50	8
4	N.S.	INHIBITOR, FILLER COMPOUND, GRITTED, COMPRESSION CONNECTIONS, 8 oz.	O100	HUBBELL	VSG8B	1.5
5	N.S.	INHIBITOR, FILLER COMPOUND, NON-GRITTED, PAD TO PAD, 8 OZ	O101	HUBBELL	VS8B	0.6
6	N.S.	SOCKET CLEVIS, 30K	H200	HUBBELL	SC30	1

*ASSEMBLY WEIGHT = 79 LBS



CONDUCTOR SUBSTATION DEADEND
795 ACSR-45/7 "TERN"

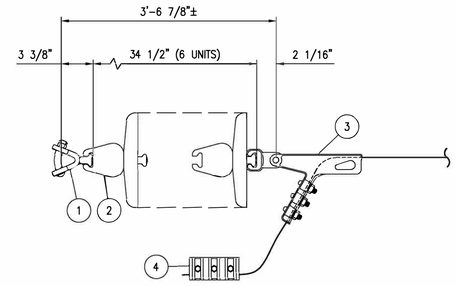
SHEET TITLE
TRANSMISSION ASSEMBLY
CONDUCTOR SUBSTATION DEADEND
POLYMER

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-SDE6PD

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48-3054	Y-CLEVIS, BALL, 30K	H500	HUBBELL	YBC30	1
2	N.S.	GLASS INSULATOR, 30K LB, M&E, ANSI CL 52-5, 10" X 5 3/4"	I102	SEDIVER	N14/146	6
3	42-1120	STRAIN CLAMP, DEADEND W/ SOCKET-EYE, 30K, 0.50 - 1.20 RANGE	L101	HUBBELL	SD112S	1
4	42-0483	PARALLEL GROOVE CONNECTOR, 0.743 - 1.152 RANGE	Q601	AFL	483.3P	1

*ONE ITEM (4) WILL BE REQUIRED FOR EVERY TWO ASSEMBLIES

ASSEMBLY WEIGHT = 75 LBS



CONDUCTOR BOLTED DEADEND
795 ACSR-45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
CONDUCTOR BOLTED DEADEND

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-BDE6D

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
DEADEND INSULATOR ASSEMBLIES
795 KCMIL 45/7 ACSR "TERN"

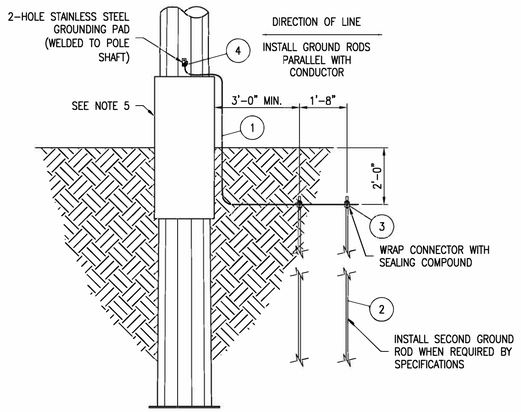
0 1" 2"

FILENAME BHE-AD-07-D-1.DWG
SCALE N.T.S.

SHEET
AD-07-1

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			10'
2	46-0588	ROD, GROUND, 5/8" X 8'-0", COPPERCLAD	P500	GALVAN	6260G13	1
3	46-0058	CLAMP, GROUND ROD, 0.128 TO 0.460 RANGE, 5/8" ROD	P701	CHANCE	C2030344	1
4	N.S.	CLAMP, VISE TYPE, LIGHTNING ARRESTOR GROUND, #2 STRANDED	P820	HUBBELL	GC207	1



STEEL POLE GROUNDING DETAIL
SCALE: N.T.S.

SPECIFICATIONS FOR DRIVEN GROUND ROD INSTALLATION:

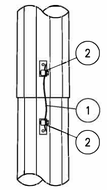
1. INSTALL 8'-0" OF GROUND ROD AND TEST THE RESISTANCE LEVEL. WHEN RESISTANCE IS 25Ω OR LESS, NO ADDITIONAL STEPS ARE NEEDED.
2. IF RESISTANCE IS 25Ω OR GREATER, INSTALL AN ADDITIONAL 8'-0" OF GROUND ROD AS SHOWN:
   - TEST RESISTANCE WITH 1ST ROD CONNECTED TO 2ND ROD WITH #2 CU FOR COMBINED PARALLEL RESISTANCE VALUE. RECORD RESISTANCE VALUE.
3. AFTER DRIVING TWO (2) GROUND RODS AS NOTED ABOVE AND THE COMBINED RESISTANCE IS 25Ω OR GREATER, THE ELECTRICAL ENGINEERING DEPARTMENT SHOULD BE CONSULTED FOR FURTHER ACTION.
4. BOND STATIC WIRE TO POLE GROUND, USE FARGO CONNECTOR (ITEM #5).
5. GROUNDING THE SAME FOR STEEL POLE ON CONCRETE PIER FOUNDATIONS.

SHEET TITLE: **TRANSMISSION ASSEMBLY**
STEEL POLE GROUNDING

REFERENCE SHEET: **1 OF 1**
EXHIBIT NUMBER: **TM-9ST**

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			4'
2	N.S.	CLAMP, VISE TYPE, LIGHTNING ARRESTOR GROUND, #2 STRANDED	P820	HUBBELL	GC207	2



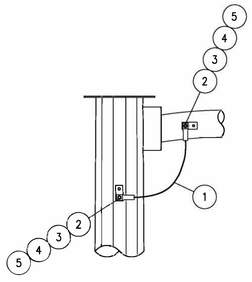
TM-9SSJ
SLIP JOINT
SCALE: N.T.S.

SHEET TITLE: **TRANSMISSION ASSEMBLY**
STEEL POLE SLIP JOINT GROUNDING

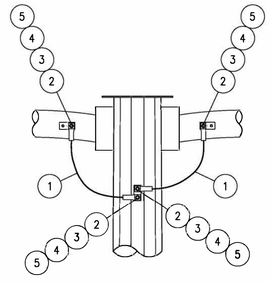
REFERENCE SHEET: **1 OF 1**
EXHIBIT NUMBER: **TM-9SSJ**

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	9SD-1	9SD-2
1	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			5'	10'
2	N.S.	COMPRESSION TERMINAL, COPPER, #6 – 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012	2	4
3	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207	2	4
4	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS	2	4
5	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD	2	4



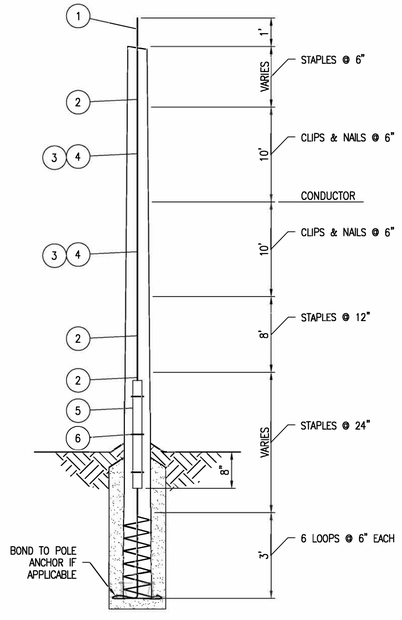
TM-9SD-1
SINGLE DAVIT GROUNDING
SCALE: N.T.S.



TM-9SD-2
DOUBLE DAVIT GROUNDING
SCALE: N.T.S.

SHEET TITLE: **TRANSMISSION ASSEMBLY**
STEEL POLE DAVIT ARM GROUNDING

REFERENCE SHEET: **1 OF 1**
EXHIBIT NUMBER: **TM-9SD**



LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	36-4000	GROUNDWIRE, #4CU SD, 40% CONDUCTIVITY	C901			125'
2	46-7494	STAPLE, CUT (SLASH) 1 1/2" X 3/8" CU-COATED, BARBED	P600	MACLEAN	J7682	50
3	46-7460	NAIL, 10D, CU-COATED	P150	MACLEAN	J7260	40
4	46-2729	CLIP, CU-COATED	P151	KEARNEY	5730-1	40
5	46-2503	WOOD MOULDING, 1-11/16" X 8'	P300	HUGHES	2503.8	1
6	46-2504	MOULDING STAPLES, 1-3/4" X 3-1/2"	P400	HUBBELL	C2050222	3

NOTES:

1. BOND ALL POLE HARDWARE TO POLE GROUND. USE BONDING CLIP.
2. ON 230/69kV CONSTRUCTION, BOND ALL 69kV HARDWARE.
3. GROUND WIRE SHALL BE INSTALLED FOR THE FULL LENGTH OF EACH POLE, ACROSS THE BOTTOM, AND BACK UP IN WRAP TURNS AS SHOWN. STAPLE THE WRAPS AT EACH INTERSECTION OF THE DOWNLEAD, AND EVERY 12" FOR THE LENGTH OF THE WRAPS.
4. THIS UNIT INCLUDES THE MEASURE AND RECORDING OF EACH POLE'S FOOTING RESISTANCE, AFTER POLE SETTING IS COMPLETED AND BEFORE INSTALLING THE OHSW.
5. FOR FOOTING RESISTANCES GREATER THAN 15 OHMS, GROUNDING CONNECTIONS SHALL BE USED TO BOND TOGETHER THE GROUND WIRES OF EACH POLE AND GUY ANCHORS IF APPLICABLE.
6. IF THE FOOTING RESISTANCE READS GREATER THAN 15 OHMS AFTER INSTALLATION PROCEDURES PER NOTE 5, CONTRACTOR SHALL NOTIFY THE ENGINEER FOR FURTHER GROUNDING INSTRUCTIONS.
7. BOND STATIC WIRE TO POLE GROUND, USE FARGO CONNECTOR. (ITEM #5)
8. SEE INDIVIDUAL STRUCTURE DRAWINGS FOR REMAINING DIMENSIONS.

SHEET TITLE: **TRANSMISSION ASSEMBLY**
WOOD POLE GROUNDING

REFERENCE SHEET: **1 OF 1**
EXHIBIT NUMBER: **TM-9**

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

ASSEMBLY DETAILS GROUNDING ASSEMBLIES

0 1" 2"

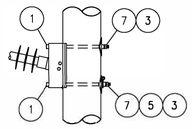
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SCALE: N.T.S.
SHEET: **AD-08-1**

1	2	3	4	5	6	7	8

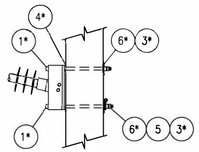
LIST OF MATERIAL

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	1A	1B	1C	1D
1	N.S.	BOLT, MACHINE, 7/8" X REQ'D LENGTH	B270			2	2*	2	–
2	N.S.	ROD, FULL THREADED, 7/8" X REQ'D LENGTH, W/ 4 NUTS	D170			–	–	–	2
3	22–7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	2	2*	2	4
4	N.S.	POLE SHIM, GAIN BASE TO FLAT	V400	N/A	N/A	–	1*	–	–
5	N.S.	WASHER, SPRING, 15/16" HOLE	W207	HUGHES	2702.8	1	1	–	–
6	N.S.	WASHER, SQUARE, 4" X 1/4", 15/16" HOLE	W322	HUGHES	SW4–80	–	2*	2	2
7	22–4425	WASHER, SQ. CURVED, 4" X 1/4", 15/16" HOLE	W504	HUGHES	SCW4–80	2	–	–	–

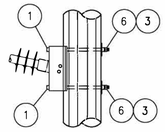
(*) DENOTES MATERIAL SUPPLIED BY LAMINATED POLE MANUFACTURER



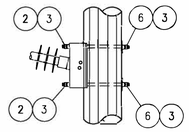
TD–1A
ROUND WOOD POLE ASSEMBLY
SCALE: N.T.S.



TD–1B
LAMINATED POLE ASSEMBLY
SCALE: N.T.S.



TD–1C
STEEL POLE ASSEMBLY
SCALE: N.T.S.



TD–1D
LARGE STEEL POLE ASSEMBLY
SCALE: N.T.S.

NOTES:

1. STRENGTH LIMITATIONS OF 7/8" BOLTS.
   - A. SINGLE SHEAR THROUGH THREADS 17,270 LBS.
   - B. SINGLE SHEAR THROUGH SHAFT 24,350 LBS.
   - C. MINIMUM TENSILE STRENGTH 25,400 LBS.

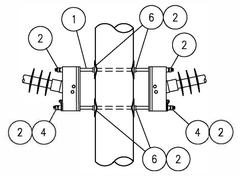
SHEET TITLE
TRANSMISSION ASSEMBLY
SINGLE INSULATOR BASE TO POLE ASSEMBLY

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: TD-1

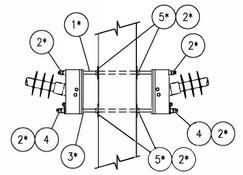
LIST OF MATERIAL

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	2A	2B	2C
1	N.S.	ROD, FULL THREADED, 7/8" X REQ'D LENGTH, W/ 4 NUTS	D170			2	2*	2
2	22–7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	8	8*	8
3	N.S.	POLE SHIM, GAIN BASE TO FLAT	V400	N/A	N/A	–	2*	–
4	N.S.	WASHER, SPRING, 15/16" HOLE	W207	HUGHES	2702.8	2	2	–
5	N.S.	WASHER, SQUARE, 4" X 1/4", 15/16" HOLE	W322	HUGHES	SW4–80	–	4*	4
6	22–4425	WASHER, SQ. CURVED, 4" X 1/4", 15/16" HOLE	W504	HUGHES	SCW4–80	4	–	–

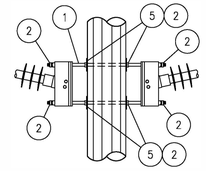
(*) DENOTES MATERIAL SUPPLIED BY LAMINATED POLE MANUFACTURER



TD–2A
ROUND WOOD POLE ASSEMBLY
SCALE: N.T.S.



TD–2B
LAMINATED POLE ASSEMBLY
SCALE: N.T.S.



TD–2C
STEEL POLE ASSEMBLY
SCALE: N.T.S.

NOTES:

1. STRENGTH LIMITATIONS OF 7/8" BOLTS.
   - A. SINGLE SHEAR THROUGH THREADS 17,270 LBS.
   - B. SINGLE SHEAR THROUGH SHAFT 24,350 LBS.
   - C. MINIMUM TENSILE STRENGTH 25,400 LBS.

SHEET TITLE
TRANSMISSION ASSEMBLY
DOUBLE INSULATOR BASE TO POLE ASSEMBLY

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: TD-2

D C B A

Black Hills Energy
Improving life with energy

HDR

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

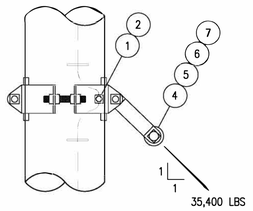
ASSEMBLY DETAILS
INSULATOR BASE TO POLE ASSEMBLIES

0 1" 2"

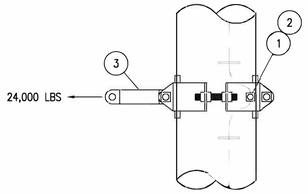
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SCALE: N.T.S.
SHEET: AD-09-1

LIST OF MATERIALS

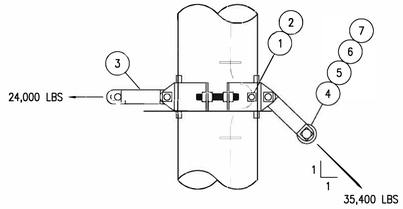
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	TG-26B QTY	TG-26C QTY	TG-26D QTY	TG-26E QTY
1	N.S.	POLE BAND ASSY. HEAVY DUTY, REQ'D POLE DIAMETER	–	HUGHES	–	1	1	1	1
1.1	18-1116	POLE BANDS, HEAVY DUTY, 7"-10" POLE	F110	HUGHES	3108.5	–	–	–	–
1.2	18-1117	POLE BANDS, HEAVY DUTY, 9"-12" POLE	F111	HUGHES	3108.6	–	–	–	–
1.3	18-1118	POLE BANDS, HEAVY DUTY, 11"-14" POLE	F112	HUGHES	3108.7	–	–	–	–
1.4	18-1119	POLE BANDS, HEAVY DUTY, 13"-16" POLE	F113	HUGHES	3108.8	–	–	–	–
2	46-2718	CLIP, BONDING, WITH 1/2" X 1 1/2" BOLT, 7/16" MAX. WIRE	P104	HUGHES	2718.55	1	1	1	1
3	14-3152	LINK, CONNECTING, 1/4" X 2" X 7 1/2", 15/16" HOLES, 24K LBS	F201	HUGHES	3152	–	2	2	–
4	14-3154	LINK, CONNECTING, 3/8" X 2" X 7 1/2", 15/16" HOLES, 38K LBS	F203	HUGHES	3154	2	–	2	4
5	18-2808	GUY, ROLLER, 1 1/8" WR, 15/16" HOLE	G100	HUGHES	28082	1	–	1	2
6	20-7803	MACHINE BOLT, 7/8" X 3"	B273	HUGHES	B83-2	1	–	1	2
7	22-7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	1	–	1	2



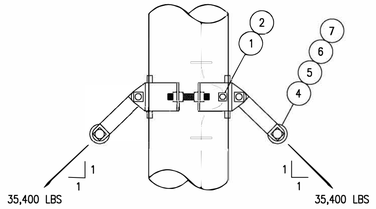
TG-26B



TG-26C



TG-26D



TG-26E

NOTES:

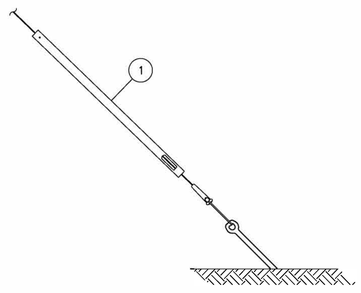
1. THE INDICATED LOADS ARE DESIGN MAXIMUMS.
2. FOR GUY SLOPES MORE THAN 1V TO 1H, THE MAXIMUM VERTICAL CAPACITY SHOULD NOT EXCEED 25,000 LBS.
3. WHEN TWO GUY ATTACHMENTS ARE NEEDED. THE ADDITIONAL POLE BAND SHALL BE 6' BELOW THE FIRST ONE.

SHEET TITLE
TRANSMISSION ASSEMBLY
POLE BAND ASSEMBLIES

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TG-26

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	GUY, GUARD, 2" X 8'-0", FULL ROUND, YELLOW	G400	MACLEAN	J1493Y	1



GUY MARKER

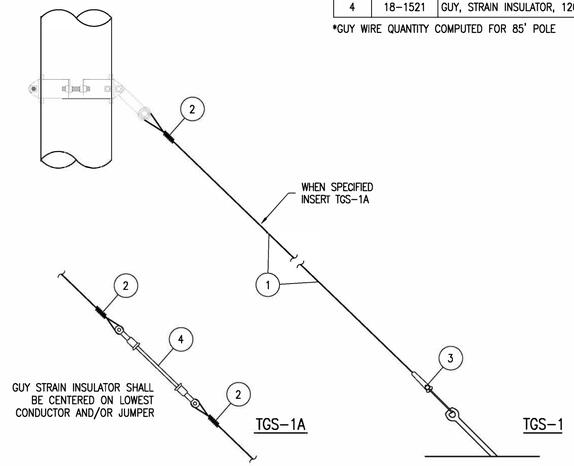
SHEET TITLE
TRANSMISSION ASSEMBLY
GUY MARKER

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TM-GM

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	TGS-1 QTY	TGS-1A QTY
1	18-7167	WIRE, GALVANIZED, 7 STEEL STRAND, 7/16" EHS	C801	–	–	110'	110'
2	18-7168	GUY DEADEND GRIP, FOR 7/16" EHS	G601	PREFORMED	GDE-1108	1	3
3	18-0716	GUY, STRANDVISE, 7/16" EHS, SHORT BAIL	G902	MACLEAN	5203	1	1
4	18-1521	GUY, STRAIN INSULATOR, 120" LONG, 21K LBS, ROLLER, ROLLER	G200	HUGHES	CF694-120R2	–	1

*GUY WIRE QUANTITY COMPUTED FOR 85' POLE



TGS-1A TGS-1

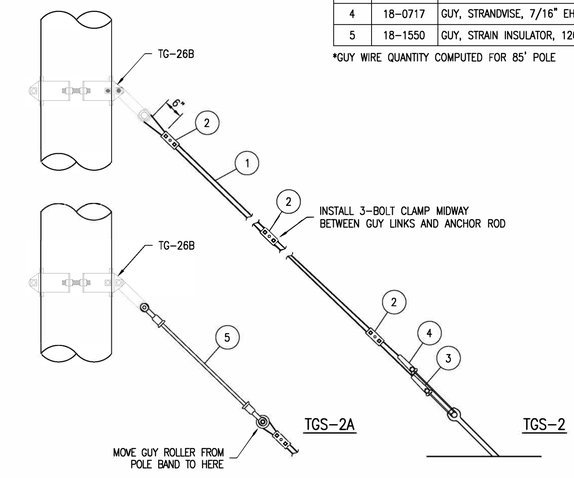
SHEET TITLE
TRANSMISSION ASSEMBLY
SINGLE GUY ASSEMBLIES
7/16" EHS

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TGS-1(A)

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	TGS-2 QTY	TGS-2A QTY
1	18-7167	WIRE, GALVANIZED, 7 STEEL STRAND, 7/16" EHS	C801	–	–	220'	220'
2	18-5816	CLAMP, 3-BOLT, 6" LONG, 5/8" BOLT, 5/16" – 1/2" RANGE	Q100	MACLEAN	J931	3	3
3	18-0716	GUY, STRANDVISE, 7/16" EHS, SHORT BAIL	G902	MACLEAN	5203	1	1
4	18-0717	GUY, STRANDVISE, 7/16" EHS, LONG BAIL	G903	MACLEAN	5203L	1	1
5	18-1550	GUY, STRAIN INSULATOR, 120" LONG, 50K LBS	G201	MACLEAN	GCC50-120-SC	–	1

*GUY WIRE QUANTITY COMPUTED FOR 85' POLE



SHEET TITLE
TRANSMISSION ASSEMBLY
DOUBLE GUY ASSEMBLY
7/16" EHS

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TGS-2(A)

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

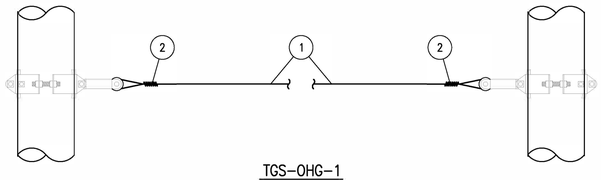
ASSEMBLY DETAILS
GUY AND ANCHOR ASSEMBLIES

0 1" 2"

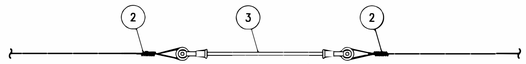
FILENAME BHE-AD-10-D-1.DWG
SCALE N.T.S.
SHEET **AD-10-1**

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	TGS–OHG–1	TGS–OHG–1A
1	18–7167	WIRE, GALVANIZED, 7 STEEL STRAND, 7/16" EHS	C801	–	–	150'	150'
2	18–7168	GUY DEADEND GRIP, FOR 7/16" EHS	G601	PREFORMED	GDE–1108	2	4
3	N.S.	GUY, STRAIN INSULATOR, 120" LONG, 21K LBS, ROLLER, ROLLER	G200	HUGHES	CF694–120R2	–	1



TGS–OHG–1



TGS–OHG–1A

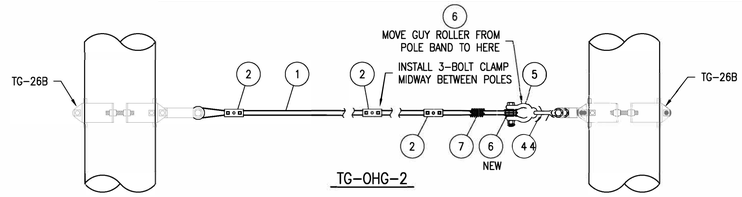
POSITION THE GUY STRAIN INSULATOR SUCH THAT THE LOWER END OF THE INSULATOR WOULD BE NO LESS THAN 10'–0" FROM THE GROUND IN AN EVENT OF BROKEN GUY WIRE

SHEET TITLE
TRANSMISSION ASSEMBLY
SINGLE OVERHEAD GUY ASSEMBLY

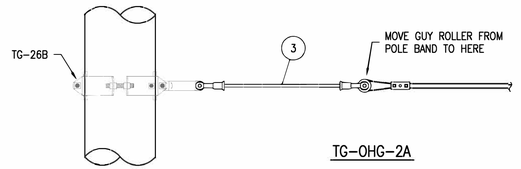
REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TGS-OHG-1(A)

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	TG–OHG–2	TG–OHG–2A
1	18–7167	7/16" EH.S. STEEL 7–STRAND GUY WIRE	C801	–	–	300'	300'
2	18–5816	CLAMP, 3–BOLT, 6" LONG, 5/8" BOLT, 5/16" – 1/2" RANGE	Q100	MACLEAN	J931	3	3
3	18–1550	GUY, STRAIN INSULATOR, 120" LONG, 50K LBS	G201	MACLEAN	GCC50–120–SC	–	1
4	N.S.	ANCHOR, SHACKLE, 3.5" LONG, 7/8" DIA., 3/4" DIA. PIN, 60K	H603	HUBBELL	AS50BNK	1	1
5	N.S.	ANCHOR, SHACKLE, 3.5" LONG, 1 7/16" WIDE, 7/8" DIA., 7/8" DIA. PIN, 72K	H604	HUBBELL	AS60875BNK	1	1
6	18–2808	GUY, ROLLER, 1 1/8" WR, 15/16" HOLE	G100	HUGHES	28082	1	1
7	18–7168	GUY DEADEND GRIP, FOR 7/16" EHS	G601	PREFORMED	GDE–1108	2	2



TG–OHG–2



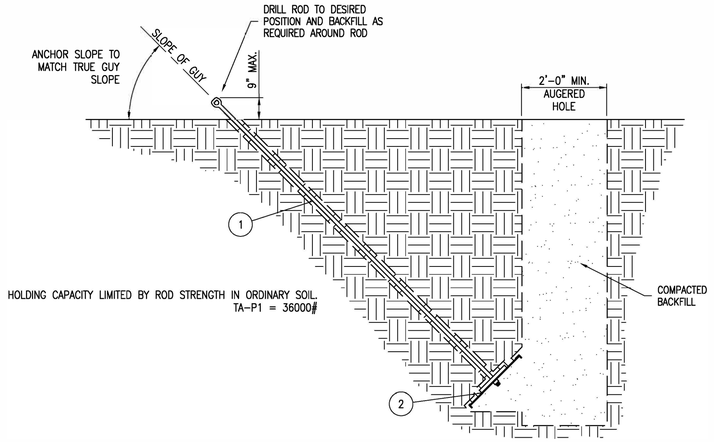
TG–OHG–2A

SHEET TITLE
TRANSMISSION ASSEMBLY
DOUBLE OVERHEAD GUY ASSEMBLY

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TG-OHG-2(A)

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	TA–P1 QTY
1	18–1102	ROD, ANCHOR, TWIN EYE 1" X 10', 36K	A100	MACLEAN	J7540	1
2	18–1024	ANCHOR, CROSS–PLATE TYPE, 400 IN BEARING AREA, 1" ROD	A200	MACLEAN	J3524	1



SHEET TITLE
TRANSMISSION ASSEMBLY
PLATE ANCHOR
AUGERED

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TA-P1

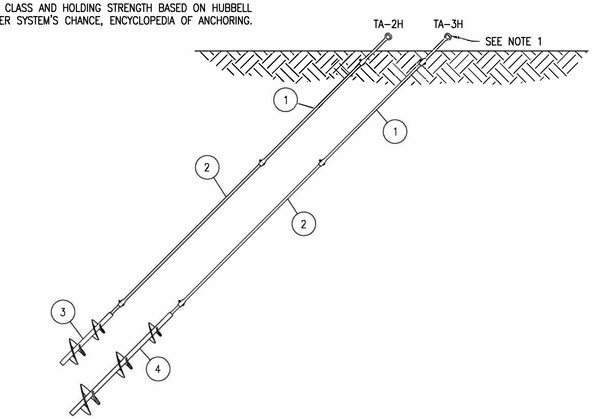
NOTES:

1. TRIPLE EYE GUY ADAPTER INCLUDED WITH ANCHOR ASSEMBLY.
2. CONTINUE TO DRIVE THE ANCHOR AND ADD EXTENSIONS UNTIL THE DESIRED TORQUE IS REACHED AND MAINTAINED FOR A MINIMUM OF THREE FEET OR THREE TIMES THE DIAMETER OF THE LARGEST HELIX.
3. A MINIMUM INSTALLATION OF THREE TIMES THE DIAMETER OF THE LARGEST HELIX (BELOW THE FREEZE/ THAW LINE) IS REQUIRED. THIS DEPTH SHOULD EQUAL OR EXCEED FIVE TIMES THE DIAMETER OF THE LARGEST HELIX FROM THE TOP SURFACE OF THE SOIL VERTICALLY.
4. MINIMUM INSTALL TORQUE IS 3,500 FT–LBS.
5. MAXIMUM INSTALLATION TORQUE IS 5,500 FT–LBS OR 1.5 TWISTS.
6. TYPICAL WORKING TORQUE IS 5,500 FT. LBS. FOR 1 1/2" SQUARE SHAFT ANCHORS.
7. SOIL CLASS AND HOLDING STRENGTH BASED ON HUBBELL POWER SYSTEM'S CHANCE, ENCYCLOPEDIA OF ANCHORING.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	TA–2H QTY	TA–3H QTY	TA–5EXT QTY
1	N.S.	ANCHOR, EXTENSION, 1 1/2" SQ. SHAFT 5'–0"	A110	CHANCE	12656	–	–	AS REQ'D
2	N.S.	ANCHOR, EXTENSION, 1 1/2" SQ. SHAFT 7'–0"	A111	CHANCE	12657	1	1	–
3	N.S.	ANCHOR, 1 1/2" SQ. SHAFT, 8" AND 10" HELIX W/ TRIPLEYE ADAPTER	A202	CHANCE	12654–3AE	1	–	–
4	N.S.	ANCHOR, 1 1/2" SQ. SHAFT, 8", 10" AND 12" HELIX W/ TRIPLEYE ADAPTER	A210	CHANCE	12654–3AEJ	–	1	–

HELIX COMBINATION	SOIL ANCHOR HOLDING STRENGTH (LBS.) VS. SOIL CLASS					
	CLASS 7	CLASS 6	CLASS 5	CLASS 4	CLASS 3	CLASS 2
8"–10"	19,000	23,000	27,000	32,000	36,000	41,000
8"–10"–12"	26,000	32,000	39,000	46,000	51,000	58,000



SHEET TITLE
TRANSMISSION ASSEMBLY
POWER INSTALLED SCREW ANCHORS

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TA-2H, 3H, 5EXT

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

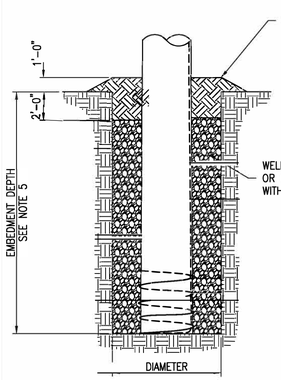
ASSEMBLY DETAILS
GUY AND ANCHOR ASSEMBLIES

0 1" 2"

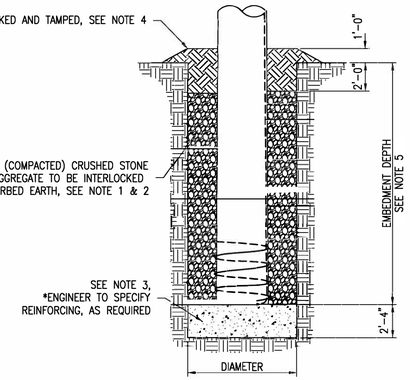
FILENAME BHE–AD–11–D–1.DWG
SCALE N.T.S.
SHEET **AD-11-1**

POLE STABILITY FOUNDATION					
IMPORTED GRANULAR BACKFILL					
POLE HT.–CL.	EMBEDMENT DEPTH (FT)	DIAMETER (FT)	POLE WIDTH (IN)	POLE WEIGHT (LB)	APPROX. QTY. CUBIC YDS. (10% + 4 FT)
60–1	10	4.0*	18.0	–	3.2
70–1	11	4.0*	18.9	–	3.6
80–H1	12	4.0*	20.9	–	3.8
90–H2	13	4.0*	23.2	–	4.0
100–H2	14	4.0*	24.0	–	4.2

(*) HOLE DIAMTER AS NEEDED TO TAMP ALL THE WAY AROUND THE POLE.



TM–101
IMPORTED BACKFILL
SCALE: N.T.S.



TM–103
IMPORTED BACKFILL AND BEARING REINFORCEMENT
SCALE: N.T.S.

GRADATION FOR IMPORTED GRANULAR BACKFILL	
SIZE OF GRAVEL OR CRUSHED STONE	SIZE OF MESH (IN)
100% BY WEIGHT TO PASS 1" SCREEN	1.00
60%–90% BY WEIGHT TO PASS 1/2" SCREEN	0.500
40%–60% BY WEIGHT TO PASS NO. 4 SCREEN	0.187
25%–50% BY WEIGHT TO PASS NO. 8 SCREEN	0.0937
20%–40% BY WEIGHT TO PASS NO. 16 SCREEN	0.0469
15%–30% BY WEIGHT TO PASS NO. 40 SCREEN	0.0165

IMPORTANT

EACH POLE SHALL BE BACKFILLED FROM BOTTOM TO TOP BY ONE LABORER SHOVELING FILL AND TWO OTHERS USING PNEUMATIC TAMPERS.

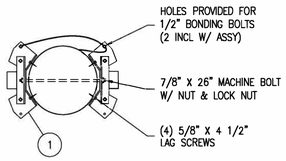
NOTES:

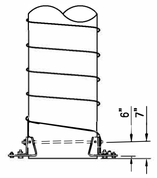
1. GRADATION FOR IMPORTED BACKFILL IS SHOWN IN THE TABLE. THE AGGREGATE SHALL BE WELL MIXED IN A STOCK PILE, AND PNEUMATICALLY PLACED AND TAMPED IN 6–INCH LIFTS.
2. THE SPECIFICATION FOR AGGREGATE GIVEN IN THE TABLE IS MINIMUM. IN AREAS WHERE SMALLER FINES ARE AVAILABLE AT COMPARABLE COST, IT IS RECOMMENDED THAT THE ENGINEER SPECIFY SMALLER FINES.
3. CONCRETE SHALL BE 2000 PSI HIGH EARLY STRENGTH CONCRETE. IT SHALL BE DEPOSITED IN A MANNER WHICH WILL PREVENT SEGREGATION OF THE AGGREGATE AND CEMENT. CARE SHOULD BE TAKEN TO AVOID GETTING DIRT MIXED WITH THE CONCRETE. THE POLE SHALL NOT BE SET UNTIL THE CONCRETE BEARING BASE HAS ATTAINED SUFFICIENT STRENGTH TO SUPPORT THE POLE. DURING THE PLACEMENT OF POLE, AVOID BUMPING CONCRETE BASE.
4. WELL TAMPED NATIVE BACKFILL SHOULD BE PLACED AROUND THE POLE AS SHOWN
5. SEE STRUCTURE DRAWINGS FOR EMBEDMENT DEPTHS.

SHEET TITLE
TRANSMISSION ASSEMBLY
POLE STABILITY FOUNDATION

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TM-101 & TM-103

LIST OF MATERIALS						
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	18–1895	ANCHOR ASSEMBLY WITH BOLTS; PAIR	F300	HUGHES	A–1895–2	1





SHEET TITLE
TRANSMISSION ASSEMBLY
POLE ANCHOR ASSEMBLY

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TP-A

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

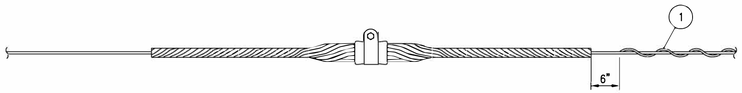
ASSEMBLY DETAILS
POLE STABILITY ASSEMBLIES

0 1" 2"

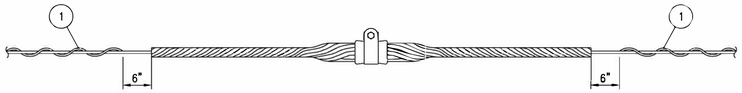
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SCALE N.T.S.

SHEET
AD-12-1

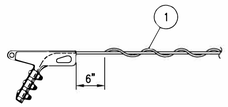
LIST OF MATERIALS								
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T1 QTY	2T1 QTY	D1 QTY
1	N.S.	SPIRAL VIBRATION DAMPER, 0.327" – 0.461" RANGE	S110	PREFORMED	5050104	1	2	1



DPR–EHS–T1



DPR–EHS–2T1



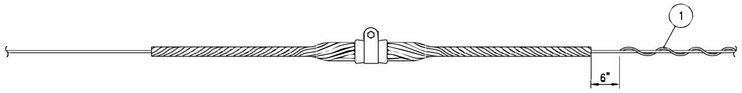
DPR–EHS–D1

SHEET TITLE
TRANSMISSION ASSEMBLY
DAMPER - 3/8" EHS

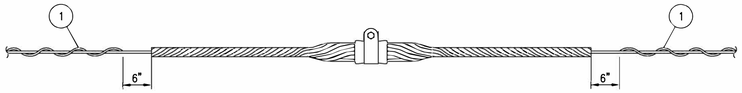
REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
DPR-EHS

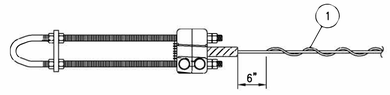
LIST OF MATERIALS								
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T1 QTY	2T1 QTY	D1 QTY
1	N.S.	SPIRAL VIBRATION DAMPER, 0.327" – 0.461" RANGE	S110	PREFORMED	5050104	1	2	1



DPR–OPGW–T1



DPR–OPGW–2T1



DPR–OPGW–D1

SHEET TITLE
TRANSMISSION ASSEMBLY
DAMPER - OPGW

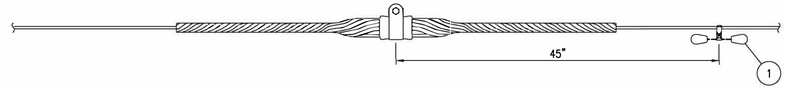
REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
DPR-OPGW

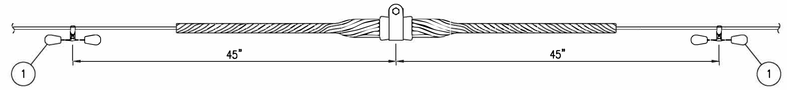
LIST OF MATERIALS								
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T1 QTY	2T1 QTY	D1 QTY	D2 QTY
1	N.S.	DAMPER, DOGBONE, 795 ACSR	S150	HUBBELL	60710–12	1	2	1	2

NOTES:

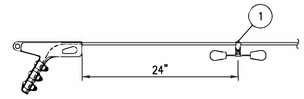
1. FIRST DAMPER AT SUSPENSION SPAN ENDS SHALL BE LOCATED FROM CENTER OF DAMPER CLAMP TO THE SUSPENSION SUPPORT PER REFERENCED DIMENSION.
2. THE ORIENTATION OF THE WEIGHTS ALONG THE CONDUCTOR IS OPTIONAL. (I.E. WHETHER THE LARGE WEIGHT IS TOWARD THE TOWER OR TOWARD THE SPAN. ORIENT THE DAMPER FOR EASY ACCESS TO THE BOLT AND TO OBTAIN VISUAL ASSURANCE OF POSITIVE CONDUCTOR SEATING.
3. FOLLOW MANUFACTURER'S INSTALLATION INSTRUCTIONS IN DELIVERY BOX.
4. SEE SAG TABLES FOR INSTALLATION DIRECTION ON THE LINE.



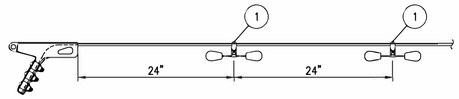
DPR–795–T1



DPR–795–2T1



DPR–795–D1



DPR–795–D2

SHEET TITLE
TRANSMISSION ASSEMBLY
DAMPER - 795 ACSR

REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
DPR-795

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
DAMPER ASSEMBLIES

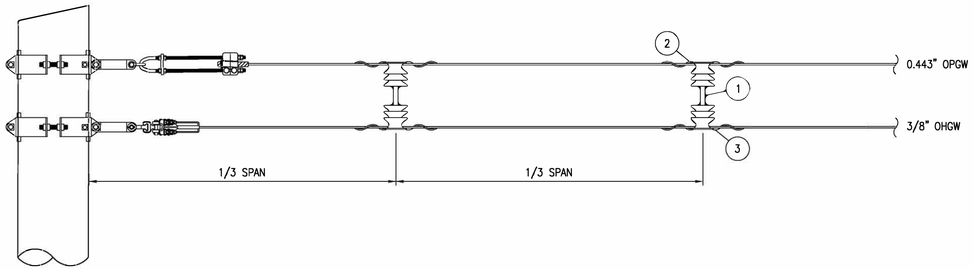
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FILENAME BHE–AD–13–D–1.DWG
SCALE N.T.S.

SHEET
AD-13-1

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	PHASE SPACER, 1'-6" LONG, 15KV	I400	HUGHES	CFB00-18C	2
2	N.S.	WRAPLOCK TIE, C-NECK, 0.443" CONDUCTOR	M600	PREFORMED	WTC-0114	2
3	N.S.	WRAPLOCK TIE, C-NECK, 0.36" CONDUCTOR	M601	PREFORMED	WTC-0109	2



SHEET TITLE
TRANSMISSION ASSEMBLY
SHIELD PHASE SPACER

REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
TM-SPS-1

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

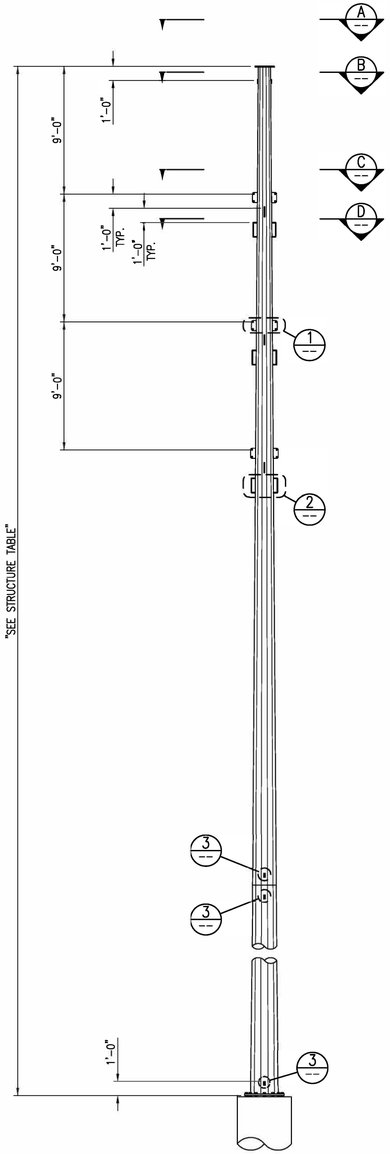
LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

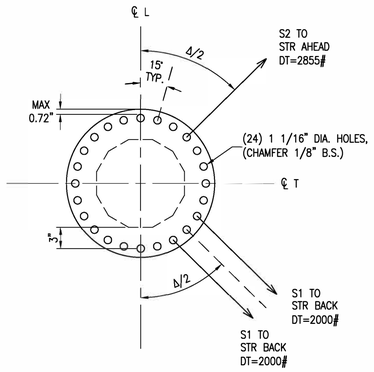
ASSEMBLY DETAILS
SPACER ASSEMBLIES

0 1" 2"

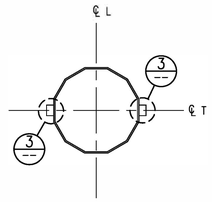
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SCALE N.T.S.

SHEET
AD-14-1

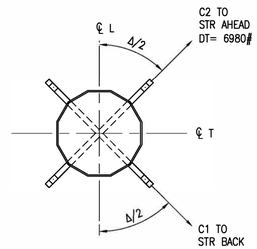




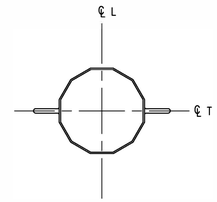
VIEW A
SHIELD ORIENTATION
SCALE: N.T.S.



SECTION B
SHIELD NEMA PAD ORIENTATION
SCALE: N.T.S.



SECTION C
CONDUCTOR ORIENTATION
SCALE: N.T.S.



SECTION D
GROUND LOOP ORIENTATION
SCALE: N.T.S.

DETAIL 1
CONDUCTOR VANGS
SCALE: N.T.S.

DETAIL 2
GROUNDING LOOP
SCALE: N.T.S.

NOTE:
PLUG WITH 1/2"ø X 3/4" MACHINE BOLT BEFORE PAINTING OR SANDBLASTING, BOLT TO REMAIN IN PLACE FOR SHIPMENT.

DETAIL 3
GROUNDING PAD
SCALE: N.T.S.

GENERAL NOTES

MAXIMUM SHIELD WIRE VANG THICKNESS = 3/4"
MAXIMUM CONDUCTOR VANG THICKNESS = 1"
LOAD TREE VALUES ARE ULTIMATE, INCLUDE OVERLOAD FACTORS, AND ARE SHOWN IN POUNDS.

DESIGN CRITERIA

(S1) SHIELD WIRE IS AFL CC-55/443 "DNO-4748" OPGW, MAXIMUM TENSION AT NESC HEAVY LOADING: 2000# R.S.= 300'
(S2) SHIELD WIRE IS AFL CC-55/443 "DNO-4748" OPGW, MAXIMUM TENSION AT NESC HEAVY LOADING: 2855# R.S.= 300'
(C1) CONDUCTOR IS 795 KCMIL 45/7 ACSR "TERN" MAXIMUM TENSION AT NESC HEAVY LOADING: 3000# R.S.= 300'
(C2) CONDUCTOR IS 795 KCMIL 45/7 ACSR "TERN" MAXIMUM TENSION AT NESC HEAVY LOADING: 6980# R.S.= 300'

WIND SPAN: 400'
WEIGHT SPAN: 600' AT NESC HEAVY LOADING
HEIGHT OF STR.: SEE STRUCTURE TABLE
ACTUAL ANGLE (Δ): SEE STRUCTURE TABLE
DESIGN MAXIMUM ANGLE: 92°00'00"

SPECIFICATIONS

1. POLES TO BE DESIGNED PER SECTION 33 71 16.23 TUBULAR STEEL POLES SPECIFICATIONS.
2. ALL STEEL TO BE WEATHERING STEEL.
3. POLES TO HAVE EITHER SLIP JOINTS OR BOLTED FLANGE TYPE SPLICES, WHICHEVER IS MORE COST EFFECTIVE.
   A. IF SLIP JOINTS ARE USED, INSTALL GROUND PADS (DETAIL 4) ABOVE AND BELOW THE SLIP JOINT.
4. STRUCTURES SHALL BE DESIGNED ASSUMING DRILLED PIER TYPE FOUNDATION.
5. THE CIRCLED LOADINGS SHOWN IN LOAD TREES CONVEY THE ADDITIONAL VERTICAL LOAD THAT WILL BE APPLIED TO THE STRUCTURE BY LINE PERSONNEL DURING CONSTRUCTION AND MAINTENANCE OPERATIONS.
   A. IT IS REQUIRED THAT ALL CONDUCTOR ATTACHMENT SUPPORTS BE DESIGNED TO MEET THIS REQUIREMENT. HOWEVER, AS THE LOADING WILL BE APPLIED TO ONLY ONE PHASE AT ANY GIVEN TIME, THE SHAFT MAY BE DESIGNED FOR ITS APPLICATION AT A SINGLE CONTROLLING PHASE LOCATION TO BE DETERMINED BY THE STEEL MANUFACTURER.

DEFLECTION

SEE TUBULAR STEEL POLE SPECIFICATION FOR DEFLECTION OF THE SHAFT UNDER LOAD CASE V.

STRUCTURE TABLE		
STR #	HEIGHT	LINE ANGLE (Δ)
1D	75'-0"	88°00'00"
2D	75'-0"	84°00'00"
42A	95'-0"	85°00'00"

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

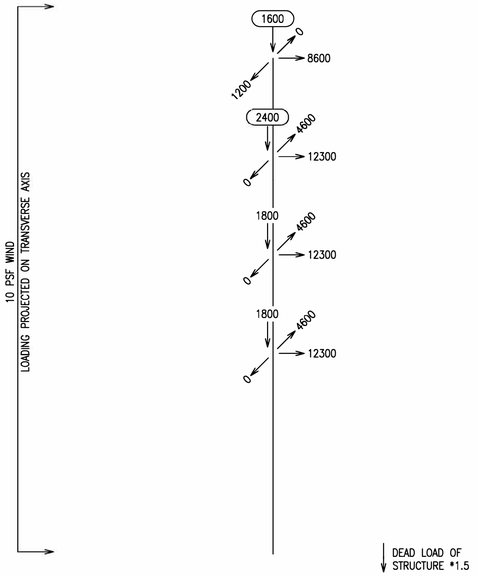
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - BEN FRENCH 1
LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

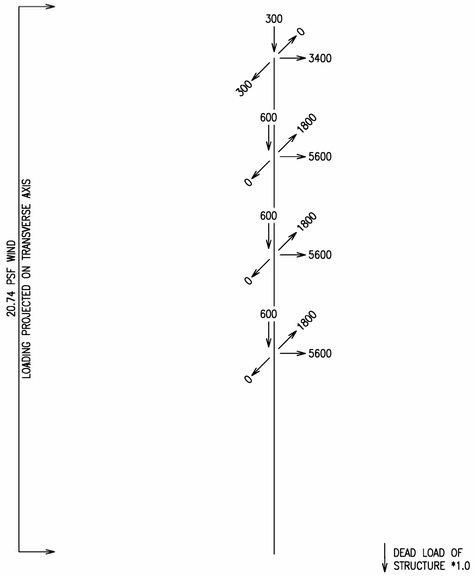
LOAD & DESIGN DETAIL
SCDE-ST-M1
STR 1D, STR 2D, & STR 42A

0 1" 2"

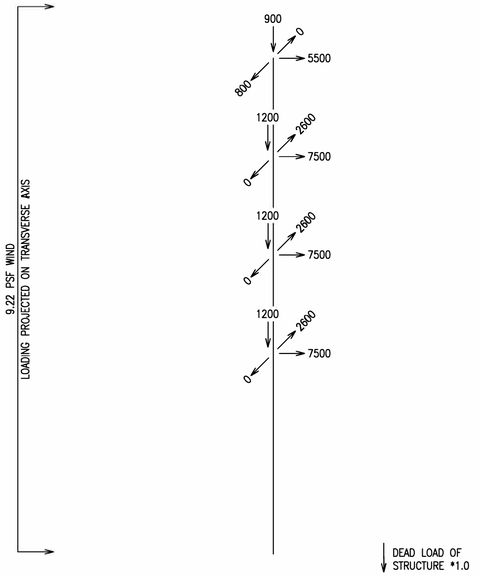
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SCALE 3/16"=1'-0"
SHEET LD-12-1



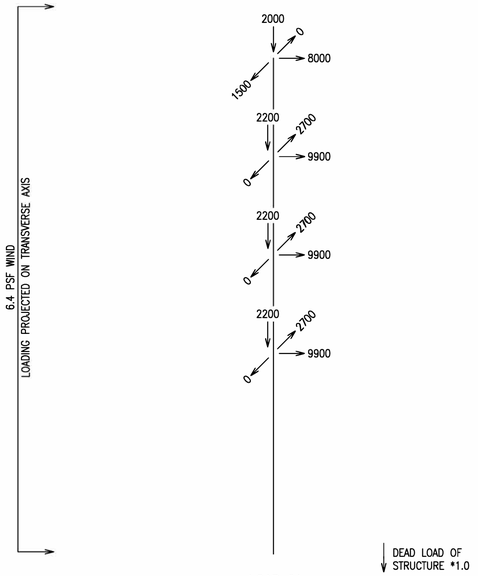
LOAD I
NESC HEAVY LOADING – RULE 250B
ALL WIRES INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 4 PSF WIND @ 0°F



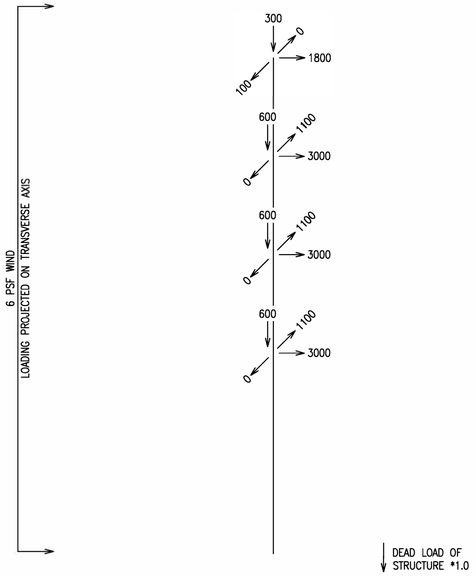
LOAD II
NESC EXTREME HIGH WIND – RULE 250C
ALL WIRES INTACT
NO ICE, 20.74 PSF WIND @ 60°F



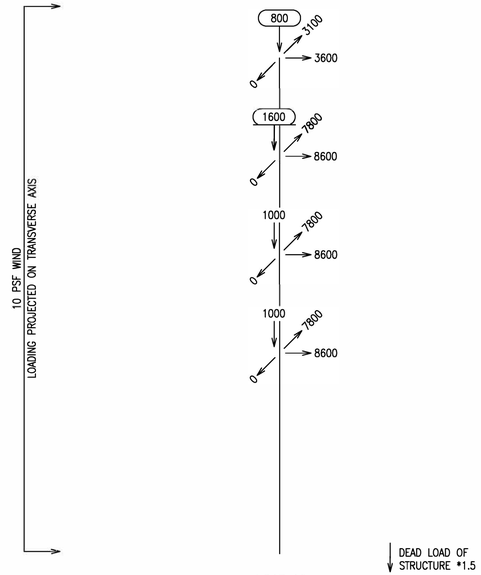
LOAD III
NESC CONCURRENT ICE/WIND – RULE 250D
ALL WIRES INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 9.22 PSF WIND @ 15°F



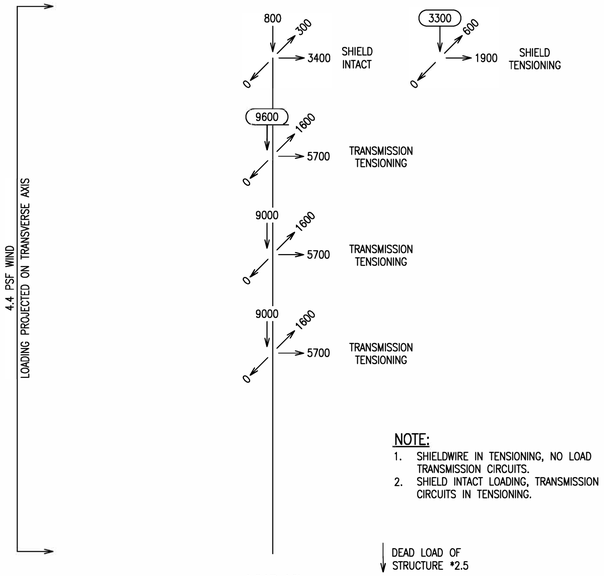
LOAD IV
BHE CONCURRENT ICE/WIND
ALL WIRES INTACT
1.0" RADIAL ICE @ 57 LBS/FT³, 6.4 PSF WIND @ 0°F



LOAD V
DEFLECTION LIMIT
ALL WIRES INTACT
NO ICE, 6 PSF WIND @ 60°F

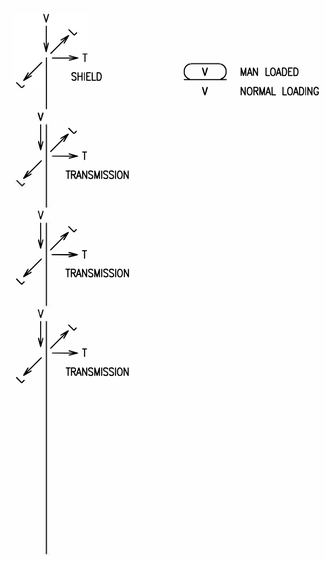


LOAD VI
TERMINAL
AHEAD SPAN INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 4 PSF WIND @ 0°F



NOTE:
1. SHIELDWIRE IN TENSIONING, NO LOAD TRANSMISSION CIRCUITS.
2. SHIELD INTACT LOADING, TRANSMISSION CIRCUITS IN TENSIONING.

LOAD VII
CONSTRUCTION LOADING
SEE NOTE
NO ICE, 4 PSF WIND @ 20°F



TYPICAL

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2	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
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DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

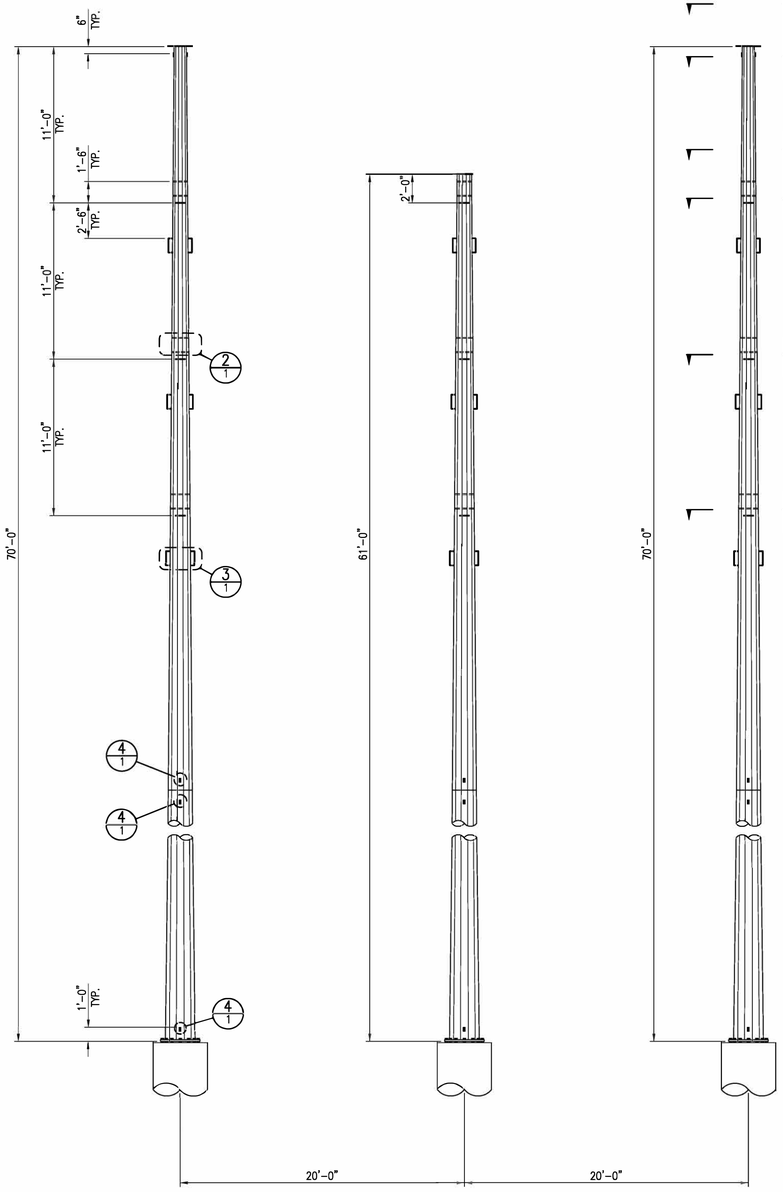
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

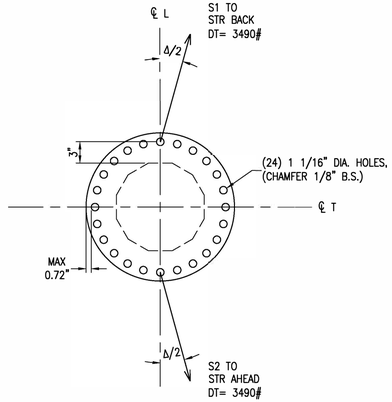
WEST RAPID CITY - BEN FRENCH 1
LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

LOAD & DESIGN DETAIL
SCDE-ST-M1
STR 1D, STR 2D, & STR 42A

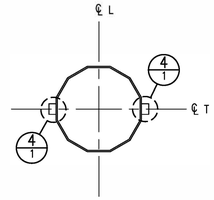
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SHEET LD-12-2

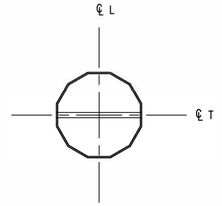




VIEW A 1
SHIELD ORIENTATION
SCALE: N.T.S.



SECTION B 1
SHIELD NEMA PAD ORIENTATION
SCALE: N.T.S.



SECTION C 1
JUMPER POST ORIENTATION
SCALE: N.T.S.

GENERAL NOTES

MAXIMUM SHIELD WIRE VANG THICKNESS = 3/4"
MAXIMUM CONDUCTOR VANG THICKNESS = 1"
LOAD TREE VALUES ARE ULTIMATE, INCLUDE OVERLOAD FACTORS, AND ARE SHOWN IN POUNDS.

DESIGN CRITERIA

(S1) SHIELD WIRE IS AFL CC-55/443 "DNO-4748" OPGW, MAXIMUM TENSION AT NESC HEAVY LOADING: 3490# R.S.= 450'
(S2) SHIELD WIRE IS AFL CC-55/443 "DNO-4748" OPGW, MAXIMUM TENSION AT NESC HEAVY LOADING: 3490# R.S.= 450'
(C1) CONDUCTOR IS 795 KCMIL 45/7 ACSR "TERN" MAXIMUM TENSION AT NESC HEAVY LOADING: 7840# R.S.= 450'
(C2) CONDUCTOR IS 795 KCMIL 45/7 ACSR "TERN" MAXIMUM TENSION AT NESC HEAVY LOADING: 7840# R.S.= 450'

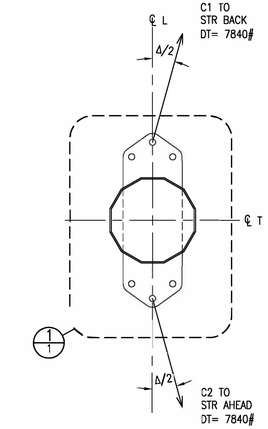
WIND SPAN: 500'
WEIGHT SPAN: 800' AT NESC HEAVY LOADING
HEIGHT OF STR: 70'-0"
DESIGN MAXIMUM ANGLE (Δ): 10°00'00"

SPECIFICATIONS

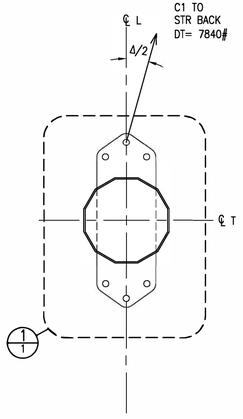
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2. ALL STEEL TO BE WEATHERING STEEL.
3. POLES TO HAVE EITHER SLIP JOINTS OR BOLTED FLANGE TYPE SPLICES, WHICHEVER IS MORE COST EFFECTIVE.
   A. IF SLIP JOINTS ARE USED, INSTALL GROUND PADS (DETAIL 4) ABOVE AND BELOW THE SLIP JOINT.
4. STRUCTURES SHALL BE DESIGNED ASSUMING DRILLED PIER TYPE FOUNDATION.
5. THE CIRCLED LOADINGS SHOWN IN LOAD TREES CONVEY THE ADDITIONAL VERTICAL LOAD THAT WILL BE APPLIED TO THE STRUCTURE BY LINE PERSONNEL DURING CONSTRUCTION AND MAINTENANCE OPERATIONS.
   A. IT IS REQUIRED THAT ALL CONDUCTOR ATTACHMENT SUPPORTS BE DESIGNED TO MEET THIS REQUIREMENT. HOWEVER, AS THE LOADING WILL BE APPLIED TO ONLY ONE PHASE AT ANY GIVEN TIME, THE SHAFT MAY BE DESIGNED FOR ITS APPLICATION AT A SINGLE CONTROLLING PHASE LOCATION TO BE DETERMINED BY THE STEEL MANUFACTURER.
6. SEE DETAIL 5 SHEET 2 FOR OPGW DOWNLEAD DETAILS.

DEFLECTION

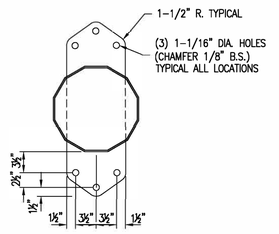
SEE TUBULAR STEEL POLE SPECIFICATION FOR DEFLECTION OF THE SHAFT UNDER LOAD CASE V.



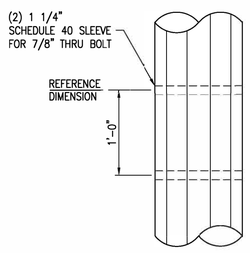
SECTION D 1
TOP AND MIDDLE CONDUCTOR ORIENTATION
SCALE: N.T.S.



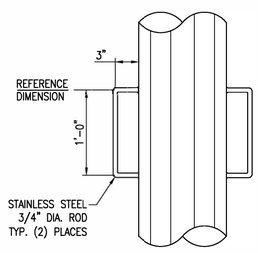
SECTION E 1
BOTTOM CONDUCTOR ORIENTATION
SCALE: N.T.S.



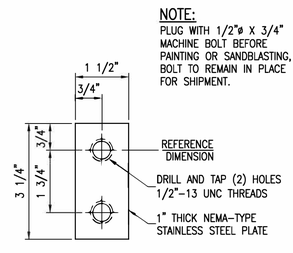
DETAIL 1 1
CONDUCTOR VANGS
SCALE: N.T.S.



DETAIL 2 1
JUMPER POST ATTACHMENT
SCALE: N.T.S.



DETAIL 3 1
GROUNDING LOOP
SCALE: N.T.S.



DETAIL 4 1
GROUNDING PAD
SCALE: N.T.S.

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
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DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

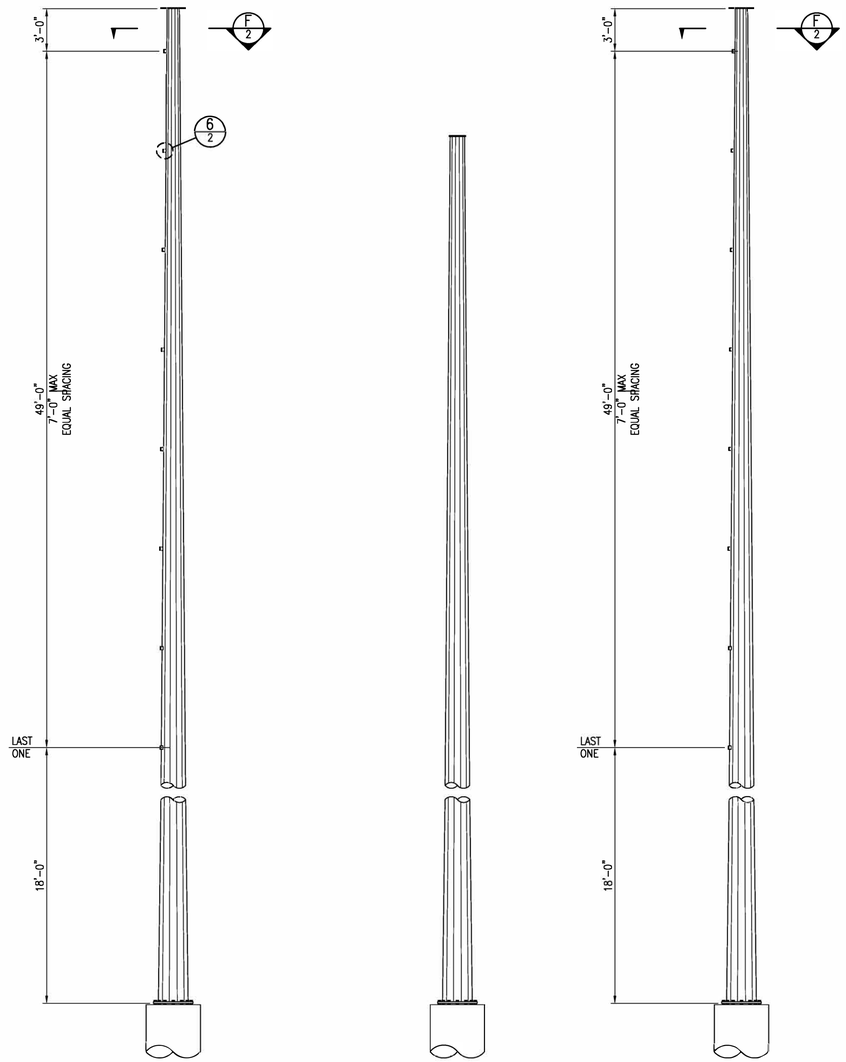
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
LANGE - BEN FRENCH
69KV TRANSMISSION LINE

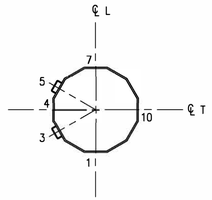
LOAD & DESIGN DETAIL
TC-3PDE-ST
STR 41

0 1" 2"

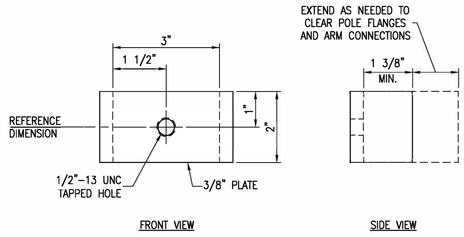
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SCALE 3/16"=1'-0"
SHEET LD-13-1



DETAIL 5/2
OPGW DOWNLEADS
SCALE: N.T.S.



SECTION F/2
OPGW DOWNLEAD
ORIENTATION
SCALE: N.T.S.



SECTION 6/2
OPGW DOWNLEAD
BRACKET
SCALE: N.T.S.

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

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DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

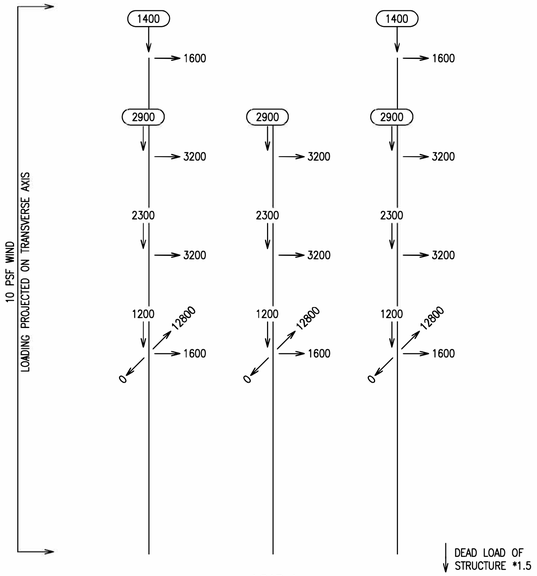
LANGE - WEST RAPID CITY
LANGE - BEN FRENCH
69KV TRANSMISSION LINE

LOAD & DESIGN DETAIL
TC-3PDE-ST
STR 41

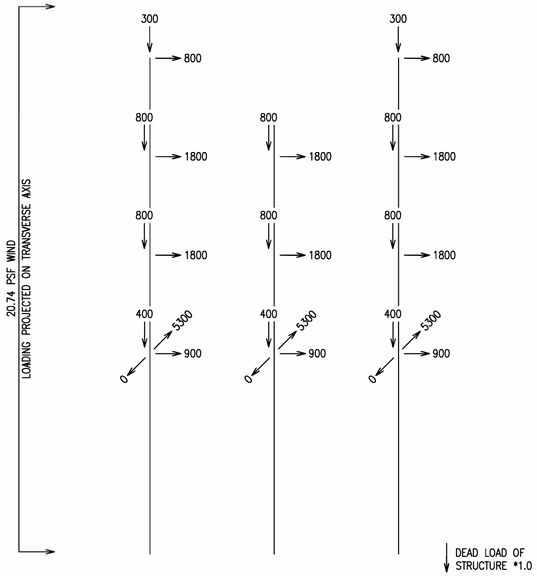
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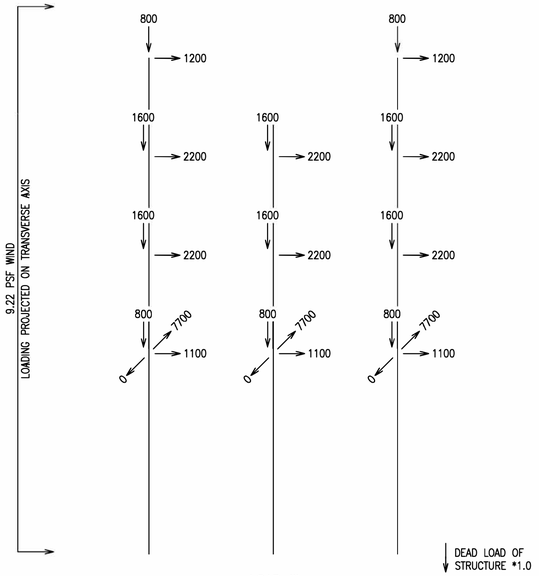
SHEET
LD-13-2



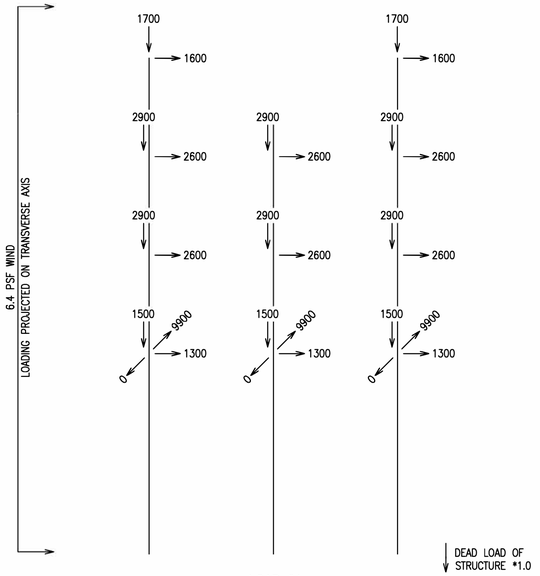
LOAD I
NESC HEAVY LOADING – RULE 250B
ALL WIRES INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 4 PSF WIND @ 0°F



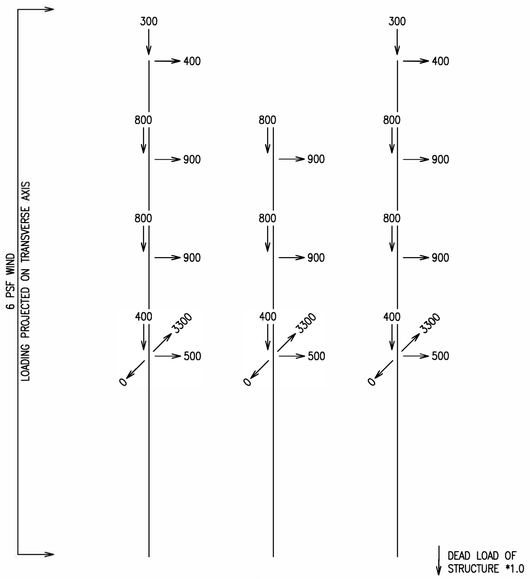
LOAD II
NESC EXTREME HIGH WIND – RULE 250C
ALL WIRES INTACT
NO ICE, 20.74 PSF WIND @ 60°F



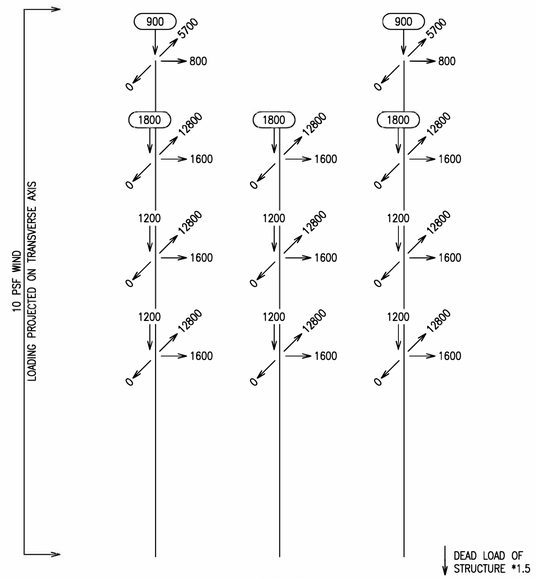
LOAD III
NESC CONCURRENT ICE/WIND – RULE 250D
ALL WIRES INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 9.22 PSF WIND @ 15°F



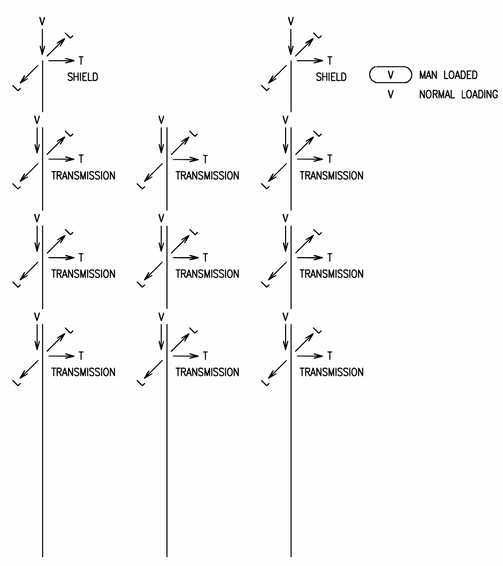
LOAD IV
BHE CONCURRENT ICE/WIND
ALL WIRES INTACT
1.0" RADIAL ICE @ 57 LBS/FT³, 6.4 PSF WIND @ 0°F



LOAD V
DEFLECTION LIMIT
ALL WIRES INTACT
NO ICE, 6 PSF WIND @ 60°F



LOAD VI
TERMINAL
BACK SPAN INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 4 PSF WIND @ 0°F



TYPICAL

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PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

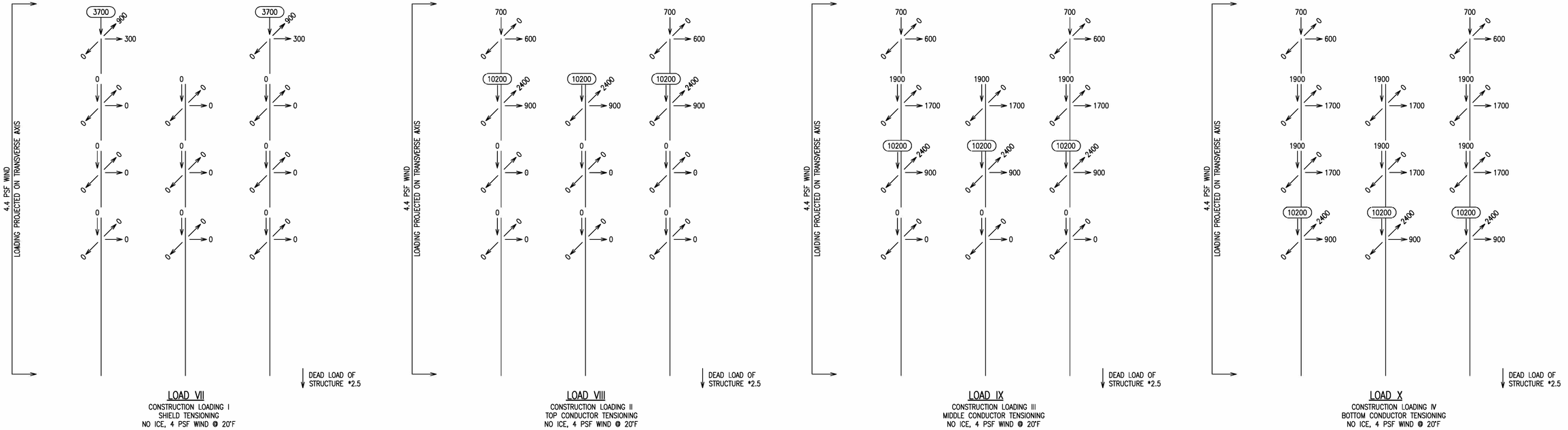
LANGE - WEST RAPID CITY
LANGE - BEN FRENCH
69KV TRANSMISSION LINE

LOAD & DESIGN DETAIL
TC-3PDE-ST
STR 41

0 1" 2"

FILENAME BHE-LD-13-D-3.DWG
SCALE 3/16"=1'-0"

SHEET
LD-13-3



ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
LANGE - BEN FRENCH
69KV TRANSMISSION LINE

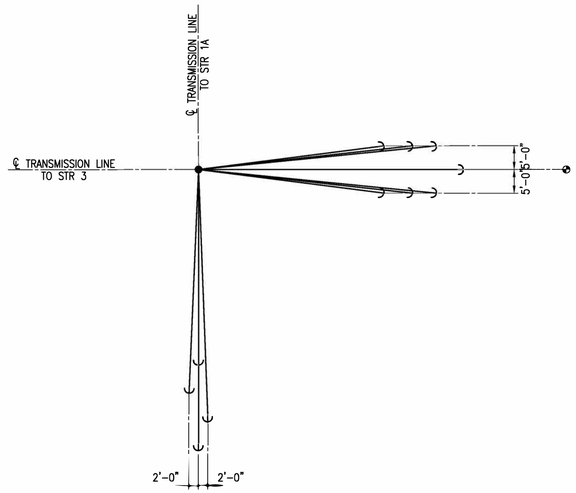
LOAD & DESIGN DETAIL
TC-3PDE-ST
STR 41

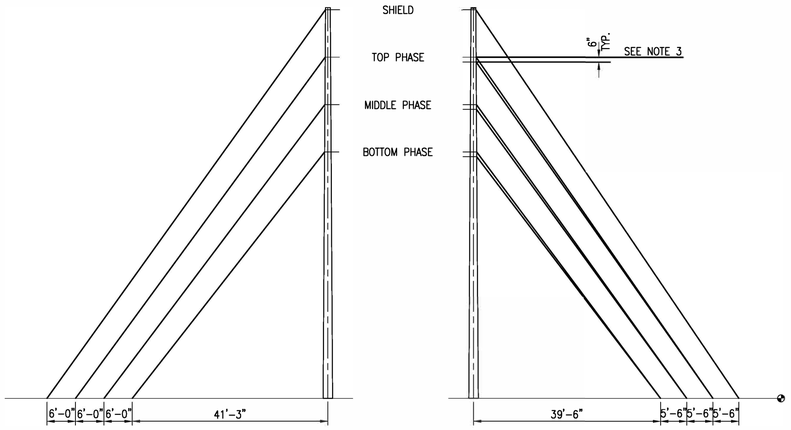
0 1" 2"

FILENAME BHE-LD-13-D-4.DWG
SCALE 3/16"=1'-0"

SHEET
LD-13-4

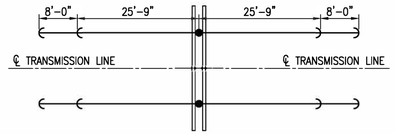
NOTES:
1. ALL GUYS ARE TGS–1A.
2. ALL ANCHORS ARE TA–3H.
3. ADDITIONAL TG–26B POLE BANDS INSTALLED 6" BELOW AHEAD ON LINE POLE BANDS.

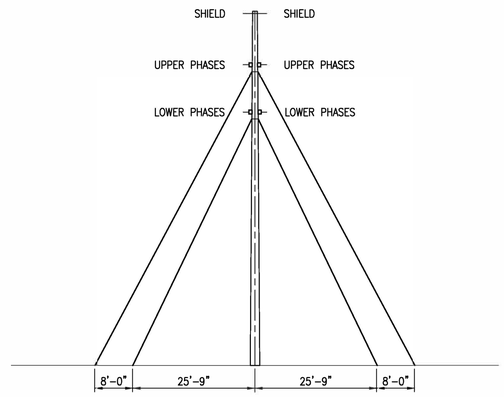




SHEET TITLE	GUYING ARRANGEMENT STRUCTURE 2A
REFERENCE SHEET	1 OF 1
EXHIBIT NUMBER	GD-STR2A

NOTES:
1. ALL GUYS ARE TGS–1A.
2. ALL ANCHORS ARE TA–3H.





SHEET TITLE	GUYING ARRANGEMENT STRUCTURE 3
REFERENCE SHEET	1 OF 1
EXHIBIT NUMBER	GD-STR3

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

Black Hills Energy
Improving life with energy

HDR

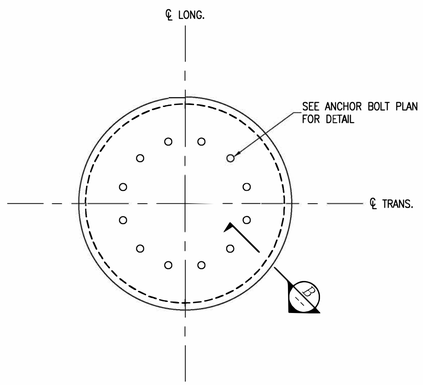
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

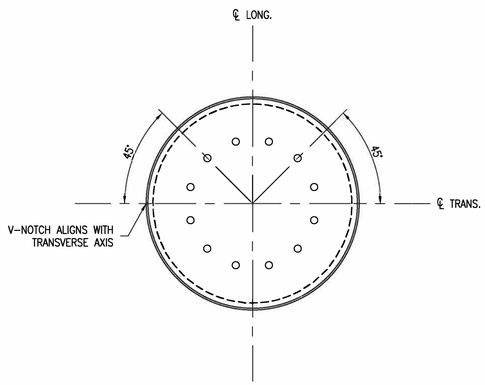
GUYING DETAIL

0 1" 2"

FILENAME	BHE–TMG–01–D–1.DWG
SCALE	NONE
SHEET	TMG-01



PIER PLAN VIEW
ROUND CAP



ANCHOR BOLT PLAN (TYP.)
SEE STEEL MANUFACTURER DRAWINGS FOR ANCHOR BOLT DETAIL

FOUNDATION DATA

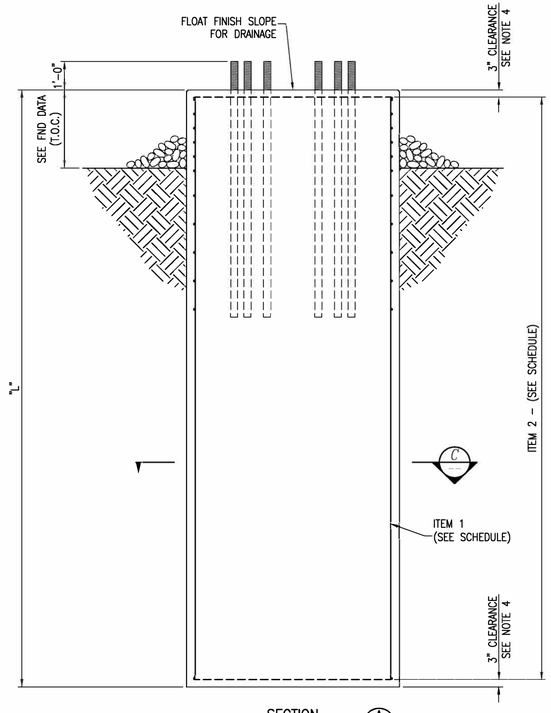
FOUNDATION	STRUCTURE INFORMATION				PIER DESIGN LOADS			ANCHOR BOLTS	PIER DATA								
FND-04	NUMBER	DRAWING	DESCRIPTION	LINE ANGLE (Δ)	MOMENT (FT-K)	AXIAL (K)	SHEAR (K)	DRAWING NUMBER	T.O.C. ELEVATION ABOVE GROUND	L	B	NEAT LINE (*) CONCRETE (CY)	ITEM	SIZE	QTY	LENGTH PER PIECE	ITEM 2 SPACING	SHAPE
FND-04-1	41 LT	TC-3PDE-ST	70'-0" OVERALL HEIGHT THREE POLE DEADEND	5°27'53" LT	2300.3	17.6	44.8	E38x	1'-0"	26.00	6.5	32.0	1	11	16	25'-6"	–	STRAIGHT
													2	6	30	21'-4"	12"	72" RING O.D.
FND-04-1	41 C	TC-3PDE-ST	60'-0" OVERALL HEIGHT THREE POLE DEADEND	5°27'53" LT	2300.3	17.6	44.8	E38x	3'-9"	28.75	6.5	35.3	1	11	16	28'-3"	–	STRAIGHT
													2	6	33	21'-4"	12"	72" RING O.D.
FND-04-1	41 RT	TC-3PDE-ST	70'-0" OVERALL HEIGHT THREE POLE DEADEND	5°27'53" LT	2300.3	17.6	44.8	E38x	6'-6"	31.50	6.5	38.7	1	11	16	31'-0"	–	STRAIGHT
													2	6	36	21'-4"	12"	72" RING O.D.
FND-04-2	42A	SCDE-ST-M1	95'-0" OVERALL HEIGHT SINGLE POLE DEADEND	84°35'51" RT	3994.7	34.8	50.5	E36	1'-0"	25.00	7.5	40.9	1	11	21	24'-6"	–	STRAIGHT
													2	6	29	24'-6"	12"	84" RING O.D.

NOTES:

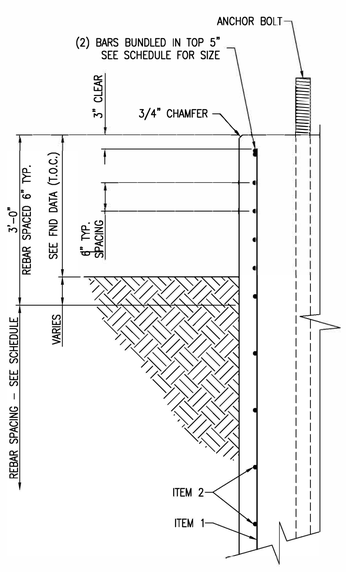
1. *ANCHOR BOLTS PROVIDED BY MANUFACTURER.
2. (*) NEAT LINE BASED ON MINIMUM DIMENSIONS.
3. O.D. = OUTSIDE DIAMETER OF ITEM 2 REBAR.
4. CLEAR DIMENSION SHALL BE MEASURED FROM THE OUTSIDE FACE OF PRINCIPAL REINFORCING.

GENERAL NOTES:

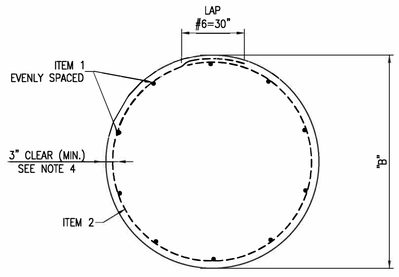
- REINFORCING STEEL SHALL CONFORM TO ASTM A-615 GRADE 60. ALL CLEAR DIMENSIONS MEASURED FROM OUTSIDE EDGE OF REINFORCING STEEL.
- CONCRETE: READY MIX CONCRETE SHALL CONFORM TO ASTM C-94.
  - A. CONCRETE STRENGTH: (MINIMUM 28 DAY COMPRESSIVE STRENGTH)
    CONCRETE PLACED IN DRY CONDITION – 4500 P.S.I.
    CONCRETE PLACED BELOW WATER TABLE USING TREMIE PIPE METHOD – 5000 P.S.I.
  - B. ENTRAINED AIR: PROVIDE AIR ENTRAINMENT IN CONCRETE RESULTING IN A TOTAL AIR CONTENT BY VOLUME OF 6% ± 1% PER ASTM C-260.
  - C. AGGREGATE: SHALL CONFORM TO ASTM C-33. MAXIMUM AGGREGATE SIZE THROUGHOUT SHALL BE 1 1/2".
  - D. SLUMP: SHALL BE 6-7 INCHES FOR CONCRETE.
  - E. WATER/ CEMENT RATIO: 0.45 MAX.
  - F. VIBRATION OF CONCRETE: SHALL BE LIMITED TO THE TOP TEN FEET OF THE FOUNDATION FOR CONCRETE PLACED BY THE TREMIE METHOD.
- SOIL OR ROCK CONDITIONS: WHERE SOIL DEPTHS, DEPTHS TO BEDROCK, OR THE CONDITIONS OF SOIL OR BEDROCK DIFFER FROM THAT SHOWN ON THE BORINGS, THE FOUNDATIONS ENGINEER SHALL BE CONTACTED.
- SEE SPECIFICATIONS AND DOCUMENTATION FOR EXCAVATION AND CONCRETE REQUIREMENTS.
- ALL PIERS SHALL BE FORMED FROM TOP OF FOUNDATION TO ONE FOOT BELOW GRADE BEFORE CONCRETE IS PLACED TO COMPLETE THE PIER.
- **GYPSUM PRESENT IN BORINGS. IN NO CASE SHALL PIERS TERMINATE IN A GYPSUM LAYER. IF THIS SHOULD OCCUR CONTACT ENGINEER.**



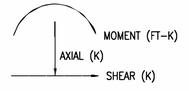
SECTION A
STEEL PARTIALLY SHOWN FOR CLARITY



SECTION B
FOUNDATION CAP
SCALE: N.T.S.



SECTION C
FOUNDATION
SCALE: N.T.S.



PIER DESIGN LOADS
SCALE: N.T.S.

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
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DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z.JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

FOUNDATION DETAILS

0 1" 2"

FILENAME BHE-FND-04-01.DWG
SCALE NONE
SHEET **FND-04-1**

STRUCTURE DATA												TRANSMISSION ASSEMBLIES							COMMENTS
STR. #	STATION (FT)	AHEAD SPAN	LINE ANGLE				STR TYPE	POLE H&C	FND	FND REVEAL	GROUND	ANCHORS	GUYS	SHIELD ASSEMBLIES	CONDUCTOR ASSEMBLIES	OPGW SPLICE	DAMPERS	MISC.	
SUB DE #A	0+00	261					DT-01-69							1)T-4DS, 1)T-4FDS	3)T-BDE6PD	SUB SPLICE BY OTHERS.		3)M400, 12)B606	OPGW WIRE TO WEST SIDE OF SUBSTATION BAY #B (SEE PLAN AND PROFILES). USE PARTS M400 & B606 FOR JUMPERS FROM CONDUCTOR DEADENDS (NOT PROVIDED BY SUBSTATION).
1A	2+61	276					SCHP-M2	1)105/H2	EMBED: 14'-6"		1)TM-9			1)T-4B, 1)T-4BF	3)T-PSD			1)TM-SPS-1	
2A	5+37	410	91°	49'	29"	RT	SCDE-69-2S	1)105/H4	EMBED: 14'-6" 1)TP-A		1)TM-9	11)TA-3H, 27)TA-5EXT	11)TGS-1A, 3)TG-26B, 11)TM-GM	2)T-4FDW, 1)T-4D	6)T-BDE6PD, 3)T-SP1				SEE SD-04-1 FOR ADDITIONAL POLE BAND LOCATIONS. SEE TMG-01 FOR GUYING DETAIL. TA-5EXT: 3 EXT PER ANCHOR WESTSIDE, 1 EXT PER ANCHOR EAST SIDE.
3	9+46	410	2°	39'	08"	LT	DC-C3309-SDE	2)75/H3	EMBED: 9'-6" 2)TP-A		2)TM-9	8)TA-3H	8)TGS-1A, 8)TM-GM	2)T-4D, 2)T-4FDW	12)T-BDE6PD, 6)T-J4PD	1)T-FSC-2	2)DPR-EHS-D1, 2)DPR-OPGW-D1, 12)DPR-795-D2		SEE TMG-01 FOR GUYING DETAIL.
4	13+57	374		15'	10"	RT	TC-H-FRAME	2)85/H1			2)TM-9			1)T-4A, 1)T-4AF	6)T-S4D				
5	17+30	403		12'	41"	LT	TC-H-FRAME	2)80/H1			2)TM-9	1)TA-P1	1)TGS-1, 1)TM-GM	1)T-4A, 1)T-4AF, 1)T-4D	6)T-S4D			1)TG-26D	
6	21+34	202	89°	27'	57"	LT	TCDE	2)70/1 1)65/1			3)TM-9	18)TA-P1	24)TGS-1, 24)TM-GM	4)T-4D, 2)T-4FDW	15)T-BDE6D				
40	134+01	323		17'	52"	LT	TC-H-FRAME	2)90/H1			2)TM-9			1)T-4A, 1)T-4AF	6)T-S4D				
41	137+24	173	7°	18'	19"	LT	TC-3PDE-ST	LD-13: 2)70'-0", 1)61'-0"	3)FND-04-1	EAST: 1'-0" MIDDLE: 3'-9" WEST: 6'-6"	3)TM-9ST, 3)TM-9SSJ			5)T-4FDS, 1)T-4DS	15)T-BDE6PD, 6)T-SP1	1)T-FSCS-3	1)DPR-EHS-D1, 3)DPR-OPGW-D1, 15)DPR-795-D2		THIRD (3) OPGW SPANS ACROSS AS OVERHEAD STRUCTURE TIE AND CONTINUES ON LANGE-BEN FRENCH 3 LINE.
42A	138+97	153	82°	45'	25"	LT	SCDE-ST-M1	1)LD-12:95'-0"	1)FND-04-2	1'-0"	1)TM-9ST, 1)TM-9SSJ			1)T-4DS, 2)T-4FDS	6)T-BDE6PD, 6)TM-EXT-15			1)TM-SPS-1	
43A	140+50	130					SCHPRC-M1	1)95/H2	EMBED: 13'-6" 1)TP-A		1)TM-9			1)T-4B, 1)T-4BF	3)T-PSD				
SUB DE	141+80						DT-01-69							1)T-4FDS, 1)T-4D	3)T-SDE6PD				OPGW TO MIDDLE STATIC MAST.

NOTES:

XXX NEW

[XXX] EXISTING

*XXX RETIRE

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

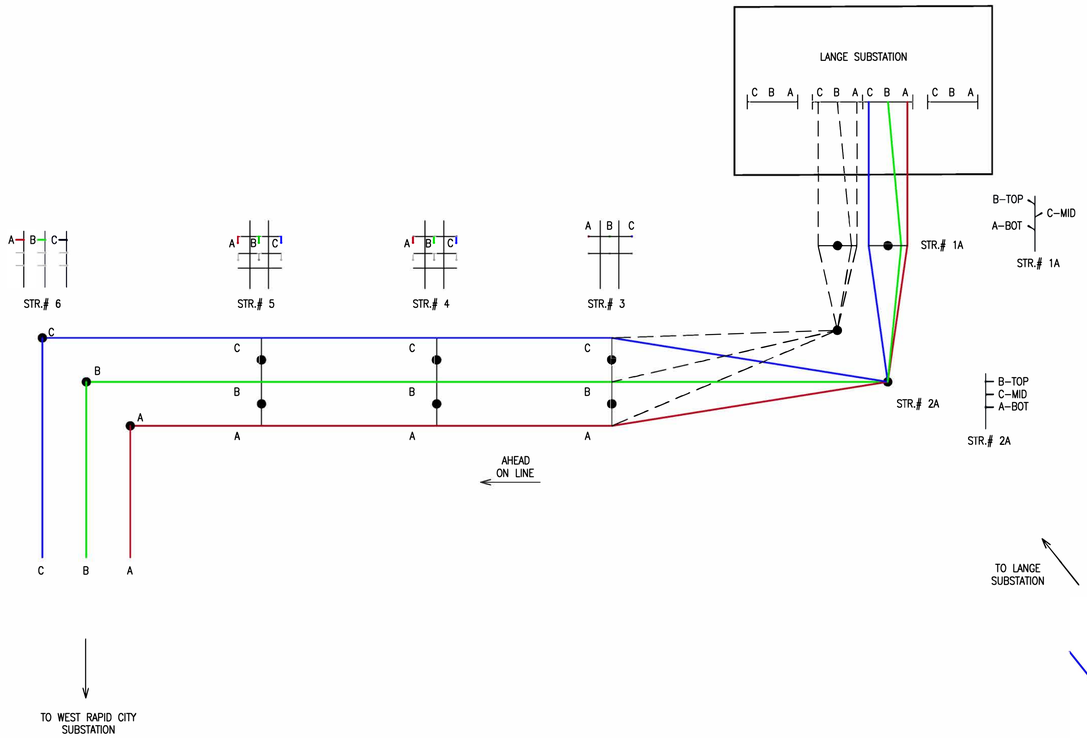
STAKING SHEETS

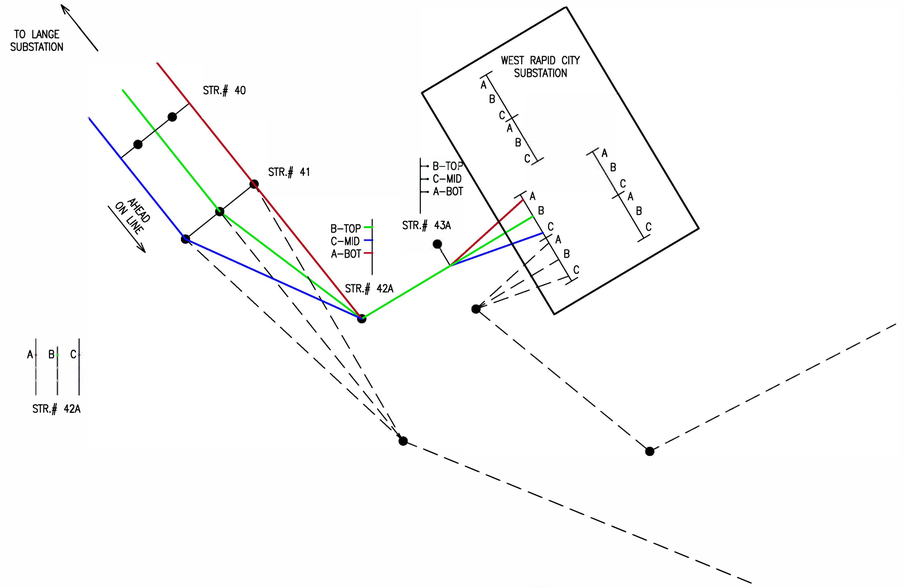
0 1" 2"

FILENAME BHE-SS-01-D-1.DWG

SCALE NONE

SHEET **SS-01**





NOTES:
1. CONTRACTOR TO VERIFY PHASING.
2. STRUCTURES SHOWN LOOKING AHEAD ON LINE.

LEGEND	
A PHASE	
B PHASE	
C PHASE	
OTHER LINES	

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
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DESIGN ENGINEER	J. PANKRATZ
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PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

PHASING DIAGRAM

0 1" 2"

FILENAME BHE–PH–01–D–1.DWG
SCALE N.T.S.

SHEET **PH-01**

INITIAL SAG TABLE			795 KCMIL 45/7 ACSR "TERN" 2500# @ NESC HEAVY LOADING														SUB DE to 2A													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
SUB DE	270	261	7.16	7.37	7.56	7.75	7.94	8.10	8.27	8.43	8.60	8.75	8.91	9.06	9.21	9.36	9.51	8.01	8.12	8.22	8.33	8.43	8.51	8.60	8.69	8.77	8.85	8.92	9.00	9.08	9.15	9.22	
1A		276	8.00	8.23	8.45	8.66	8.87	9.05	9.24	9.42	9.61	9.78	9.95	10.13	10.29	10.46	10.62	8.46	8.58	8.69	8.80	8.91	9.00	9.09	9.18	9.27	9.35	9.43	9.52	9.59	9.67	9.75	
SUB-PHASE TENS. LBS			1063	1033	1007	982	960	940	921	903	886	871	855	841	827	814	801																SUBTOTAL DAMPERS NEEDED:0

INITIAL SAG TABLE			795 KCMIL 45/7 ACSR "TERN" 5760# @ NESC HEAVY LOADING														2A to 3													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
2A	410	410	5.50	5.91	6.32	6.72	7.12	7.51	7.90	8.28	8.66	9.02	9.37	9.72	10.06	10.39	10.71	7.02	7.27	7.52	7.75	7.98	8.20	8.41	8.61	8.80	8.98	9.16	9.32	9.48	9.64	9.79	
3																																	3)DPR-795-D2 BOL, 3)DPR-795-D2 AOL
SUB-PHASE TENS. LBS			3416	3184	2977	2798	2640	2503	2379	2271	2173	2085	2007	1936	1871	1811	1757																SUBTOTAL DAMPERS NEEDED:12

INITIAL SAG TABLE			795 KCMIL 45/7 ACSR "TERN" 6515# @ NESC HEAVY LOADING														41 to 42A													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
41	173	173	0.48	0.52	0.56	0.62	0.69	0.78	0.89	1.03	1.20	1.41	1.63	1.86	2.10	2.32	2.54	2.07	2.15	2.25	2.35	2.48	2.64	2.82	3.03	3.28	3.55	3.82	4.08	4.33	4.56	4.77	3)DPR-795-D2 BOL, 3)DPR-795-D2 AOL
SUB-PHASE TENS. LBS			6839	6343	5832	5307	4769	4234	3703	3197	2733	2339	2015	1764	1568	1415	1295																SUBTOTAL DAMPERS NEEDED:12

INITIAL SAG TABLE			795 KCMIL 45/7 ACSR "TERN" 2500# @ NESC HEAVY LOADING														42A to SUB DE													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
42A	140	153	1.74	1.99	2.23	2.46	2.67	2.87	3.06	3.24	3.41	3.57	3.73	3.88	4.03	4.17	4.31	3.94	4.21	4.46	4.69	4.89	5.07	5.23	5.38	5.52	5.65	5.78	5.89	6.00	6.11	6.21	
43A		130	1.28	1.46	1.64	1.81	1.96	2.11	2.25	2.38	2.51	2.62	2.74	2.85	2.96	3.06	3.17	3.38	3.61	3.83	4.02	4.19	4.34	4.48	4.61	4.73	4.84	4.95	5.05	5.15	5.24	5.32	
SUB-PHASE TENS. LBS			1494	1306	1164	1054	970	904	848	801	761	727	696	668	644	622	602																SUBTOTAL DAMPERS NEEDED:0

ISSUE	DATE	DESCRIPTION
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DESIGN ENGINEER	J. PANKRATZ
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E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

INITIAL SAG TABLES

795 KCMIL 45/7 ACSR "TERN"

0 1" 2"

FILENAME BHE-STC-01-D-1.DWG

SCALE NONE

SHEET **STC-01-1**

INITIAL SAG TABLE			AFL CC-55/443 "DNO-4748" OPGW 1590# @ NESC HEAVY LOADING														SUB DE to 2A													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
SUB DE	270	261	5.64	5.79	5.95	6.10	6.24	6.39	6.53	6.67	6.81	6.94	7.07	7.20	7.33	7.46	7.58	7.10	7.20	7.29	7.38	7.47	7.56	7.64	7.72	7.80	7.88	7.95	8.03	8.10	8.17	8.24	
1A		276	6.28	6.45	6.62	6.79	6.95	7.11	7.27	7.42	7.58	7.72	7.87	8.02	8.16	8.30	8.44	7.49	7.60	7.70	7.79	7.88	7.97	8.06	8.15	8.23	8.31	8.39	8.47	8.54	8.62	8.69	
SUB-PHASE TENS. LBS			443	431	420	410	400	391	383	375	367	360	353	347	341	335	330																SUBTOTAL DAMPERS NEEDED:0

INITIAL SAG TABLE			AFL CC-55/443 "DNO-4748" OPGW 2645# @ NESC HEAVY LOADING														2A to 3													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
2A	410	410	6.39	6.67	6.94	7.22	7.48	7.75	8.01	8.27	8.52	8.77	9.02	9.26	9.50	9.74	9.97	7.56	7.72	7.88	8.03	8.18	8.32	8.46	8.60	8.73	8.86	8.98	9.10	9.22	9.33	9.44	
3																																	1)DPR-OPGW-D1 BOL & 1)DPR-OPGW-D1
SUB-PHASE TENS. LBS			962	922	887	853	822	794	768	744	722	702	682	664	648	632	617																SUBTOTAL DAMPERS NEEDED:2

INITIAL SAG TABLE			AFL CC-55/443 "DNO-4748" OPGW 2345# @ NESC HEAVY LOADING														41 to 42A													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
41	173	173	0.56	0.60	0.64	0.70	0.76	0.82	0.90	0.99	1.09	1.21	1.33	1.47	1.61	1.76	1.91	2.23	2.31	2.40	2.50	2.60	2.71	2.84	2.98	3.12	3.28	3.45	3.62	3.80	3.97	4.14	1)DPR-OPGW-D1 AOL
SUB-PHASE TENS. LBS			1945	1815	1686	1560	1437	1320	1203	1095	995	901	814	740	673	617	567																SUBTOTAL DAMPERS NEEDED:1

INITIAL SAG TABLE			AFL CC-55/443 "DNO-4748" OPGW 1500# @ NESC HEAVY LOADING														42A to SUB DE													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
42A	140	153	1.01	1.13	1.27	1.42	1.57	1.73	1.89	2.04	2.20	2.35	2.49	2.64	2.77	2.91	3.04	3.01	3.18	3.37	3.56	3.75	3.93	4.11	4.28	4.44	4.58	4.72	4.86	4.98	5.10	5.21	
43A		130	0.75	0.85	0.95	1.06	1.17	1.29	1.41	1.52	1.64	1.75	1.86	1.97	2.07	2.17	2.26	2.60	2.75	2.91	3.08	3.24	3.40	3.55	3.69	3.83	3.96	4.08	4.20	4.30	4.40	4.50	
SUB-PHASE TENS. LBS			844	753	673	603	544	494	453	418	388	364	342	324	308	294	281																SUBTOTAL DAMPERS NEEDED:0

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z.JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

INITIAL SAG TABLES

AFL CC-55/443 "DNO-4748" OPGW

0 1" 2"

FILENAME BHE-STF-01-D-1.DWG

SCALE NONE

SHEET **STF-01-1**

INITIAL SAG TABLE			3/8" 7 STRAND EHS 1500# @ NESC HEAVY LOADING														SUB DE to 2A													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
SUB DE	270	261	5.79	5.91	6.03	6.14	6.26	6.37	6.49	6.60	6.71	6.82	6.92	7.03	7.13	7.23	7.34	7.19	7.27	7.34	7.41	7.48	7.55	7.62	7.68	7.75	7.81	7.87	7.93	7.99	8.04	8.10	
1A		276	6.41	6.55	6.68	6.81	6.94	7.06	7.19	7.31	7.43	7.56	7.67	7.79	7.91	8.02	8.13	7.57	7.65	7.73	7.80	7.88	7.95	8.02	8.09	8.15	8.22	8.28	8.35	8.41	8.47	8.53	
SUB-PHASE TENS. LBS			404	396	388	381	373	367	360	354	349	343	338	333	328	323	319																SUBTOTAL DAMPERS NEEDED:0

INITIAL SAG TABLE			3/8" 7 STRAND EHS 1375# @ NESC HEAVY LOADING														42A to SUB DE													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
42A	140	153	1.22	1.33	1.45	1.58	1.71	1.84	1.96	2.09	2.21	2.33	2.45	2.56	2.67	2.78	2.89	3.30	3.45	3.61	3.76	3.91	4.05	4.19	4.32	4.44	4.56	4.68	4.79	4.89	4.99	5.08	
43A		130	0.90	0.98	1.07	1.16	1.26	1.35	1.44	1.54	1.62	1.71	1.80	1.88	1.97	2.05	2.13	2.83	2.96	3.09	3.23	3.35	3.48	3.59	3.71	3.81	3.92	4.01	4.11	4.19	4.28	4.36	
SUB-PHASE TENS. LBS			656	600	549	506	468	435	407	383	362	343	327	312	299	287	277																SUBTOTAL DAMPERS NEEDED:0

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z.JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

INITIAL SAG TABLES

3/8" 7 STRAND EHS

0 1" 2"

FILENAME BHE-STS-01-D-1.DWG

SCALE NONE

SHEET **STS-01-1**

ITEM NO.	QTY	DESCRIPTION	MANUFACTURER	MANUFACTURER PART #	CLIENT #	SCHP-M2	SCHPRC-M1	SCDE-69-2S	SCDE-ST-M1	DC-C3309-SDE	TC-3PDE-ST	DT-01-69	T-4B	T-4D	T-4DS	T-4BF	T-4FDW	T-4FDS	T-FSC-2	T-FSC-3	T-SP1	T-PSD	T-J4PD	T-BDE6PD	T-SD6P6PD	TM-EXT-15	TM-9	TM-9ST	TM-9SSI	TG-26B (11' - 14')	TG-26B (13' -16')	TGS-1A	TA-3H	TA-5EXT	TM-GM	TM-SPS-1	TP-A	DPR-EHS-D1	DPR-OPGW-D1	DPR-7DS-D2	3/8" EHS	DNO-4748	795 ACSR	3/8 EHS SPLICE	795 ACSR SPLICE	B608	M40D	EXTRA
		Lange-West Rapid City - QTY:				1	1	1	1	1	1	2	2	4	3	2	4	9	1	1	9	6	6	42	3	27	5	4	4	1	2	19	19	27	19	2	4	1	5	27	1000	2500	4600	1	3	12	3	1
A110	27	ANCHOR, EXTENSION, 1 1/2" SQ. SHAFT 5'-0"	CHANCE	12656	N.S.																													1															
A111	19	ANCHOR, EXTENSION, 1 1/2" SQ. SHAFT 7'-0"	CHANCE	12657	N.S.																													1															
A210	19	ANCHOR, 1 1/2" SQ. SHAFT, 8", 10", AND 12" HELIX W/ TRIPLEYE ADAPTER	CHANCE	12654-3AEJ	N.S.																													1															
B2526	2	BOLT, MACHINE, 5/8" X 26"	HUGHES	B626-6	N.S.														2																															
B273	24	BOLT, MACHINE, 7/8" X 3"	HUGHES	B83-2	20-7803			8		13																					1	1																	
B2716	2	BOLT, MACHINE, 7/8" X 16"	HUGHES	B816-6	20-7816					2																																							
B2718	8	BOLT, MACHINE, 7/8" X 18"	HUGHES	B818-6	20-7818	2	2			4																																							
B2720	10	BOLT, MACHINE, 7/8" X 20"	HUGHES	B820-6	20-7820	2	2			6																																							
B2722	8	BOLT, MACHINE, 7/8" X 22"	HUGHES	B822-6	20-7822	2	2	4																																								
B2724	2	BOLT, MACHINE, 7/8" X 24"	HUGHES	B824-6	20-7824			2																																							
B283.5	4	BOLT, MACHINE, 1" X 1 1/2"	HUGHES	B103-1/2-2-1/2	N.S.					4																																						
B603	12	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	BURNDY	50 FWSS	N.S.									1			1																															
B605	12	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	BURNDY	50 SWSSMD	N.S.									1			1																															
B606	36	BOLT, NUT, BELLEVILLE, FLAT, STAINLESS STEEL, ASSEMBLY	CMC	SBA20-50	N.S.																			8																								1	
B614	12	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	FASTENAL	70207	N.S.									1			1																															
C107	4600	CONDUCTOR, 795 KCMIL ACSR, 45/7 "TERN"	SOUTHWIRE		N.S.																																						1					
C800	1000	WIRE, GALVANIZED, 7 STEEL STRAND, 3/8" EHS	MITCHELL		N.S.																																				1							
C801	2090	WIRE, GALVANIZED, 7 STEEL STRAND, 7/16" EHS	MITCHELL		18-7167																										110																	
C901	625	WIRE, COPPER, #4 SOLID, 40% CONDUCTIVITY	SOUTHWIRE		36-4000																					125																						
C902	86	WIRE, COPPER, #2 STRANDED, CLASS B	SOUTHWIRE		N.S.							2	2	6											10	4																					
D17120	4	ROD, FULL THREADED, 7/8" X 120", ASTM A307 GRADE B	PORTLAND BOLT	13919-10'	N.S.						4																																					
D2732	2	ROD, THREADED, DOUBLE END, 7/8" X 32", W/ 2 NUTS	HUGHES	TR832-5	N.S.					2																																					
D2734	2	ROD, THREADED, DOUBLE END, 7/8" X 34", W/ 2 NUTS	HUGHES	TR834-5	N.S.					2																																					
E576	4	BOLT, BENT, 7/8" X 6"	HUGHES	2722.1B-B	N.S.					4																																					
E676	2	BOLT, BENT STUD, 7/8" X 8"	HUGHES	2722.1D-B	N.S.					2																																					
F111	7	3108.6 POLE BANDS, HEAVY DUTY, 9"-12" POLE	HUGHES	3108.6	18-1117	1	1	3		2																																					
F112	5	3108.7 POLE BANDS, HEAVY DUTY, 11"-14" POLE	HUGHES	3108.7	18-1118			2		2																					1																
F113	8	3108.8 POLE BANDS, HEAVY DUTY, 13"-16" POLE	HUGHES	3108.8	18-1119			4		2																						1																
F201	22	LINK, CONNECTING, 1/4" X 2" X 7 1/2", 15/16" HOLES, 24K LBS	HUGHES	3152	14-3152	4	4	6		8																																					
F203	60	LINK, CONNECTING, 3/8" X 2" X 7 1/2", 15/16" HOLES, 38K LBS	HUGHES	3154	14-3154			28		26																					2	2																
F300	4	ANCHOR ASSEMBLY WITH BOLTS, PAIR	HUGHES	A1895-2	N.S.																																1											
F900	4	TEE, DEAD END, 15/16" BOLT HOLE, 60K LBS	HUGHES	2817-17	18-2817					4																																					
G100	25	GUY, ROLLER, 1 1/8" WR, 15/16" HOLE	HUGHES	28082	18-2808			8		14																					1	1																
G200	19	GUY, STRAIN INSULATOR, 120" LONG, 21K LBS, ROLLER, ROLLER	HUGHES	CF694-120R2	18-1521																											1																
G400	19	GUY, GUARD, 2" X 8'-0", FULL ROUND, YELLOW	MacLEAN	J1493Y	N.S.																														1												
G601	57	GUY DEADEND GRIP, FOR 7/16" EHS	PREFORMED	GDE-1108	18-7168																											3																
G902	19	GUY, STRANDVISE, 7/16" EHS, SHORT BAIL	MacLEAN	5203	18-0716																											1																
H102	7	SOCKET EYE, 18K, 1/2" WIDTH, 11/16" HOLE, 2-1/16" LENGTH	HUBBELL	SA04	N.S.								1	1																																	
H200	3	SOCKET CLEVIS, 30K	HUBBELL	SC30	N.S.																			1																								
H400	27	HOT LINK EXTENSION, CHAIN EYE - CHAIN EYE, 15" LONG, 30K LBS	HUBBELL	HOO3015	N.S.																				1																								
H500	7	Y-CLEVIS BALL, 30K	HUBBELL	YBC30	48-3054								1	1																																	
H602	13	ANCHOR, SHACKLE, 3" LONG, 3/4" DIA., 7/8" DIA. PIN, 35K LBS	HUGHES	2865-B3	N.S.												1	1																													
H603	27	ANCHOR, SHACKLE, 3.5" LONG, 7/8" DIA., 3/4" DIA. PIN, 60K LBS	HUBBELL	AS50BNK	N.S.																				1																								
H901	4	Y-CLEVIS, EYE, 90, 20K	ANDERSON	YCS-05-90	48-5207							1			1																																	
H902	6	Y-CLEVIS, EYE, 90, 40K	HUBBELL	YCS-06-90-40	48-3053																	1																											
H950	1	JAW & ROD END EYE TURNBUCKLE, 4/8" X 12"	HUGHES	AS2545-D	N.S.					1																																						
I110	6	INSULATOR, SUSPENSION, Y-CLEVIS BALL, 36.2" LENGTH, 25K LBS	MACLEAN	S14080025MXAL015	48-6924																		1																										
I220	6	INSULATOR, HORIZONTAL POST, DROP TONGUE, 69KV	HUBBELL	P25004330020	48-1007																	1																										
I250	9	INSULATOR, HORIZONTAL POST, CLAMPTOP, 69KV	HUBBELL	P25004331020	N.S.																1																										
I300	45	INSULATOR, DEADEND, Y-CLEVIS BALL, 54" LENGTH, 25K LBS	MACLEAN	S14080042MXAL027	48-6927																		1	1																										
I400	4	PHASE SPACER, 1'-6" LONG, 15KV	HUGHES	CF800-18C	N.S.																															2												
J100	2500	AFL CC-55/443 "DNO-4748" OPGW	AFL	DNO-4748	N.S.																																						1						
J200	2	FIBERLIGN SUSPENSION ASSY. W/ GROUNDWIRE	PREFORMED	4300104G	N.S.										1																																	
J300	13	FIBER OPTIC DEADEND, 18" U-BOLT (48 FIBER), W/ GROUND WIRE	PREFORMED	2801303G	N.S.												1	1																														
J401	10	DOWNLEAD CUSHION KIT 0.443 OPGW W/ HARDWARE FOR WOOD POLE	PREFORMED	8663041-H1	N.S.														10																													
J403	28	DOWNLEAD CUSHION KIT, 0.443 OPGW W/ 1/2"-13 X 3" MOUNTING KIT	PREFORMED	8003041-H3	N.S.															28																													
J501	2	VERTICAL CABLE STORAGE ASSEMBLY	PREFORMED	8003569	N.S.														1	1																													
J502	2	VERTICAL MOUNTING BRACKET KIT	PREFORMED	8003472	N.S.														1	1																													
J510	2	6" X 22" COYOTE CLOSURE KIT W/ 6 PORT END PLATE	PREFORMED	8006659	N.S.														1	1																													
J511	2	COYOTE DEFENDER FOR 6" X 22" CLOSURE	PREFORMED	8003492	N.S.														1	1																													
J600	6	SPLICE TRAY KIT, 36 COUNT TRAY	PREFORMED	80805514	N.S.														2	4																													
J700	5	CLOSURE END PLATE GROMMETS, 7/8" PORT, 0.443" OPGW	PREFORMED	8003597	N.S.														2	3																													
J720	3	FUTURE CABLE PORT KIT, 7/8" PORT	PREFORMED	8003371	N.S.														2	1																													
J730	2	GROMMET PLUG, 3/4" PORT, QTY 2	PREFORMED	80806037	N.S.														1	1																													
J950	60	BOLT-A-BAND 3/4" X REQ'D LENGTH	PREFORMED	BAB-38XX	N.S.															60																													
J951	2	BUCKLE, BANDING, FOR 3/4" BANDING	PREFORMED	BAB-38	N.S.															2																													
K102	6	SUSPENSION CLAMP W/ SOCKET, 25K	HUBBELL	HAS-118-S	42-0118																		1																										
K300	9	CLAMP, TRUNNION, 795 KCMIL 45/7 ACSR "TERN", 2,800 LBS	HUBBELL	TSC150	48-7020																1																													
K400	2	AGS SUSPENSION ASSEMBLY, 15K, 3/8" EHS	PREFORMED	AGS-7104	40-7104							1																																				
K500	6	AGS SUSPENSION ASSEMBLY, 25K, 795 ACSR-45/7 "TERN"	PREFORMED	AGS-5128	40-5114																	1																											
L101	42	STRAIN CLAMP, DEADEND W/ SOCKET-EYE, 30K, 0.50 - 1.20 RANGE	HUBBELL	SD-112-S	42-1120																		1																										
L300	7	STRAIN CLAMP, DE, 20K, 3/8" EHS	HUBBELL	SWDE55N	44-4053								1	1																																	
L502	3	COMPRESSION DEADEND ASSY, DOUBLE TONGUE, W/ 15" TERMINAL "TERN"	AFL	VED-123	42-8230																				1																								

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
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DESIGN ENGINEER	J. PANKRATZ
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PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

MATERIAL LIST

0 1" 2"

FILENAME BHE-ML-01-D-1.DWG
SCALE NONE
SHEET ML-01-1

ITEM NO.	QTY	DESCRIPTION	MANUFACTURER	MANUFACTURER PART #	CLIENT #	SCHP-M2	SCHPRC-M1	SCDE-69-25	SCDE-ST-M1	DC-C3309-SDE	TC-3PDE-ST	DT-01-69	T-4B	T-4D	T-4DS	T-4BF	T-4FDW	T-4FDS	T-FSC-2	T-FSCS-3	T-3P1	T-PSD	T-HPD	T-8DEGPD	T-5DEGPD	TM-EXT-15	TM-9	TM-9ST	TM-9SS	TG-2BB (11°-14°)	TG-2BB (13°-16°)	TGS-1A	TA-3H	TA-5EXT	TM-GM	TM-SPS-1	TP-A	DPR-EHS-D1	DPR-OPGW-D1	DPR-795-D2	3/8" EHS	DNO-4748	795 ACSR	3/8 EHS SPLICE	795 ACSR SPLICE	B606	M400	EXTRA
				Lange-West Rapid City - QTY:		1	1	1	1	1	1	2	2	4	3	2	4	9	1	1	9	6	6	42	3	27	5	4	4	1	2	19	19	27	19	2	4	1	5	27	1000	2500	4600	1	3	12	3	1
M201	3	SPLICE, COMPRESSION, 795 26/7 ACSR "DRAKE"	HUBBELL	A1512451	N.S.																																									1			
M300	1	SPLICE, COMPRESSION, 3/8" EHS	HUBBELL	811425	N.S.																																								1			
M400	3	COMPRESSION TERMINAL, STRAIGHT, 4-HOLE, 795 TERN	ALCOA	TS-12	N.S.																																									1		
M500	12	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	HUBBELL	VHCL1012	N.S.										1			1																															
M600	4	WRAPLOCK TIE, C-NECK, 0.443" CONDUCTOR	PREFORMED	WTC-0114	N.S.																																2											
M601	4	WRAPLOCK TIE, C-NECK, 0.36" CONDUCTOR	PREFORMED	WTC-0109	N.S.																																2											
N107	27	NUT, SQUARE, 7/8"	HUGHES	N80	47-0242			3			24																																				
N405	2	NUT, LOCK, MF TYPE, 5/8"	HUGHES	MF60	N.S.														2																													
N407	86	NUT, LOCK, MF TYPE, 7/8"	HUGHES	MF80	22-7856	6	6	14		33	24																			1	1																
N408	4	NUT, LOCK, MF TYPE, 1"	HUGHES	MF100	N.S.					4																																					
O100	4.5	INHIBITOR, FILLER COMPOUND, GRITTED, COMPRESSION CONNECTIONS, 8 oz.	HUBBELL	VS68B	N.S.																			1.5																							
O101	1.8	INHIBITOR, FILLER COMPOUND, NON-GRITTED, PAD TO PAD, 8 OZ	HUBBELL	VS8B	N.S.																			0.6																							
O102	0.9	INHIBITOR, RUST (NO-OX-ID), 1 PT CAN, GRADE "A"	SANCHEM INC	NO-OX-ID "A" SPECIAL	N.S.																0.06		0.06																							
P104	20	CLIP, BONDING, WITH 1/2" X 1 1/2" BOLT, 7/16" MAX. WIRE	HUGHES	2718.55	46-2718	1	1	9		6																				1	1																
P150	200	NAIL, 10D, CU-COATED	MACLEAN	J7260	46-7460																						40																				
P151	200	CLIP, CU-COATED	KEARNEY	5730-1	46-2729																						40																				
P207	3	CLIP, BONDING, FOR 7/8" DIA. BOLT, 5/16" MAX. WIRE	HUGHES	2727.8	46-2728			3																																					
P300	12	WOOD MOULDING, 1-11/16" X 8'-0"	HUGHES	2503.8	46-2503	4	3																				1																				
P400	50	MOULDING, STAPLES, 3 1/2" X 1 3/4"	HUBBELL	C25050222	46-2504	20	15																				3																				
P500	4	ROD, GROUND, 5/8" X 8'-0", COPPERCLAD	GALVAN	6260G13	46-0588																							1																				
P600	250	STAPLES, CUT (SLASH), 1 1/2" X 3/8", COPPER COATED, BARBED	MACLEAN	J7682	46-7494																						50																				
P701	4	CLAMP, GROUND ROD, 0.128 TO 0.460 RANGE, 5/8" ROD	CHANCE	C2030344	46-0058																							1																				
P820	12	CLAMP, VISE TYPE, LIGHTNING ARRESTOR GROUND, #2 STRANDED	HUBBELL	GC207	N.S.																							1	2																				
Q100	7	CLAMP, 3-BOLT, 6" LONG, 5/8" BOLT, 5/16" - 1/2" RANGE	MACLEAN	J931	18-5816									1	1																																	
Q500	6	CONNECTOR, COMPRESSION #4 COPPER TO #4 COPPER	HOMAC	CC44	N.S.											1	1																															
Q501	6	GROUND CLAMP. #2 STRANDED TO #4 SOLID	HOMAC	CC24	36-0002							1	1																																			
Q550	9	CLAMP, SINGLE BOLT, VISE TYPE, 3/8" EHS TO #2 STR CU	HUBBELL	GA9020GLSS	46-6810							1	1	1																																	
Q551	2	CLAMP, SINGLE BOLT, #4 STR CU TO 4/0 AWG STR. CU	HUBBELL	LC1602	N.S.								1																																		
Q552	2	CLAMP, VISE TYPE, 3/8 EHS TO 4/0 AWG STR CU	HUBBELL	GA9040L55	N.S.								1																																		
Q601	42	PARALLEL GROOVE CONNECTOR, 0.743 - 1.152 RANGE	AFL	483.3A	42-0483																			1																							
S110	6	SPIRAL VIBRATION DAMPER, 0.327" - 0.461" RANGE	PREFORMED	5050104	N.S.																																	1	1									
S150	54	DAMPER, DOG BONE, 795 ACSR	HUBBELL	60710-12	N.S.																																			2								
V170	8	POLE GAIN FITTING, 5 5/8" X 7 1/2" CROSSARM, 15/16" HOLE	HUGHES	A783.1Y-15	N.S.					8																																					
V500	4	GRID GAIN, 4 1/2" X 9" X 1/4", 31/32" HOLE, OUTER HOLES BONDED	HUGHES	1260-AB2	N.S.					4																																					
W205	2	WASHER, SPRING, 11/16" HOLE	HUGHES	2702.6	N.S.														2																													
W207	21	WASHER, SPRING, 15/16" HOLE	HUGHES	2702.8	N.S.	3	3	3		12																																					
W304	4	WASHER, SQUARE, 2" X 1/4", 11/16" HOLE	HUGHES	SW2-60	N.S.														4																													
W322	12	WASHER, SQUARE, 4" X 1/4", 15/16" HOLE	HUGHES	SW4-80	N.S.						12																																					
W410	30	WASHER, ROUND, 2" X 1/4", 15/16" HOLE	HUGHES	RW2-80	N.S.	6	6	6			12																																					
W504	18	WASHER, SQ. CURVED, 4" X 1/4", 15/16" HOLE	HUGHES	SCW4-80	22-4425	6	6	6																																							
W602	8	WASHER, CURVED, 4" X 1/4", 15/16" HOLE	HUGHES	CW80	N.S.					8																																					
X104	2	CROSSARM ASSY., 5 5/8" X 7 1/2" X 26'-0"	HUGHES	C3309.12A	N.S.					2																																					
Y101	1	SET 2096-12-6 X-BRACE, 12'-6" POLE SPACING, 4 5/8 X 5 5/8	HUGHES	2096-12-6	N.S.					1																																					
Y101A	2	2840.1E CENTER CLAMP ROD	HUGHES	2840.1E	N.S.					2																																					
Y101B	2	2087.4A CENTER CLAMP STRAP	HUGHES	2087.4A	N.S.					2																																					
Y200	8	2025-BDV-86 VEE BRACE, 7'-2" CC HOLES, 6'-7" W.L., 37-1/2 DEG & 52-1/2 DEG FITT	HUGHES	2025-BDV-86	N.S.					8																																					

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWING
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

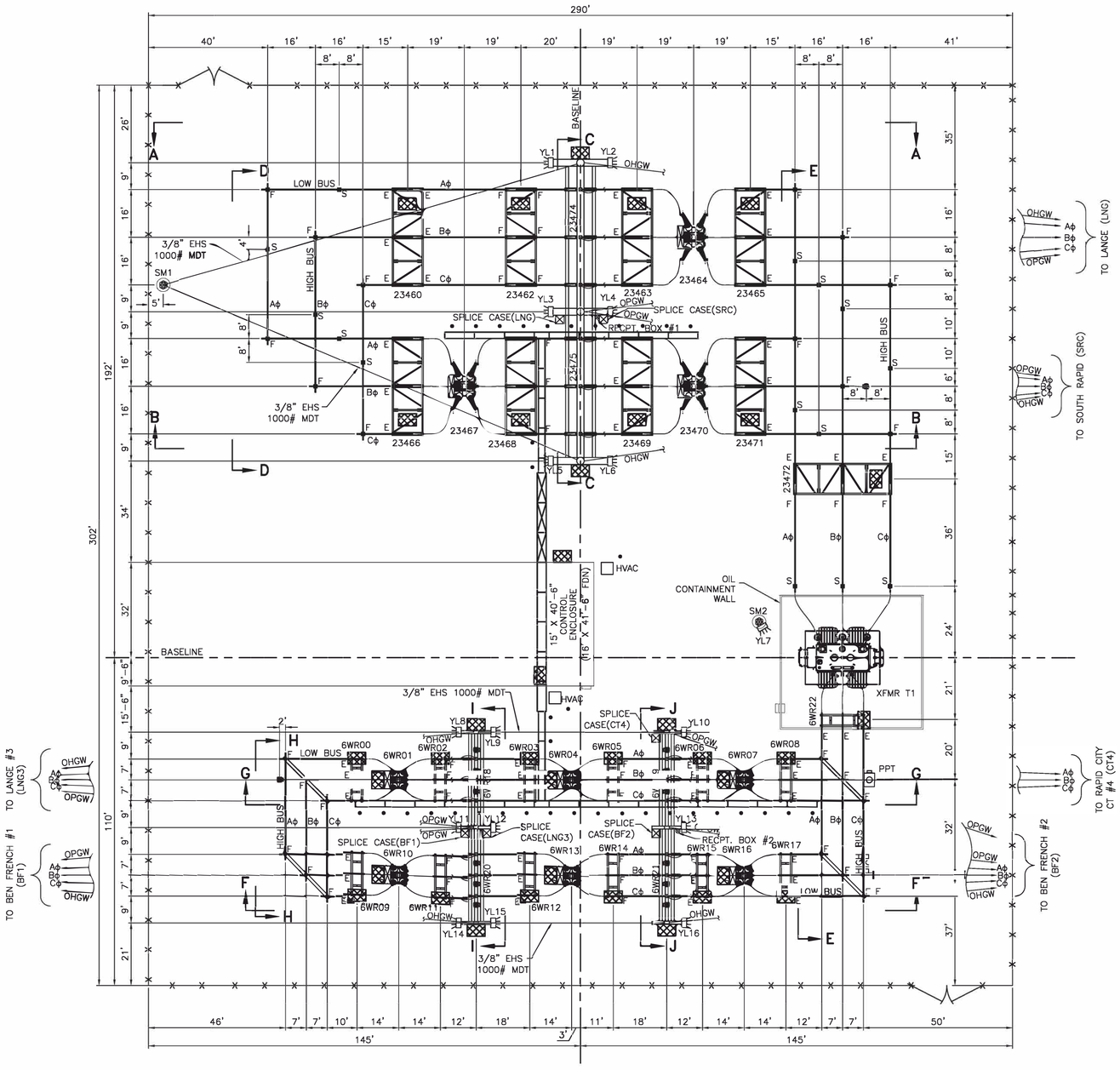
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

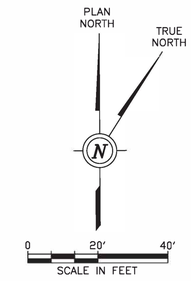
LANGE - WEST RAPID CITY
69KV TRANSMISSION LINE

MATERIAL LIST

0 1" 2"

FILENAME BHE-ML-01-D-2.DWG
SCALE NONE
SHEET ML-01-2





NOTES:

1. 230 kV LOW AND HIGH BUS SHALL BE 3–1/2" AL IPS, SCH. 40, 6063–T6 ALUM. ALLOY WITH 795 ACSR "DRAKE" DAMPENING CABLE.
2. 230 kV BREAKER JUMPERS SHALL BE MADE OF DOUBLE 1272 AAC "NARCISSUS" CONDUCTORS.
3. 230 kV TRANSFORMER JUMPERS SHALL BE MADE OF SINGLE 1272 AAC "NARCISSUS" CONDUCTORS.
4. 69 kV BUS SHALL BE 3–1/2" AL IPS, SCH. 40, 6063–T6 ALUM. ALLOY WITH 795 ACSR "DRAKE" DAMPENING CABLE.
5. 69 kV BREAKER JUMPERS SHALL BE MADE OF DOUBLE 1272 AAC "NARCISSUS" CONDUCTORS.
6. 69 kV TRANSFORMER JUMPERS SHALL BE MADE OF DOUBLE 1272 AAC "NARCISSUS" CONDUCTORS.
7. BUS COUPLING LOCATIONS SHALL BE DETERMINED BY CONTRACTOR AS NEEDED BASED UPON BUS LENGTHS USED. LOCATE AS NEEDED PER THE SPECIFICATIONS. CONTRACTOR SHALL ACQUIRE 40' LONG BUS PIPE AND LIMIT USE OF COUPLERS ON LONG SPANS. DO NOT USE COUPLERS OR EXCESS SHORTER BUS PIECES TO CREATE A LONGER PIECE LESS THAN 40' IN LENGTH.

LEGEND:

- F FIXED (WELDED)
- E EXPANSION
- S SLIP
- FLOOD LIGHT
- YARD RECEPTACLE BOX
- SAFETY BOLLARD
- CABLE TRENCH DRIVE SECTION (HS20 RATED)
- CABLE TRENCH PEDESTRIAN SECTION
- CHAINLINK FENCE
- OPERATOR PLATFORM

REGISTERED PROFESSIONAL ENGINEER — REG. NO. 10443 — PAUL D. KONECHNE — SOUTH DAKOTA

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly Registered Professional Engineer under the laws of the State of South Dakota.

By _____ Paul D. Konechne, P.E.

Registration Number 10443 Date: 01-18-19

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DGR ENGINEERING
ROCK RAPIDS, IOWA
(712) 472-2531

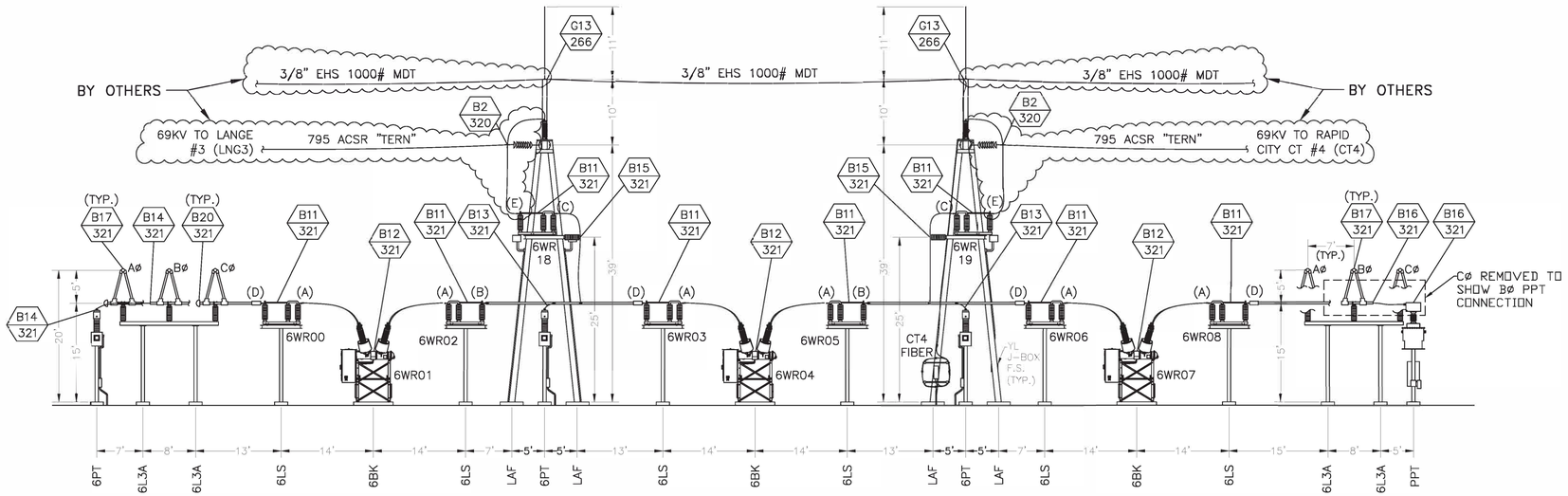
DATE	DRAWN BY	NO.	APPROVED BY	REVISION DESCRIPTION
01-19	KLV	0	PJK	FOR CONSTRUCTION

BLACK HILLS ENERGY

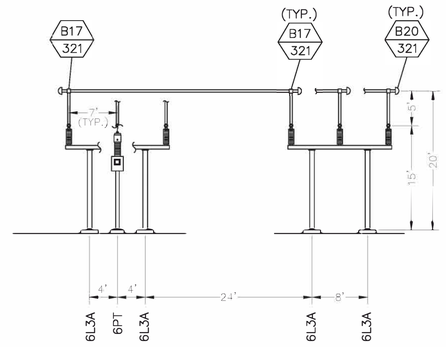
WEST RAPID CITY SUBSTATION

GENERAL ARRANGEMENT

DRAWN BY KLV DATE 08-18
APPROVED BY PJK DATE 08-18
DWG NO. WRC-C-101
REVISION NO. 0



SECTION G–G



SECTION H–H

NOTES:

1. BUS COUPLING LOCATIONS SHALL BE DETERMINED BY CONTRACTOR AS NEEDED BASED UPON BUS LENGTHS PROCURED.

LEGEND

B27 / 320 — DETAIL # / DWG #
1L1 — STRUCTURE #
(A) — SUB-DETAIL ASSIGNMENT

0' 10' 20'
SCALE IN FEET

REGISTERED PROFESSIONAL ENGINEER
REG. NO.
10443
PAUL D. KONECHNE
SOUTH DAKOTA

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By _____
Paul D. Konechne, P.E.

Registration Number 10443 Date: 01-18-19

P:\04233\115\DWG\WRC-C-305.DWG

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ROCK RAPIDS, IOWA
(712) 472-2531

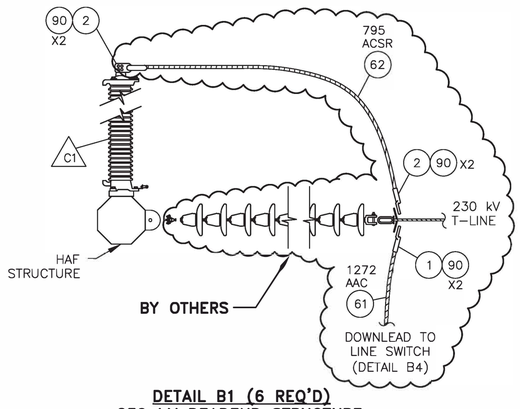
DATE	DRAWN BY	NO.	APPROVED BY	REVISION DESCRIPTION
01-19	KLV	0	PJK	FOR CONSTRUCTION

BLACK HILLS ENERGY

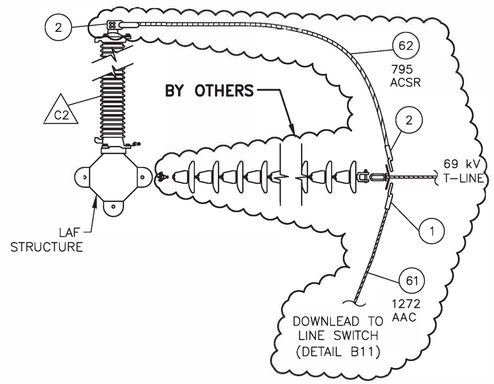
WEST RAPID CITY SUBSTATION

SECTIONS G AND H

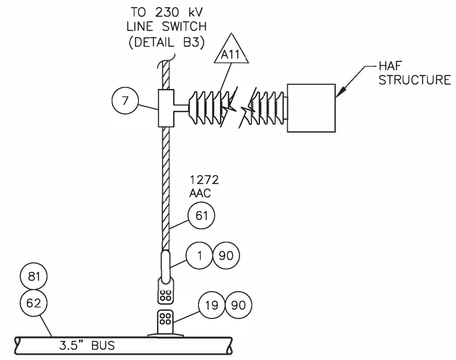
DRAWN BY KLV DATE 10-18
APPROVED BY PJK DATE 10-18
DWG NO. WRC-C-305
REVISION 0



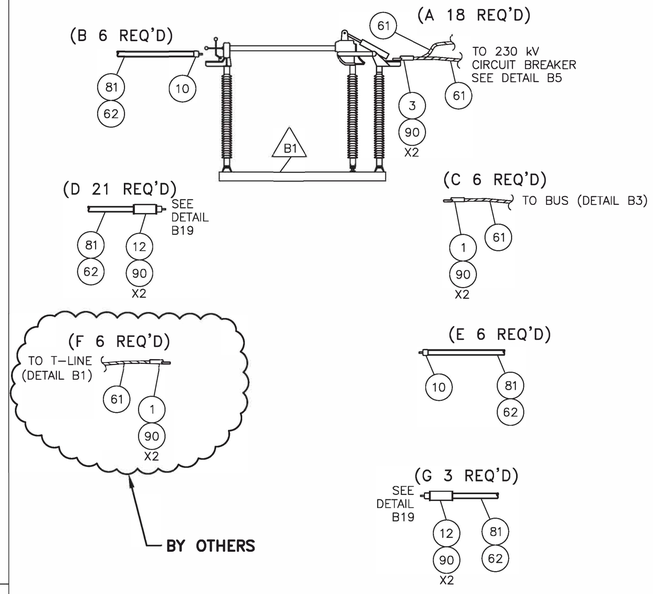
DETAIL B1 (6 REQ'D)
230 kV DEADEND STRUCTURE
T–LINE ATTACHMENT DETAIL



DETAIL B2 (12 REQ'D)
69 kV DEADEND STRUCTURE
T–LINE ATTACHMENT DETAIL



DETAIL B3 (6 REQ'D)
BUS CONNECTION DETAIL
230 kV DOWNLEAD CONNECTIONS

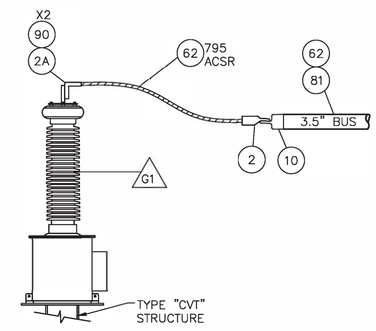


DETAIL B4
230 kV DISCONNECT SWITCH
CONNECTION DETAIL

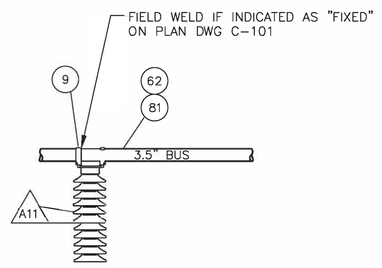
DETAIL B5 (9 REQ'D)
230 kV PCB CONNECTION DETAIL

DETAIL B6 (3 REQ'D)
230/69 kV TRANSFORMER HIGHSIDE
CONNECTION DETAIL

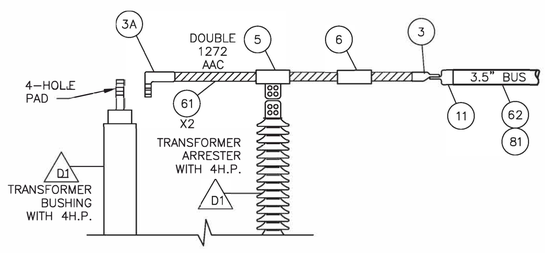
DETAIL B7 (12 REQ'D)
230 kV BUS BI–LEVEL
SUPPORT ASSEMBLY DETAIL



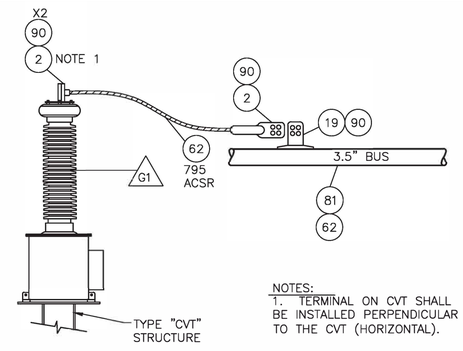
DETAIL B10A (1 REQ'D)
230 kV BUS CVT
CONNECTION DETAIL



DETAIL B8 (14 REQ'D)
230 kV BUS SUPPORT
ASSEMBLY DETAIL



DETAIL B9 (3 REQ'D)
230/69 kV TRANSFORMER LOWSIDE
CONNECTION DETAIL



DETAIL B10 (6 REQ'D)
230 kV LINE CVT
CONNECTION DETAIL

REGISTERED PROFESSIONAL ENGINEER
REG. NO.
10443
PAUL D.
KONECHNE
SOUTH DAKOTA

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By _____
Paul D. Konechne, P.E.

Registration Number 10443 Date: 01-18-19

DATE	DRAWN BY	NO.	APPROVED BY	REVISION DESCRIPTION
01-19	KLV	0	PDK	FOR CONSTRUCTION

BLACK HILLS ENERGY

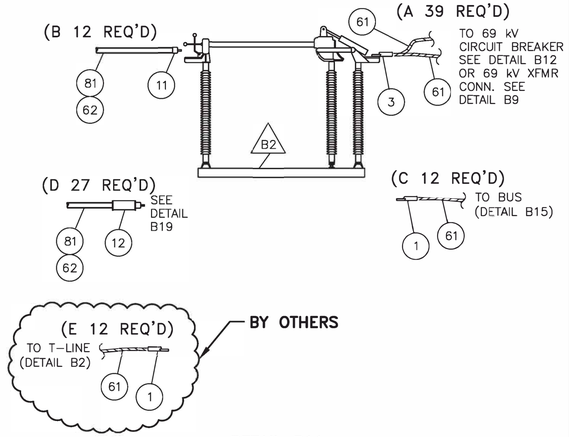
WEST RAPID CITY SUBSTATION

BUS CONNECTION DETAILS

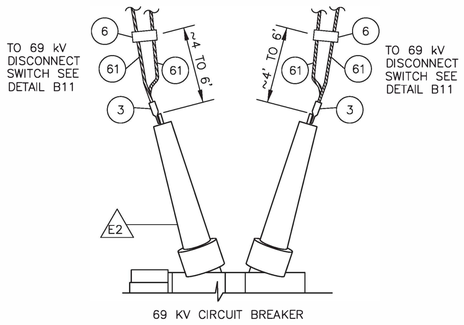
DRAWN BY KLV DATE 10-18
APPROVED BY PDK DATE 10-18
DWG NO. WRC-C-320 REVISION 0

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(712) 472-2531

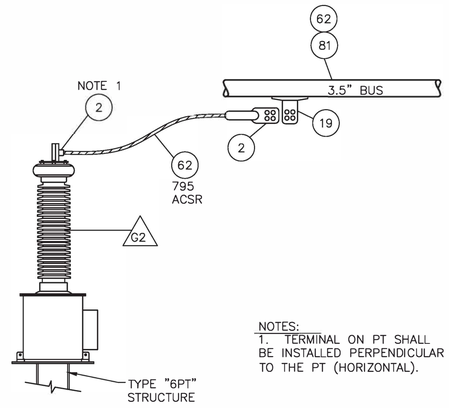
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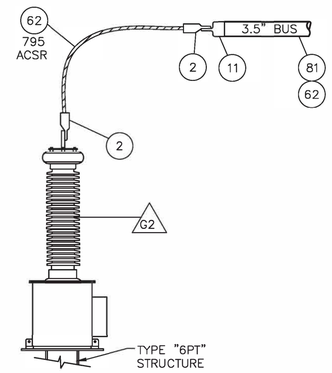
DETAIL B11
69 kV DISCONNECT SWITCH CONNECTION DETAIL



DETAIL B12 (18 REQ'D)
69 kV PCB CONNECTION DETAIL



DETAIL B13 (12 REQ'D)
69 kV LINE PT'S CONNECTION DETAIL



DETAIL B14 (1 REQ'D)
69 kV BUS PT CONNECTION DETAIL

DETAIL B15 (12 REQ'D)
BUS CONNECTION DETAIL
69 kV DOWNLEAD CONNECTIONS

DETAIL B16 (1 REQ'D)
69 kV POWER PT CONNECTION DETAIL

DETAIL B17 (12 REQ'D)
69 kV BUS BI-LEVEL SUPPORT ASSEMBLY DETAIL

DETAIL B18 (AS REQ'D)
BUS COUPLER JOINT

DETAIL B19
EXPANSION BUS TERMINAL DETAIL

DETAIL B20 (39 REQ'D)
END CAP DETAIL

DETAIL B21 (AS REQ'D)
69 kV 4-HOLE NEMA PAD CONNECTIONS

DETAIL B22 (AS REQ'D)
230 kV 4-HOLE NEMA PAD CONNECTIONS

P:\04233\15\DWG\WRC-C-321.DWG

DGR ENGINEERING
ROCK RAPIDS, IOWA
(712) 472-2531

REGISTERED PROFESSIONAL ENGINEER — REG. NO. 10443 — PAUL D. KONECHNE — SOUTH DAKOTA

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Registration Number 10443 Date: 01-18-19

DATE	DRAWN BY	NO.	APPROVED BY	REVISION DESCRIPTION
01-19	KLV	0	PDK	FOR CONSTRUCTION

BLACK HILLS ENERGY

WEST RAPID CITY SUBSTATION

BUS CONNECTION DETAILS

DRAWN BY KLV DATE 10-18
APPROVED BY PDK DATE 10-18
DWG NO. WRC-C-321 REVISION NO. 0

Item No.	OFM	Catalog Number	Description	Manufacturer	"Total Required"
1	X	WCF-136-D	CONNECTOR, TERMINAL, WELDED, 1272 AAC TO 4" NEMA 4HP	ANDERSON	75
1A	X	WCF-136-D-Y45	CONNECTOR, TERMINAL, WELDED, 1272 AAC TO 4" NEMA 4HP, 45°	ANDERSON	3
1B	X	WCF-136-D-Y90	CONNECTOR, TERMINAL, WELDED, 1272 AAC TO 4" NEMA 4HP, 90°	ANDERSON	3
2	X	WCF-106-D	CONNECTOR, TERMINAL, WELDED, 795 ACSR TO 4" NEMA 4HP	ANDERSON	77
2A	X	WCF-106-D-Y90	CONNECTOR, TERMINAL, WELDED, 795 ACSR TO 4" NEMA 4HP, 90°	ANDERSON	1
3	X	W2CF-136-D	CONNECTOR, TERMINAL, WELDED, (2) 1272 AAC TO 4" NEMA 4HP	ANDERSON	114
3A	X	W2CF-136-D-Y90	CONNECTOR, TERMINAL, WELDED, (2) 1272 AAC TO 4" NEMA 4HP, 90°	ANDERSON	3
4	X	ORT-2114-D	CONNECTOR, TEE, COMPRESSION, 1272 AAC MAIN TO 4" NEMA 4HP	ANDERSON	3
4A	X	ATCF-15401	CONNECTOR, TEE, BOLTED, 1272 AAC MAIN TO 4" NEMA 4HP	ANDERSON	3
5	X	110-121-CSTD-4-90	CONNECTOR, SPACER, BOLTED, (2) 1272 AAC, 4" SPACING TO 4" NEMA 4HP, 90°	TRAVIS (PDU)	3
6	X	APCS-15-4	CONNECTOR, SPACER, BOLTED, (2) 1272 AAC, 4" SPACING	ANDERSON	69
7	X	HVCS-12995	BUS SUPPORT, BOLTED, EHV, 1272 AAC TO 5" BOLT CIRCLE	ANDERSON	6
8	X	ACS-163	BUS SUPPORT, BOLTED, 1272 AAC TO 3" BOLT CIRCLE	ANDERSON	12
9	X	WTH-34-5	BUS SUPPORT, WELDED/SLIP, 3-1/2" IPS TO 5" BOLT CIRCLE	ANDERSON	38
10	X	WSTFE-34-D-CF-EHV	CONNECTOR, TERMINAL, WELDED, EHV, 3-1/2" IPS TO 4" NEMA 4HP, CENTER FORMED, WITH BOLT SHIELD	ANDERSON	16
11	X	WSTF-34-D-CF	CONNECTOR, TERMINAL, WELDED, 3-1/2" IPS TO 4" NEMA 4HP, CENTER FORMED	ANDERSON	17
12	X	WFTFV-34D	CONNECTOR, TERMINAL, WELDED, EXPANSION, 3-1/2" IPS TO 4" NEMA 4HP, 90°	ANDERSON	51
13	X	WTT-15-3424	FITTING, WELDED TEE, 15 DEGREE, 3-1/2" IPS MAIN TO 2-1/2" IPS TAP	ANDERSON	24
14	X	WTT-15-3434	FITTING, WELDED TEE, 15 DEGREE, 3-1/2" IPS MAIN TO 3-1/2" IPS TAP	ANDERSON	24
15	X	WTT2-15-3424	FITTING, WELDED VEE, 15 DEGREE, 3-1/2" IPS MAIN TO 2-1 /2" IPS VEE	ANDERSON	12
16	X	WTT2-15-3434	FITTING, WELDED VEE, 15 DEGREE, 3-1/2" IPS MAIN TO 3-1 /2" IPS VEE	ANDERSON	12
17	X	WCI-3434	FITTING, COUPLER, WELDED, INTERNAL, 3-1/2" IPS TO 3-1/2" IPS	ANDERSON	13
18	X	WLI45-3434	FITTING, COUPLER, WELDED, 45°, INTERNAL, 3-1/2" IPS TO 3-1/2" IPS	ANDERSON	6
19	X	WTTFR-30-60-D	FITTING, TEE, WELDED, 3"-6" IPS RUN TO 4" NEMA 4HP, INLINE PAD	ANDERSON	36
20	X	WEB34	FITTING, CORONA BELL, WELDED, INTERNAL FIT, 3-1/2" IPS	ANDERSON	39
41	X	E/INS-150-G	WILDLIFE PROTECTOR, SPLIT TUBING, GRAY, FOR 1272 AAC, 20 KV PHASE-GND	MIDSUN GROUP	10'
42	X	E/FTP-250G	WILDLIFE PROTECTOR, FUSING TAPE, GRAY, 2.5" WIDE, FOR EXPOSED CONNECTORS & W/ITEM 41 & 43	MIDSUN GROUP	AS REQ'D
43	X	E/BSC-350	WILDLIFE PROTECTOR, COVER FOR XFMR ARRESTERS	MIDSUN GROUP	3
44	X	E/BC-DBL-LEAD	WILDLIFE PROTECTOR, BUSHING COVER FOR TRANSFORMER	MIDSUN GROUP	3
61	X	NARCISSUS	CONDUCTOR, 1272 MCM AAC, 61 STRANDING	ALCOA	2500'
62	X	TERN	CONDUCTOR, 795 MCM ACSR 45/7 STRANDING, FOR HIGH VOLTAGE CONNECTIONS	ALCOA	500'
62	X	TERN	CONDUCTOR, 795 MCM ACSR 45/7 STRANDING, FOR BUS DAMPENING	ALCOA	2000'
80		2.5" - 6063-T6	CONDUCTOR, BUS, 2-1/2" IPS, SCHEDULE 40 ALUMINUM, 40' LENGTHS	ALCOA	200'
81		3.5" - 6063-T6	CONDUCTOR, BUS, 3-1/2" IPS, SCHEDULE 40 ALUMINUM, 40' LENGTHS	ALCOA	2520'
90	X	EVHS-D	HARDWARE SHIELDS, EHV, 4" NEMA 4HP (BOLT SHIELDS)	ANDERSON	230
91		HBS-XXX	STAINLESS STEEL BOLTS, 1/2" FOR ALUMINUM BUS CONNECTIONS, CONTRACTOR TO DETERMINE LENGTH	ANDERSON	AS REQ'D
92		BW500	STAINLESS STEEL BELLEVILLE WASHER, 1/2", 1.06" O.D.	ANDERSON	AS REQ'D
93		HNB500	SILICON BRONZE NUT, HIGH STRENGTH, 1/2"	ANDERSON	AS REQ'D
94		HFS5001	STAINLESS STEEL WASHER, 1/2", 1.13" O.D.	ANDERSON	AS REQ'D
96		PENETROX A	ELECTRICAL FILLER COMPOUND, NON-PETROLEUM BASED	BURNDY	AS REQ'D
200		4/0 COPPER	CONDUCTOR, 4/0 STRANDED SOFT DRAWN COPPER		14,000'
201		633400	GROUND ROD, 3/4" DIAMETER, 10' LONG, COPPER CLAD	ERICO	106
202		CR-34	GROUND ROD COUPLING, FOR CONNECTING MULTIPLE GROUND RODS OR DRIVE STUDS	ERICO	70
203		DS34	GROUND ROD DRIVING STUD	ERICO	20
205		GYR182Q	MOLD, GROUNDING CONNECTOR, EXOTHERMIC, 4/0 CABLE-3/4" GROUND ROD (USE 150 WELD)	ERICO	4
206		XBQ2Q2Q	MOLD, GROUNDING CONNECTOR, EXOTHERMIC, 4/0 CABLE - 4/0 CABLE CROSS (USE 250 WELD)	ERICO	25
207		TAC2Q2Q	MOLD, GROUNDING CONNECTOR, EXOTHERMIC, 4/0 CABLE - 4/0 CABLE TEE (USE 150 WELD)	ERICO	40
208		SSC2Q	MOLD, GROUNDING CONNECTOR, EXOTHERMIC, 4/0 CABLE - 4/0 CABLE SPLICE (USE 90 WELD)	ERICO	3
210		90	WELD METAL, 90 CARTRIDGE SIZE, FOR USE WITH ITEM 208	ERICO	40
211		150	WELD METAL, 150 CARTRIDGE SIZE, FOR USE WITH ITEMS 205 & 207	ERICO	400
212		250	WELD METAL, 250 CARTRIDGE SIZE, FOR USE WITH ITEM 206	ERICO	350
221		GC-141A-02	CONNECTOR, BRONZE, BOLTED, 1-4/0 COPPER TO FLAT SURFACE	ANDERSON	650
222		GC-143A-02	CONNECTOR, BRONZE, BOLTED, 2-4/0 COPPER TO FLAT SURFACE	ANDERSON	200
223		K3	CONNECTOR, BRONZE, BOLTED, 2 PARALLEL 4/0 COPPER	ANDERSON	150
224		K1	CONNECTOR, BRONZE, BOLTED, 2 PARALLEL #4 COPPER	ANDERSON	10
225		SWL-025-B	CONNECTOR, BRONZE, BOLTED, #4-4/0 COPPER TO NEMA 2HP	ANDERSON	80
226		C-4	CONNECTOR, BOLTED, 1-#4 SOLID COPPER TO TYPE A4 BARBED WIRE/FENCE FABRIC	ANDERSON	200
227		GC-111-5B	CONNECTOR, BOLTED, 1-#4 SOLID COPPER TO 1-5/8" FENCE TOP RAIL/GATE FRAME	ANDERSON	60
228		GC-110-82C	CONNECTOR, BOLTED, 2-4/0 STRANDED COPPER TO 2-1/2" FENCE LINE POST	ANDERSON	20
229		GC-110-102C	CONNECTOR, BOLTED, 2-4/0 STRANDED COPPER TO 3" FENCE CORNER POST	ANDERSON	4
230		GC-110-142C	CONNECTOR, BOLTED, 2-4/0 STRANDED COPPER TO 4" GATE POST	ANDERSON	4
231		GC-109-06	CONNECTOR, BOLTED, FLEXIBLE COPPER BRAID TO 2" GATE FRAME	ANDERSON	8
233		GB-100-3B	FLEXIBLE COPPER BRAID 24" LONG WITH TIN PLATED FERRULES EACH END	ANDERSON	8
240		#4 SD SOLID CU	CONDUCTOR, #4 SOLID SOFTDRAWN COPPER		500'
241		#6 SD SOLID CU	CONDUCTOR, #6 SOLID SOFTDRAWN COPPER		150'
242		3/8" EHS	CONDUCTOR, 7 WIRE, 3/8" EXTRA HIGH STRENGTH STEEL		500'
250		SWDE46N	DEADEND, BOLTED, STATIC WIRE, 3/8" EHS STEEL, QUADRANT STRAIN CLAMP	ANDERSON	8
251		YCS-04-90	Y-CLEVIS EYE, FOR STATIC WIRE DEADEND, 90°	ANDERSON	8

Item No.	OFM	Catalog Number	Description	Manufacturer	"Total Required"
271	X	804-LL8-400PE	FIBER OPTIC CABLE, MULTIMODE DUPLEX		400'
272	X	12048R101	FIBER OPTIC CABLE, MULTI-FIBER	SUPERIOR ESSEX	1460'
273	X	DF4X1C-XXXX	CONDUIT, INNERDUCT, 1" ORANGE CORROGATED W/TAPE	CARLON	1500'
280	X		CONTROL CABLE, (3) CONDUCTOR #12, 3/C-#12 SH		350'
281	X		CONTROL CABLE, (2) CONDUCTOR #10, 2/C-#10 SH		3600'
282	X		CONTROL CABLE, SHIELDED, (4) CONDUCTOR #10, 4/C-#10 SH		500'
283	X		CONTROL CABLE, SHIELDED, (9) CONDUCTOR #10, 9/C-#10 SH		5500'
284	X		CONTROL CABLE, SHIELDED, (12) CONDUCTOR #10, 12/C-#10 SH		5600'
285	X		CONTROL CABLE, (2) CONDUCTOR #6, 2/C-#6 SH		1500'
286	X		CONTROL CABLE, (3) CONDUCTOR #6, 3/C-#6 SH		2100'
287	X		POWER CABLE, (1) CONDUCTOR 500 MCM, 1/C-500		1000'
291			TERMINAL CONNECTORS, CONTROL CABLE, VARIOUS SIZES		1850
292			TERMINAL CONNECTORS, CONTROL CABLE, SHIELD		130
293			TERMINAL CONNECTORS, POWER CABLE, 500 MCM		18
294			CABLE MARKERS		1 LOT
300			CONDUIT, BELOW-GRADE, VARIOUS SIZES, SCHEDULE 40 PVC AND ASSOCIATED FITTINGS AND PULL WIRE		1 LOT
301			CONDUIT, STATION POWER RISERS, 90° ELBOW, 3-1/2" RIGID GALVANIZED STEEL, 40" MIN RADIUS		4
310			CONDUIT, ABOVE-GRADE, VARIOUS SIZES, RIGID GALVANIZED STEEL AND ASSOCIATED FITTINGS		1 LOT
311			CONDUIT, ABOVE-GRADE, VARIOUS SIZES, LIQUID-TIGHT FLEXIBLE AND ASSOCIATED FITTINGS		1 LOT
330			ANTI-CORROSION TAPE, FOR RIGID GALVANIZED STEEL INSTALLED BELOW GRADE		1 LOT
380	X		CABLE TRENCH ASSEMBLY	TRENWA	1 LOT
381	X		CABLE TRENCH GROUND CLAMPS	TRENWA	90
382			DRAIN TILE, 4" PERFORATED, HDPE, WITH COUPLINGS & ACCESSORIES AS NEEDED		630'
383			OUTLET, DRAIN TILE, 4", PREFABRICATED CMP, FLARED END, WITH RODENT GUARD		2
384			FENCE POST, MARKER FOR DRAIN TILE OUTLET		2
390			CONDUIT MARKER		9
400	X	FXL-56L-190-5K-W-U-Y-GR	FLOOD LIGHT, LED, 120-277 VAC, 187 WATT (400W MH EQUIVALENT)	HUBBELL	16
401	X	4024CM53	FLOOD LIGHT SLIP-FITTER, STEEL FOR 2" PIPE, 2 3/8" O.D. YOKE MOUNT	HUBBELL	16
402	X	6387	FLOOD LIGHT WALL BRACKET, 2" SLIP FITTER, GRAY	HOLOPHANE	16
500		FENCE	CHAIN-LINK FENCE SYSTEM		1184'
501		GATES	GATE, CHAIN-LINK DOUBLE GATE, 24' TOTAL WIDTH, WITH ONE PERSONNEL GATE		2

NOTES:
1. SEE PROJECT SPECIFICATIONS AND DETAIL DRAWINGS FOR FURTHER MATERIAL DETAILS AS NEEDED.
2. SUPPLIER SHALL BE RESPONSIBLE FOR PROVIDING OFM QUANTITIES AS REQUIRED TO COMPLETE THE PROJECT.
3. QUANTITIES OF CONTRACTOR-FURNISHED MATERIALS SHALL BE VERIFIED BY CONTRACTOR.
4. OWNER SHALL BE NOTIFIED OF ANY QUANTITIES THAT MAY BE SHOWN INCORRECTLY ON THIS DRAWING.

REGISTERED PROFESSIONAL ENGINEER — REG. NO. 10443 — PAUL D. KONECHNE — SOUTH DAKOTA

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly Registered Professional Engineer under the laws of the State of South Dakota.

By _____
Paul D. Konechne, P.E.

Registration Number 10443 Date: 01-18-19

P:\04233115\DWG\WRC-C-380.DWG

DGR ENGINEERING
ROCK RAPIDS, IOWA
(712) 472-2531

DATE	DRAWN BY	NO.	APPROVED BY	REVISION DESCRIPTION
01-19	KLV	0	PJK	FOR CONSTRUCTION

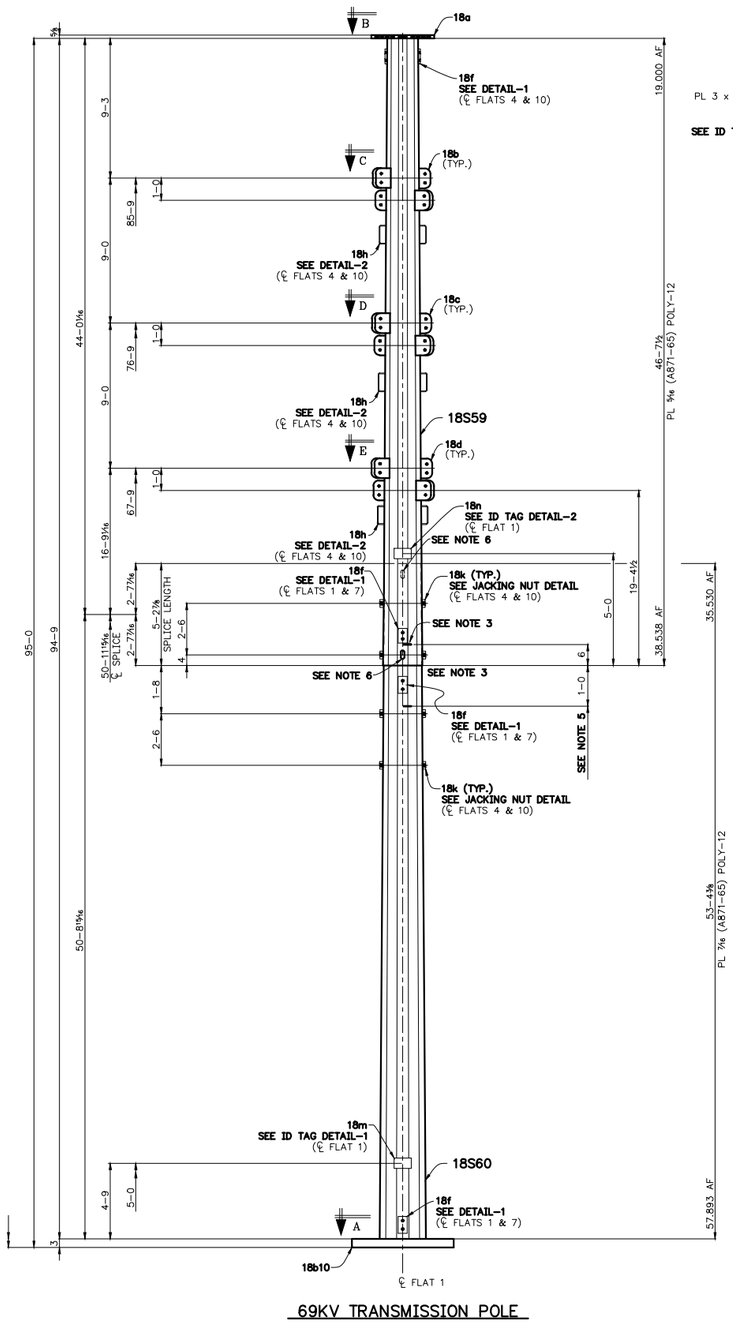
BLACK HILLS ENERGY

WEST RAPID CITY SUBSTATION

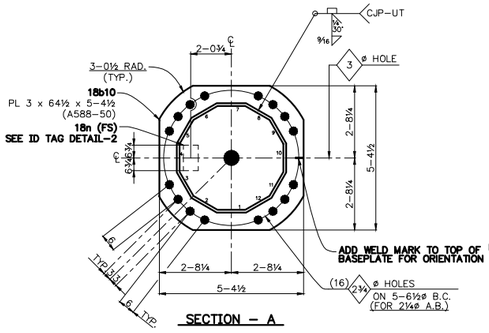
MATERIAL LIST

DRAWN BY KLV DATE 01-19
APPROVED BY PJK DATE 01-19

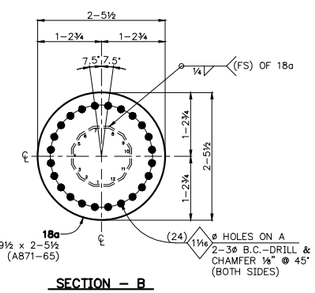
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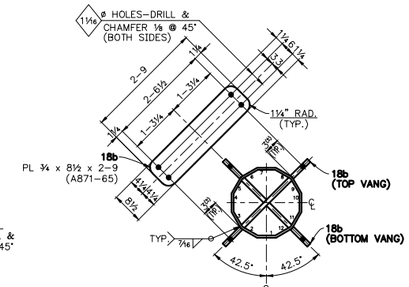
69KV TRANSMISSION POLE



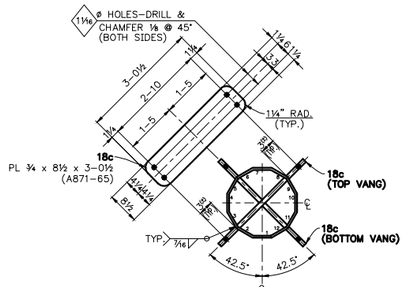
SECTION – A



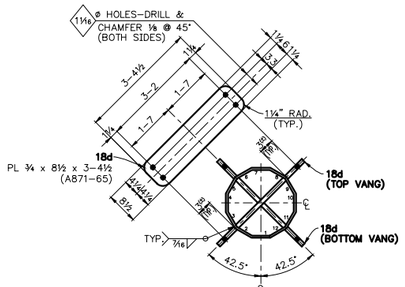
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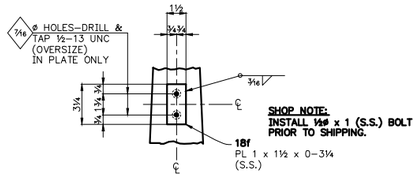
SECTION – C



SECTION – D



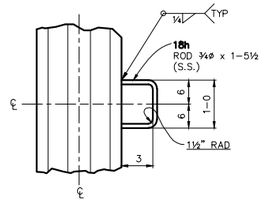
SECTION – E



DETAIL – 1

GROUNDING SCHEDULE DIM'S TO CENTER OF GROUND PLATE SEE DETAIL–1		
POLE – 18S59		POLE – 18S60
℄ OF FLATS 1 & 7	℄ OF FLATS 4 & 10	℄ OF FLATS 1 & 7
0–11	45–7½	0–9
		47–2½

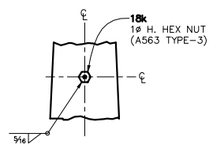
ALL DIMENSIONS FROM BOTTOM OF SHAFT



DETAIL – 2

GROUND LOOP SCHEDULE DIM'S TO CENTER OF GROUND LOOP SEE DETAIL–2
POLE – 18S59
℄ OF FLATS 4 & 10
17–1½
26–1½
35–1½

ALL DIMENSIONS FROM BOTTOM OF SHAFT



JACKING NUT DETAIL

MATERIAL REQ'D. FOR ASSEMBLY			
MARK	QTY.	DESCRIPTION	BLACK WT.
18S59	ONE	POLY–12 POLE	5,074
18S60	ONE	POLY–12 POLE	15,321
		TOTAL BLACK WT.	20,395#

HARDWARE REQD. FOR ASSEMBLY		
MARK	QTY.	DESCRIPTION
(1)	ONE	SEE ANCHOR BOLT CAGE DETAIL ON SHEET E36.

MATERIAL BILLED FOR ONE MAKE (ONE) TIME

GENERAL NOTES:

1. ALL WELDS SHALL BE IN ACCORDANCE WITH A.W.S. (D1.1.) UNLESS NOTED OTHERWISE.
   a.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL BE U.T. TESTED IN ACCORDANCE WITH AWS & ASNDT.
   b.) ALL MATERIAL WELDED WITH E80–SERIES, LOW HYDROGEN ELECTRODES.
   c.) ALL FILLET WELDS AT JOINT TERMINATIONS OR ABRUPT CHANGES IN WELD DIRECTION SHALL HAVE END RETURNS TO WRAP CORNERS AS GEOMETRY PERMITS. IF JOINT GEOMETRY DOES NOT PERMIT A FULL SIZE RETURN, A SEAL WELD SHALL BE PROVIDED WHERE ACCESSIBLE.
   d.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL USE 3/16" X 1 1/4", (A36) STEEL BACKING (GALVANIZED POLES); (A588–50) (NON–GALVANIZED), MINIMUM. BACKING BARS SHALL BE SPLICED ON SHAFT FLATS ONLY, WITH A C.J.P. GROOVE WELD. BACKING BARS SHALL BE SEAL WELDED ALL AROUND, WHEN ACCESSIBLE.
   e.) LONGITUDINAL SEAM WELDS SHALL ACHIEVE A MINIMUM OF 80% PENETRATION. LONGITUDINAL SEAM WELDS SHALL ACHIEVE 100% PENETRATION WITHIN A MINIMUM OF 6" FROM THE ENDS OF THE SHAFT AND THE FULL LENGTH OF THE FEMALE SECTION IN THE SLIP JOINT.
2. LONGITUDINAL SEAM WELDS IN FEMALE SECTION OF THE SLIP JOINT SHALL BE FULL PENETRATION WELDS.
3. FOR PROPER SHAFT ALIGNMENT FOR ASSEMBLY, A 6" HORIZONTAL WELD BEAD AND A MARK NUMBER ARE POSITIONED ON EACH SHAFT AT EACH SPLICE. THE 6" HORIZONTAL WELD BEADS ARE ON MATCHING CORNERS. THE MARK NUMBER IS ON AN ADJACENT FLAT. THE HORIZONTAL WELD BEAD CORNERS SHALL BE ALIGNED TOP TO BOTTOM OF THE POLE. MATCH NUMBERS SHALL BE MATCHED FOR EACH SPLICE.
4. FIELD ASSEMBLY HOLES (1 1/16ø) WITH 1"ø H. HEX NUTS ARE LOCATED ON OPPOSING SECTION FLATS ABOVE AND BELOW SPLICES FOR JACKING SHAFTS TOGETHER.
5. THE LOWER WELD ORIENTATION MARK AT EACH SPLICE LOCATION SHALL BE TELESCOPED IN THE FIELD TO WITHIN 24" OF THE UPPER WELD ORIENTATION MARK. AFTER TELESCOPED, THE SECTIONS SHOULD SHOW NO FURTHER MOVEMENT AND THERE SHOULD BE ADEQUATE METAL–TO–METAL CONTACT ON ALL FLATS.
6. TWO SLOTS (1 1/2ø x 2 1/2") WILL BE PROVIDED AT THE SLIP FITTED END OF EACH SHAFT.
7. POLE TAPER = 0.419053 IN/FT
8. FIELD BOLT SHIPPING QUANTITIES WILL INCLUDE A MAXIMUM 5% OVERAGE FOR BOLTS 1"ø OR LESS. FIELD BOLTS OVER 1"ø WILL BE EXACT COUNT UNLESS NOTED OTHERWISE.
9. ALL HARDWARE NOTED WITH "PT" SHALL BE PRE–TENSIONED PER THE TURN–OF–NUT METHOD. ALL OTHER HARDWARE SHALL BE SNUG–TIGHT. SPARE SHIPPING QUANTITIES WILL INCLUDE THREE EXTRA ASSEMBLIES OF EACH BOLT TYPE DESIGNATED AS "PT" FOR FIELD VERIFICATION OF PRE–TENSIONING METHOD.
10. **POLE SHALL BE SWEEP BLASTED DULLED AFTER FABRICATION.**

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL,
DO NOT GALVANIZE.

(STR. 42A) 19–9462PE35

DIS-TRAN Steel, LLC
P.O. BOX 5109•ALEXANDRIA, LA, 71307–5709
PHONE 318–448–0274•FAX 318–445–4454

WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

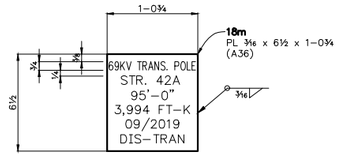
69KV TRANSMISSION POLE / ITEM – 23

ERECTION ELEVATION, SECTIONS & DETAILS

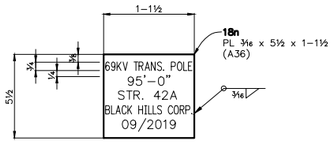
SCALE	DATE	JOB NUMBER	DRAWING NUMBER	REV. NO.
N.T.S.	07/12/19	19–9462P	E35	1
DRAWN BY: DLW	CHK'D. BY: KLN	APP'D. BY: KEJ		

NOTICE TO ERECTOR
BACKCHARGES FOR CORRECTIVE WORK OR REPLACED MATERIALS WILL NOT BE ACCEPTED UNLESS EXPRESSLY AUTHORIZED BY DIS–TRAN BEFORE ANY SUCH COST ARE INCURRED.

REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19
2					
3					
4					
5					
6					
7					
8					

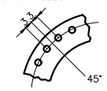


ID TAG DETAIL – 1

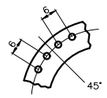


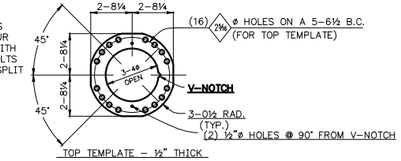
ID TAG DETAIL – 2

SPACE ANCHOR BOLTS 6" APART IN ALL FOUR QUADRANTS. START WITH THE FIRST TWO A–BOLTS IN EACH QUADRANT SPLIT ON THE 45° LINES AS SHOWN BELOW.

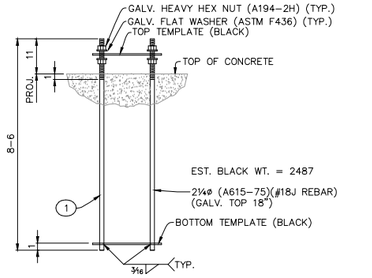


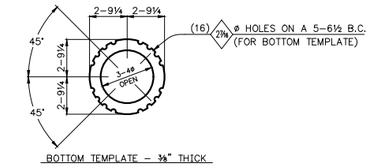
THEN LOCATE THE OTHER ANCHOR BOLTS 6" APART AS SHOWN BELOW.





TOP TEMPLATE – ½" THICK





BOTTOM TEMPLATE – ⅜" THICK

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL, DO NOT GALVANIZE.

(STR. 42A) 19–9462PE36

DIS-TRAN Steel, LLC
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WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

69KV TRANSMISSION POLE / ITEM – 23

SECTIONS & DETAILS (CONTINUED)

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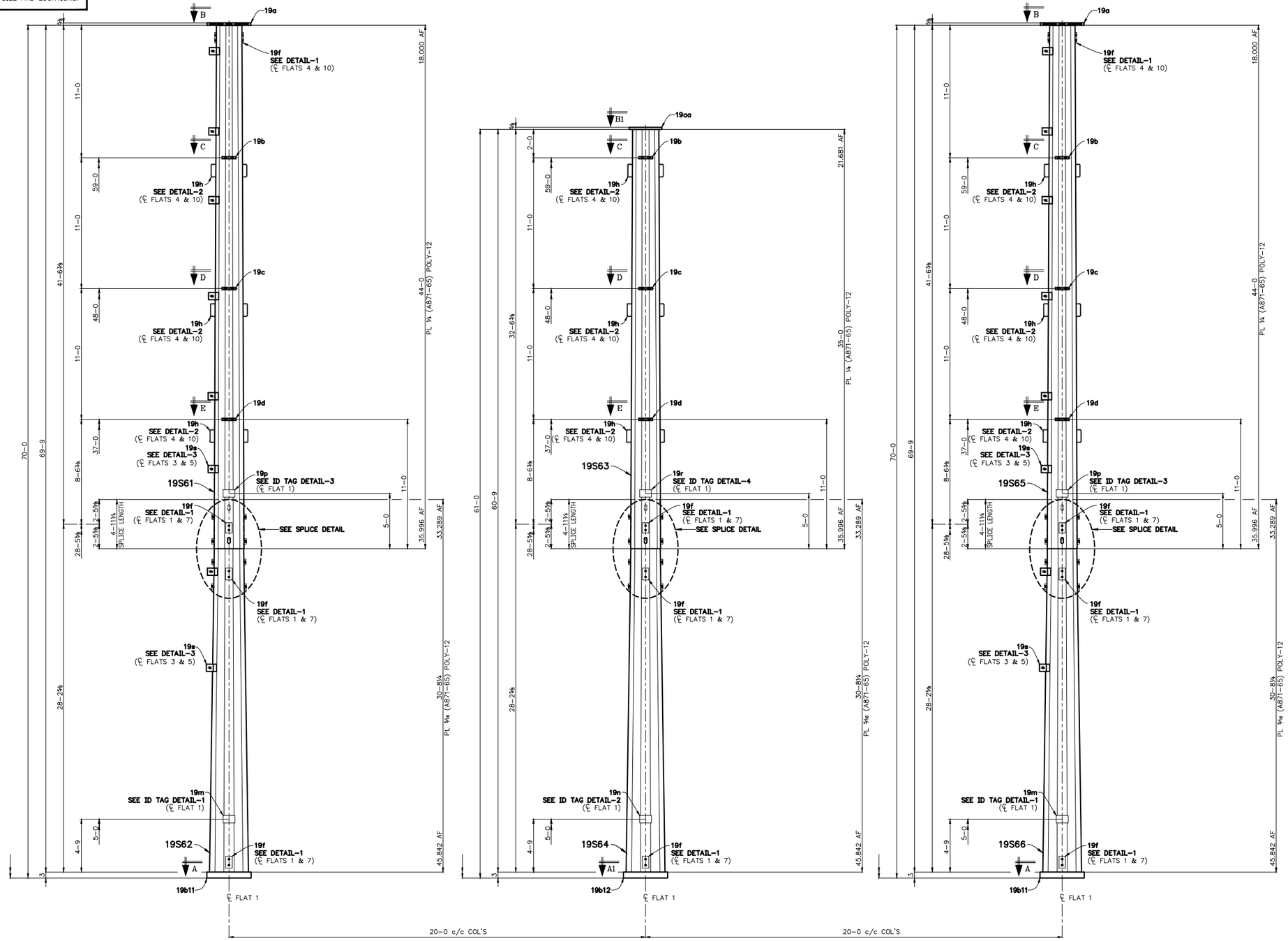
DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ

NOTICE TO ERECTOR
BACKCHARGES FOR CORRECTIVE WORK OR REPLACED MATERIALS WILL NOT BE ACCEPTED UNLESS EXPRESSLY AUTHORIZED BY DIS–TRAN BEFORE ANY SUCH COST ARE INCURRED.

REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
4					
3					
2					
1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19

REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
8					
7					
6					
5					

SHOP NOTE:
SEE HOLE DETAIL & SCHEDULE FOR HOLE SIZE AND LOCATIONS.



69KV 3-POLE DEADEND STRUCTURE

MATERIAL REQ'D. FOR ASSEMBLY			
MARK	QTY.	DESCRIPTION	BLACK WT.
19S61	ONE	POLY-12 POLE	3,732
19S62	ONE	POLY-12 POLE	6,172
19S63	ONE	POLY-12 POLE	3,205
19S64	ONE	POLY-12 POLE	6,159
19S65	ONE	POLY-12 POLE	3,732
19S66	ONE	POLY-12 POLE	6,172
		TOTAL BLACK WT.	29,172#

HARDWARE REQD. FOR ASSEMBLY		
MARK	QTY.	DESCRIPTION
(1)	ONE	SEE ANCHOR BOLT CAGE DETAIL ON SHEET E38x.

MATERIAL BILLED FOR ONE MAKE (ONE) TIME

GENERAL NOTES:

1. ALL WELDS SHALL BE IN ACCORDANCE WITH A.W.S. (D1.1.) UNLESS NOTED OTHERWISE.
   a.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL BE U.T. TESTED IN ACCORDANCE WITH AWS & ASNDT.
   b.) ALL MATERIAL WELDED WITH E80-SERIES, LOW HYDROGEN ELECTRODES.
   c.) ALL FILLET WELDS AT JOINT TERMINATIONS OR ABRUPT CHANGES IN WELD DIRECTION SHALL HAVE END RETURNS TO WRAP CORNERS AS GEOMETRY PERMITS. IF JOINT GEOMETRY DOES NOT PERMIT A FULL SIZE RETURN, A SEAL WELD SHALL BE PROVIDED WHERE ACCESSIBLE.
   d.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL USE 3/16" X 1 1/4", (A36) STEEL BACKING (GALVANIZED POLES); (A588-50) (NON-GALVANIZED), MINIMUM. BACKING BARS SHALL BE SPLICED ON SHAFT FLATS ONLY, WITH A C.J.P. GROOVE WELD. BACKING BARS SHALL BE SEAL WELDED ALL AROUND, WHEN ACCESSIBLE.
   e.) LONGITUDINAL SEAM WELDS SHALL ACHIEVE A MINIMUM OF 80% PENETRATION. LONGITUDINAL SEAM WELDS SHALL ACHIEVE 100% PENETRATION WITHIN A MINIMUM OF 6" FROM THE ENDS OF THE SHAFT AND THE FULL LENGTH OF THE FEMALE SECTION IN THE SLIP JOINT.
2. LONGITUDINAL SEAM WELDS IN FEMALE SECTION OF THE SLIP JOINT SHALL BE FULL PENETRATION WELDS.
3. FOR PROPER SHAFT ALIGNMENT FOR ASSEMBLY, A 6" HORIZONTAL WELD BEAD AND A MARK NUMBER ARE POSITIONED ON EACH SHAFT AT EACH SPLICE. THE 6" HORIZONTAL WELD BEADS ARE ON MATCHING CORNERS. THE MARK NUMBER IS ON AN ADJACENT FLAT. THE HORIZONTAL WELD BEAD CORNERS SHALL BE ALIGNED TOP TO BOTTOM OF THE POLE. MATCH NUMBERS SHALL BE MATCHED FOR EACH SPLICE.
4. FIELD ASSEMBLY HOLES (1⅛ø) WITH 1"ø H. HEX NUTS ARE LOCATED ON OPPOSING SECTION FLATS ABOVE AND BELOW SPLICES FOR JACKING SHAFTS TOGETHER.
5. THE LOWER WELD ORIENTATION MARK AT EACH SPLICE LOCATION SHALL BE TELESCOPED IN THE FIELD TO WITHIN 24" OF THE UPPER WELD ORIENTATION MARK. AFTER TELESCOPED, THE SECTIONS SHOULD SHOW NO FURTHER MOVEMENT AND THERE SHOULD BE ADEQUATE METAL-TO-METAL CONTACT ON ALL FLATS.
6. TWO SLOTS (1⅛ø x 2½") WILL BE PROVIDED AT THE SLIP FITTED END OF EACH SHAFT.
7. POLE TAPER = 0.409000 IN/FT (INNER & OUTER POLES)
8. FIELD BOLT SHIPPING QUANTITIES WILL INCLUDE A MAXIMUM 5% OVERAGE FOR BOLTS 1"ø OR LESS. FIELD BOLTS OVER 1"ø WILL BE EXACT COUNT UNLESS NOTED OTHERWISE.
9. ALL HARDWARE NOTED WITH "PT" SHALL BE PRE-TENSIONED PER THE TURN-OF-NUT METHOD. ALL OTHER HARDWARE SHALL BE SNUG-TIGHT. SPARE SHIPPING QUANTITIES WILL INCLUDE THREE EXTRA ASSEMBLIES OF EACH BOLT TYPE DESIGNATED AS "PT" FOR FIELD VERIFICATION OF PRE-TENSIONING METHOD.
10. **POLE SHALL BE SWEEP BLASTED DULLED AFTER FABRICATION.**

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL, DO NOT GALVANIZE.

(STR. 41) 19-9462PE37

DIS-TRAN Steel, LLC
P.O. BOX 5109•ALEXANDRIA, LA, 71307-5709
PHONE 318-448-0274•FAX 318-445-4454

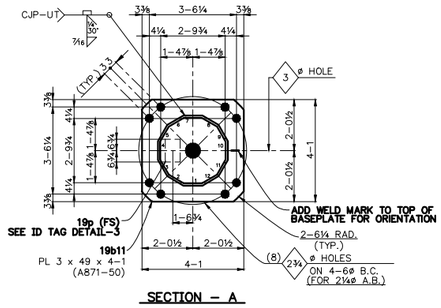
WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

69KV 3-POLE DEADEND STRUCTURE / ITEM - 24
ERECTION ELEVATION, SECTIONS & DETAILS

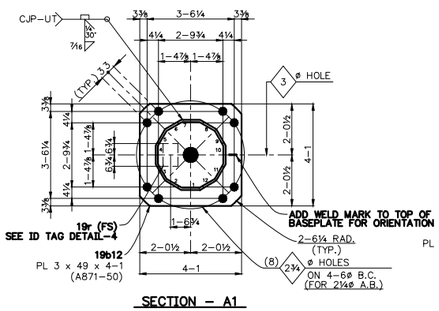
SCALE	DATE	JOB NUMBER	DRAWING NUMBER	REV. NO.
N.T.S.	07/12/19	19-9462P	E37	1
DRAWN BY: DLW	CHK'D. BY: KLN	APP'D. BY: KEJ		

NOTICE TO ERECTOR
BACKCHARGES FOR CORRECTIVE WORK OR REPLACED MATERIALS WILL NOT BE ACCEPTED UNLESS EXPRESSLY AUTHORIZED BY DIS-TRAN BEFORE ANY SUCH COST ARE INCURRED.

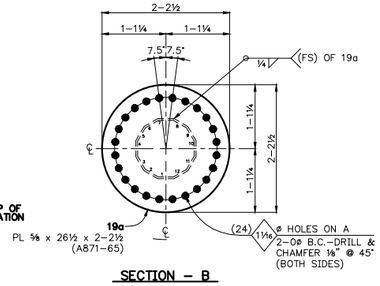
REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
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2					
3					
4					
5					
6					
7					
8					



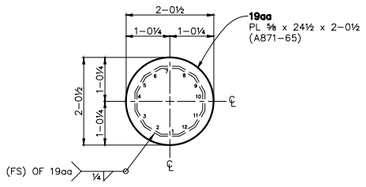
SECTION – A



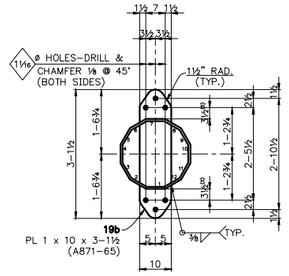
SECTION – A1



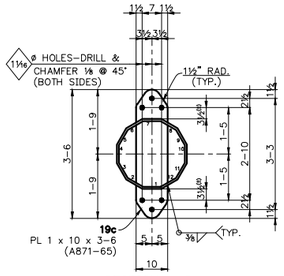
SECTION – B



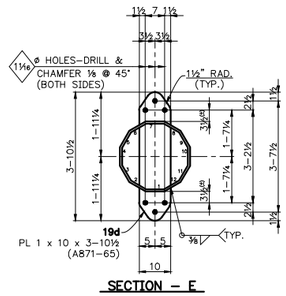
SECTION – B1



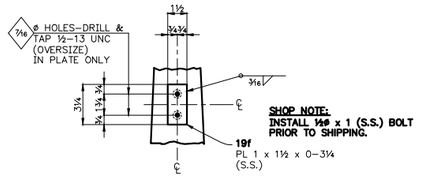
SECTION – C



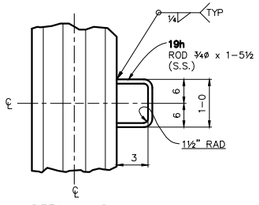
SECTION – D



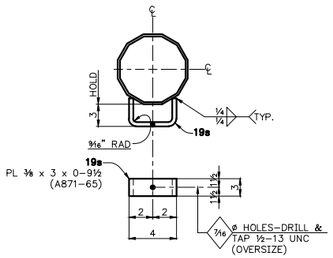
SECTION – E



DETAIL – 1



DETAIL – 2



DETAIL – 3

GROUNDING SCHEDULE
DIM'S TO CENTER OF GROUND PLATE
SEE DETAIL–1

POLES – 19S61 & 19S65		POLES – 19S62, 19S64 & 19S66	POLE – 19S63
℄ OF FLATS 1 & 7	℄ OF FLATS 4 & 10	℄ OF FLATS 1 & 7	℄ OF FLATS 1 & 7
0–11	43–6	0–9	0–11
		24–10	

ALL DIMENSIONS FROM BOTTOM OF SHAFT

GROUND LOOP SCHEDULE
DIM'S TO CENTER OF GROUND LOOP
SEE DETAIL–2

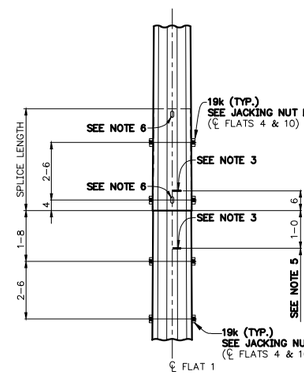
POLES – 19S61, 19S63 & 19S65
℄ OF FLATS 4 & 10
8–0
19–0
30–0

ALL DIMENSIONS FROM BOTTOM OF SHAFT

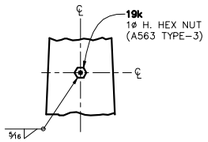
OPGW SCHEDULE
DIM'S TO CENTER OF OPGW
SEE DETAIL–3

POLES – 19S61 & 19S65	POLES – 19S62 & 19S66
℄ OF FLATS 3 & 5	℄ OF FLATS 3 & 5
6–0	17–9
13–0	24–9
20–0	
27–0	
34–0	
41–0	

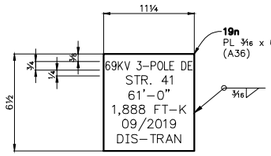
ALL DIMENSIONS FROM BOTTOM OF SHAFT



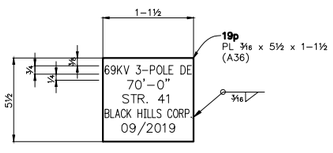
SPLICE DETAIL
(DETAIL–1 REMOVED FOR CLARITY)



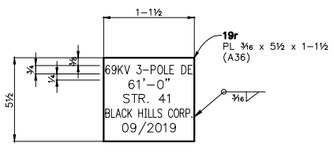
JACKING NUT DETAIL



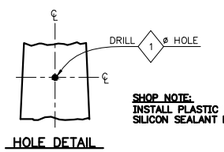
ID TAG DETAIL – 2



ID TAG DETAIL – 3



ID TAG DETAIL – 4



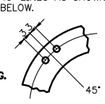
HOLE DETAIL

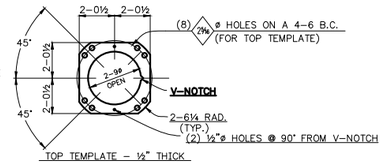
HOLE SCHEDULE
DIM'S TO CENTER OF HOLES
SEE HOLE DETAIL

POLES – 19S61, 19S63 & 19S65
℄ OF FLATS 4 & 10
11–6
12–6
22–6
23–6
33–6
34–6

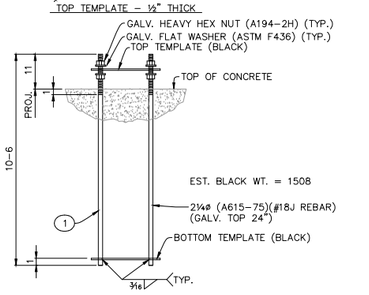
ALL DIMENSIONS FROM BOTTOM OF SHAFT

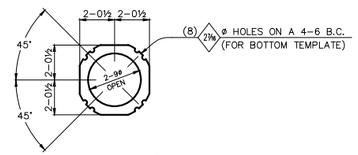
SPACE ANCHOR BOLTS 6" APART IN ALL FOUR QUADRANTS. LOCATE TWO A–BOLTS IN EACH QUADRANT SPLIT ON THE 45° LINES AS SHOWN BELOW.



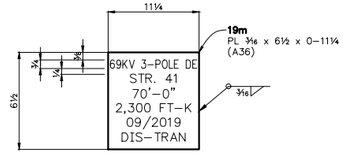


TOP TEMPLATE – ½" THICK





BOTTOM TEMPLATE – ⅜" THICK



ID TAG DETAIL – 1

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL, DO NOT GALVANIZE.

(STR. 41) 19–9462PE38

DIS–TRAN Steel, LLC
P.O. BOX 5109 • ALEXANDRIA, LA, 71307–5709
PHONE 318–448–0274 • FAX 318–445–4454

WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

69KV 3–POLE DEADEND STRUCTURE / ITEM – 24
SECTIONS & DETAILS (CONTINUED)

SCALE	DATE	JOB NUMBER	DRAWING NUMBER	REV. NO.
N.T.S.	07/12/19	19–9462P	E38x	1

DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ

NOTICE TO ERECTOR
BACKCHARGES FOR CORRECTIVE WORK OR REPLACED MATERIALS WILL NOT BE ACCEPTED UNLESS EXPRESSLY AUTHORIZED BY DIS–TRAN BEFORE ANY SUCH COST ARE INCURRED.

REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
4					
3					
2					
1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19

REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
8					
7					
6					
5					

BLACK HILLS ENERGY

WEST RAPID CITY TO CT4 69KV TRANSMISSION LINE

DRAWING LIST

DRAWING #	DRAWING DESCRIPTION
DL–01	DRAWING LIST
	ROUTE MAP
RM–01	ROUTE MAP
	PLAN AND PROFILE DRAWINGS
PP–01	WEST RAPID CITY SUB – CT4, 2A–1 – CT1, 2A–2 – CT3–3, 2A–2 – CT2–3
	STRUCTURE DETAILS
SD–01–1	SCUBDE–M1
SD–02–1	SCHP–M1
SD–03–1	SCDE–69–M1
SD–04–1	DT–01–69
SD–05–1	SCDE–69
SD–06–1	SRCR
SD–07–1	C3309–C
	ASSEMBLY DETAILS
AD–01–1	T–4A,B,S, T–4D(S), T–4C
AD–02–1	T–4F, T–4FD, T–4FC
AD–03–1	T–FDL, T–FSC–2
AD–04–1	T–SP(1), T–BPD, T–PSD
AD–05–1	T–BDE6PD, T–SDE6PD, TM–EXT–15, T–BDE6D
AD–06–1	TM–9
AD–07–1	TD–1, TD–2
AD–08–1	TGS–1(A), TGS–2(A), TM–GM, TA–2H, 3H, 5EXT
AD–09–1	TGS–OHG–1(A), TG–OHG–2(A), TA–P1,2, TG–26
AD–10–1	TM–101 & TM–103, TP–A
AD–11–1	DPR–OPGW, DPR–795, DPR–EHS
AD–12–1	T–2S5, 2S6, T–2SPD2, T–R5D, T–RPD
	GUYING DETAILS
TMG–2G	STR 2A–2
TMG–MOD–1	STR 2A–1
TMG–MOD–2	STR 2A–3

DRAWING #	DRAWING DESCRIPTION
	STAKING SHEETS
SS–01	STR SUB 1 – STR CT2–3
	PHASING DIAGRAM
PH–01	PHASING DIAGRAM
	SAG TABLES 795 KCMIL 45/7 ACSR "TERN"
STC–01–1	STR SUB 1 – STR 2A, STR 2A – STR 2A–2, INITIAL
STC–02–1	STR 2A–2 – STR 2A–3, FINAL
	SAG TABLES AFL CC–55/443 "DNO–4748" OPGW
STF–01–1	STR SUB 1 – STR 2A, STR 2A – STR 2A–1, INITIAL
STF–02–1	STR 2A–1 – STR CT1, FINAL
	SAG TABLES 3/8" 7 STRAND EHS
STS–01–1	STR SUB 1 – STR 2A, STR 2A–1 – STR 2A–2, INITIAL
	SAG TABLES 3/8" 7 STRAND HS
STS–02–1	STR 2A–1 – STR CT1–1, STR 2A–2 – 2A–3, STR 2A–2 – CT3–3, STR 2A–2 – STR CT2–3, FINAL
	MATERIAL LIST
ML–01	MATERIAL LIST
	APPENDIX
	WEST RAPID CITY SUBSTATION REFERENCE DRAWINGS
WRC–C–101	GENERAL ARRANGEMENT
WRC–C–305	SECTION G AND H
WRC–C–320	BUS CONNECTION DETAILS
WRC–C–321	BUS CONNECTION DETAILS
WRC–C–380	MATERIAL LIST

1	REVISION
DESCRIPTION: MOVED STR 2A	
NAME: DATE: REG. NO.:	
PROJECT #: 10114217	ISSUE DATE: 11/15/2019
PROJECT MANAGER: J. ELLSWORTH	
DESIGN ENGINEER: J. PANKRATZ	
DRAWN BY: Z. JANSEN	

2	REVISION
DESCRIPTION: RECORD DRAWINGS	
NAME: DATE: REG. NO.:	
PROJECT #: 10114217	ISSUE DATE: 6/12/2020
PROJECT MANAGER: J. ELLSWORTH	
DESIGN ENGINEER: J. PANKRATZ	
DRAWN BY: Z. JANSEN	

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

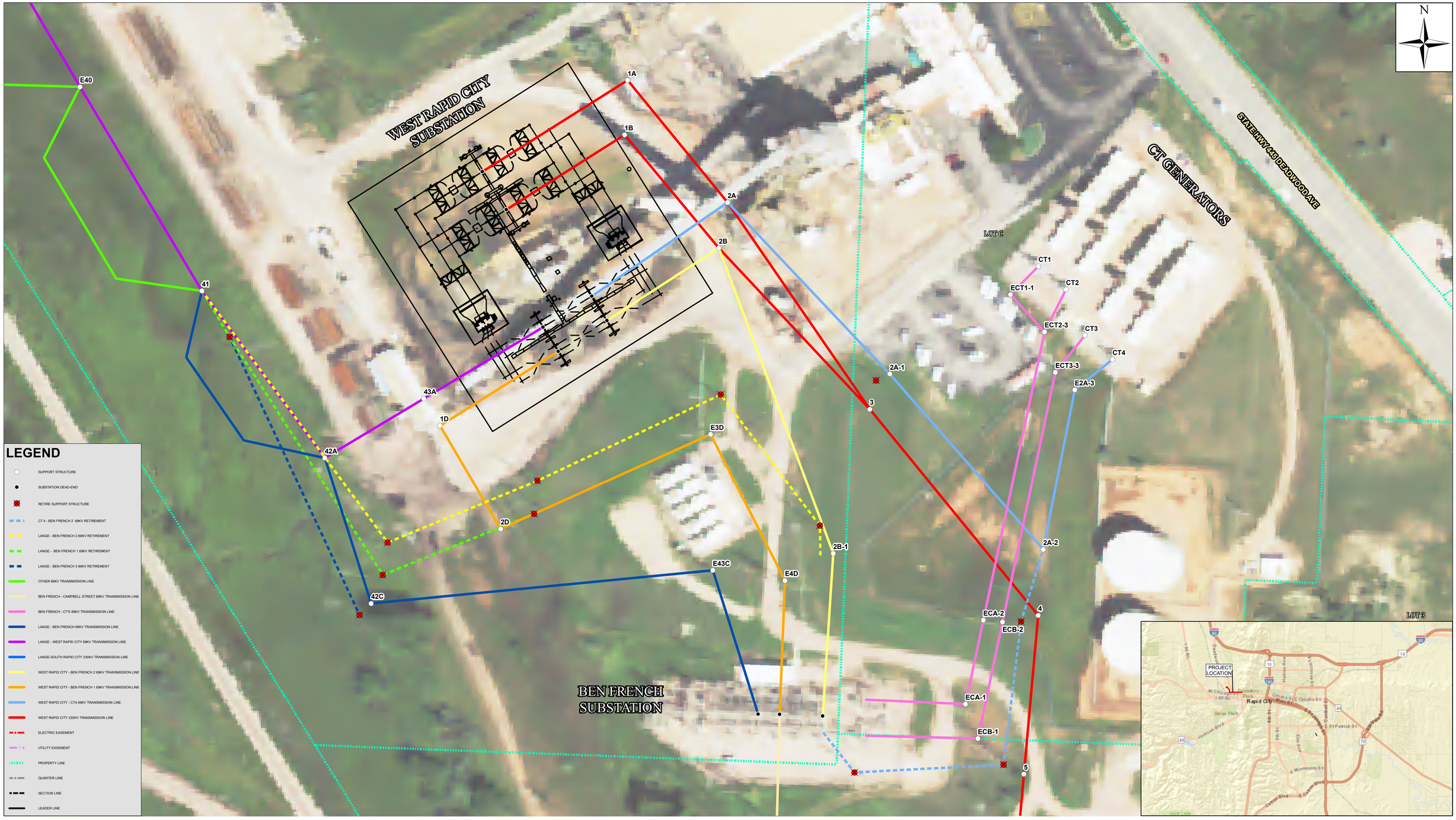
WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

DRAWING LIST

0 1" 2"

FILENAME BHE–DL–01–01.DWG
SCALE NONE

SHEET **DL-01**



LEGEND

- SUPPORT STRUCTURE
- SUBSTATION DEAD-END
- RETIRE SUPPORT STRUCTURE
- CT 4 - BEN FRENCH 2 69KV RETIREMENT
- LANGE - BEN FRENCH 2 69KV RETIREMENT
- LANGE - BEN FRENCH 1 69KV RETIREMENT
- LANGE - BEN FRENCH 3 69KV RETIREMENT
- OTHER 69KV TRANSMISSION LINE
- BEN FRENCH - CAMPBELL STREET 69KV TRANSMISSION LINE
- BEN FRENCH - CT'S 69KV TRANSMISSION LINE
- LANGE - BEN FRENCH 69KV TRANSMISSION LINE
- LANGE - WEST RAPID CITY 69KV TRANSMISSION LINE
- LANGE-SOUTH RAPID CITY 230KV TRANSMISSION LINE
- WEST RAPID CITY - BEN FRENCH 2 69KV TRANSMISSION LINE
- WEST RAPID CITY - BEN FRENCH 1 69KV TRANSMISSION LINE
- WEST RAPID CITY - CT4 69KV TRANSMISSION LINE
- WEST RAPID CITY 230KV TRANSMISSION LINE
- ELECTRIC EASEMENT
- UTILITY EASEMENT
- PROPERTY LINE
- QUARTER LINE
- SECTION LINE
- LEADER LINE

Black Hills Energy
Improving life with energy

HDR

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	09/11/2019	ISSUE FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CADD TECHNICIAN	Z. JANSEN
GIS TECHNICIAN	S.GRIFFIN
PROJECT NUMBER	10114217

BLACK HILLS POWER
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
69KV TERMINATIONS

ROUTE MAP

0 20 40 80 Feet

FILENAME	West Rapid City 69kV Terminations 22x34
SCALE	1 inch = 50 feet

SHEET
RM-01



PLAN NOTES:

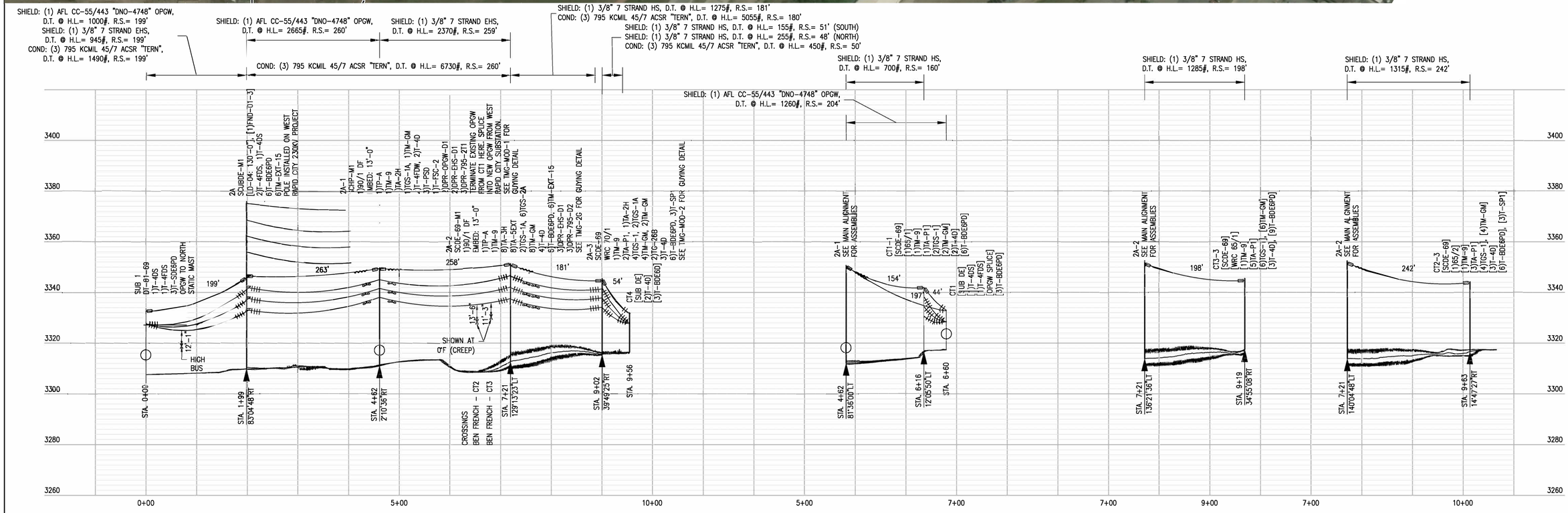
- ● STRUCTURE
- —— ALIGNMENT
- — — ALIGNMENT OF ANOTHER LINE

NOTES:

1. [XXX] – EXISTING ASSEMBLY
2. *XXX – RETIREMENT ASSEMBLY
3. T[XXX] – TRANSFER UNIT ASSEMBLY
4. SHIELD WIRE SHOWN AT 60°F (CREEP)
5. CONDUCTOR SHOWN AT 212°F (MAX SAG)

PROFILE NOTES:

- CONDUCTOR DAMPER
- SHIELD DAMPER
- ◯ OPGW SPLICE



		PROJECT MANAGER	J. ELLSWORTH
		PROJECT ENGINEER	J. PANKRATZ
		DESIGN ENGINEER	J. PANKRATZ
		CAD TECHNICIAN	Z. JANSEN
2	6/12/2020 RECORD DRAWINGS		
0	9/11/2019 ISSUE FOR CONSTRUCTION	**E. O. R.**	J. BRUNNER
ISSUE	**DATE** **DESCRIPTION**	**PROJECT NUMBER**	10114217

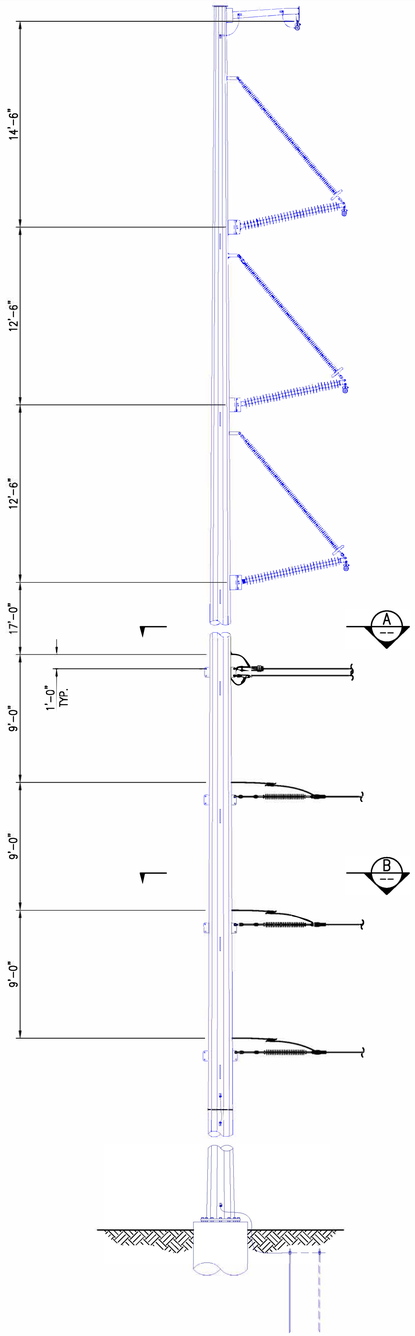
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

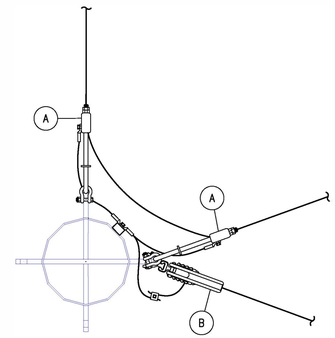
WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

PLAN AND PLOT

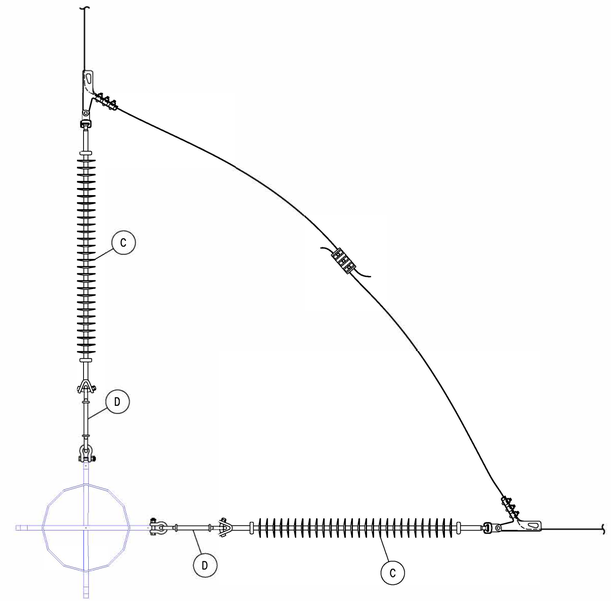
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FILENAME BHE-PP-01-D-1.DWG
SCALE H:1"=100' V:1"=20'
SHEET PP-01





SECTION A
SHIELD
SCALE: N.T.S.



SECTION B
PHASE
SCALE: N.T.S.

LIST OF ASSEMBLIES (CALLED OUT SEPARATELY)			
ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T-4FDS	OPGW DEADEND ASSEMBLY - STEEL POLE	2
B	T-4DS	OHSW DEADEND ASSEMBLY - STEEL POLE	1
C	T-BDE6PD	CONDUCTOR DEADEND ASSEMBLY	6
D	TM-EXT-15	EXTENSION LINK ASSEMBLY	6

NOTES:

1. SEE LOAD AND DESIGN DRAWINGS FOR STEEL DESIGN DETAILS.
2. SEE STEEL POLE MANUFACTURING DRAWINGS FOR STEEL POLE DETAILS.
3. STATIC/CONDUCTOR ASSEMBLIES ARE SEPARATE UNITS.
4. BLUE ASSEMBLIES ARE CALLED OUT IN THE WEST RAPID CITY 230 KV TRANSMISSION LINE.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
69KV SINGLE CIRCUIT UNDERBUILD DEADEND
NON-TYPICAL

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: SCUBDE-M1

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

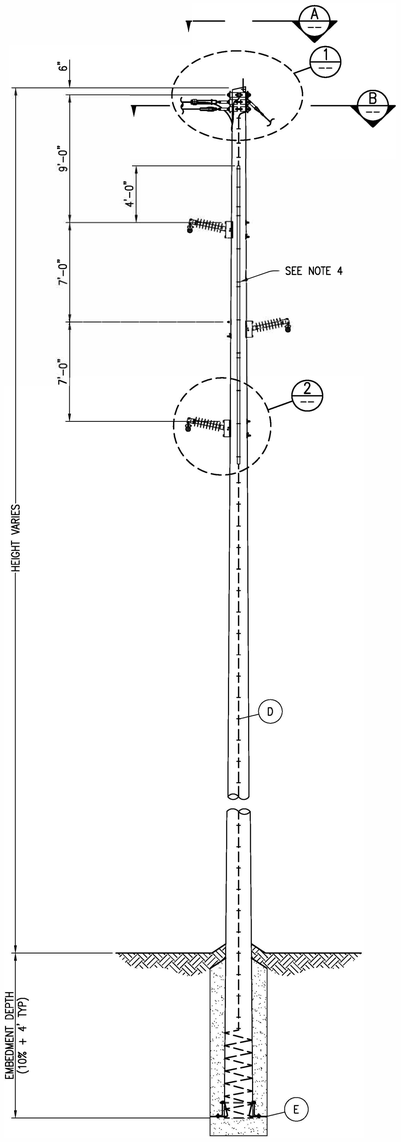
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

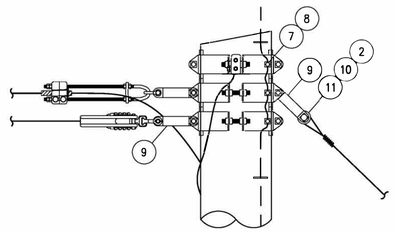
STRUCTURE DETAILS
69KV SINGLE CIRCUIT UNDERBUILD DEADEND
STR 2A

0 1" 2"

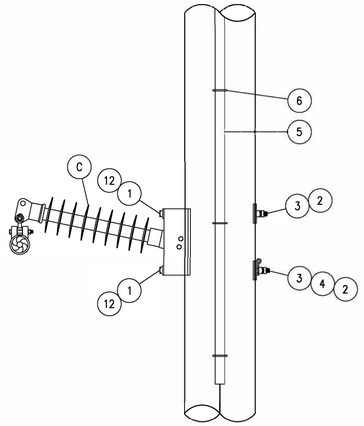
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SCALE: 3/16"=1'-0"
SHEET: SD-01-1



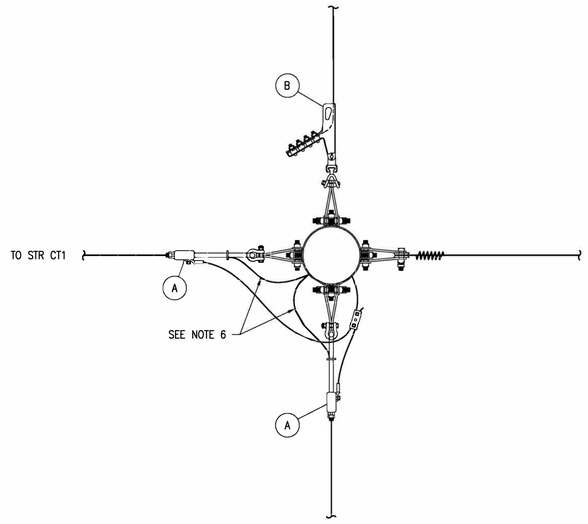
ELEVATION VIEW
SCALE: N.T.S.



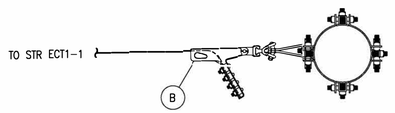
DETAIL 1
SHIELD
SCALE: N.T.S.



DETAIL 2
PHASE
SCALE: N.T.S.



VIEW A
SHIELD
SCALE: N.T.S.



SECTION B
SHIELD
SCALE: N.T.S.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	–	BOLT, MACHINE, 7/8" X REQ'D LENGTH	B270	HUGHES	–	6
1.1	20–7818	BOLT, MACHINE, 7/8" X 18"	B2718	HUGHES	B818–6	–
1.2	20–7820	BOLT, MACHINE, 7/8" X 20"	B2720	HUGHES	B820–6	–
1.3	20–7822	BOLT, MACHINE, 7/8" X 22"	B2722	HUGHES	B822–6	–
1.4	20–7824	BOLT, MACHINE, 7/8" X 24"	B2724	HUGHES	B824–6	–
2	22–7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	7
3	22–4425	WASHER, SQ. CURVED, 4" X 1/4", 15/16" HOLE	W504	HUGHES	SCW4–80	6
4	N.S.	WASHER, SPRING, 15/16" HOLE	W207	HUGHES	2702.8	3
5	46–2503	MOULDING, GROUNDWIRE, 1 11/16" X 1 3/16" X 8'–0"	P300	HUGHES	2503.8	3
6	46–2504	MOULDING STAPLES, 3–1/2" X 1 3/4"	P400	HUBBELL	C2050222	15
7	–	3108 POLE BANDS, HEAVY DUTY, REQ'D POLE DIAMETER	–	HUGHES	–	3
7.1	18–1116	3108 POLE BANDS, HEAVY DUTY, 7"–10" POLE	F110	HUGHES	3108.5	–
7.2	18–1117	3108 POLE BANDS, HEAVY DUTY, 9"–12" POLE	F111	HUGHES	3108.6	–
8	46–2718	CLIP, BONDING, WITH 1/2" X 1 1/2" BOLT, 7/16" MAX. WIRE	P104	HUGHES	2718.55	3
9	14–3154	LINK, CONNECTING, 3/8" X 2" X 7 1/2", 15/16" HOLES, 38K LBS	F203	HUGHES	3154	10
10	20–7803	BOLT, MACHINE, 7/8" X 3"	B273	HUGHES	B83–2	1
11	18–2808	GUY, ROLLER, 1 1/8" WR, 15/16" HOLE	G100	HUGHES	28082	1
12	N.S.	WASHER, ROUND, 2" X 1/4", 15/16" HOLE	W410	HUGHES	RW2–80	6

TYPICAL ADDITIONAL ASSEMBLIES (CALLED OUT SEPARATELY)

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T–4FDW	OPGW DEADEND ASSEMBLY – WOOD POLE	2
B	T–4D	OHSW DEADEND ASSEMBLY – WOOD POLE	2
C	T–PSD	69KV HORIZONTAL POST ASSEMBLY	3
D	TM–9	WOOD POLE GROUNDING ASSEMBLY	1
E	TP–A	POLE ANCHOR ASSEMBLY	1

TYPICAL BOLTS (QTY)*

ITEM NO.	POLE CLASS		
	2–1	H1–H2	H3–H4
1.1	4	2	–
1.2	2	2	2
1.3	–	2	2
1.4	–	–	2

*SEE NOTE 3

TYPICAL POLE BANDS (QTY)*

ITEM NO.	POLE CLASS		
	2–1	H1–H2	H3–H4
7.1	3	–	–
7.2	–	3	3

NOTES:

1. DRILLED HOLES SHALL BE 1/16" GREATER THAN THE SPECIFIED BOLT DIAMETER.
2. FIELD DRILLED HOLES SHALL BE THOROUGHLY TREATED.
3. BOLT LENGTHS AND STATIC WIRE SUPPORT LENGTHS ARE ESTIMATED BASED ON STANDARD CLASS DOUGLAS FIR POLE DIMENSIONS. ACTUAL POLE DIAMETERS MAY VARY.
4. WOOD MOULDING SHALL BE STAPLED TO THE POLE WITH (5) STAPLES PER 8'–0" MOULDING STICK. FIRST STAPLES 6" FROM BOTH ENDS.
5. POLE GROUNDS, GUYS, ANCHORS, POLE ANCHORS, AND STATIC/CONDUCTOR ASSEMBLIES ARE SEPARATE UNITS.
6. OPGW SPLICE LOCATION. TERMINATE EXISTING OPGW FROM STR CT1 HERE.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
69KV TANGENT POST
NON-TYPICAL

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: SCHP-M1

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

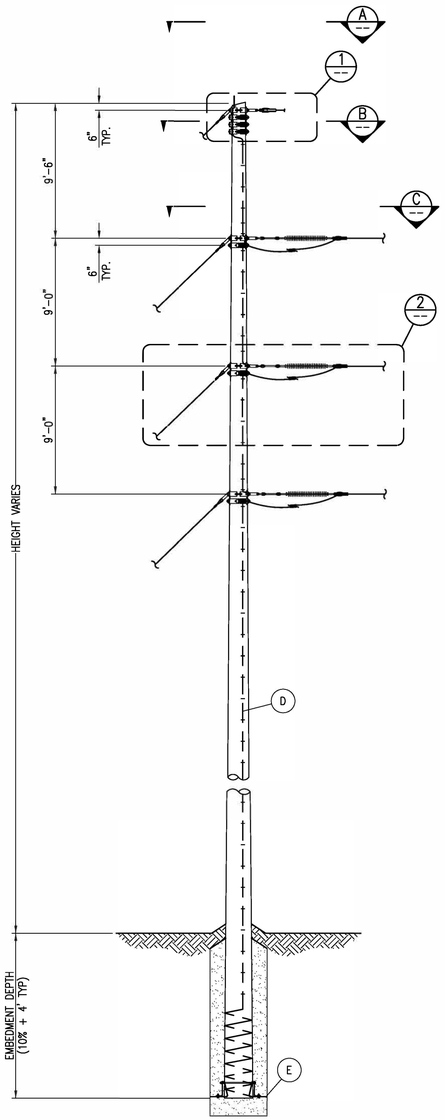
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

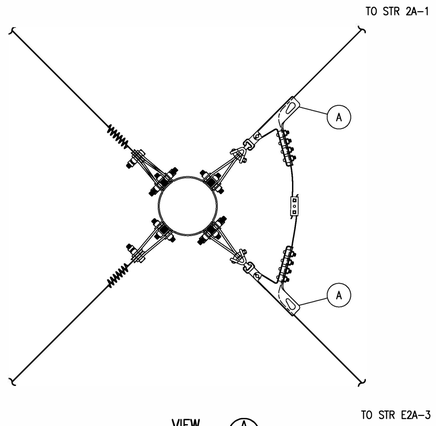
STRUCTURE DETAILS
69KV TANGENT POST
STR 2A-1

0 1" 2"

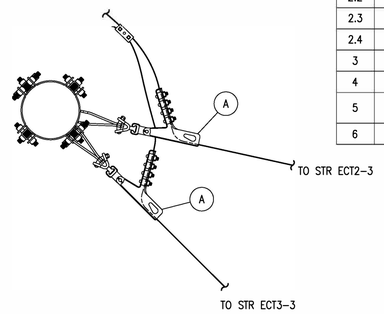
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SCALE: 3/16"=1'–0"
SHEET: SD-02-1



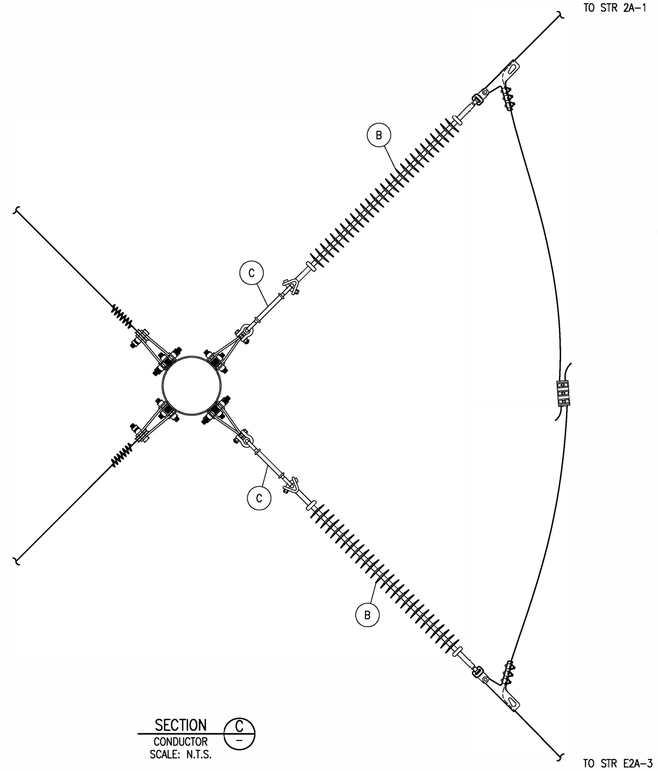
ELEVATION VIEW
SCALE: N.T.S.



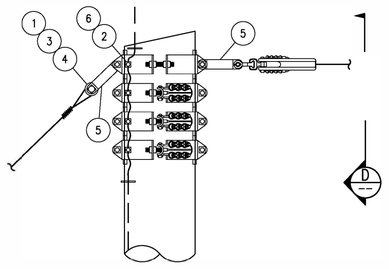
VIEW A
SHIELD
SCALE: N.T.S.



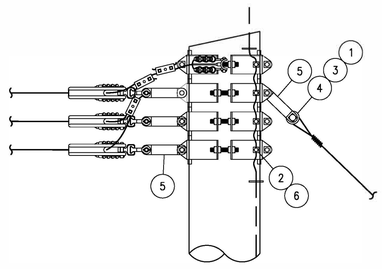
SECTION B
SHIELD
SCALE: N.T.S.



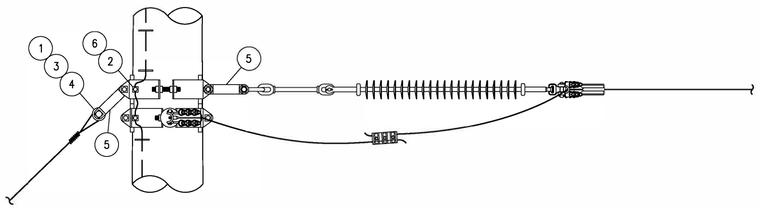
SECTION C
CONDUCTOR
SCALE: N.T.S.



DETAIL 1
SHIELD ATTACHMENT
SCALE: N.T.S.



VIEW D
SHIELD ATTACHMENT
SCALE: N.T.S.



DETAIL 2
CONDUCTOR ATTACHMENT
SCALE: N.T.S.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY.
1	22-7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	8
2	–	3108 POLE BANDS, HEAVY DUTY, REQ'D POLE DIAMETER	–	HUGHES	–	10
2.1	18-1116	3108 POLE BANDS, HEAVY DUTY, 7"-10" POLE	F110	HUGHES	3108.5	–
2.2	18-1117	3108 POLE BANDS, HEAVY DUTY, 9"-12" POLE	F111	HUGHES	3108.6	–
2.3	18-1118	3108 POLE BANDS, HEAVY DUTY, 11"-14" POLE	F112	HUGHES	3108.7	–
2.4	18-1119	3108 POLE BANDS, HEAVY DUTY, 13"-16" POLE	F113	HUGHES	3108.8	–
3	20-7803	BOLT, MACHINE, 7/8" X 3"	B273	HUGHES	B83-2	8
4	18-2808	GUY, ROLLER, 1 1/8" WR, 15/16" HOLE	G100	HUGHES	28082	8
5	14-3154	LINK, CONNECTING, 3/8" X 2" X 7 1/2", 15/16" HOLES, 38K LBS	F203	HUGHES	3154	36
6	46-2718	CLIP, BONDING, WITH 1/2" X 1 1/2" BOLT, 7/16" MAX. WIRE	P104	HUGHES	2718.55	10

TYPICAL ADDITIONAL ASSEMBLIES (CALLED OUT SEPARATELY)

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T-4D	OHSW DEADEND ASSEMBLY	4
B	T-BDE6PD	CONDUCTOR DEADEND ASSEMBLY	6
C	TM-EXT-15	15" EXTENSION LINK ASSEMBLY	6
D	TM-9	WOOD POLE GROUNDING ASSEMBLY	1
E	TP-A	POLE ANCHOR ASSEMBLY	1

TYPICAL POLE BANDS (QTY)*

ITEM NO.	POLE CLASS		
	2-1	H1-H2	H3-H4
2.1	4	–	–
2.2	4	4	4
2.3	2	4	2
2.4	–	2	4

*SEE NOTE 3

NOTES:

1. DRILLED HOLES SHALL BE 1/16" GREATER THAN THE SPECIFIED BOLT DIAMETER.
2. FIELD DRILLED HOLES SHALL BE THOROUGHLY TREATED.
3. BOLT LENGTHS AND POLE BAND DIAMETERS ARE ESTIMATED BASED ON STANDARD CLASS DOUGLAS FIR POLE DIMENSIONS. ACTUAL POLE DIAMETERS MAY VARY.
4. BOND ALL HARDWARE TO POLE GROUND UNIT.
5. POLE GROUND, GUYS, ANCHORS, POLE ANCHORS, AND STATIC/CONDUCTOR ASSEMBLIES ARE SEPARATE UNITS.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
69kV SINGLE CIRCUIT DEADEND
NON-TYPICAL

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: SCDE-69-M1

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

STRUCTURE DETAILS
69KV SINGLE CIRCUIT DEADEND
WOOD POLE
STR 2A-2

0 1" 2"

FILENAME: BHE-SD-03-D-1.DWG
SCALE: 3/16"=1'-0"
SHEET: **SD-03-1**

LIST OF PARTS

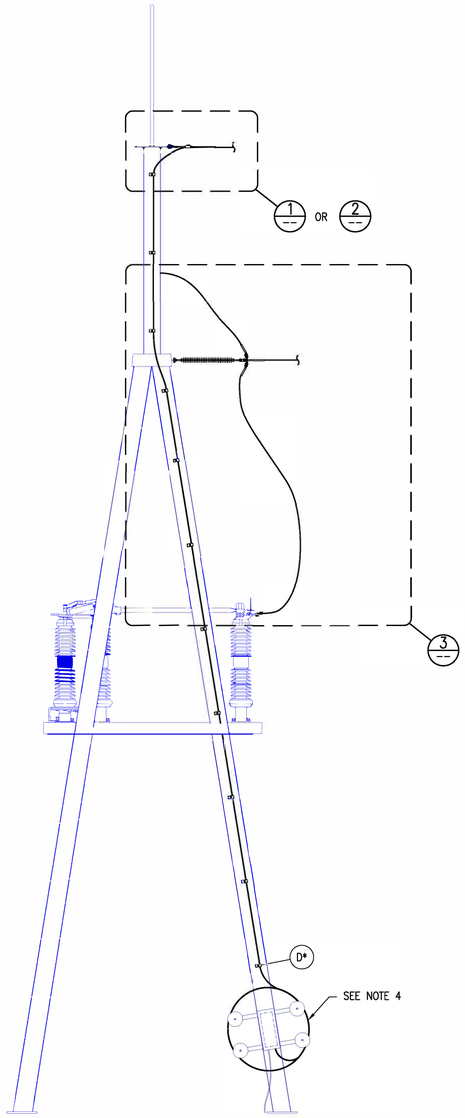
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N/A	CLAMP, SINGLE BOLT, #4 STR CU TO 4/0 AWG STR. CU	Q551	HUBBELL	LC1602	1
2	N/A	CLAMP, VISE TYPE, 3/8" EHS TO 4/0 AWG STR CU	Q552	HUBBELL	GA9040L55	1

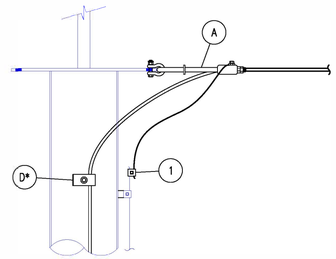
LIST OF ASSEMBLIES (CALLED OUT SEPARATELY)

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T-4FDS	OPGW DEADEND ASSEMBLY - STEEL POLE	1
B	T-4D	OHSW DEADEND ASSEMBLY	1
C	T-SDE6PD	CONDUCTOR SUBSTATION DEADEND	3
D*	N/A	DOWNLEAD CLAMPS	AS REQ'D*

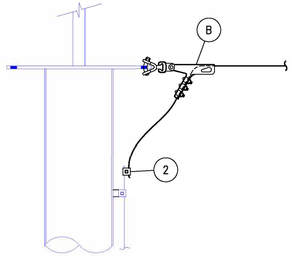
NOTES:

1. BLUE ASSEMBLIES ARE SUPPLIED AND INSTALLED BY THE SUBSTATION CONTRACTOR.
2. (*) ITEMS ARE SUPPLIED BY THE SUBSTATION CONTRACTOR AND INSTALLED BY THE TRANSMISSION CONTRACTOR.
3. MINIMUM BEND RADIUS FOR OPGW IS 9 INCHES.
4. COIL 50 FEET OF OPGW ON THE COIL BRACKET, CAP AND TAPE THE ENDS.
5. COORDINATE WITH SUBSTATION CONTRACTOR FOR PARTS SUPPLIED BY SUBSTATION.

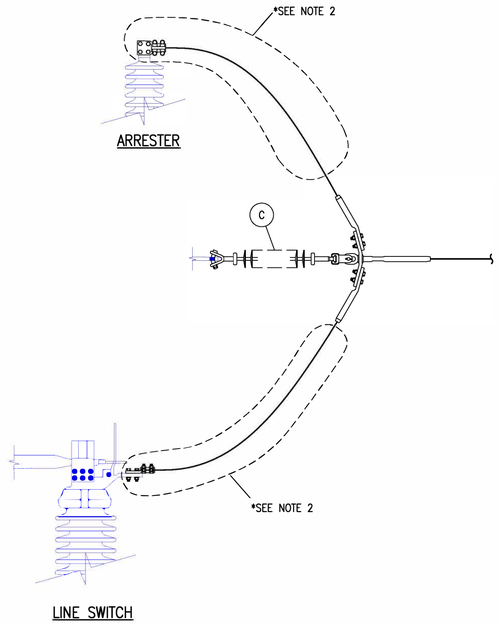




DETAIL 1
OPGW
SCALE: N.T.S.



DETAIL 2
OHSW
SCALE: N.T.S.



DETAIL 3
PHASE
SCALE: N.T.S.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
SUBSTATION DEADEND TOWER CONNECTION

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: DT-01-69

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

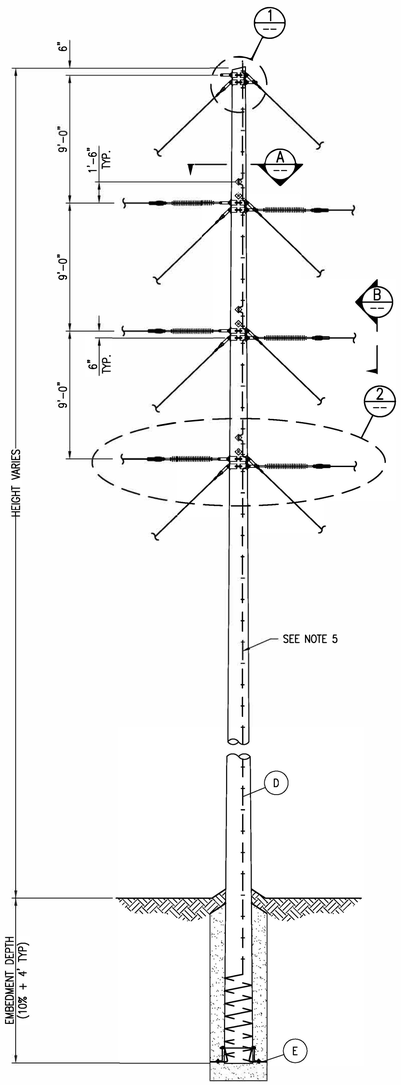
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

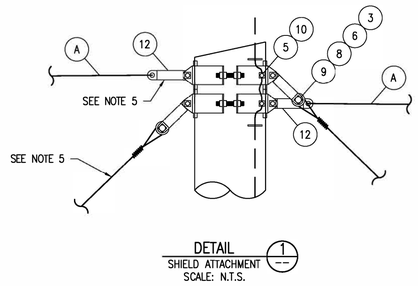
STRUCTURE DETAILS
SUBSTATION DEADEND TOWER CONNECTION

0 1" 2"

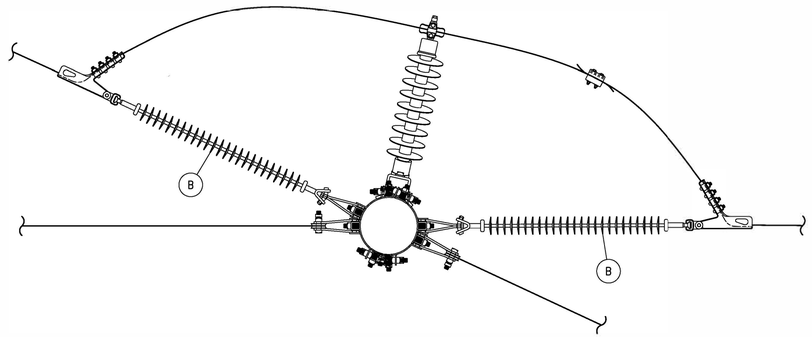
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SCALE: 3/16"=1'-0"
SHEET: **SD-04-1**



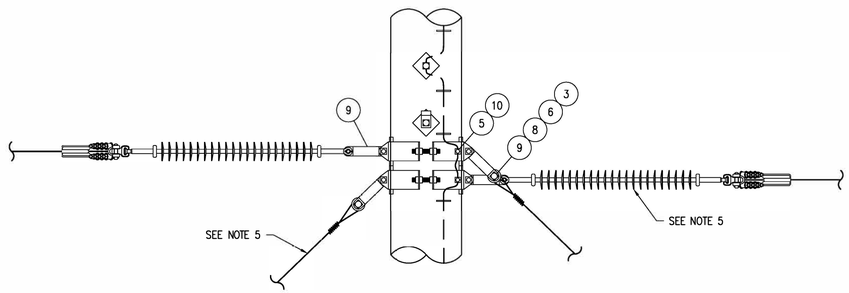
ELEVATION VIEW
SCALE: N.T.S.



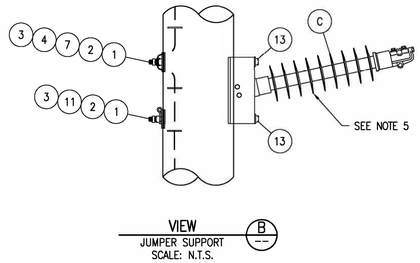
DETAIL (1)
SHIELD ATTACHMENT
SCALE: N.T.S.



SECTION (A)
SCALE: N.T.S.



DETAIL (2)
CONDUCTOR ATTACHMENT
SCALE: N.T.S.



VIEW (B)
JUMPER SUPPORT
SCALE: N.T.S.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY.
1	–	BOLT, MACHINE, 7/8" X REQ'D LENGTH	B270	HUGHES	–	6
1.1	20–7818	BOLT, MACHINE, 7/8" X 18"	B2718	HUGHES	B818–6	–
1.2	20–7820	BOLT, MACHINE, 7/8" X 20"	B2720	HUGHES	B820–6	–
1.3	20–7822	BOLT, MACHINE, 7/8" X 22"	B2722	HUGHES	B822–6	–
1.4	20–7824	BOLT, MACHINE, 7/8" X 24"	B2724	HUGHES	B824–6	–
2	22–4425	WASHER, SQ. CURVED, 4" X 1/4", 15/16" HOLE	W504	HUGHES	SCW4–80	6
3	22–7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	14
4	47–0242	NUT, SQUARE, 7/8"	N107	HUGHES	N80	3
5	–	3108 POLE BANDS, HEAVY DUTY, REQ'D POLE DIAMETER	–	HUGHES	–	8
5.1	18–1116	3108 POLE BANDS, HEAVY DUTY, 7"–10" POLE	F110	HUGHES	3108.5	–
5.2	18–1117	3108 POLE BANDS, HEAVY DUTY, 9"–12" POLE	F111	HUGHES	3108.6	–
5.3	18–1118	3108 POLE BANDS, HEAVY DUTY, 11"–14" POLE	F112	HUGHES	3108.7	–
5.4	18–1119	3108 POLE BANDS, HEAVY DUTY, 13"–16" POLE	F113	HUGHES	3108.8	–
6	20–7803	BOLT, MACHINE, 7/8" X 3"	B273	HUGHES	B83–2	8
7	46–2728	CLIP, BONDING, FOR 7/8" DIA. BOLT, 5/16" MAX. WIRE	P207	HUGHES	2727.8	3
8	18–2808	GUY, ROLLER, 1 1/8" WR, 15/16" HOLE	G100	HUGHES	28082	8
9	14–3154	LINK, CONNECTING, 3/8" X 2" X 7 1/2", 15/16" HOLES, 38K LBS	F203	HUGHES	3154	28
10	46–2718	CLIP, BONDING, WITH 1/2" X 1 1/2" BOLT, 7/16" MAX. WIRE	P104	HUGHES	2718.55	8
11	N.S.	WASHER, SPRING, 15/16" HOLE	W207	HUGHES	2702.8	3
12	14–3152	LINK, CONNECTING, 1/4" X 2" X 7 1/2", 15/16" HOLES, 24K LBS	F201	HUGHES	3152	4
13	N.S.	WASHER, ROUND, 2" X 1/4", 15/16" HOLE	W410	HUGHES	RW2–80	6

TYPICAL ADDITIONAL ASSEMBLIES (CALLED OUT SEPARATELY)

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T–4D	OHSW DEADEND ASSEMBLY	2
	T–4FDW	OPGW DEADEND ASSEMBLY	
B	T–BDE6PD	CONDUCTOR DEADEND ASSEMBLY – POLYMER	6
	T–BDE6D	CONDUCTOR DEADEND ASSEMBLY – BELLS	
C	T–SP1	CONDUCTOR JUMPER ASSEMBLY	3
D	TM–9	WOOD POLE GROUNDING ASSEMBLY	1
E	TP–A	POLE ANCHOR ASSEMBLY	1

TYPICAL BOLTS (QTY)*

ITEM NO.	POLE CLASS		
	2–1	H1–H2	H3–H4
1.1	4	–	–
1.2	2	4	–
1.3	–	2	4
1.4	–	–	2

*SEE NOTE 3

TYPICAL POLE BANDS (QTY)*

ITEM NO.	POLE CLASS		
	2–1	H1–H2	H3–H4
5.1	2	–	–
5.2	4	2	2
5.3	2	4	2
5.4	–	2	4

*SEE NOTE 3

NOTES:

1. DRILLED HOLES SHALL BE 1/16" GREATER THAN THE SPECIFIED BOLT DIAMETER.
2. FIELD DRILLED HOLES SHALL BE THOROUGHLY TREATED.
3. BOLT LENGTHS AND POLE BAND DIAMETERS ARE ESTIMATED BASED ON STANDARD CLASS DOUGLAS FIR POLE DIMENSIONS. ACTUAL POLE DIAMETERS MAY VARY.
4. BOND ALL HARDWARE TO POLE GROUND UNIT.
5. POLE GROUND, GUYS, ANCHORS, POLE ANCHORS, JUMPER SUPPORT, AND STATIC/CONDUCTOR ASSEMBLIES ARE SEPARATE UNITS.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
69kV SINGLE CIRCUIT DEADEND
LIGHT TO HEAVY ANGLE WITH POST

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: SCDE-69

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

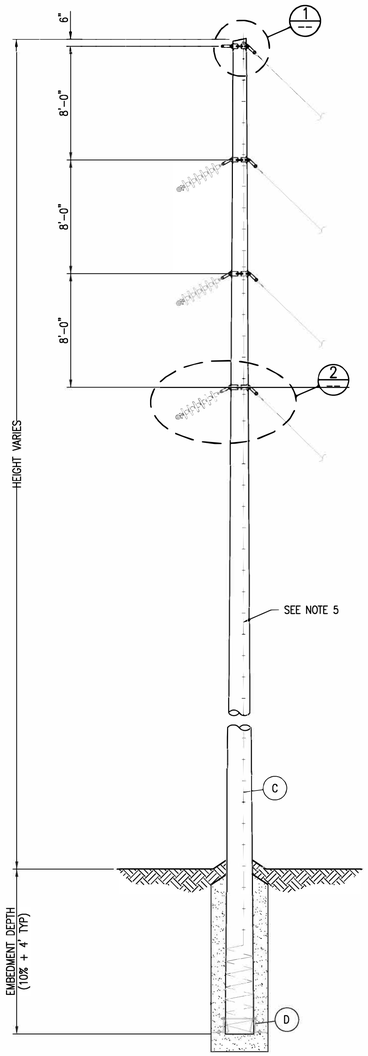
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

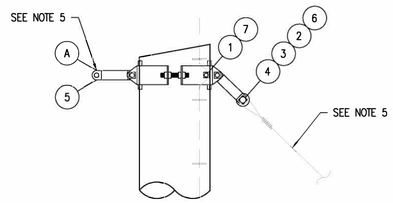
STRUCTURE DETAILS
69KV SINGLE CIRCUIT DEADEND

0 1" 2"

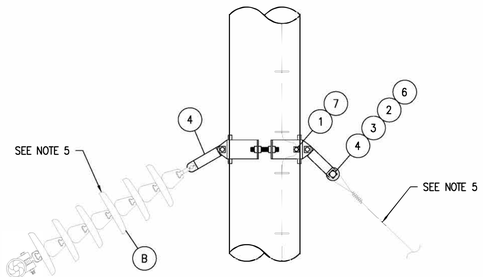
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SCALE: 3/16"=1'–0"
SHEET: SD-05-1



ELEVATION VIEW
SCALE: N.T.S.



DETAIL 1
SCALE: N.T.S.



DETAIL 2
SCALE: N.T.S.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY.
1	–	3108 POLE BANDS, HEAVY DUTY, REQ'D POLE DIAMETER	–	HUGHES	–	4
1.1	18–1116	3108 POLE BANDS, HEAVY DUTY, 7"–10" POLE	F110	HUGHES	3108.5	–
1.2	18–1117	3108 POLE BANDS, HEAVY DUTY, 9"–12" POLE	F111	HUGHES	3108.6	–
1.3	18–1118	3108 POLE BANDS, HEAVY DUTY, 11"–14" POLE	F112	HUGHES	3108.7	–
1.4	18–1119	3108 POLE BANDS, HEAVY DUTY, 13"–16" POLE	F113	HUGHES	3108.8	–
2	20–7803	BOLT, MACHINE, 7/8" X 3"	B273	HUGHES	B83–2	4
3	18–2808	GUY, ROLLER, 1 1/8" WR, 15/16" HOLE	G100	HUGHES	28082	4
4	14–3154	LINK, CONNECTING, 3/8" X 2" X 7 1/2", 15/16" HOLES, 38K LBS	F203	HUGHES	3154	14
5	14–3151	LINK, CONNECTING, 1/4" X 3" X 9 1/2", 15/16" MT HOLE, 1 1/4" ATT HOLE, 24K LBS	F200	HUGHES	3151	2
6	22–7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	4
7	46–2718	CLIP, BONDING, WITH 1/2" X 1 1/2" BOLT, 7/16" MAX. WIRE	P104	HUGHES	2718.55	4

TYPICAL ADDITIONAL ASSEMBLIES (CALLED OUT SEPARATELY)

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T–4B	OHSW SUSPENSION ASSEMBLY	1
	T–4C	OHSW DOUBLE SUSPENSION ASSEMBLY	
	T–4BF	OPGW SUSPENSION ASSEMBLY	
	T–4FC	OPGW DOUBLE SUSPENSION ASSEMBLY	
B	T–R5D	CONDUCTOR RUNNING ANGLE – BELLS	3
	T–S25	CONDUCTOR DOUBLE SUSPENSION – BELLS	
	T–RPD	CONDUCTOR RUNNING ANGLE – POLYMER	
	T–2SPD2	CONDUCTOR DOUBLE SUSPENSION – POLYMER	
C	TM–9	WOOD POLE GROUNDING ASSEMBLY	1
D	TP–A	POLE ANCHOR ASSEMBLY	1

TYPICAL POLE BANDS (QTY)*

ITEM NO.	POLE CLASS		
	2–1	H1–H2	H3–H4
1.1	1	–	–
1.2	2	1	1
1.3	1	2	1
1.4	–	1	2

*SEE NOTE 3

NOTES:

1. DRILLED HOLES SHALL BE 1/16" GREATER THAN THE SPECIFIED BOLT DIAMETER.
2. FIELD DRILLED HOLES SHALL BE THOROUGHLY TREATED.
3. POLE BAND DIAMETERS ARE ESTIMATED BASED ON STANDARD CLASS DOUGLAS FIR POLE DIMENSIONS. ACTUAL POLE DIAMETERS MAY VARY.
4. BOND ALL HARDWARE TO THE POLE GROUND UNIT.
5. POLE GROUND, GUYS, ANCHORS, POLE ANCHORS, AND STATIC/CONDUCTOR ASSEMBLIES ARE SEPARATE UNITS.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
69kV SINGLE CIRCUIT RUNNING CORNER

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: SCRC

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

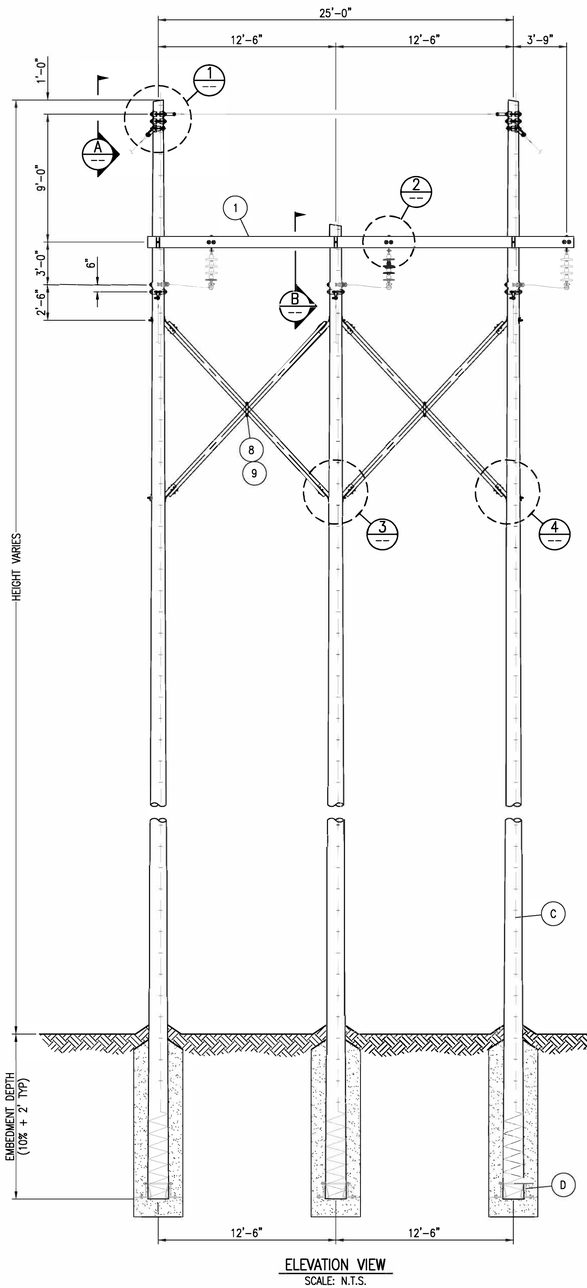
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

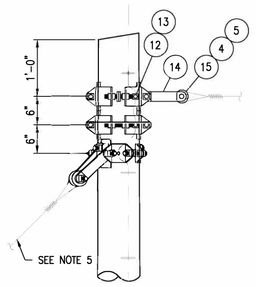
STRUCTURE DETAILS

0 1" 2"

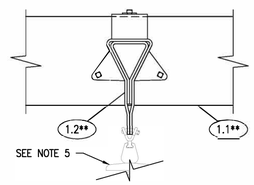
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SHEET: **SD-06-1**



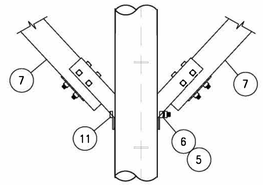
ELEVATION VIEW
SCALE: N.T.S.



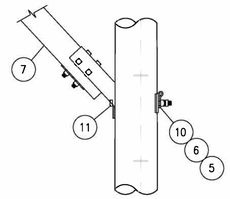
DETAIL 1
SHIELD WITH GUY ATTACHMENT
SCALE: N.T.S.



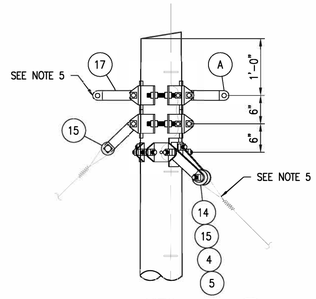
DETAIL 2
ADJUSTABLE SPACER
SCALE: N.T.S.



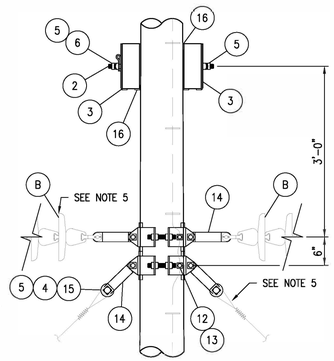
DETAIL 3
X-BRACE CONNECTION – MIDDLE POLE
SCALE: N.T.S.



DETAIL 4
X-BRACE CONNECTION – OUTSIDE POLE
SCALE: N.T.S.



VIEW A
SHIELD AND GUY ATTACHMENT
SCALE: N.T.S.



SECTION B
PHASE, CROSSARM, & GUY ATTACHMENTS
SCALE: N.T.S.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY.
1	N.S.	CROSSARM ASSY. 2 5/8" X 9 1/2" X 30'–0"	X102	HUGHES	C3309.6B	1
1.1	–	CROSSARM, 2 5/8" X 9 1/2" X 30'–0"	–	HUGHES	–	2**
1.2	–	ADJUSTABLE SPACER ASSY.	V300	HUGHES	3414.2AN–100	3**
2	–	ROD, THREADED, DOUBLE END, 7/8" X REQ'D LENGTH, W/2 NUTS	D270	HUGHES	–	3
2.1	N.S.	ROD, THREADED, DOUBLE END, 7/8" X 22", W/2 NUTS	D2722	HUGHES	TR822–5	–
2.2	N.S.	ROD, THREADED, DOUBLE END, 7/8" X 24", W/2 NUTS	D2724	HUGHES	TR824–5	–
2.3	N.S.	ROD, THREADED, DOUBLE END, 7/8" X 26", W/2 NUTS	D2726	HUGHES	TR826–5	–
2.4	N.S.	ROD, THREADED, DOUBLE END, 7/8" X 28", W/2 NUTS	D2728	HUGHES	TR828–5	–
3	N.S.	RIBBED TIE PLATE, 9 1/2" CROSSARM, 7/8" THRU BOLT	V120	HUGHES	1005.81	6
4	20–7803	BOLT, MACHINE, 7/8" X 3"	B273	HUGHES	B83–2	12
5	22–7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	24
6	N.S.	WASHER, SPRING, 15/16" HOLE	W207	HUGHES	2702.8	9
7	N.S.	SET 1042–12–6 X–BRACE, 12'–6" POLE SPACING	Y100	HUGHES	1042–12–6	2
8	N.S.	2840.1B CENTER CLAMP ROD	Y100A	HUGHES	2840.1B	4
9	N.S.	2840.2E CENTER CLAMP STRAP	Y100B	HUGHES	2840.2E	4
10	N.S.	WASHER, CURVED, 4" X 1/4", 15/16" HOLE	W602	HUGHES	CW80	4
11	N.S.	BOLT, MACHINE, 7/8" X REQ'D LENGTH	B270	HUGHES	–	6
11.1	20–7814	BOLT, MACHINE, 7/8" X 14"	B2714	HUGHES	B814–6	–
11.2	20–7816	BOLT, MACHINE, 7/8" X 16"	B2716	HUGHES	B816–6	–
11.3	20–7818	BOLT, MACHINE, 7/8" X 18"	B2718	HUGHES	B818–6	–
11.4	20–7820	BOLT, MACHINE, 7/8" X 20"	B2720	HUGHES	B820–6	–
12	N.S.	310B POLE BANDS, HEAVY DUTY, REQ'D POLE DIAMETER	–	HUGHES	–	12
12.1	18–1116	310B POLE BANDS, HEAVY DUTY, 7"–10" POLE	F110	HUGHES	3108.5	–
12.2	18–1117	310B POLE BANDS, HEAVY DUTY, 9"–12" POLE	F111	HUGHES	3108.6	–
12.3	18–1118	310B POLE BANDS, HEAVY DUTY, 11"–14" POLE	F112	HUGHES	3108.7	–
12.4	18–1119	310B POLE BANDS, HEAVY DUTY, 13"–16" POLE	F113	HUGHES	3108.8	–
13	46–2718	CLIP, BONDING, WITH 1/2" X 1 1/2" BOLT, 7/16" MAX. WIRE	P104	HUGHES	2718.55	12
14	14–3154	LINK, CONNECTING, 3/8" X 2" X 7 1/2", 15/16" HOLES, 38K LBS	F203	HUGHES	3154	36
15	18–2808	GUY, ROLLER, 1 1/8" WR, 15/16" HOLE	G100	HUGHES	28082	12
16	N.S.	FLAT GAIN PLATE, 9 1/2" CROSSARM, 7/8" THRU BOLT	V150	HUGHES	1004.81	6
17	14–3152	LINK, CONNECTING, 1/4" X 2" X 7 1/2", 15/16" HOLES, 24K LBS	F201	HUGHES	3152	8

TYPICAL ADDITIONAL ASSEMBLIES (CALLED OUT SEPARATELY)

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T–4D	OHSW DEADEND ASSEMBLY	2
	T–4FDW	OPGW DEADEND ASSEMBLY	
B	T–BDE6PD	CONDUCTOR DEADEND ASSEMBLY – POLYMER	3
	T–BDE6D	CONDUCTOR DEADEND ASSEMBLY – BELLS	
C	TM–9	WOOD POLE GROUNDING ASSEMBLY	1
D	TP–A	POLE ANCHOR ASSEMBLY	1

TYPICAL THREADED ROD (QTY)*

ITEM NO.	POLE CLASS		
	2–1	H1–H2	H3–H4
2.1	1	–	–
2.2	2	1	–
2.3	–	2	1
2.4	–	–	2

*SEE NOTE 3

TYPICAL POLE BANDS (QTY)*

ITEM NO.	POLE CLASS		
	2–1	H1–H2	H3–H4
12.1	8	–	–
12.2	4	8	–
12.3	–	4	8
12.4	–	–	4

*SEE NOTE 3

TYPICAL BOLTS (QTY)*

ITEM NO.	POLE CLASS		
	2–1	H1–H2	H3–H4
11.1	3	–	–
11.2	3	3	–
11.3	–	3	3
11.4	–	–	3

*SEE NOTE 3

NOTES:

1. DRILLED HOLES SHALL BE 1/16" GREATER THAN THE SPECIFIED BOLT DIAMETER.
2. FIELD DRILLED HOLES SHALL BE THOROUGHLY TREATED.
3. POLE BANDS, BOLT LENGTHS, AND THREADED ROD LENGTHS ARE ESTIMATED BASED ON STANDARD CLASS DOUGLAS FIR POLE DIMENSIONS. ACTUAL POLE DIAMETERS MAY VARY.
4. (**) IMPLIES ITEMS SUPPLIED BY ARM ASSEMBLY MANUFACTURER.
5. POLE GROUND, GUYS, ANCHORS, POLE ANCHORS, CROSS TIE, AND STATIC/CONDUCTOR ASSEMBLIES ARE SEPARATE UNITS.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
69kV 3-POLE DEADEND STRUCTURE

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: C3309-C

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

STRUCTURE DETAILS

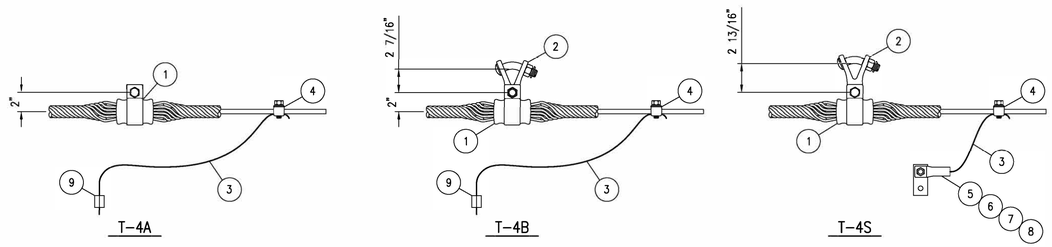
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SCALE: 3/16"=1'–0"
SHEET: SD-07-1

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4A QTY	T-4B QTY	T-4S QTY
1	40-7104	AGS SUSPENSION ASSY, 15K, 3/8" EHS	K400	PREFORMED	AGS-7104	1	1	1
2	48-5207	Y-CLEVIS - EYE, 90, 20K	H901	ANDERSON	YCS-05-90		1	1
3	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			2'	2'	6'
4	46-6810	CLAMP, SINGLE BOLT, VISE TYPE, 3/8" EHS TO #2 STR CU	Q550	HUBBELL	GA9020GLSS	1	1	1
5	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012			1
6	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207			1
7	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS			1
8	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD			1
9	36-0002	GROUND CLAMP, #2 STRANDED TO #4 SOLID	Q501	HOMAC	CC24	1	1	

*MAX. LINE ANGLE = 30°



OHSW SUSPENSION
3/8" EHS 7 STRAND GALV.

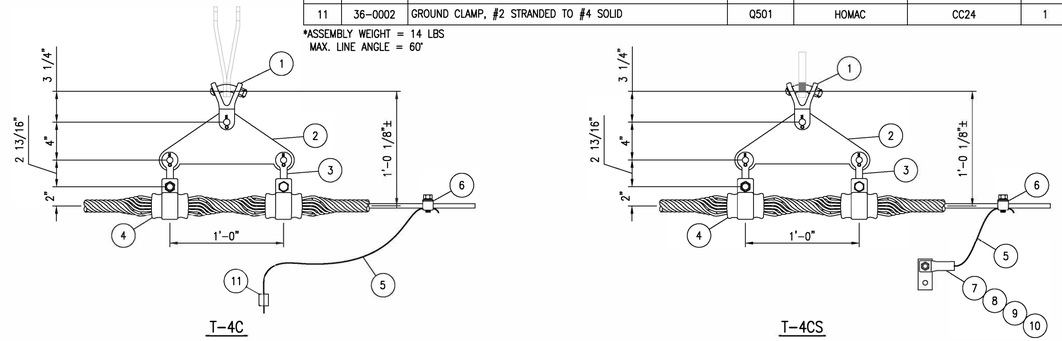
SHEET TITLE
TRANSMISSION ASSEMBLY
OHSW ATTACHMENT

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4A,B,S

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4C QTY	T-4CS QTY
1	48-5208	Y-CLEVIS, CLEVIS, 90, 3 1/4" LONG, 3/4" PIN, 30K	H801	HUBBELL	YCC3090	1	1
2	48-8510	AGS YOKE PLATE, 12" SPACING, 1/2" PLATE, 30K	H700	PREFORMED	YP-5907	1	1
3	48-5206	Y-CLEVIS, EYE, 20K	H900	ANDERSON	YCS-05	2	2
4	40-7804	AGS DOUBLE SUSPENSION ASSEMBLY, 15K, 3/8" EHS	K401	PREFORMED	AGS-7804	1	1
5	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			2'	6'
6	46-6810	CLAMP, SINGLE BOLT, VISE TYPE, 3/8" EHS TO #2 STR CU	Q550	HUBBELL	GA9020GLSS	1	1
7	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012		1
8	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207		1
9	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS		1
10	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD		1
11	36-0002	GROUND CLAMP, #2 STRANDED TO #4 SOLID	Q501	HOMAC	CC24	1	

*ASSEMBLY WEIGHT = 14 LBS
MAX. LINE ANGLE = 60°



OHSW DOUBLE SUSPENSION
3/8" EHS 7 STRAND GALV.

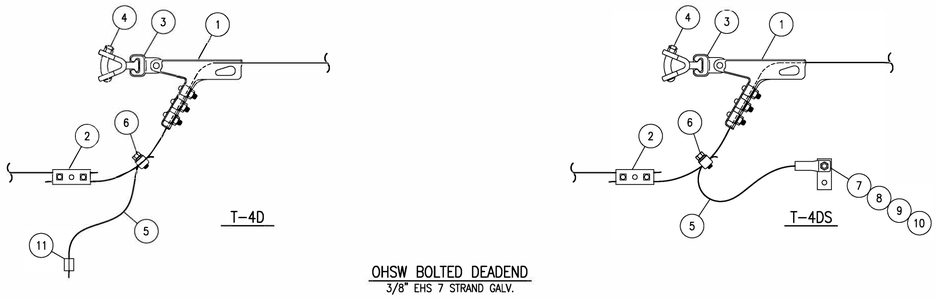
SHEET TITLE
TRANSMISSION ASSEMBLY
OHSW DOUBLE SUSPENSION

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4C

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4D QTY	T-4DS QTY
1	44-4053	STRAIN CLAMP, DE, 20K, 3/8" EHS	L300	HUBBELL	SWDE55N	1	1
2	18-5816	CLAMP, 3-BOLT, 6" LONG, 5/8" BOLT, 5/16" - 1/2" RANGE	Q100	MACLEAN	J931	1	1
3	N.S.	SOCKET EYE, 18K, 1/2" WIDTH, 11/16" HOLE, 2-1/16" LENGTH	H102	HUBBELL	SA04	1	1
4	48-3054	Y-CLEVIS BALL, 30K	H500	HUBBELL	YBC30	1	1
5	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			2'	6'
6	46-6810	CLAMP, SINGLE BOLT, VISE TYPE, 3/8" EHS TO #2 STR CU	Q550	HUBBELL	GA9020GLSS	1	1
7	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012		1
8	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207		1
9	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS		1
10	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD		1
11	36-0002	GROUND CLAMP, #2 STRANDED TO #4 SOLID	Q501	HOMAC	CC24	1	

*ONE ITEM (2) WILL BE REQUIRED FOR EVERY TWO ASSEMBLIES



OHSW BOLTED DEADEND
3/8" EHS 7 STRAND GALV.

SHEET TITLE
TRANSMISSION ASSEMBLY
OHSW DEADEND

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4D(S)

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
OHSW ASSEMBLIES

0 1" 2"

FILENAME BHE-AD-01-D-1.DWG
SCALE N.T.S.

SHEET
AD-01-1

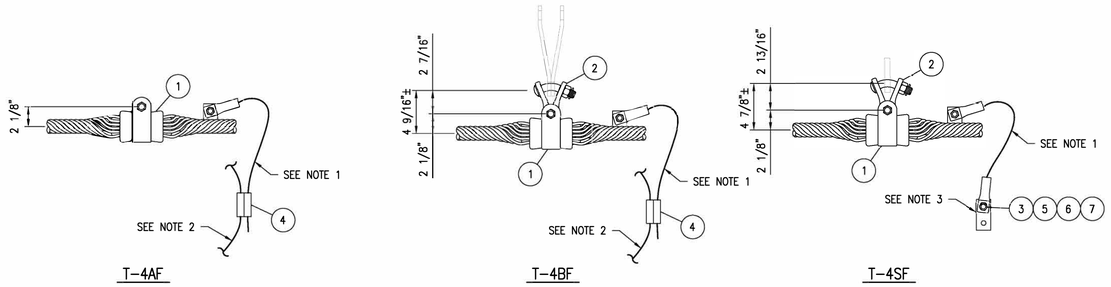
NOTES:

1. #4 STRANDED COPPER WITH CONNECTOR AND BOLTS. FURNISHED WITH ITEM 1.
2. WOOD POLE GROUND.
3. STEEL POLE NEMA PAD.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4AF QTY	T-4BF QTY	T-4SF QTY
1	N.S.	FIBERLIGN SUSPENSION ASSY, W/ GROUNDWIRE	J200	PREFORMED	4300104G	1	1	1
2	48-5207	Y-CLEVIS - EYE, 90, 20K	H901	ANDERSON	YCS-05-90		1	1
3	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012			1
4	N.S.	CONNECTOR, COMPRESSION #4 COPPER TO #4 COPPER	Q500	HOMAC	CC44	1	1	
5	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207			1
6	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS			1
7	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD			1

*MAX. LINE ANGLE = 30°



T-4AF T-4BF T-4SF

OPGW SUSPENSION
0.443" OPGW CABLE

SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW ATTACHMENT

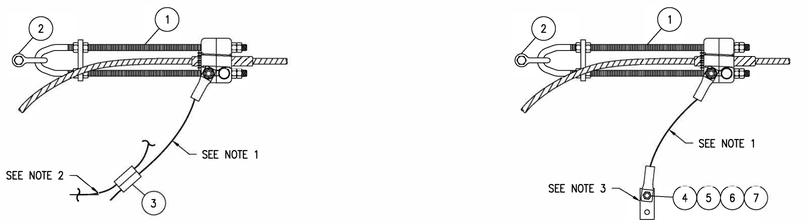
REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4F

NOTES:

1. #4 STRANDED COPPER WITH CONNECTOR AND BOLTS. FURNISHED WITH ITEM 1.
2. WOOD POLE GROUND.
3. STEEL POLE NEMA PAD.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4FDW QTY	T-4FDS QTY
1	N.S.	FIBER OPTIC DEADEND, 18" U-BOLT (48 FIBER), W/GROUNDWIRE	J300	PREFORMED	2801303G	1	1
2	N.S.	ANCHOR, SHACKLE, 3" LONG, 3/4" DIA., 7/8" DIA. PIN, 35K LBS	H602	HUGHES	2865-B3	1	1
3	N.S.	CONNECTOR, COMPRESSION #4 COPPER TO #4 COPPER	Q500	HOMAC	CC44	1	
4	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012		1
5	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207		1
6	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS		1
7	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD		1



T-4FDW T-4FDS

OPGW DEADEND
0.443" OPGW CABLE

SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW DEADEND

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4FD

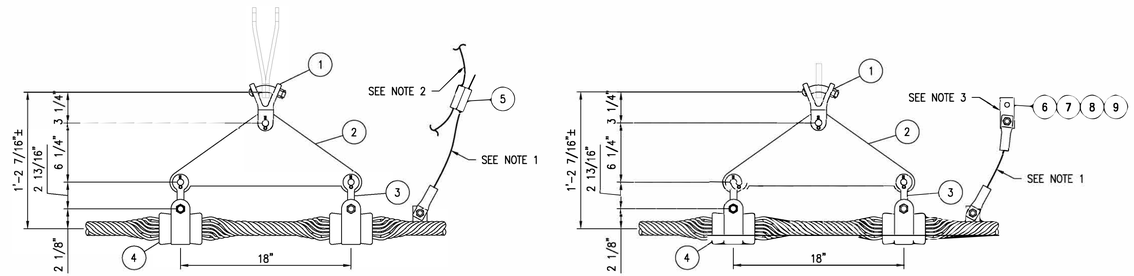
NOTES:

1. #4 STRANDED COPPER WITH CONNECTOR AND BOLTS. FURNISHED WITH ITEM 1.
2. WOOD POLE GROUND.
3. STEEL POLE NEMA PAD.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4FC QTY	T-4FCS QTY
1	48-5208	Y-CLEVIS, CLEVIS, 90, 3 1/4" LONG, 3/4" PIN, 30K	H801	HUBBELL	YCC3090	1	
2	48-8510	AGS YOKE PLATE, 18" SPACING, 1/2" PLATE, 30K	H702	HUGHES	AS2585-Z	1	1
3	48-5206	Y-CLEVIS, EYE, 20K	H900	ANDERSON	YCS-05	2	2
4	N.S.	FIBERLIGN DOUBLE SUSPENSION ASSY, W/ GROUNDWIRE	J201	PREFORMED	4300204G	1	1
5	N.S.	CONNECTOR, COMPRESSION #4 COPPER TO #4 COPPER	Q500	HOMAC	CC44	1	
6	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012		1
7	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207		1
8	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS		1
9	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD		1

*MAX. LINE ANGLE = 60°



T-4FC T-4FCS

OPGW DOUBLE SUSPENSION
0.433" OPGW CABLE

SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW DOUBLE SUSPENSION

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4FC

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
OPGW ASSEMBLIES

0 1" 2"

FILENAME BHE-AD-02-D-1.DWG
SCALE N.T.S.

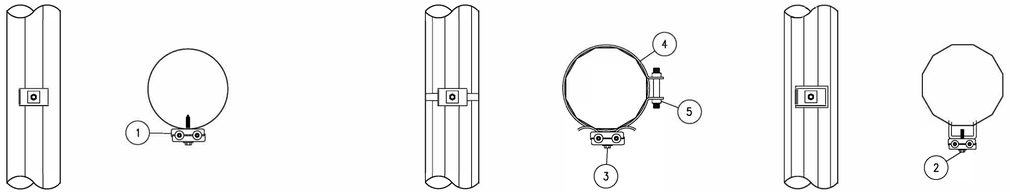
SHEET
AD-02-1

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-FDL-W QTY	T-FDL-S1 QTY	T-FDL-S2 QTY
1	N.S.	DOWNLEAD CUSHION KIT 0.443 OPGW W/ HARDWARE FOR WOOD POLE	J401	PREFORMED	8003041-H1	1	–	–
2	N.S.	DOWNLEAD CUSHION KIT, 0.443" OPGW W/ 1/2" -13 X 3" MOUNTING KIT	J403	PREFORMED	8003041-H3	–	–	1
3	N.S.	DOWNLEAD CUSHION KIT, 0.443" OPGW W/ BANDING BRACKET	J402	PREFORMED	8003041-B1	–	1	–
4	N.S.	BOLT-A-BAND, 3/4" X REQ'D LENGTH	J950	ALUMA-FORM	3/4-201-SSB-100	–	10'	–
5	N.S.	BUCKLE, BANDING, FOR 3/4" BANDING	J951	ALUMA-FORM	BAB-38	–	1	–

NOTES:

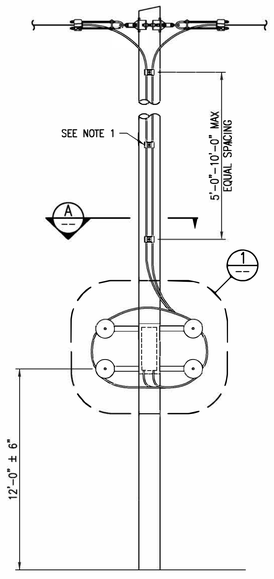
1. OPGW CONTINUOUS TO SPLICE BOX.
2. UNIT CONSISTS OF ONE DOWNLEAD CUSHION INSTALLED. SPECIFIC QUANTITY REQUIRED WILL VARY WITH STRUCTURE HEIGHT.



SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW DOWNLEAD

REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
T-FDL

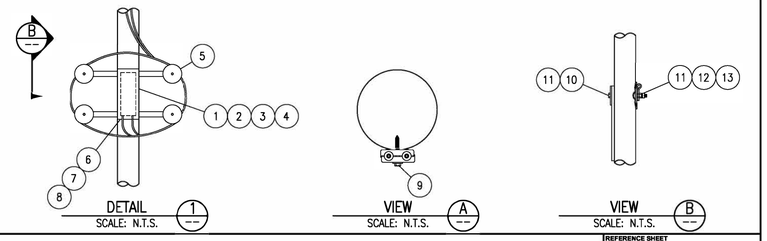


LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	6" X 22" COYOTE CLOSURE KIT W/ 6 PORT END PLATE	J510	PREFORMED	8006659	1
2	N.S.	SPLICE TRAY KIT, 36 COUNT TRAY	J600	PREFORMED	80805514	2
3	N.S.	VERTICAL MOUNTING BRACKET KIT	J502	PREFORMED	8003472	1
4	N.S.	COYOTE DEFENDER FOR 6"X 22" CLOSURE	J511	PREFORMED	8003492	1
5	N.S.	VERTICAL CABLE STORAGE ASSEMBLY	J501	PREFORMED	8003569	1
6	N.S.	CLOSURE END PLATE GROMMETS, 7/8" PORT, 0.443" OPGW	J700	PREFORMED	8003597	2
7	N.S.	FUTURE CABLE PORT KIT, 7/8" PORT	J720	PREFORMED	8003371	2
8	N.S.	GROMMET PLUG, 3/4" PORT, QTY 2	J730	PREFORMED	80806037	1
9	N.S.	DOWNLEAD CUSHION KIT 0.443 OPGW W/ HARDWARE FOR WOOD POLE	J401	PREFORMED	8003041-H1	10
10	N.S.	BOLT, MACHINE, 5/8" X REQ'D LENGTH	B250	HUGHES	–	2
11	N.S.	WASHER, SQUARE, 2" X 1/4", 11/16"	W304	HUGHES	SW2-60	4
12	N.S.	WASHER, SPRING, 11/16" HOLE	W205	HUGHES	2702.6	2
13	N.S.	NUT, LOCK, MF TYPE, 5/8"	N405	HUGHES	MF60	2

NOTES:

1. SEE T-FDL FOR MORE DETAIL.
2. OPGW CONTINUOUS TO SPLICE BOX.
3. COIL 50 FEET OF OPGW AROUND COIL BRACKET ON DOWNLEAD.



SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW SPLICE CASE - 2 OPGW
WOOD POLE

REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
T-FSC-2

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

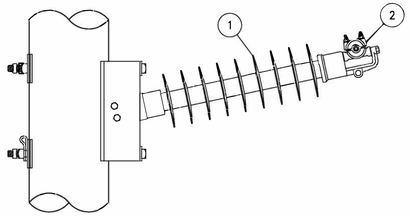
WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
OPGW SPLICE DETAILS

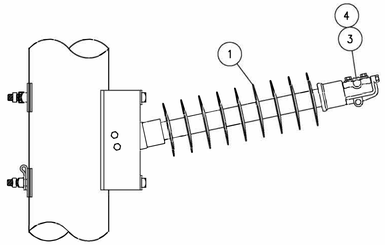
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FILENAME BHE-AD-03-D-1.DWG
SCALE N.T.S.
SHEET **AD-03-1**

LIST OF MATERIALS							
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-SP QTY	T-SP1 QTY
1	N.S.	INSULATOR, HORIZONTAL POST, CLAMPTOP, 69KV	I250	HUBBELL	P250043S1020	1	1
2	N.S.	AGS SUPPORT ASSEMBLY, 795 KCMIL 45/7 ACSR "TERN"	K350	PREFORMED	AGS-5227	1	–
3	48-7020	CLAMP, TRUNNION, 795 KCMIL 45/7 ACSR "TERN", 2,800 LBS	K300	HUBBELL	TSC150	–	1
4	N.S.	INHIBITOR, RUST (NO-OX-ID), 1 PT CAN, GRADE "A"	O102	SANCHEM INC	NO-OX-ID "A" SPECIAL	–	0.06



CONDUCTOR SUPPORT T-SP
795 ACSR-45/7 "TERN"

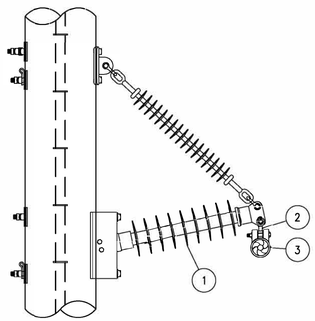


JUMPER SUPPORT T-SP1
795 ACSR-45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
69kV HORIZONTAL CLAMPTOP
795 ACSR - 45/7 "TERN"

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-SP(1)

LIST OF MATERIALS						
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	INSULATOR, HORIZONTAL BRACED POST ASSEMBLY, 69KV	I200	HUBBELL	BLP043G1200	1
2	48-3053	Y-CLEVIS, EYE, 90, 40K	H902	HUBBELL	YCS-06-90-40	1
3	40-5114	AGS SUPSENSION ASSEMBLY, 25K, 795 ACSR-45/7 "TERN"	K500	PREFORMED	AGS-5128	1

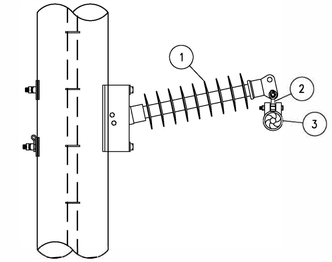


69kV BRACED POST ASSEMBLY
795 ACSR-45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
69kV BRACED POST ASSEMBLY
795 ACSR - 45/7 "TERN"

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-BPD

LIST OF MATERIALS						
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	INSULATOR, HORIZONTAL POST, DROP TONGUE, 69KV	I220	HUBBELL	P250043S0020	1
2	48-3053	Y-CLEVIS, EYE, 90, 40K	H902	HUBBELL	YCS-06-90-40	1
3	40-5114	AGS SUPSENSION ASSEMBLY, 25K, 795 ACSR-45/7 "TERN"	K500	PREFORMED	AGS-5128	1



69kV HORIZONTAL POST
795 ACSR-45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
69kV HORIZONTAL POST
795 ACSR - 45/7 "TERN"

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-PSD

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
POST INSULATOR ASSEMBLIES
795 KCMIL 45/7 ACSR "TERN"

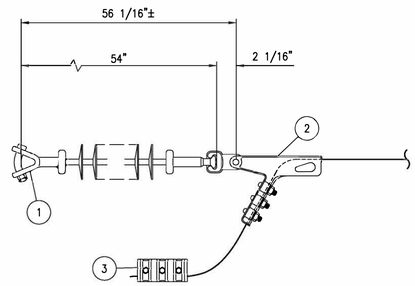
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FILENAME BHE-AD-04-D-1.DWG
SCALE N.T.S.

SHEET
AD-04-1

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48-6927	INSULATOR, DEADEND, Y-CLEVIS BALL, 54" LENGTH, 25K	I300	MACLEAN	S14080042MXAL027	1
2	42-1120	STRAIN CLAMP, DEADEND W/ SOCKET-EYE, 30K, 0.50 - 1.20 RANGE	L101	HUBBELL	SD112S	1
3	42-0483	PARALLEL GROOVE CONNECTOR, 0.743 - 1.152 RANGE	Q601	AFL	483.3P	1

*ONE ITEM (3) WILL BE REQUIRED FOR EVERY TWO ASSEMBLIES

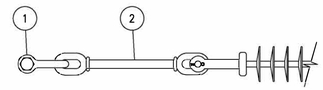


CONDUCTOR BOLTED DEADEND
795 ACSR-45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
CONDUCTOR BOLTED DEADEND
POLYMER

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-BDE6PD

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	ANCHOR SHACKLE, 3.5" LONG, 7/8" DIA, 3/4" PIN, 60K LBS	H603	HUBBELL	AS50BNK	1
2	N.S.	HOT LINK EXTENSION, CHAIN EYE - CHAIN EYE, 15" LONG, 30K LBS	H400	HUBBELL	H003015	1



TM-EXT-15
15" EXTENSION LINK

SHEET TITLE
TRANSMISSION ASSEMBLY
15" EXTENSION LINK

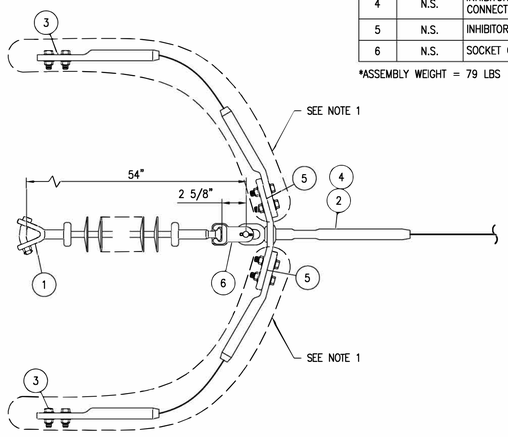
REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TM-EXT-15

NOTE:

1. JUMPERS AND TERMINALS SUPPLIED BY SUBSTATION, INSTALLED BY TRANSMISSION. SEE WEST RAPID CITY SUBSTATION REFERENCE SHEETS IN APPENDIX.

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48-6927	INSULATOR, DEADEND, Y-CLEVIS BALL, 54" LENGTH, 25K	I300	MACLEAN	S14080042MXAL027	1
2	42-8230	COMPRESSION DEADEND ASSY, DOUBLE TONGUE, W/ 15' TERMINAL "TERN"	L502	AFL	VED-123	1
3	N.S.	BOLT, NUT, BELLEVILLE, FLAT, STAINLESS STEEL ASSEMBLY	B606	CMC	SBA20-50	8
4	N.S.	INHIBITOR, FILLER COMPOUND, GRITTED, COMPRESSION CONNECTIONS, 8 oz.	O100	HUBBELL	VSG8B	1.5
5	N.S.	INHIBITOR, FILLER COMPOUND, NON-GRITTED, PAD TO PAD, 8 OZ	O101	HUBBELL	VS8B	0.6
6	N.S.	SOCKET CLEVIS, 30K	H200	HUBBELL	SC30	1

*ASSEMBLY WEIGHT = 79 LBS



CONDUCTOR SUBSTATION DEADEND
795 ACSR-45/7 "TERN"

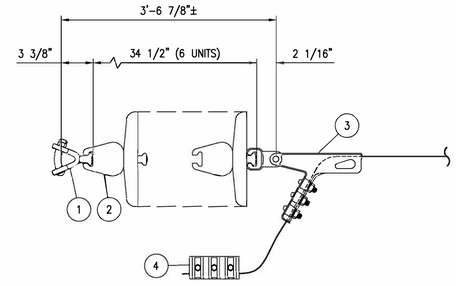
SHEET TITLE
TRANSMISSION ASSEMBLY
CONDUCTOR SUBSTATION DEADEND
POLYMER

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-SDE6PD

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48-3054	Y-CLEVIS, BALL, 30K	H500	HUBBELL	YBC30	1
2	N.S.	GLASS INSULATOR, 30K LB, M&E, ANSI CL 52-5, 10" X 5 3/4"	I102	SEDIVER	N14/146	6
3	42-1120	STRAIN CLAMP, DEADEND W/ SOCKET-EYE, 30K, 0.50 - 1.20 RANGE	L101	HUBBELL	SD112S	1
4	42-0483	PARALLEL GROOVE CONNECTOR, 0.743 - 1.152 RANGE	Q601	AFL	483.3P	1

*ONE ITEM (4) WILL BE REQUIRED FOR EVERY TWO ASSEMBLIES

ASSEMBLY WEIGHT = 75 LBS



CONDUCTOR BOLTED DEADEND
795 ACSR-45/7 "TERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
CONDUCTOR BOLTED DEADEND

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-BDE6D

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

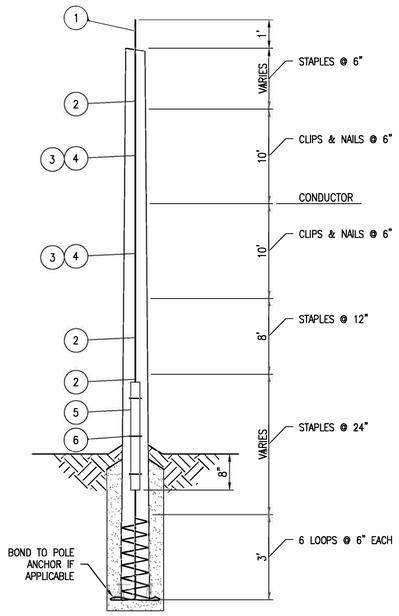
WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
DEADEND INSULATOR ASSEMBLIES
795 KCMIL 45/7 ACSR "TERN"

0 1" 2"

FILENAME BHE-AD-05-D-1.DWG
SCALE N.T.S.

SHEET
AD-05-1



LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	36-4000	GROUNDWIRE, #4CU SD, 40% CONDUCTIVITY	C901			125'
2	46-7494	STAPLE, CUT (SLASH) 1 1/2" X 3/8" CU-COATED, BARBED	P600	MACLEAN	J7682	50
3	46-7460	NAIL, 10D, CU-COATED	P150	MACLEAN	J7260	40
4	46-2729	CLIP, CU-COATED	P151	KEARNEY	5730-1	40
5	46-2503	WOOD MOULDING, 1-11/16" X 8'	P300	HUGHES	2503.8	1
6	46-2504	MOULDING STAPLES, 1-3/4" X 3-1/2"	P400	HUBBELL	C2050222	3

NOTES:

1. BOND ALL POLE HARDWARE TO POLE GROUND. USE BONDING CLIP.
2. ON 230/69kV CONSTRUCTION, BOND ALL 69kV HARDWARE.
3. GROUND WIRE SHALL BE INSTALLED FOR THE FULL LENGTH OF EACH POLE, ACROSS THE BOTTOM, AND BACK UP IN WRAP TURNS AS SHOWN. STAPLE THE WRAPS AT EACH INTERSECTION OF THE DOWNLEAD, AND EVERY 12" FOR THE LENGTH OF THE WRAPS.
4. THIS UNIT INCLUDES THE MEASURE AND RECORDING OF EACH POLE'S FOOTING RESISTANCE, AFTER POLE SETTING IS COMPLETED AND BEFORE INSTALLING THE OHSW.
5. FOR FOOTING RESISTANCES GREATER THAN 15 OHMS, GROUNDING CONNECTIONS SHALL BE USED TO BOND TOGETHER THE GROUND WIRES OF EACH POLE AND GUY ANCHORS IF APPLICABLE.
6. IF THE FOOTING RESISTANCE READS GREATER THAN 15 OHMS AFTER INSTALLATION PROCEDURES PER NOTE 5, CONTRACTOR SHALL NOTIFY THE ENGINEER FOR FURTHER GROUNDING INSTRUCTIONS.
7. BOND STATIC WIRE TO POLE GROUND, USE FARGO CONNECTOR. (ITEM #5)
8. SEE INDIVIDUAL STRUCTURE DRAWINGS FOR REMAINING DIMENSIONS.

SHEET TITLE
TRANSMISSION ASSEMBLY
WOOD POLE GROUNDING

REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
TM-9

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
GROUNDING ASSEMBLIES

0 1" 2"

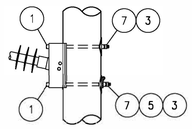
FILENAME BHE-AD-06-D-1.DWG
SCALE N.T.S.

SHEET
AD-06-1

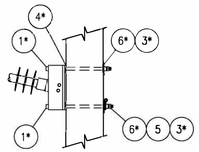
LIST OF MATERIAL

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	1A	1B	1C	1D
1	N.S.	BOLT, MACHINE, 7/8" X REQ'D LENGTH	B270			2	2*	2	–
2	N.S.	ROD, FULL THREADED, 7/8" X REQ'D LENGTH, W/ 4 NUTS	D170			–	–	–	2
3	22–7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	2	2*	2	4
4	N.S.	POLE SHIM, GAIN BASE TO FLAT	V400	N/A	N/A	–	1*	–	–
5	N.S.	WASHER, SPRING, 15/16" HOLE	W207	HUGHES	2702.8	1	1	–	–
6	N.S.	WASHER, SQUARE, 4" X 1/4", 15/16" HOLE	W322	HUGHES	SW4–80	–	2*	2	2
7	22–4425	WASHER, SQ. CURVED, 4" X 1/4", 15/16" HOLE	W504	HUGHES	SCW4–80	2	–	–	–

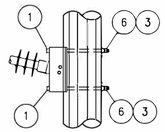
(*) DENOTES MATERIAL SUPPLIED BY LAMINATED POLE MANUFACTURER



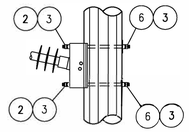
TD–1A
ROUND WOOD POLE ASSEMBLY
SCALE: N.T.S.



TD–1B
LAMINATED POLE ASSEMBLY
SCALE: N.T.S.



TD–1C
STEEL POLE ASSEMBLY
SCALE: N.T.S.



TD–1D
LARGE STEEL POLE ASSEMBLY
SCALE: N.T.S.

NOTES:

1. STRENGTH LIMITATIONS OF 7/8" BOLTS.
   A. SINGLE SHEAR THROUGH THREADS 17,270 LBS.
   B. SINGLE SHEAR THROUGH SHAFT 24,350 LBS.
   C. MINIMUM TENSILE STRENGTH 25,400 LBS.

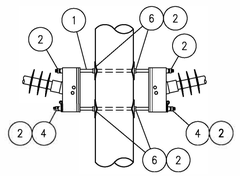
SHEET TITLE
TRANSMISSION ASSEMBLY
SINGLE INSULATOR BASE TO POLE ASSEMBLY

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TD-1

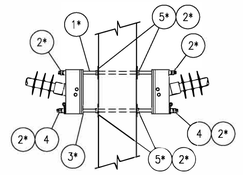
LIST OF MATERIAL

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	2A	2B	2C
1	N.S.	ROD, FULL THREADED, 7/8" X REQ'D LENGTH, W/ 4 NUTS	D170			2	2*	2
2	22–7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	8	8*	8
3	N.S.	POLE SHIM, GAIN BASE TO FLAT	V400	N/A	N/A	–	2*	–
4	N.S.	WASHER, SPRING, 15/16" HOLE	W207	HUGHES	2702.8	2	2	–
5	N.S.	WASHER, SQUARE, 4" X 1/4", 15/16" HOLE	W322	HUGHES	SW4–80	–	4*	4
6	22–4425	WASHER, SQ. CURVED, 4" X 1/4", 15/16" HOLE	W504	HUGHES	SCW4–80	4	–	–

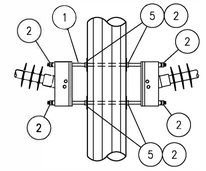
(*) DENOTES MATERIAL SUPPLIED BY LAMINATED POLE MANUFACTURER



TD–2A
ROUND WOOD POLE ASSEMBLY
SCALE: N.T.S.



TD–2B
LAMINATED POLE ASSEMBLY
SCALE: N.T.S.



TD–2C
STEEL POLE ASSEMBLY
SCALE: N.T.S.

NOTES:

1. STRENGTH LIMITATIONS OF 7/8" BOLTS.
   A. SINGLE SHEAR THROUGH THREADS 17,270 LBS.
   B. SINGLE SHEAR THROUGH SHAFT 24,350 LBS.
   C. MINIMUM TENSILE STRENGTH 25,400 LBS.

SHEET TITLE
TRANSMISSION ASSEMBLY
DOUBLE INSULATOR BASE TO POLE ASSEMBLY

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TD-2

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
INSULATOR BASE TO POLE ASSEMBLIES

0 1" 2"

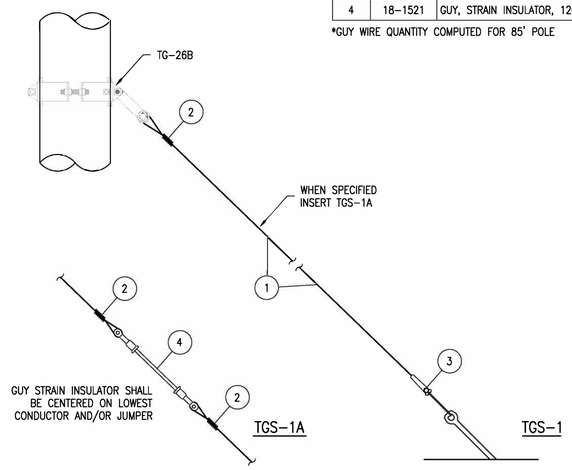
FILENAME BHE–AD–07–D–1.DWG
SCALE N.T.S.

SHEET
AD-07-1

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	TGS–1 QTY	TGS–1A QTY
1	18–7167	WIRE, GALVANIZED, 7 STEEL STRAND, 7/16" EHS	C801	–	–	110'	110'
2	18–7168	GUY DEADEND GRIP, FOR 7/16" EHS	G601	PREFORMED	GDE–1108	1	3
3	18–0716	GUY, STRANDVISE, 7/16" EHS, SHORT BAIL	G902	MACLEAN	5203	1	1
4	18–1521	GUY, STRAIN INSULATOR, 120" LONG, 21K LBS, ROLLER, ROLLER	G200	HUGHES	CF694–120R2	–	1

*GUY WIRE QUANTITY COMPUTED FOR 85' POLE

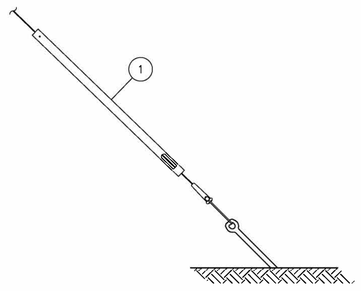


SHEET TITLE
TRANSMISSION ASSEMBLY
SINGLE GUY ASSEMBLIES
7/16" EHS

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TGS-1(A)

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	GUY, GUARD, 2" X 8'–0", FULL ROUND, YELLOW	G400	MACLEAN	J1493Y	1



GUY MARKER

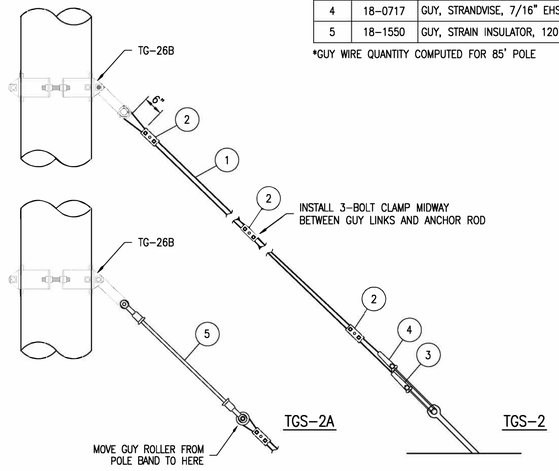
SHEET TITLE
TRANSMISSION ASSEMBLY
GUY MARKER

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TM-GM

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	TGS–2 QTY	TGS–2A QTY
1	18–7167	WIRE, GALVANIZED, 7 STEEL STRAND, 7/16" EHS	C801	–	–	220'	220'
2	18–5816	CLAMP, 3–BOLT, 6" LONG, 5/8" BOLT, 5/16" – 1/2" RANGE	Q100	MACLEAN	J931	3	3
3	18–0716	GUY, STRANDVISE, 7/16" EHS, SHORT BAIL	G902	MACLEAN	5203	1	1
4	18–0717	GUY, STRANDVISE, 7/16" EHS, LONG BAIL	G903	MACLEAN	5203L	1	1
5	18–1550	GUY, STRAIN INSULATOR, 120" LONG, 50K LBS	G201	MACLEAN	GCC50–120–SC	–	1

*GUY WIRE QUANTITY COMPUTED FOR 85' POLE



SHEET TITLE
TRANSMISSION ASSEMBLY
DOUBLE GUY ASSEMBLY
7/16" EHS

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TGS-2(A)

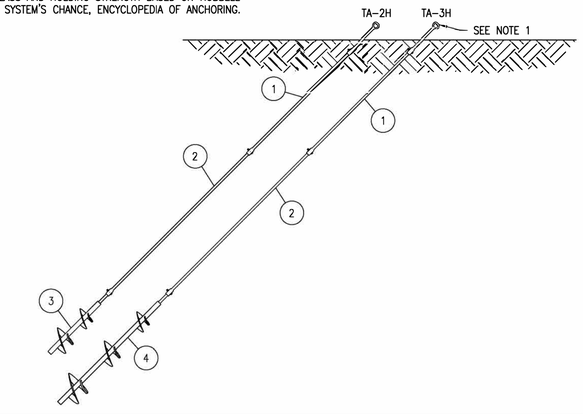
NOTES:

1. TRIPLE EYE GUY ADAPTER INCLUDED WITH ANCHOR ASSEMBLY.
2. CONTINUE TO DRIVE THE ANCHOR AND ADD EXTENSIONS UNTIL THE DESIRED TORQUE IS REACHED AND MAINTAINED FOR A MINIMUM OF THREE FEET OR THREE TIMES THE DIAMETER OF THE LARGEST HELIX.
3. A MINIMUM INSTALLATION OF THREE TIMES THE DIAMETER OF THE LARGEST HELIX (BELOW THE FREEZE/ THAW LINE) IS REQUIRED. THIS DEPTH SHOULD EQUAL OR EXCEED FIVE TIMES THE DIAMETER OF THE LARGEST HELIX FROM THE TOP SURFACE OF THE SOIL VERTICALLY.
4. MINIMUM INSTALL TORQUE IS 3,500 FT–LBS.
5. MAXIMUM INSTALLATION TORQUE IS 5,500 FT–LBS OR 1.5 TWISTS.
6. TYPICAL WORKING TORQUE IS 5,500 FT. LBS. FOR 1 1/2" SQUARE SHAFT ANCHORS.
7. SOIL CLASS AND HOLDING STRENGTH BASED ON HUBBELL POWER SYSTEM'S CHANCE, ENCYCLOPEDIA OF ANCHORING.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	TA–2H QTY	TA–3H QTY	TA–5EXT QTY
1	N.S.	ANCHOR, EXTENSION, 1 1/2" SQ. SHAFT 5'–0"	A110	CHANCE	12656	–	–	AS REQ'D
2	N.S.	ANCHOR, EXTENSION, 1 1/2" SQ. SHAFT 7'–0"	A111	CHANCE	12657	1	1	–
3	N.S.	ANCHOR, 1 1/2" SQ. SHAFT, 8" AND 10" HELIX W/ TRIPLEYE ADAPTER	A202	CHANCE	12654–3AE	1	–	–
4	N.S.	ANCHOR, 1 1/2" SQ. SHAFT, 8", 10" AND 12" HELIX W/ TRIPLEYE ADAPTER	A210	CHANCE	12654–3AEJ	–	1	–

HELIX COMBINATION	SOIL ANCHOR HOLDING STRENGTH (LBS.) VS. SOIL CLASS					
	CLASS 7	CLASS 6	CLASS 5	CLASS 4	CLASS 3	CLASS 2
8"–10"	19,000	23,000	27,000	32,000	36,000	41,000
8"–10"–12"	26,000	32,000	39,000	46,000	51,000	58,000



SHEET TITLE
TRANSMISSION ASSEMBLY
POWER INSTALLED SCREW ANCHORS

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TA-2H, 3H, 5EXT

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
GUY AND ANCHOR ASSEMBLIES

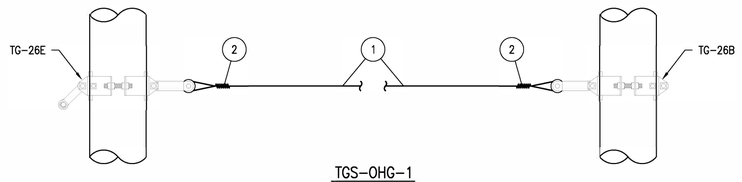
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FILENAME BHE–AD–08–D–1.DWG
SCALE N.T.S.

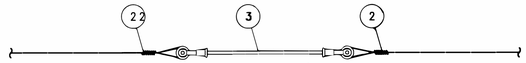
SHEET
AD-08-1

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	TGS–OHG–1	TGS–OHG–1A
1	18–7167	WIRE, GALVANIZED, 7 STEEL STRAND, 7/16" EHS	C801	–	–	150'	150'
2	18–7168	GUY DEADEND GRIP, FOR 7/16" EHS	G601	PREFORMED	GDE–1108	2	4
3	N.S.	GUY, STRAIN INSULATOR, 120" LONG, 21K LBS, ROLLER, ROLLER	G200	HUGHES	CF694–120R2	–	1



TGS–OHG–1



TGS–OHG–1A

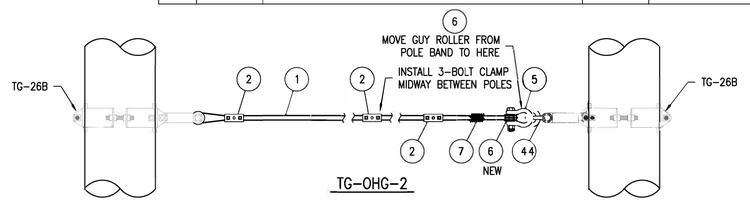
POSITION THE GUY STRAIN INSULATOR SUCH THAT THE LOWER END OF THE INSULATOR WOULD BE NO LESS THAN 10'–0" FROM THE GROUND IN AN EVENT OF BROKEN GUY WIRE

SHEET TITLE
TRANSMISSION ASSEMBLY
SINGLE OVERHEAD GUY ASSEMBLY

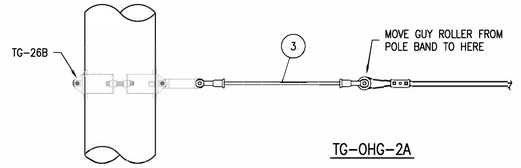
REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TGS-OHG-1(A)

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	TG–OHG–2	TG–OHG–2A
1	18–7167	7/16" EH.S. STEEL 7–STRAND GUY WIRE	C801	–	–	300'	300'
2	18–5816	CLAMP, 3–BOLT, 6" LONG, 5/8" BOLT, 5/16" – 1/2" RANGE	Q100	MACLEAN	J931	3	3
3	18–1550	GUY, STRAIN INSULATOR, 120" LONG, 50K LBS	G201	MACLEAN	GCC50–120–SC	–	1
4	N.S.	ANCHOR, SHACKLE, 3.5" LONG, 7/8" DIA., 3/4" DIA. PIN, 60K	H603	HUBBELL	AS50BNK	1	1
5	N.S.	ANCHOR, SHACKLE, 3.5" LONG, 1 7/16" WIDE, 7/8" DIA., 7/8" DIA. PIN, 72K	H604	HUBBELL	AS60875BNK	1	1
6	18–2808	GUY, ROLLER, 1 1/8" WR, 15/16" HOLE	G100	HUGHES	28082	1	1
7	18–7168	GUY DEADEND GRIP, FOR 7/16" EHS	G601	PREFORMED	GDE–1108	2	2



TG–OHG–2



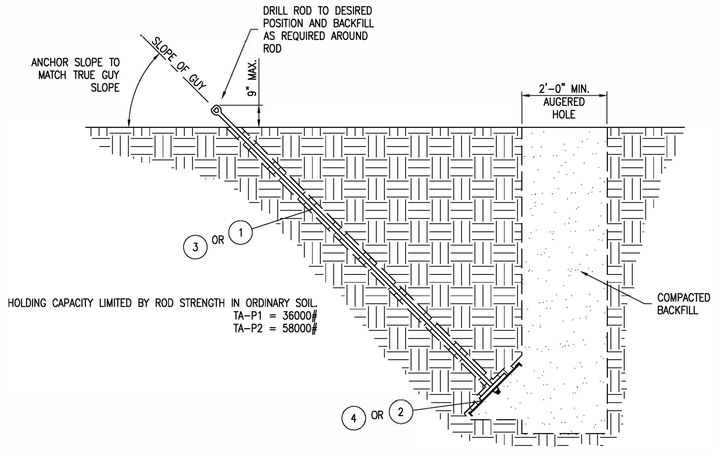
TG–OHG–2A

SHEET TITLE
TRANSMISSION ASSEMBLY
DOUBLE OVERHEAD GUY ASSEMBLY

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TG-OHG-2(A)

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	TA–P1 QTY	TA–P2 QTY
1	18–1102	ROD, ANCHOR, TWIN EYE 1" X 10', 36K	A100	MACLEAN	J7540	1	
2	18–1024	ANCHOR, CROSS–PLATE TYPE, 400 IN BEARING AREA, 1" ROD	A200	MACLEAN	J3524	1	
3	N.S.	ROD, ANCHOR, TRIPLE EYE 1 1/4" X 10', 58K	A101	MACLEAN	J7350		1
4	N.S.	ANCHOR, CROSS–PLATE TYPE, 400 IN BEARING AREA, 1 1/4" ROD	A201	MACLEAN	J3524–1		1

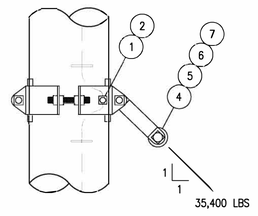


SHEET TITLE
TRANSMISSION ASSEMBLY
PLATE ANCHOR
AUGERED

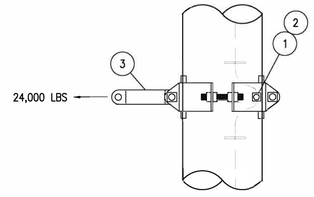
REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TA-P1,2

LIST OF MATERIALS

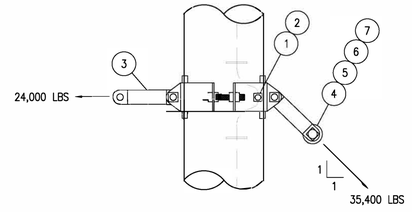
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	TG–26B QTY	TG–26C QTY	TG–26D QTY	TG–26E QTY
1	N.S.	POLE BAND ASSY. HEAVY DUTY, REQ'D POLE DIAMETER	–	HUGHES	–	1	1	1	1
1.1	18–1116	POLE BANDS, HEAVY DUTY, 7"–10" POLE	F110	HUGHES	3108.5	–	–	–	–
1.2	18–1117	POLE BANDS, HEAVY DUTY, 9"–12" POLE	F111	HUGHES	3108.6	–	–	–	–
1.3	18–1118	POLE BANDS, HEAVY DUTY, 11"–14" POLE	F112	HUGHES	3108.7	–	–	–	–
1.4	18–1119	POLE BANDS, HEAVY DUTY, 13"–16" POLE	F113	HUGHES	3108.8	–	–	–	–
2	46–2718	CLIP, BONDING, WITH 1/2" X 1 1/2" BOLT, 7/16" MAX. WIRE	P104	HUGHES	2718.55	1	1	1	1
3	14–3152	LINK, CONNECTING, 1/4" X 2" X 7 1/2", 15/16" HOLES, 24K LBS	F201	HUGHES	3152	–	2	2	–
4	14–3154	LINK, CONNECTING, 3/8" X 2" X 7 1/2", 15/16" HOLES, 38K LBS	F203	HUGHES	3154	2	–	2	4
5	18–2808	GUY, ROLLER, 1 1/8" WR, 15/16" HOLE	G100	HUGHES	28082	1	–	1	2
6	20–7803	MACHINE BOLT, 7/8" X 3"	B273	HUGHES	B83–2	1	–	1	2
7	22–7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	1	–	1	2



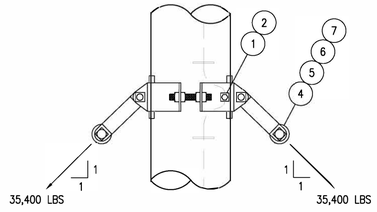
TG–26B



TG–26C



TG–26D



TG–26E

NOTES:

1. THE INDICATED LOADS ARE DESIGN MAXIMUMS.
2. FOR GUY SLOPES MORE THAN 1V TO 1H, THE MAXIMUM VERTICAL CAPACITY SHOULD NOT EXCEED 25,000 LBS.
3. WHEN TWO GUY ATTACHMENTS ARE NEEDED. THE ADDITIONAL POLE BAND SHALL BE 6' BELOW THE FIRST ONE.

SHEET TITLE
TRANSMISSION ASSEMBLY
POLE BAND ASSEMBLIES

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TG-26

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
GUY AND ANCHOR ASSEMBLIES

0 1" 2"

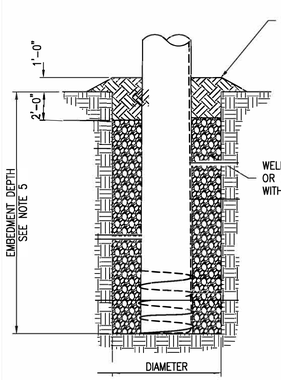
FILENAME BHE–AD–09–D–1.DWG
SCALE N.T.S.

SHEET
AD-09-1

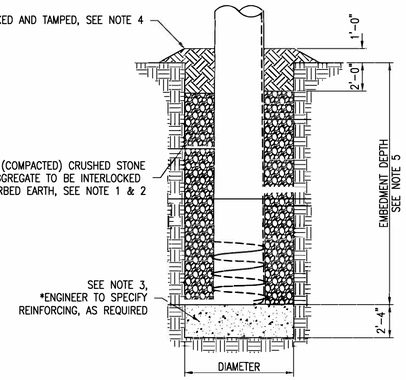
POLE STABILITY FOUNDATION
IMPORTED GRANULAR BACKFILL

POLE HT.–CL.	EMBEDMENT DEPTH (FT)	DIAMETER (FT)	POLE WIDTH (IN)	POLE WEIGHT (LB)	APPROX. QTY. CUBIC YDS. (10% + 4 FT)
60–1	10	4.0*	18.0	–	3.2
70–1	11	4.0*	18.9	–	3.6
80–H1	12	4.0*	20.9	–	3.8
90–H2	13	4.0*	23.2	–	4.0
100–H2	14	4.0*	24.0	–	4.2

(*) HOLE DIAMTER AS NEEDED TO TAMP ALL THE WAY AROUND THE POLE.



TM–101
IMPORTED BACKFILL
SCALE: N.T.S.



TM–103
IMPORTED BACKFILL AND BEARING REINFORCEMENT
SCALE: N.T.S.

GRADATION FOR IMPORTED GRANULAR BACKFILL	
SIZE OF GRAVEL OR CRUSHED STONE	SIZE OF MESH (IN)
100% BY WEIGHT TO PASS 1" SCREEN	1.00
60%–90% BY WEIGHT TO PASS 1/2" SCREEN	0.500
40%–60% BY WEIGHT TO PASS NO. 4 SCREEN	0.187
25%–50% BY WEIGHT TO PASS NO. 8 SCREEN	0.0937
20%–40% BY WEIGHT TO PASS NO. 16 SCREEN	0.0469
15%–30% BY WEIGHT TO PASS NO. 40 SCREEN	0.0165

IMPORTANT

EACH POLE SHALL BE BACKFILLED FROM BOTTOM TO TOP BY ONE LABORER SHOVELING FILL AND TWO OTHERS USING PNEUMATIC TAMPERS.

NOTES:

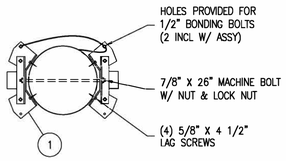
1. GRADATION FOR IMPORTED BACKFILL IS SHOWN IN THE TABLE. THE AGGREGATE SHALL BE WELL MIXED IN A STOCK PILE, AND PNEUMATICALLY PLACED AND TAMPED IN 6–INCH LIFTS.
2. THE SPECIFICATION FOR AGGREGATE GIVEN IN THE TABLE IS MINIMUM. IN AREAS WHERE SMALLER FINES ARE AVAILABLE AT COMPARABLE COST, IT IS RECOMMENDED THAT THE ENGINEER SPECIFY SMALLER FINES.
3. CONCRETE SHALL BE 2000 PSI HIGH EARLY STRENGTH CONCRETE. IT SHALL BE DEPOSITED IN A MANNER WHICH WILL PREVENT SEGREGATION OF THE AGGREGATE AND CEMENT. CARE SHOULD BE TAKEN TO AVOID GETTING DIRT MIXED WITH THE CONCRETE. THE POLE SHALL NOT BE SET UNTIL THE CONCRETE BEARING BASE HAS ATTAINED SUFFICIENT STRENGTH TO SUPPORT THE POLE. DURING THE PLACEMENT OF POLE, AVOID BUMPING CONCRETE BASE.
4. WELL TAMPED NATIVE BACKFILL SHOULD BE PLACED AROUND THE POLE AS SHOWN
5. SEE STRUCTURE DRAWINGS FOR EMBEDMENT DEPTHS.

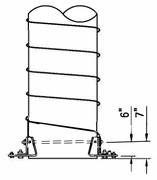
SHEET TITLE
TRANSMISSION ASSEMBLY
POLE STABILITY FOUNDATION

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TM-101 & TM-103

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	18–1895	ANCHOR ASSEMBLY WITH BOLTS; PAIR	F300	HUGHES	A–1895–2	1





SHEET TITLE
TRANSMISSION ASSEMBLY
POLE ANCHOR ASSEMBLY

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TP-A

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

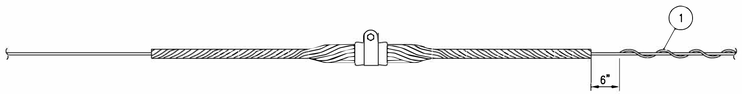
WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
POLE STABILITY ASSEMBLIES

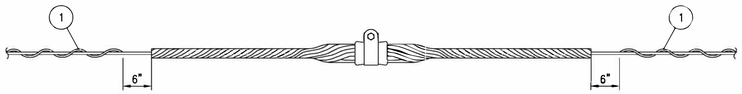
0 1" 2"

FILENAME BHE–AD–10–D–1.DWG
SCALE N.T.S.
SHEET **AD-10-1**

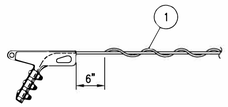
LIST OF MATERIALS								
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T1 QTY	2T1 QTY	D1 QTY
1	N.S.	SPIRAL VIBRATION DAMPER, 0.327" – 0.461" RANGE	S110	PREFORMED	5050104	1	2	1



DPR–EHS–T1



DPR–EHS–2T1



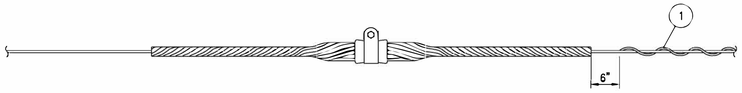
DPR–EHS–D1

SHEET TITLE
TRANSMISSION ASSEMBLY
DAMPER - 3/8" EHS

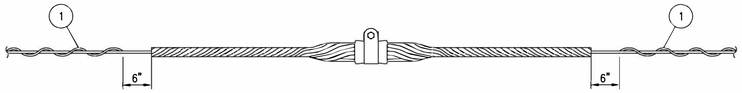
REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
DPR-EHS

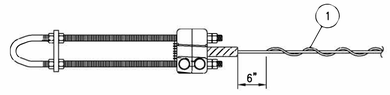
LIST OF MATERIALS								
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T1 QTY	2T1 QTY	D1 QTY
1	N.S.	SPIRAL VIBRATION DAMPER, 0.327" – 0.461" RANGE	S110	PREFORMED	5050104	1	2	1



DPR–OPGW–T1



DPR–OPGW–2T1



DPR–OPGW–D1

SHEET TITLE
TRANSMISSION ASSEMBLY
DAMPER - OPGW

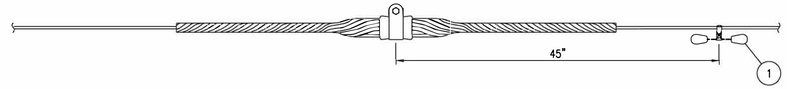
REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
DPR-OPGW

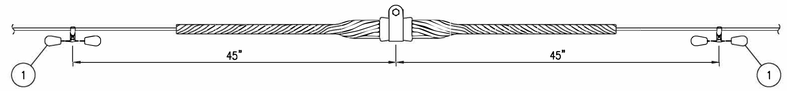
LIST OF MATERIALS								
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T1 QTY	2T1 QTY	D1 QTY	D2 QTY
1	N.S.	DAMPER, DOGBONE, 795 ACSR	S150	HUBBELL	60710–12	1	2	1	2

NOTES:

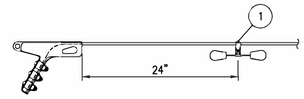
1. FIRST DAMPER AT SUSPENSION SPAN ENDS SHALL BE LOCATED FROM CENTER OF DAMPER CLAMP TO THE SUSPENSION SUPPORT PER REFERENCED DIMENSION.
2. THE ORIENTATION OF THE WEIGHTS ALONG THE CONDUCTOR IS OPTIONAL. (I.E. WHETHER THE LARGE WEIGHT IS TOWARD THE TOWER OR TOWARD THE SPAN. ORIENT THE DAMPER FOR EASY ACCESS TO THE BOLT AND TO OBTAIN VISUAL ASSURANCE OF POSITIVE CONDUCTOR SEATING.
3. FOLLOW MANUFACTURER'S INSTALLATION INSTRUCTIONS IN DELIVERY BOX.
4. SEE SAG TABLES FOR INSTALLATION DIRECTION ON THE LINE.



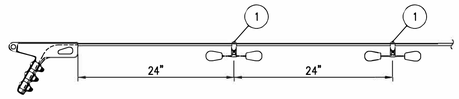
DPR–795–T1



DPR–795–2T1



DPR–795–D1



DPR–795–D2

SHEET TITLE
TRANSMISSION ASSEMBLY
DAMPER - 795 ACSR

REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
DPR-795

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
DAMPER ASSEMBLIES

0 1" 2"

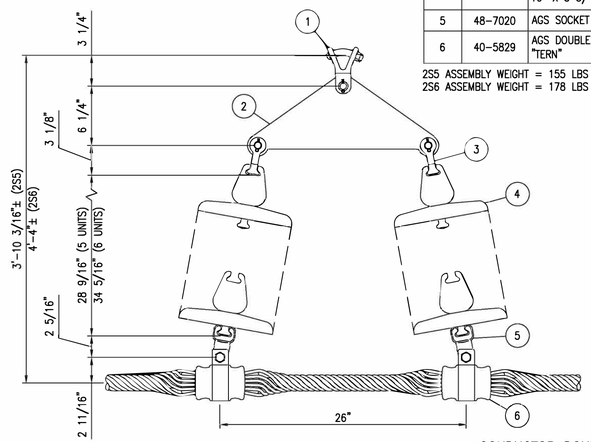
FILENAME BHE–AD–11–D–1.DWG
SCALE N.T.S.

SHEET
AD-11-1

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-2S5 QTY	T-2S6 QTY
1	48-5208	Y-CLEVIS, CELVIS, 90°, 30K	H801	HUBBELL	YCC3090	1	1
2	48-5180	AGS YOKE PLATE, 18" SPACING, 5/8" PLATE, 40K	H701	PREFORMED	YP-5908	1	1
3	48-3055	BALL CLEVIS, 30K	H550	HUBBELL	BC30	2	2
4	40-0027	GLASS INSULATOR, 22K LB, M&E, ANSI CLASS 52-3, 10" X 5 3/4"	I100	SEDIVER	N100/146	10	12
5	48-7020	AGS SOCKET EYE, 25K	H100	PREFORMED	SE-5154	2	2
6	40-5829	AGS DOUBLE SUSPENSION ASSY., 50K, 795 ACSR 45/7 "TERN"	K501	PREFORMED	AGS-5829	1	1

2S5 ASSEMBLY WEIGHT = 155 LBS
2S6 ASSEMBLY WEIGHT = 178 LBS



CONDUCTOR DOUBLE SUSPENSION
795 ACSR-45/7 "TERN"
MAX. LINE ANGLE = 60°

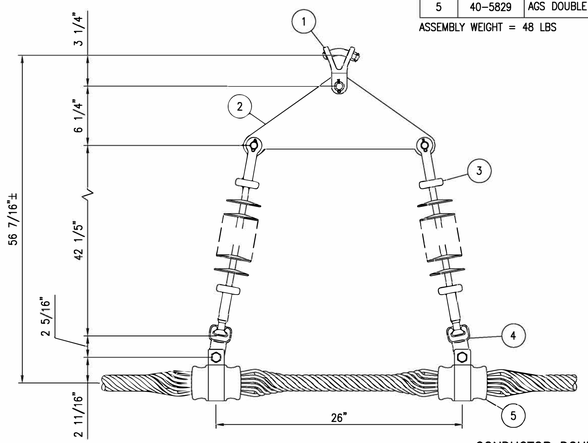
SHEET TITLE
TRANSMISSION STANDARD
CONDUCTOR DOUBLE SUSPENSION
PORCELAIN

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: T-2S5,2S6

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48-5208	Y-CLEVIS, CELVIS, 90°, 30K	H801	HUBBELL	YCC3090	1
2	48-5180	AGS YOKE PLATE, 18" SPACING, 5/8" PLATE, 40K	H701	PREFORMED	YP-5908	1
3	48-6925	INSULATOR, SUSPENSION, Y-CLEVIS BALL, 42.2" LENGTH, 25K	I111	MACLEAN	S14080031MXAL019	2
4	48-7020	AGS SOCKET EYE, 25K	H100	PREFORMED	SE-5154	2
5	40-5829	AGS DOUBLE SUSPENSION ASSY., 50K, 795 ACSR 45/7 "TERN"	K501	PREFORMED	AGS-5829	1

ASSEMBLY WEIGHT = 48 LBS



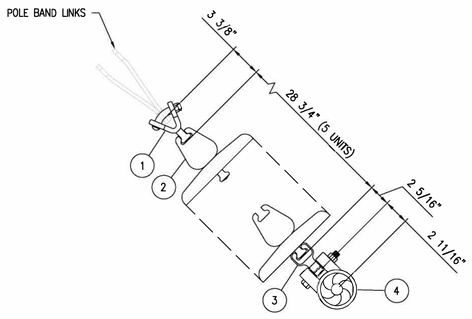
CONDUCTOR DOUBLE SUSPENSION
795 ACSR-45/7 "TERN"
MAX. LINE ANGLE = 60°

SHEET TITLE
TRANSMISSION STANDARD
CONDUCTOR DOUBLE SUSPENSION
POLYMER

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: T-2SPD2

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48-3054	Y-CLEVIS, BALL, 30K	H500	HUBBELL	YBC30	1
2	48-0027	GLASS INSULATOR, 22K LB, M&E, ANSI CLASS 52-3, 10" X 5 3/4"	I100	SEDIVER	N100/146	5
3	42-7020	AGS SOCKET EYE, 25K	H100	PREFORMED	SE-5154	1
4	40-5114	AGS SUSPENSION ASSY., 25K, 795 ACSR 45/7 "TERN"	K500	PREFORMED	AGS-5128	1



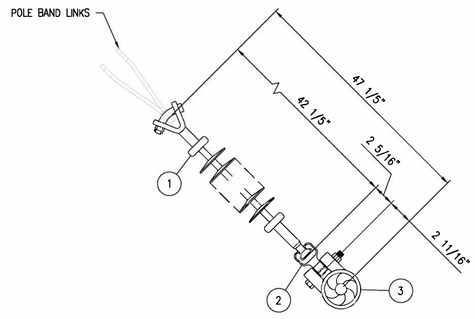
CONDUCTOR RUNNING ANGLE
795 ACSR-45/7 "TERN"
MAX. LINE ANGLE = 30°

SHEET TITLE
TRANSMISSION STANDARD
CONDUCTOR RUNNING ANGLE
PORCELAIN

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: T-R5D

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48-6925	INSULATOR, SUSPENSION, Y-CLEVIS BALL, 42.2" LENGTH, 25K	I111	MACLEAN	S14080031MXAL019	1
2	42-7020	AGS SOCKET EYE, 25K	H100	PREFORMED	SE-5154	1
3	40-5114	AGS SUSPENSION ASSY., 25K, 795 ACSR 45/7 "TERN"	K500	PREFORMED	AGS-5128	1



CONDUCTOR RUNNING ANGLE
795 ACSR-45/7 "TERN"
MAX. LINE ANGLE = 30°

SHEET TITLE
TRANSMISSION STANDARD
CONDUCTOR RUNNING ANGLE
POLYMER

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: T-RPD

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

ASSEMBLY DETAILS
DAMPER ASSEMBLIES

0 1" 2"

FILENAME: BHE-AD-12-D-1.DWG
SCALE: N.T.S.
SHEET: **AD-12-1**

TMG–2G GUYING DETAILS																
	HOLDING BACK SPAN								HOLDING AHEAD SPAN							
STR	FIG.	"A"	"B"	"C"	DIR.	SHIELD GUY TYPE	PHASE GUY TYPE	ANC. TYPE	FIG.	"A"	"B"	"C"	DIR.	SHIELD GUY TYPE	PHASE GUY TYPE	ANC. TYPE	COMMENTS
2A–2	4	29'–9"	5'–6"	5'–6"	SE	TGS–1A	TGS–2A	TA–3H	4	35'–3"	6'–0"	6'–0"	S	TGS–1A	TGS–2A	TA–3H	

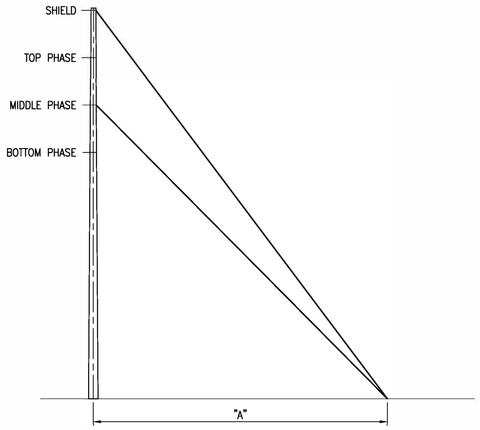


FIGURE 1

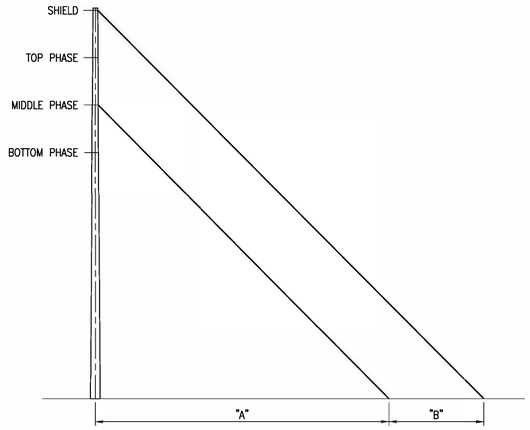


FIGURE 2

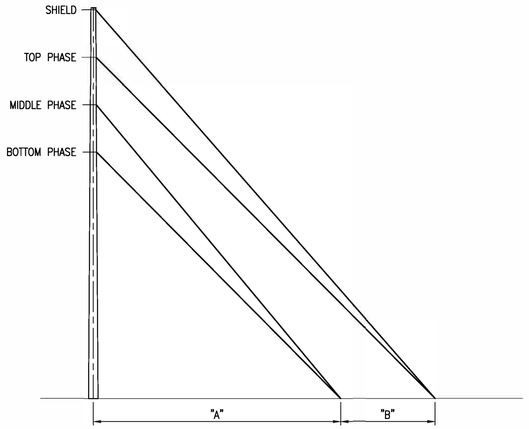


FIGURE 3

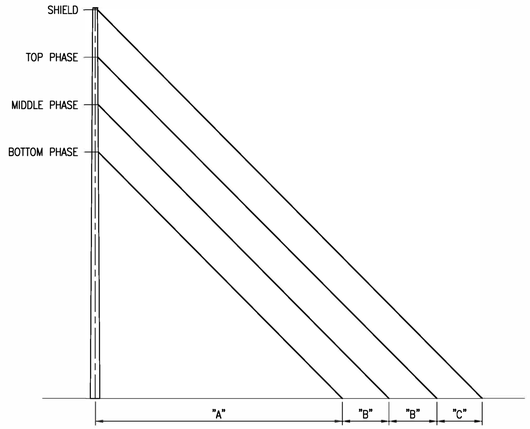


FIGURE 4

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E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

GUYING DETAIL
VERTICAL DEADENDS

0 1" 2"

FILENAME BHE–TMG–2G–D–1.DWG
SCALE NONE

SHEET
TMG-2G

TMG–MOD–1 GUYING DETAILS						
STR	FIG	"A"	DIR.	GUY TYPE	ANC. TYPE	COMMENTS
2A–1	1	64'–0"	SW	TGS–1A	TA–2H	

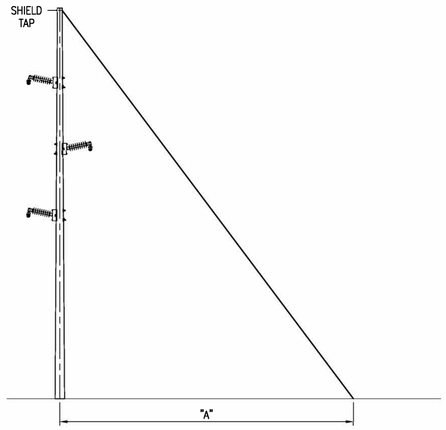


FIGURE 1

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BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

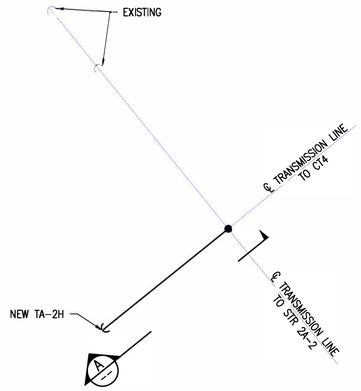
WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

GUYING DETAIL
ADDITIONAL DETAILS

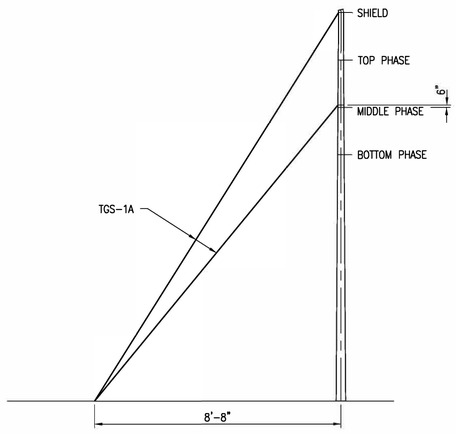
0 1" 2"

FILENAME BHE–TMG–MOD–1–D–1.DWG
SCALE NONE

SHEET
TMG-MOD-1



STR E2A-3



VIEW A
SCALE: N.T.S.

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BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

GUYING DETAIL
STR 2A-3

0 1" 2"

FILENAME BHE-TMG-MOD-2-D-1.DWG
SCALE NONE

SHEET
TMG-MOD-2

STRUCTURE DATA												TRANSMISSION ASSEMBLIES							COMMENTS
STR. #	STATION (FT)	AHEAD SPAN	LINE ANGLE				STR TYPE	POLE H&C	FND	FND REVEAL	GROUND	ANCHORS	GUYS	SHIELD ASSEMBLIES	CONDUCTOR ASSEMBLIES	OPGW SPLICE	DAMPERS	MISC.	
SUB 1	0+00	199					DT-01-69							1)T-4DS, 1)T-4FDS	3)T-SDE6PD	SPLICE BY SUBSTATION			OPGW TO NORTH STATIC MAST
2A	1+99	263	83°	04'	48"	RT	SCUBDE-M1	[LD-04:130'-0"]	[1)FND-01-3]	[1'-0"]				2)T-4FDS, 1)T-4DS	6)T-BDE6PD, 6)TM-EXT-15				POLE INSTALLED ON WEST RAPID CITY 230KV PROJECT.
2A-1	4+62	259	2°	10'	36"	RT	SCHP-M1	1)90/1	EMBED: 13'-0", 1)TP-A		1)TM-9	1)TA-2H	1)TGS-1A, 1)TM-GM	2)T-4FDW, 2)T-4D	3)T-PSD	1)T-FSC-2	2)DPR-OPGW-D1, 2)DPR-EHS-D1, 3)DPR-795-2T1		TERMINATE EXISTING OPGW FROM CT1 HERE. SPLICE INTO NEW OPGW FROM WEST RAPID CITY SUBSTATION 69KV. SEE STR 2A-1 BELOW FOR OPGW & OHGWTAP. SEE TMG-MOD-1 FOR GUYING DETAIL.
2A-2	7+21	181	129°	13'	23"	LT	SCDE-69-M1	1)90/1	EMBED: 13'-0", 1)TP-A		1)TM-9	8)TA-3H, 8)TA-5EXT	2)TGS-1A, 6)TGS-2A, 8)TM-GM	4)T-4D	6)T-BDE6PD, 6)TM-EXT-15		3)DPR-EHS-D1, 3)DPR-795-D2		SEE STR 2A-2 BELOW FOR TWO (2) OHGW TAPS. SEE TMG-2G FOR GUYING DETAIL. ONE (1) TA-5EXT INSTALLED ON ALL ANCHORS.
2A-3	9+02	54	39°	49'	25"	RT	SCDE-69	WRC 70/1			1)TM-9	2)TA-P1, 1)TA-2H	4)TGS-1, 4)TM-GM, 2)TGS-1A, 2)TM-GM	3)T-4D	6)T-BDE6PD, 3)T-SP1			2)TG-26B	EXISTING STRUCTURE. ADDING GUYS TO BACK UP SUBSTATION SPAN. SEE TMG-MOD-2 FOR GUYING DETAIL.
CT4	9+56						SUB DE							3)T-4D	3)T-BDE6PD				
2A-1	4+62	154	81°	36'		LT	SEE STR 2A-1 ABOVE	SEE STR 2A-1 ABOVE	SEE STR 2A-1 ABOVE		SEE STR 2A-1 ABOVE	SEE STR 2A-1 ABOVE	SEE STR 2A-1 ABOVE	SEE STR 2A-1 ABOVE	SEE STR 2A-1 ABOVE	SEE STR 2A-1 ABOVE			OPGW TAP TO STR CT1, OHGW TAP TO STR CT1-1
CT1-1	6+16	44	12°	05'	50"	LT	[SCDE-69]	[1)65/1]			[1)TM-9]	[1)TA-P1]	[2)TGS-1], [2)TM-GM]	[2)T-4D]	[6)T-BDE6PD]				STR ON BEN FRENCH-CT1 69KV LINE
CT1	6+60						[SUB DE]							[1)T-4DS], [1)T-4FDS]	[3)T-BDE6PD]	[OPGW SPLICE]			STR ON BEN FRENCH-CT1 69KV LINE
2A-2	7+21	198	136°	21'	36"	LT	SEE STR 2A-2 ABOVE	SEE STR 2A-2 ABOVE	SEE STR 2A-2 ABOVE		SEE STR 2A-2 ABOVE	SEE STR 2A-2 ABOVE	SEE STR 2A-2 ABOVE	SEE STR 2A-2 ABOVE	SEE STR 2A-2 ABOVE				OHGW TAP TO STR ECT3-3.
CT3-3	9+19		34°	55'	08"	RT	[SCDE-69]	[WRC 65/1]			[1)TM-9]	[5)TA-P1]	[6)TGS-1], [6)TM-GM]	[3)T-4D]	[9)T-BDE6PD]				STR ON BEN FRENCH-CT3 69KV LINE.
2A-2	7+21	242	140°	04'	48"	LT	SEE STR 2A-2 ABOVE	SEE STR 2A-2 ABOVE	SEE STR 2A-2 ABOVE		SEE STR 2A-2 ABOVE	SEE STR 2A-2 ABOVE	SEE STR 2A-2 ABOVE	SEE STR 2A-2 ABOVE	SEE STR 2A-2 ABOVE				OHGW TAP TO STR CT2-3.
CT2-3	9+63		14°	47'	27"	RT	[SCDE-69]	[1)65/2]			[1)TM-9]	[3)TA-P1]	[4)TGS-1], [4)TM-GM]	[2)T-4D]	[6)T-BDE6PD], [3)T-SP1]				STR ON CT2 TAP-CT1 69KV LINE.

NOTES:

XXX NEW

[XXX] EXISTING

*XXX RETIRE

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E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

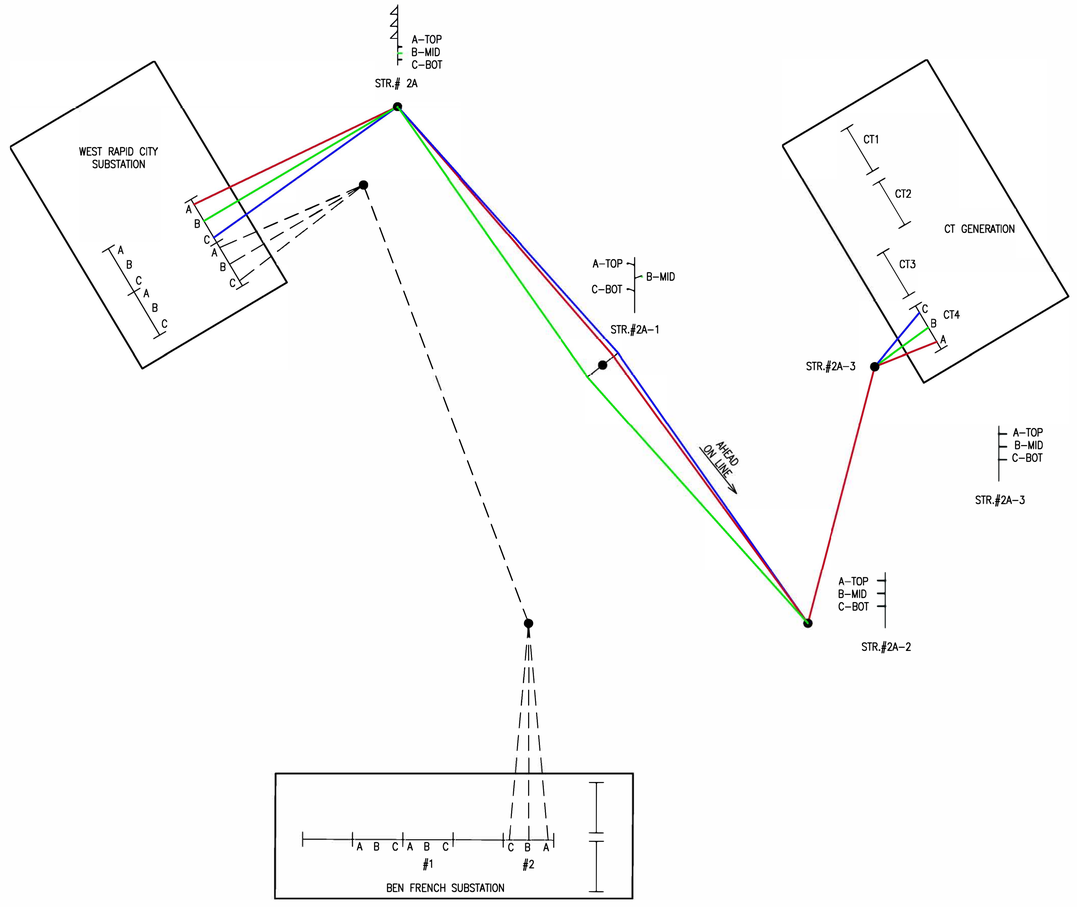
STAKING SHEETS

0 1" 2"

FILENAME BHE-SS-01-D-1.DWG

SCALE NONE

SHEET **SS-01**



LEGEND

A PHASE	
B PHASE	
C PHASE	
OTHER LINES	

NOTES:
1. CONTRACTOR TO VERIFY PHASING.
2. STRUCTURES SHOWN LOOKING AHEAD ON LINE.

ISSUE	DATE	DESCRIPTION
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CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

PHASING DIAGRAM

0 1" 2"

FILENAME BHE–PH–01–D–1.DWG
SCALE N.T.S.
SHEET PH-01

INITIAL SAG TABLE			795 KCMIL 45/7 ACSR "TERN" 1490# @ NESC HEAVY LOADING														SUB 1 to 2A													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
SUB 1	199	199	8.13	8.27	8.40	8.53	8.66	8.79	8.90	9.02	9.14	9.24	9.36	9.45	9.57	9.66	9.74	8.53	8.60	8.67	8.73	8.80	8.86	8.92	8.98	9.04	9.09	9.15	9.20	9.25	9.30	9.34	
SUB-PHASE TENS. LBS			593	583	574	565	557	549	542	535	528	522	516	510	504	499	495																SUBTOTAL DAMPERS NEEDED:0

INITIAL SAG TABLE			795 KCMIL 45/7 ACSR "TERN" 6730# @ NESC HEAVY LOADING														2A to 2A-2													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
2A	260	263	1.17	1.26	1.38	1.51	1.67	1.86	2.09	2.34	2.63	2.92	3.23	3.54	3.85	4.15	4.44	3.24	3.36	3.51	3.68	3.87	4.08	4.32	4.58	4.85	5.11	5.38	5.63	5.87	6.09	6.30	
2A-1		259	1.16	1.25	1.36	1.49	1.65	1.84	2.07	2.32	2.60	2.89	3.20	3.50	3.81	4.10	4.39	3.22	3.34	3.49	3.66	3.85	4.06	4.30	4.55	4.82	5.09	5.35	5.60	5.84	6.06	6.27	3)DPR-795-2T1
SUB-PHASE TENS. LBS			6484	6004	5511	5023	4540	4073	3633	3237	2888	2595	2348	2143	1971	1830	1710																SUBTOTAL DAMPERS NEEDED:6

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E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

INITIAL SAG TABLES

795 KCMIL 45/7 ACSR "TERN"

0 1" 2"

FILENAME BHE-STC-01-D-1.DWG
SCALE NONE

SHEET **STC-01-1**

FINAL SAG TABLE			795 KCMIL 45/7 ACSR "TERN" 5055# INITIAL @ NESC HEAVY LOADING														2A-2 to 2A-3														
			SAG FT														3RD WAVE TIME SEC.														
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
2A-2	180	181	0.81	0.93	1.09	1.28	1.50	1.73	1.98	2.22	2.46	2.68	2.90	3.11	3.31	3.50	3.68	2.69	2.89	3.13	3.38	3.66	3.94	4.20	4.46	4.69	4.90	5.09	5.28	5.44	5.59	5.74	3)DPR-795-D2
SUB-PHASE TENS. LBS			4486	3889	3328	2844	2428	2100	1840	1638	1480	1356	1254	1169	1099	1039	987																SUBTOTAL DAMPERS NEEDED:6

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PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

FINAL SAG TABLES

795 KCMIL 45/7 ACSR "TERN"

0 1" 2"

FILENAME BHE-STC-02-D-1.DWG

SCALE NONE

SHEET **STC-02-1**

INITIAL SAG TABLE			AFL CC-55/443 "DNO-4748" OPGW 1000# @ NESC HEAVY LOADING														SUB 1 to 2A													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
SUB 1	199	199	6.52	6.63	6.73	6.84	6.94	7.04	7.14	7.24	7.34	7.44	7.53	7.63	7.72	7.81	7.91	7.64	7.70	7.76	7.82	7.88	7.94	7.99	8.05	8.10	8.16	8.21	8.26	8.31	8.36	8.41	
SUB-PHASE TENS. LBS			244	240	236	232	229	226	223	220	217	214	211	208	206	204	201																SUBTOTAL DAMPERS NEEDED:0

INITIAL SAG TABLE			AFL CC-55/443 "DNO-4748" OPGW 2665# @ NESC HEAVY LOADING														2A to 2A-1													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
2A	260	260	1.31	1.40	1.50	1.61	1.73	1.87	2.02	2.18	2.35	2.53	2.72	2.92	3.12	3.32	3.52	3.42	3.54	3.66	3.79	3.94	4.09	4.25	4.41	4.58	4.76	4.93	5.11	5.28	5.45	5.61	
2A-1																																	1)DPR-OPGW-D1 BOL
SUB-PHASE TENS. LBS			1889	1768	1649	1536	1427	1322	1226	1136	1054	977	909	848	793	745	702																SUBTOTAL DAMPERS NEEDED:1

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BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

INITIAL SAG TABLES

AFL CC-55/443 "DNO-4748" OPGW

0 1" 2"

FILENAME BHE-STF-01-D-1.DWG
SCALE NONE

SHEET **STF-01-1**

FINAL SAG TABLE			AFL CC-55/443 "DNO-4748" OPGW 1260# INITIAL @ NESC HEAVY LOADING														2A-1 to CT1													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
2A-1	197	197	4.07	4.20	4.32	4.45	4.57	4.69	4.80	4.92	5.03	5.14	5.25	5.35	5.46	5.56	5.66	6.03	6.13	6.22	6.31	6.39	6.48	6.55	6.63	6.71	6.78	6.85	6.92	6.99	7.05	7.11	DPR-OPGW-D1 AOL
SUB-PHASE TENS. LBS			344	333	324	315	306	299	291	285	278	272	267	261	257	252	247																SUBTOTAL DAMPERS NEEDED:1

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E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

FINAL SAG TABLE

AFL CC-55/443 "DNO-4748" OPGW

0 1" 2"

FILENAME BHE-STF-02-D-1.DWG

SCALE NONE

SHEET **STF-02-1**

INITIAL SAG TABLE			3/8" 7 STRAND EHS 945# @ NESC HEAVY LOADING														SUB 1 to 2A													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
SUB 1	199	199	6.55	6.63	6.71	6.80	6.88	6.96	7.04	7.12	7.20	7.28	7.36	7.43	7.50	7.58	7.66	7.65	7.70	7.75	7.80	7.84	7.89	7.94	7.98	8.02	8.07	8.11	8.15	8.19	8.24	8.28	
SUB-PHASE TENS. LBS			227	224	221	218	216	213	211	209	206	204	202	200	198	196	194																SUBTOTAL DAMPERS NEEDED:0

INITIAL SAG TABLE			3/8" 7 STRAND EHS 2370# @ NESC HEAVY LOADING														2A-1 to 2A-2													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
2A-1	259	259	1.61	1.71	1.83	1.95	2.08	2.22	2.36	2.51	2.67	2.82	2.98	3.14	3.31	3.47	3.63	3.79	3.92	4.04	4.18	4.31	4.45	4.59	4.74	4.88	5.02	5.17	5.30	5.44	5.57	5.70	1)DPR-EHS-D1
SUB-PHASE TENS. LBS			1418	1331	1247	1170	1098	1029	967	909	856	809	765	726	690	658	629																SUBTOTAL DAMPERS NEEDED:1

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

INITIAL SAG TABLES

3/8" 7 STRAND EHS

0 1" 2"

FILENAME BHE-STS-01-D-1.DWG

SCALE NONE

SHEET **STS-01-1**

FINAL SAG TABLE			3/8" 7 STRAND HS 700# @ NESC HEAVY LOADING														2A-1 to CT1-1														
			SAG FT														3RD WAVE TIME SEC.														
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
2A-1	154	154	4.92	4.98	5.03	5.08	5.14	5.19	5.25	5.30	5.35	5.40	5.46	5.50	5.56	5.61	5.66	6.64	6.67	6.71	6.74	6.78	6.81	6.85	6.89	6.92	6.95	6.99	7.02	7.05	7.08	7.11	1)DPR-EHS-D1
SUB-PHASE TENS. LBS			163	161	159	158	156	155	153	151	150	149	147	146	144	143	142																SUBTOTAL DAMPERS NEEDED:1

FINAL SAG TABLE			3/8" 7 STRAND HS 1275# @ NESC HEAVY LOADING														2A-2 to 2A-3														
			SAG FT														3RD WAVE TIME SEC.														
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
2A-2	181	181	2.82	2.93	3.04	3.15	3.26	3.37	3.47	3.58	3.68	3.77	3.87	3.96	4.06	4.15	4.24	5.02	5.12	5.22	5.31	5.40	5.49	5.57	5.66	5.73	5.81	5.88	5.95	6.02	6.09	6.16	1)DPR-EHS-D1
SUB-PHASE TENS. LBS			395	379	365	353	341	330	320	311	302	295	287	281	274	268	263																SUBTOTAL DAMPERS NEEDED:1

FINAL SAG TABLE			3/8" 7 STRAND HS 1285# @ NESC HEAVY LOADING														2A-2 to CT3-3														
			SAG FT														3RD WAVE TIME SEC.														
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
2A-2	198	198	3.52	3.63	3.75	3.86	3.97	4.08	4.18	4.28	4.39	4.48	4.58	4.68	4.77	4.86	4.95	5.61	5.70	5.79	5.87	5.96	6.04	6.11	6.19	6.26	6.33	6.40	6.47	6.53	6.60	6.66	1)DPR-EHS-D1
SUB-PHASE TENS. LBS			377	365	354	344	334	325	317	310	303	296	290	284	278	273	268																SUBTOTAL DAMPERS NEEDED:1

FINAL SAG TABLE			3/8" 7 STRAND HS 1315# @ NESC HEAVY LOADING														2A-2 to CT2-3														
			SAG FT														3RD WAVE TIME SEC.														
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
2A-2	242	242	5.72	5.84	5.95	6.06	6.17	6.28	6.39	6.49	6.60	6.70	6.80	6.89	6.99	7.09	7.19	7.16	7.23	7.30	7.36	7.43	7.50	7.56	7.62	7.68	7.74	7.80	7.85	7.91	7.96	8.02	1)DPR-EHS-D1
SUB-PHASE TENS. LBS			348	342	335	329	323	318	312	307	303	298	294	289	285	282	278																SUBTOTAL DAMPERS NEEDED:1

ISSUE	DATE	DESCRIPTION
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PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

FINAL SAG TABLES

3/8" 7 STRAND HS

0 1" 2"

FILENAME: BHE-STS-02-D-1.DWG
SCALE: NONE

SHEET: **STS-02-1**

					SCHP-M1	SCOE-69-M1	SCUBDE-M1	DT-01-69	T-4D	T-4DS	T-4FDW	T-4FDS	T-FSC-2	T-PSD	T-BDEGPD	T-SDEGPD	TM-EXT-15	TM-9	TG-268 (9"-12")	TG-268 (11"-14")	TGS-1A	TGS-2A	TA-2H	TA-3H	TA-5EXT	TM-GM	TP-A	DPR-EHS-D1	DPR-OPGW-D1	DPR-795-211	DPR-795-D2	3/8" EHS	DNO-4748	795-ACSR	EXTRA
				West Rapid City - CT4 - QTY:	1	1	1	1	6	2	2	3	1	3	12	3	8	2	1	1	5	6	2	8	10	11	2	5	2	3	3	300	600	2800	1
ITEM NO.	QTY	DESCRIPTION	MANUFACTURER	MANUFACTURER PART #	CLIENT #																													
A110	10	ANCHOR, EXTENSION, 1 1/2" SQ. SHAFT 5'-0"	CHANCE	12656	N.S.																			1										
A111	10	ANCHOR, EXTENSION, 1 1/2" SQ. SHAFT 7'-0"	CHANCE	12657	N.S.																	1	1											
A202	2	ANCHOR, 1 1/2" SQ. SHAFT, 8" AND 10" HELIX W/ TRIPLEYE ADAPTER	CHANCE	12654-3AE	N.S.																	1												
A210	8	ANCHOR, 1 1/2" SQ. SHAFT, 8", 10", AND 12" HELIX W/ TRIPLEYE ADAPTER	CHANCE	12654-3AEJ	N.S.																		1											
B2526	2	BOLT, MACHINE, 5/8" X 26"	HUGHES	B626-6	N.S.								2																					
B273	11	BOLT, MACHINE, 7/8" X 3"	HUGHES	B83-2	20-7803	1	8												1	1														
B2718	4	BOLT, MACHINE, 7/8" X 18"	HUGHES	B818-6	20-7818	4																												
B2720	2	BOLT, MACHINE, 7/8" X 20"	HUGHES	B820-6	20-7820	2																												
B603	5	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	BURNDY	50 FWSS	N.S.					1		1																						
B605	5	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	BURNDY	50 SWSSMD	N.S.					1		1																						
B606	24	BOLT, NUT, BELLEVILLE, FLAT, STAINLESS STEEL, ASSEMBLY	CMC	SBA20-50	N.S.											8																		
B614	5	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	FASTENAL	70207	N.S.					1		1																						
C107	2800	CONDUCTOR, 795 KCMIL ACSR, 45/7 "TERN"	SOUTHWIRE		N.S.																												1	
C800	300	WIRE, GALVANIZED, 7 STEEL STRAND, 3/8" EHS	MITCHELL		N.S.																										1			
C801	1870	WIRE, GALVANIZED, 7 STEEL STRAND, 7/16" EHS	MITCHELL		18-7167															110	220													
C901	250	WIRE, COPPER, #4 SOLID, 40% CONDUCTIVITY	SOUTHWIRE		36-4000													125																
C902	24	WIRE, COPPER, #2 STRANDED, CLASS B	SOUTHWIRE		N.S.				2	6																								
F110	7	3108.5 POLE BANDS, HEAVY DUTY, 7"-10" POLE	HUGHES	3108.5	18-1116	3	4																											
F111	5	3108.6 POLE BANDS, HEAVY DUTY, 9"-12" POLE	HUGHES	3108.6	18-1117		4												1															
F112	3	3108.7 POLE BANDS, HEAVY DUTY, 11"-14" POLE	HUGHES	3108.7	18-1118		2													1														
F203	50	LINK, CONNECTING, 3/8" X 2" X 7 1/2", 15/16" HOLES, 38K LBS	HUGHES	3154	14-3154	10	36												2	2														
F300	2	ANCHOR ASSEMBLY WITH BOLTS, PAIR	HUGHES	A1895-2	N.S.																					1								
G100	11	GUY, ROLLER, 1 1/8" WR, 15/16" HOLE	HUGHES	28082	18-2808	1	8												1	1														
G200	5	GUY, STRAIN INSULATOR, 120" LONG, 21K LBS, ROLLER, ROLLER	HUGHES	CF694-120R2	18-1521																1													
G201	6	GUY, STRAIN INSULATOR, 120" LONG, 50K LBS	MACLEAN	GCC50-120-SC	18-1550																	1												
G400	11	GUY, GUARD, 2" X 8'-0", FULL ROUND, YELLOW	MacLEAN	J1493Y	N.S.																				1									
G601	15	GUY DEADEND GRIP, FOR 7/16" EHS	PREFORMED	GDE-1108	18-7168																3													
G902	11	GUY, STRANDVISE, 7/16" EHS, SHORT BAIL	MacLEAN	5203	18-0716																1	1												
G903	6	GUY, STRANDVISE, 7/16" EHS, LONG BAIL	MacLEAN	5203L	18-0717																	1												
H102	8	SOCKET EYE, 18K, 1/2" WIDTH, 11/16" HOLE, 2-1/16" LENGTH	HUBBELL	SA04	N.S.				1	1																								
H200	3	SOCKET CLEVIS, 30K	HUBBELL	SC30	N.S.											1																		
H400	8	HOT LINK EXTENSION, CHAIN EYE - CHAIN EYE, 15" LONG, 30K LBS	HUBBELL	HOO3015	N.S.												1																	
H500	8	Y-CLEVIS BALL, 30K	HUBBELL	YBC30	48-3054				1	1																								
H602	5	ANCHOR, SHACKLE, 3" LONG, 3/4" DIA., 7/8" DIA. PIN, 35K LBS	HUGHES	2865-B3	N.S.						1	1																						
H603	8	ANCHOR, SHACKLE, 3.5" LONG, 7/8" DIA., 3/4" DIA. PIN, 60K LBS	HUBBELL	AS50BNK	N.S.												1																	
H902	3	Y-CLEVIS, EYE, 90, 40K	HUBBELL	YCS-06-90-40	48-3053									1																				
I220	3	INSULATOR, HORIZONTAL POST, DROP TONGUE, 69KV	HUBBELL	P25004350020	48-1007									1																				
I300	15	INSULATOR, DEADEND, Y-CLEVIS BALL, 54" LENGTH, 25K LBS	MACLEAN	S140800 42MXAL027	48-6927										1	1																		
J100	600	AFL CC-55/443 "DNO-4748" OPGW	AFL	DNO-4748	N.S.																											1		
J300	5	FIBER OPTIC DEADEND, 18" U-BOLT (48 FIBER), W/ GROUND WIRE	PREFORMED	2801303G	N.S.						1	1																						
J401	10	DOWNLEAD CUSHION KIT 0.443 OPGW W/ HARDWARE FOR WOOD POLE	PREFORMED	8663041-H1	N.S.								10																					
J501	1	VERTICAL CABLE STORAGE ASSEMBLY	PREFORMED	8003569	N.S.								1																					
J502	1	VERTICAL MOUNTING BRACKET KIT	PREFORMED	8003472	N.S.								1																					
J510	1	6" X 22" COYOTE CLOSURE KIT W/ 6 PORT END PLATE	PREFORMED	8006659	N.S.								1																					
J511	1	COYOTE DEFENDER FOR 6" X 22" CLOSURE	PREFORMED	8003492	N.S.								1																					
J600	2	SPLICE TRAY KIT, 36 COUNT TRAY	PREFORMED	80805514	N.S.								2																					
J700	2	CLOSURE END PLATE GROMMETS, 7/8" PORT, 0.443" OPGW	PREFORMED	8003597	N.S.								2																					
J720	2	FUTURE CABLE PORT KIT, 7/8" PORT	PREFORMED	8003371	N.S.								2																					
J730	1	GROMMET PLUG, 3/4" PORT, QTY 2	PREFORMED	80806037	N.S.								1																					
K500	3	AGS SUSPENSION ASSEMBLY, 25K, 795 ACSR-45/7 "TERN"	PREFORMED	AGS-5128	40-5114									1																				
L101	12	STRAIN CLAMP, DEADEND W/ SOCKET-EYE, 30K, 0.50 - 1.20 RANGE	HUBBELL	SD-112-S	42-1120										1																			
L300	8	STRAIN CLAMP, DE, 20K, 3/8" EHS	HUBBELL	SWDE55N	44-4053				1	1																								
L502	3	COMPRESSION DEADEND ASSY, DOUBLE TONGUE, W/ 15" TERMINAL "TERN"	AFL	VED-123	42-8230											1																		
M500	5	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	HUBBELL	VHCL1012	N.S.					1		1																						
N405	2	NUT, LOCK, MF TYPE, 5/8"	HUGHES	MF60	N.S.								2																					
N407	17	NUT, LOCK, MF TYPE, 7/8"	HUGHES	MF80	22-7856	7	8												1	1														
O100	4.5	INHIBITOR, FILLER COMPOUND, GRITTED, COMPRESSION CONNECTIONS, 8 oz.	HUBBELL	VS68B	N.S.											1.5																		
O101	1.8	INHIBITOR, FILLER COMPOUND, NON-GRITTED, PAD TO PAD, 8 OZ	HUBBELL	VS8B	N.S.											0.6																		
P104	15	CLIP, BONDING, WITH 1/2" X 1 1/2" BOLT, 7/16" MAX. WIRE	HUGHES	2718.55	46-2718	3	10												1	1														
P150	80	NAIL, 10D, CU-COATED	MACLEAN	J7260	46-7460													40																
P151	80	CLIP, CU-COATED	KEARNEY	5730-1	46-2729													40																
P300	5	WOOD MOULDING, 1-11/16" X 8'-0"	HUGHES	2503.8	46-2503	3												1																
P400	21	MOULDING, STAPLES, 3 1/2" X 1 3/4"	HUBBELL	C25050222	46-2504	15												3																
P600	100	STAPLES, CUT (SLASH), 1 1/2" X 3/8", COPPER COATED, BARBED	MACLEAN	J7682	46-7494													50																
Q100	26	CLAMP, 3-BOLT, 6" LONG, 5/8" BOLT, 5/16" - 1/2" RANGE	MACLEAN	J931	18-5816				1	1												3												
Q500	2	CONNECTOR, COMPRESSION #4 COPPER TO #4 COPPER	HOMAC	CC44	N.S.						1																							
Q501	6	GROUND CLAMP, #2 STRANDED TO #4 SOLID	HOMAC	CC24	36-0002				1																									
Q550	8	CLAMP, SINGLE BOLT, VISE TYPE, 3/8" EHS TO #2 STR CU	HUBBELL	GA9020GLSS	46-6810				1	1																								
Q551	1	CLAMP, SINGLE BOLT, #4 STR CU TO 4/0 AWG STR. CU	HUBBELL	LC1602	N.S.			1																										
Q552	1	CLAMP, VISE TYPE, 3/8 EHS TO 4/0 AWG STR CU	HUBBELL	GA9040L55	N.S.			1																										
Q601	12	PARALLEL GROOVE CONNECTOR, 0.743 - 1.152 RANGE	AFL	483.3A	42-0483										1																			
S110	7	SPIRAL VIBRATION DAMPER, 0.327" - 0.461" RANGE	PREFORMED	5050104	N.S.																					1	1							
S150	12	DAMPER, DOG BONE, 795 ACSR	HUBBELL	60710-12	N.S.																							2	2					
W205	2	WASHER, SPRING, 11/16" HOLE	HUGHES	2702.6	N.S.								2																					
W207	3	WASHER, SPRING, 15/16" HOLE	HUGHES	2702.8	N.S.	3																												
W304	4	WASHER, SQUARE, 2" X 1/4", 11/16" HOLE	HUGHES	SW2-60	N.S.								4																					
W410	6	WASHER, ROUND, 2" X 1/4", 15/16" HOLE	HUGHES	RW2-80	N.S.	6																												
W504	6	WASHER, SQ. CURVED, 4" X 1/4", 15/16" HOLE	HUGHES	SCW4-80	22-4425	6																												

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
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DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

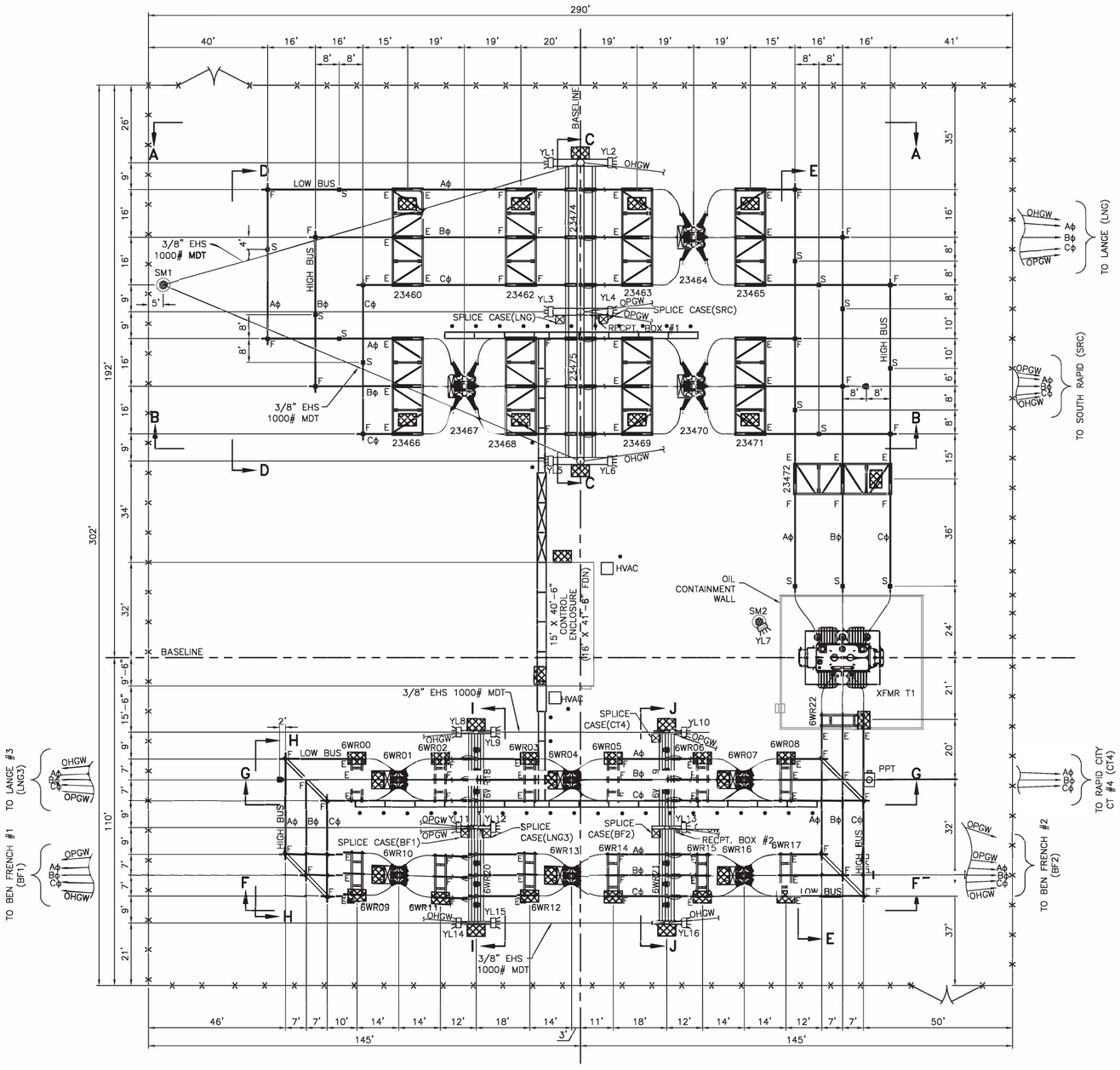
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY - CT4
69KV TRANSMISSION LINE

MATERIAL LIST

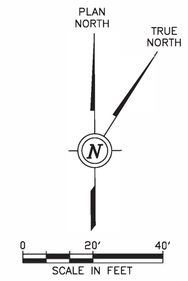
0 1" 2"

FILENAME BHE-ML-01-D-1.DWG
SCALE NONE
SHEET ML-01



NOTES:

1. 230 kV LOW AND HIGH BUS SHALL BE 3–1/2" AL IPS, SCH. 40, 6063–T6 ALUM. ALLOY WITH 795 ACSR "DRAKE" DAMPENING CABLE.
2. 230 kV BREAKER JUMPERS SHALL BE MADE OF DOUBLE 1272 AAC "NARCISSUS" CONDUCTORS.
3. 230 kV TRANSFORMER JUMPERS SHALL BE MADE OF SINGLE 1272 AAC "NARCISSUS" CONDUCTORS.
4. 69 kV BUS SHALL BE 3–1/2" AL IPS, SCH. 40, 6063–T6 ALUM. ALLOY WITH 795 ACSR "DRAKE" DAMPENING CABLE.
5. 69 kV BREAKER JUMPERS SHALL BE MADE OF DOUBLE 1272 AAC "NARCISSUS" CONDUCTORS.
6. 69 kV TRANSFORMER JUMPERS SHALL BE MADE OF DOUBLE 1272 AAC "NARCISSUS" CONDUCTORS.
7. BUS COUPLING LOCATIONS SHALL BE DETERMINED BY CONTRACTOR AS NEEDED BASED UPON BUS LENGTHS USED. LOCATE AS NEEDED PER THE SPECIFICATIONS. CONTRACTOR SHALL ACQUIRE 40' LONG BUS PIPE AND LIMIT USE OF COUPLERS ON LONG SPANS. DO NOT USE COUPLERS OR EXCESS SHORTER BUS PIECES TO CREATE A LONGER PIECE LESS THAN 40' IN LENGTH.



LEGEND:

- F FIXED (WELDED)
- E EXPANSION
- S SLIP
- FLOOD LIGHT
- YARD RECEPTACLE BOX
- SAFETY BOLLARD
- CABLE TRENCH DRIVE SECTION (HS20 RATED)
- CABLE TRENCH PEDESTRIAN SECTION
- CHAINLINK FENCE
- OPERATOR PLATFORM

REGISTERED PROFESSIONAL ENGINEER — REG. NO. 10443 — PAUL D. KONECHNE — SOUTH DAKOTA

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly Registered Professional Engineer under the laws of the State of South Dakota.

By _____ Paul D. Konechne, P.E.

Registration Number 10443 Date: 01-18-19

DATE	DRAWN BY	NO.	APPROVED BY	REVISION DESCRIPTION
01-19	KLV	0	PJK	FOR CONSTRUCTION

DGR ENGINEERING
ROCK RAPIDS, IOWA
(712) 472-2531

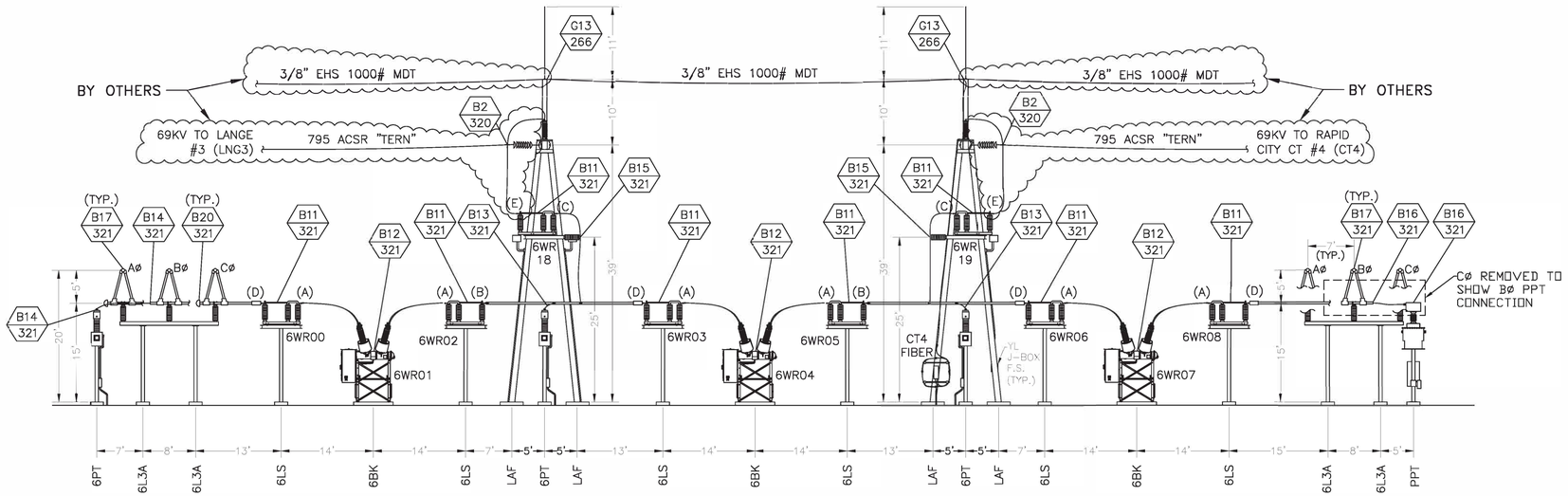
BLACK HILLS ENERGY

WEST RAPID CITY SUBSTATION

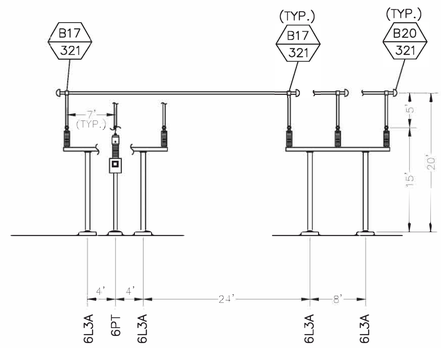
GENERAL ARRANGEMENT

DRAWN BY KLV DATE 08-18
APPROVED BY PJK DATE 08-18
DWG NO. WRC-C-101
REVISION NO. 0

P:\04233\15\DWG\WRC-C-101.DWG



SECTION G–G



SECTION H–H

NOTES:

1. BUS COUPLING LOCATIONS SHALL BE DETERMINED BY CONTRACTOR AS NEEDED BASED UPON BUS LENGTHS PROCURED.

LEGEND

B27 / 320 — DETAIL # / DWG #
1L1 — STRUCTURE #
(A) — SUB-DETAIL ASSIGNMENT

0' 10' 20'
SCALE IN FEET

REGISTERED PROFESSIONAL ENGINEER — REG. NO. 10443 — PAUL D. KONECHNE — SOUTH DAKOTA

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly Registered Professional Engineer under the laws of the State of South Dakota.

By _____
Paul D. Konechne, P.E.

Registration Number 10443 Date: 01-18-19

DATE	DRAWN BY	NO.	APPROVED BY	REVISION DESCRIPTION
01-19	KLV	0	PJK	FOR CONSTRUCTION

BLACK HILLS ENERGY

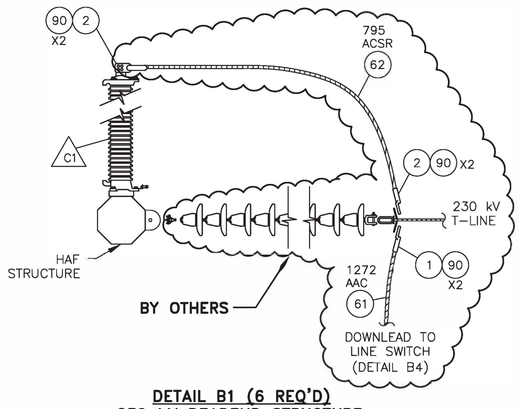
WEST RAPID CITY SUBSTATION

SECTIONS G AND H

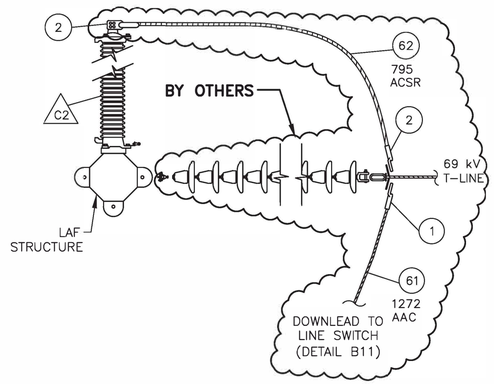
DRAWN BY KLV DATE 10-18
APPROVED BY PJK DATE 10-18
DWG NO. WRC-C-305
REVISION 0

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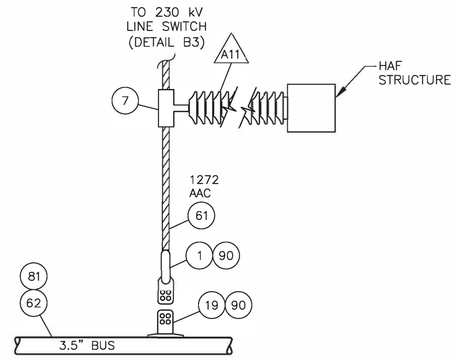
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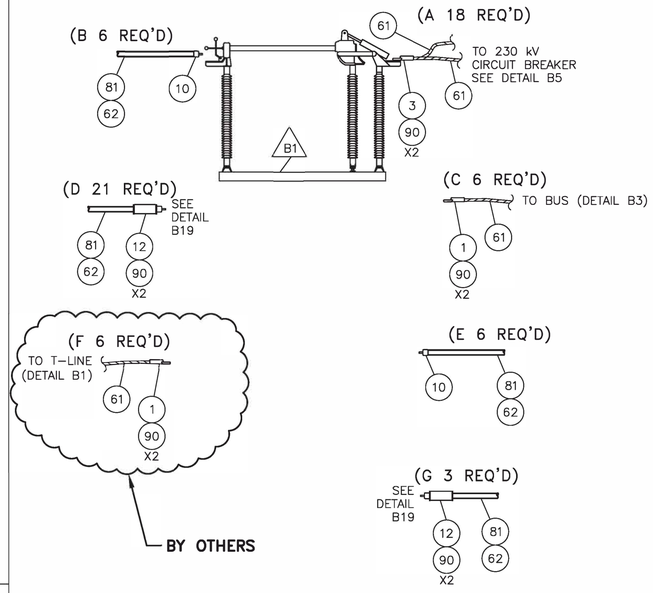
DETAIL B1 (6 REQ'D)
230 kV DEADEND STRUCTURE
T–LINE ATTACHMENT DETAIL



DETAIL B2 (12 REQ'D)
69 kV DEADEND STRUCTURE
T–LINE ATTACHMENT DETAIL



DETAIL B3 (6 REQ'D)
BUS CONNECTION DETAIL
230 kV DOWNLEAD CONNECTIONS

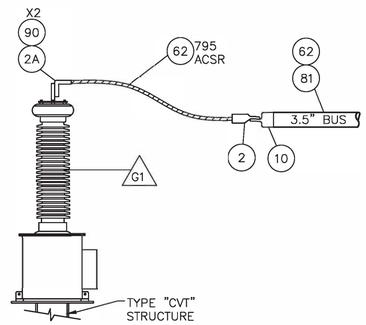


DETAIL B4
230 kV DISCONNECT SWITCH
CONNECTION DETAIL

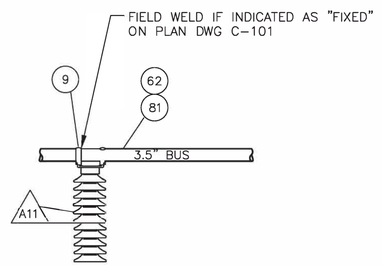
DETAIL B5 (9 REQ'D)
230 kV PCB CONNECTION DETAIL

DETAIL B6 (3 REQ'D)
230/69 kV TRANSFORMER HIGHSIDE
CONNECTION DETAIL

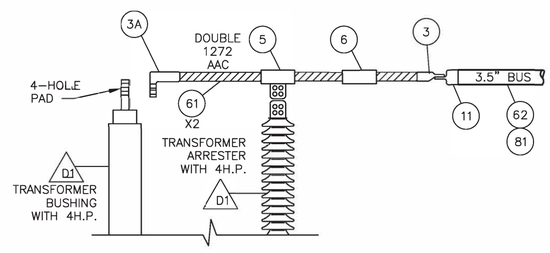
DETAIL B7 (12 REQ'D)
230 kV BUS BI–LEVEL
SUPPORT ASSEMBLY DETAIL



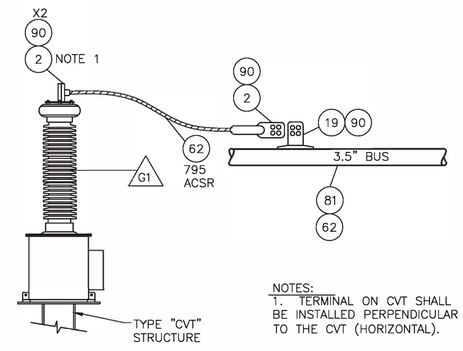
DETAIL B10A (1 REQ'D)
230 kV BUS CVT
CONNECTION DETAIL



DETAIL B8 (14 REQ'D)
230 kV BUS SUPPORT
ASSEMBLY DETAIL



DETAIL B9 (3 REQ'D)
230/69 kV TRANSFORMER LOWSIDE
CONNECTION DETAIL



DETAIL B10 (6 REQ'D)
230 kV LINE CVT
CONNECTION DETAIL

REGISTERED PROFESSIONAL ENGINEER
REG. NO.
10443
PAUL D.
KONECHNE
SOUTH DAKOTA

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By _____
Paul D. Konechne, P.E.

Registration Number 10443 Date: 01-18-19

DATE	DRAWN BY	NO.	APPROVED BY	REVISION DESCRIPTION
01-19	KLV	0	PDK	FOR CONSTRUCTION

BLACK HILLS ENERGY

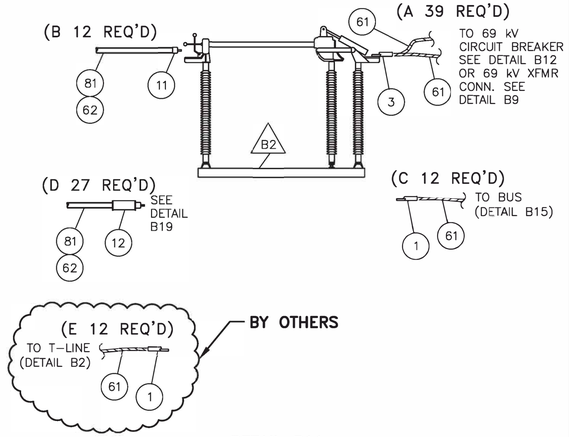
WEST RAPID CITY SUBSTATION

BUS CONNECTION DETAILS

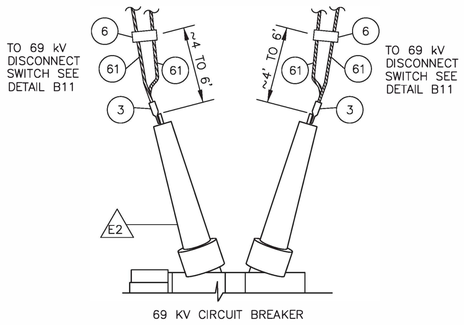
DRAWN BY KLV DATE 10-18
APPROVED BY PDK DATE 10-18
DWG NO. WRC-C-320 REVISION 0

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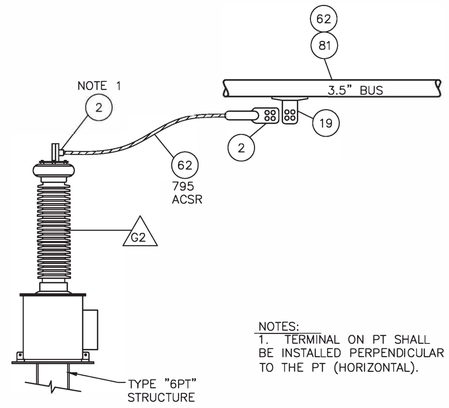
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(712) 472-2531



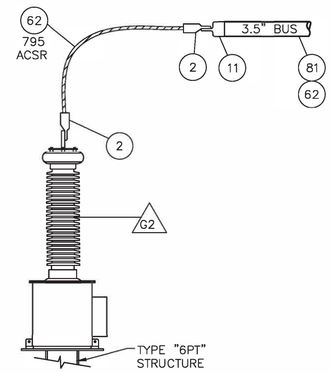
DETAIL B11
69 kV DISCONNECT SWITCH CONNECTION DETAIL



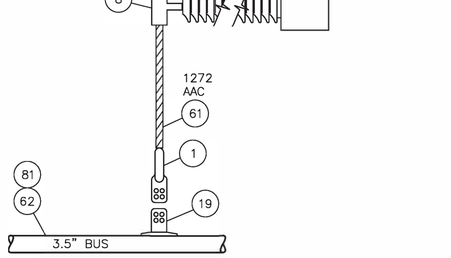
DETAIL B12 (18 REQ'D)
69 kV PCB CONNECTION DETAIL



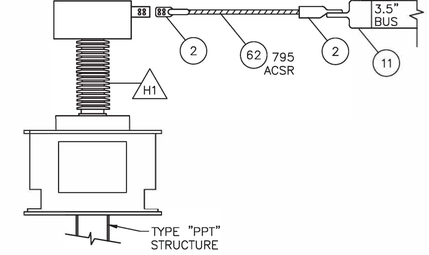
DETAIL B13 (12 REQ'D)
69 kV LINE PT'S CONNECTION DETAIL



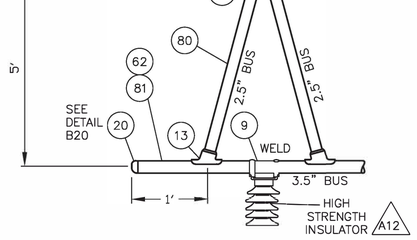
DETAIL B14 (1 REQ'D)
69 kV BUS PT CONNECTION DETAIL



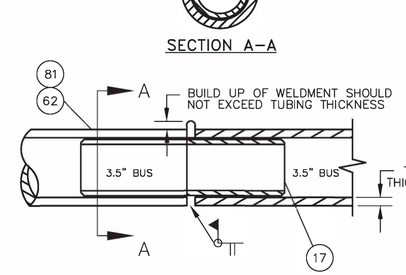
DETAIL B15 (12 REQ'D)
BUS CONNECTION DETAIL
69 kV DOWNLEAD CONNECTIONS



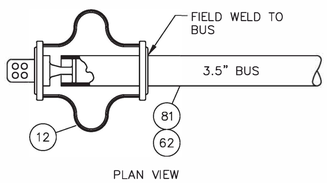
DETAIL B16 (1 REQ'D)
69 kV POWER PT CONNECTION DETAIL



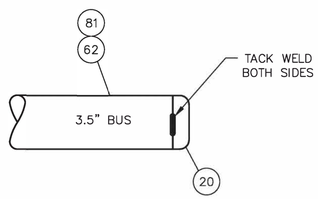
DETAIL B17 (12 REQ'D)
69 kV BUS BI-LEVEL SUPPORT ASSEMBLY DETAIL



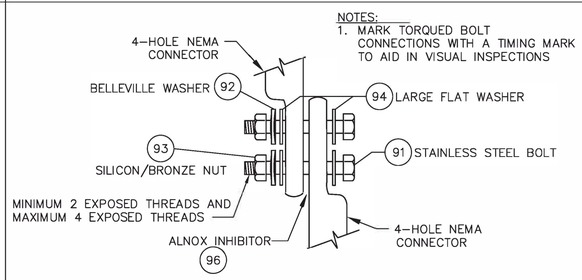
DETAIL B18 (AS REQ'D)
BUS COUPLER JOINT



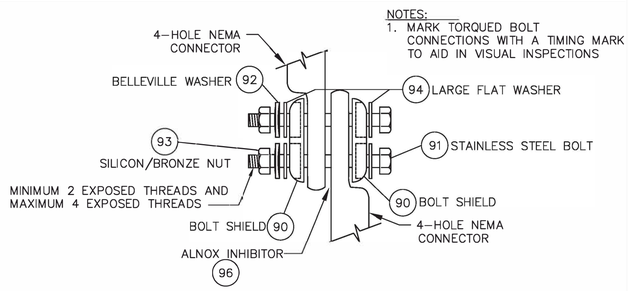
DETAIL B19
EXPANSION BUS TERMINAL DETAIL



DETAIL B20 (39 REQ'D)
END CAP DETAIL



DETAIL B21 (AS REQ'D)
69 kV 4-HOLE NEMA PAD CONNECTIONS



DETAIL B22 (AS REQ'D)
230 kV 4-HOLE NEMA PAD CONNECTIONS

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(712) 472-2531

REGISTERED PROFESSIONAL ENGINEER — REG. NO. 10443 PAUL D. KONECHNE — SOUTH DAKOTA

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly Registered Professional Engineer under the laws of the State of South Dakota.

By _____
Paul D. Konechne, P.E.

Registration Number 10443 Date: 01-18-19

DATE	DRAWN BY	NO.	APPROVED BY	REVISION DESCRIPTION
01-19	KLV	0	PDK	FOR CONSTRUCTION

BLACK HILLS ENERGY

WEST RAPID CITY SUBSTATION

BUS CONNECTION DETAILS

DRAWN BY KLV DATE 10-18
APPROVED BY PDK DATE 10-18
DWG NO. WRC-C-321 REVISION NO. 0

Item No.	OFM	Catalog Number	Description	Manufacturer	"Total Required"
1	X	WCF-136-D	CONNECTOR, TERMINAL, WELDED, 1272 AAC TO 4" NEMA 4HP	ANDERSON	75
1A	X	WCF-136-D-Y45	CONNECTOR, TERMINAL, WELDED, 1272 AAC TO 4" NEMA 4HP, 45°	ANDERSON	3
1B	X	WCF-136-D-Y90	CONNECTOR, TERMINAL, WELDED, 1272 AAC TO 4" NEMA 4HP, 90°	ANDERSON	3
2	X	WCF-106-D	CONNECTOR, TERMINAL, WELDED, 795 ACSR TO 4" NEMA 4HP	ANDERSON	77
2A	X	WCF-106-D-Y90	CONNECTOR, TERMINAL, WELDED, 795 ACSR TO 4" NEMA 4HP, 90°	ANDERSON	1
3	X	W2CF-136-D	CONNECTOR, TERMINAL, WELDED, (2) 1272 AAC TO 4" NEMA 4HP	ANDERSON	114
3A	X	W2CF-136-D-Y90	CONNECTOR, TERMINAL, WELDED, (2) 1272 AAC TO 4" NEMA 4HP, 90°	ANDERSON	3
4	X	ORT-2114-D	CONNECTOR, TEE, COMPRESSION, 1272 AAC MAIN TO 4" NEMA 4HP	ANDERSON	3
4A	X	ATCF-15401	CONNECTOR, TEE, BOLTED, 1272 AAC MAIN TO 4" NEMA 4HP	ANDERSON	3
5	X	110-121-CSTD-4-90	CONNECTOR, SPACER, BOLTED, (2) 1272 AAC, 4" SPACING TO 4" NEMA 4HP, 90°	TRAVIS (PDU)	3
6	X	APCS-15-4	CONNECTOR, SPACER, BOLTED, (2) 1272 AAC, 4" SPACING	ANDERSON	69
7	X	HVCS-12995	BUS SUPPORT, BOLTED, EHV, 1272 AAC TO 5" BOLT CIRCLE	ANDERSON	6
8	X	ACS-163	BUS SUPPORT, BOLTED, 1272 AAC TO 3" BOLT CIRCLE	ANDERSON	12
9	X	WTH-34-5	BUS SUPPORT, WELDED/SLIP, 3-1/2" IPS TO 5" BOLT CIRCLE	ANDERSON	38
10	X	WSTFE-34-D-CF-EHV	CONNECTOR, TERMINAL, WELDED, EHV, 3-1/2" IPS TO 4" NEMA 4HP, CENTER FORMED, WITH BOLT SHIELD	ANDERSON	16
11	X	WSTF-34-D-CF	CONNECTOR, TERMINAL, WELDED, 3-1/2" IPS TO 4" NEMA 4HP, CENTER FORMED	ANDERSON	17
12	X	WFTFV-34D	CONNECTOR, TERMINAL, WELDED, EXPANSION, 3-1/2" IPS TO 4" NEMA 4HP, 90°	ANDERSON	51
13	X	WTT-15-3424	FITTING, WELDED TEE, 15 DEGREE, 3-1/2" IPS MAIN TO 2-1/2" IPS TAP	ANDERSON	24
14	X	WTT-15-3434	FITTING, WELDED TEE, 15 DEGREE, 3-1/2" IPS MAIN TO 3-1/2" IPS TAP	ANDERSON	24
15	X	WTT2-15-3424	FITTING, WELDED VEE, 15 DEGREE, 3-1/2" IPS MAIN TO 2-1 /2" IPS VEE	ANDERSON	12
16	X	WTT2-15-3434	FITTING, WELDED VEE, 15 DEGREE, 3-1/2" IPS MAIN TO 3-1 /2" IPS VEE	ANDERSON	12
17	X	WCI-3434	FITTING, COUPLER, WELDED, INTERNAL, 3-1/2" IPS TO 3-1/2" IPS	ANDERSON	13
18	X	WLI45-3434	FITTING, COUPLER, WELDED, 45°, INTERNAL, 3-1/2" IPS TO 3-1/2" IPS	ANDERSON	6
19	X	WTTFR-30-60-D	FITTING, TEE, WELDED, 3"-6" IPS RUN TO 4" NEMA 4HP, INLINE PAD	ANDERSON	36
20	X	WEB34	FITTING, CORONA BELL, WELDED, INTERNAL FIT, 3-1/2" IPS	ANDERSON	39
41	X	E/INS-150-G	WILDLIFE PROTECTOR, SPLIT TUBING, GRAY, FOR 1272 AAC, 20 KV PHASE-GND	MIDSUN GROUP	10'
42	X	E/FTP-250G	WILDLIFE PROTECTOR, FUSING TAPE, GRAY, 2.5" WIDE, FOR EXPOSED CONNECTORS & W/ITEM 41 & 43	MIDSUN GROUP	AS REQ'D
43	X	E/BSC-350	WILDLIFE PROTECTOR, COVER FOR XFMR ARRESTERS	MIDSUN GROUP	3
44	X	E/BC-DBL-LEAD	WILDLIFE PROTECTOR, BUSHING COVER FOR TRANSFORMER	MIDSUN GROUP	3
61	X	NARCISSUS	CONDUCTOR, 1272 MCM AAC, 61 STRANDING	ALCOA	2500'
62	X	TERN	CONDUCTOR, 795 MCM ACSR 45/7 STRANDING, FOR HIGH VOLTAGE CONNECTIONS	ALCOA	500'
62	X	TERN	CONDUCTOR, 795 MCM ACSR 45/7 STRANDING, FOR BUS DAMPENING	ALCOA	2000'
80		2.5" - 6063-T6	CONDUCTOR, BUS, 2-1/2" IPS, SCHEDULE 40 ALUMINUM, 40' LENGTHS	ALCOA	200'
81		3.5" - 6063-T6	CONDUCTOR, BUS, 3-1/2" IPS, SCHEDULE 40 ALUMINUM, 40' LENGTHS	ALCOA	2520'
90	X	EVHS-D	HARDWARE SHIELDS, EHV, 4" NEMA 4HP (BOLT SHIELDS)	ANDERSON	230
91		HBS-XXX	STAINLESS STEEL BOLTS, 1/2" FOR ALUMINUM BUS CONNECTIONS, CONTRACTOR TO DETERMINE LENGTH	ANDERSON	AS REQ'D
92		BW500	STAINLESS STEEL BELLEVILLE WASHER, 1/2", 1.06" O.D.	ANDERSON	AS REQ'D
93		HNB500	SILICON BRONZE NUT, HIGH STRENGTH, 1/2"	ANDERSON	AS REQ'D
94		HFS5001	STAINLESS STEEL WASHER, 1/2", 1.13" O.D.	ANDERSON	AS REQ'D
96		PENETROX A	ELECTRICAL FILLER COMPOUND, NON-PETROLEUM BASED	BURNDY	AS REQ'D
200		4/0 COPPER	CONDUCTOR, 4/0 STRANDED SOFT DRAWN COPPER		14,000'
201		633400	GROUND ROD, 3/4" DIAMETER, 10' LONG, COPPER CLAD	ERICO	106
202		CR-34	GROUND ROD COUPLING, FOR CONNECTING MULTIPLE GROUND RODS OR DRIVE STUDS	ERICO	70
203		DS34	GROUND ROD DRIVING STUD	ERICO	20
205		GYR182Q	MOLD, GROUNDING CONNECTOR, EXOTHERMIC, 4/0 CABLE-3/4" GROUND ROD (USE 150 WELD)	ERICO	4
206		XBQ2Q2Q	MOLD, GROUNDING CONNECTOR, EXOTHERMIC, 4/0 CABLE - 4/0 CABLE CROSS (USE 250 WELD)	ERICO	25
207		TAC2Q2Q	MOLD, GROUNDING CONNECTOR, EXOTHERMIC, 4/0 CABLE - 4/0 CABLE TEE (USE 150 WELD)	ERICO	40
208		SSC2Q	MOLD, GROUNDING CONNECTOR, EXOTHERMIC, 4/0 CABLE - 4/0 CABLE SPLICE (USE 90 WELD)	ERICO	3
210		90	WELD METAL, 90 CARTRIDGE SIZE, FOR USE WITH ITEM 208	ERICO	40
211		150	WELD METAL, 150 CARTRIDGE SIZE, FOR USE WITH ITEMS 205 & 207	ERICO	400
212		250	WELD METAL, 250 CARTRIDGE SIZE, FOR USE WITH ITEM 206	ERICO	350
221		GC-141A-02	CONNECTOR, BRONZE, BOLTED, 1-4/0 COPPER TO FLAT SURFACE	ANDERSON	650
222		GC-143A-02	CONNECTOR, BRONZE, BOLTED, 2-4/0 COPPER TO FLAT SURFACE	ANDERSON	200
223		K3	CONNECTOR, BRONZE, BOLTED, 2 PARALLEL 4/0 COPPER	ANDERSON	150
224		K1	CONNECTOR, BRONZE, BOLTED, 2 PARALLEL #4 COPPER	ANDERSON	10
225		SWL-025-B	CONNECTOR, BRONZE, BOLTED, #4-4/0 COPPER TO NEMA 2HP	ANDERSON	80
226		C-4	CONNECTOR, BOLTED, 1-#4 SOLID COPPER TO TYPE A4 BARBED WIRE/FENCE FABRIC	ANDERSON	200
227		GC-111-5B	CONNECTOR, BOLTED, 1-#4 SOLID COPPER TO 1-5/8" FENCE TOP RAIL/GATE FRAME	ANDERSON	60
228		GC-110-82C	CONNECTOR, BOLTED, 2-4/0 STRANDED COPPER TO 2-1/2" FENCE LINE POST	ANDERSON	20
229		GC-110-102C	CONNECTOR, BOLTED, 2-4/0 STRANDED COPPER TO 3" FENCE CORNER POST	ANDERSON	4
230		GC-110-142C	CONNECTOR, BOLTED, 2-4/0 STRANDED COPPER TO 4" GATE POST	ANDERSON	4
231		GC-109-06	CONNECTOR, BOLTED, FLEXIBLE COPPER BRAID TO 2" GATE FRAME	ANDERSON	8
233		GB-100-3B	FLEXIBLE COPPER BRAID 24" LONG WITH TIN PLATED FERRULES EACH END	ANDERSON	8
240		#4 SD SOLID CU	CONDUCTOR, #4 SOLID SOFTDRAWN COPPER		500'
241		#6 SD SOLID CU	CONDUCTOR, #6 SOLID SOFTDRAWN COPPER		150'
242		3/8" EHS	CONDUCTOR, 7 WIRE, 3/8" EXTRA HIGH STRENGTH STEEL		500'
250		SWDE46N	DEADEND, BOLTED, STATIC WIRE, 3/8" EHS STEEL, QUADRANT STRAIN CLAMP	ANDERSON	8
251		YCS-04-90	Y-CLEVIS EYE, FOR STATIC WIRE DEADEND, 90°	ANDERSON	8

Item No.	OFM	Catalog Number	Description	Manufacturer	"Total Required"
271	X	804-LL8-400PE	FIBER OPTIC CABLE, MULTIMODE DUPLEX		400'
272	X	12048R101	FIBER OPTIC CABLE, MULTI-FIBER	SUPERIOR ESSEX	1460'
273	X	DF4X1C-XXXX	CONDUIT, INNERDUCT, 1" ORANGE CORROGATED W/TAPE	CARLON	1500'
280	X		CONTROL CABLE, (3) CONDUCTOR #12, 3/C-#12 SH		350'
281	X		CONTROL CABLE, (2) CONDUCTOR #10, 2/C-#10 SH		3600'
282	X		CONTROL CABLE, SHIELDED, (4) CONDUCTOR #10, 4/C-#10 SH		500'
283	X		CONTROL CABLE, SHIELDED, (9) CONDUCTOR #10, 9/C-#10 SH		5500'
284	X		CONTROL CABLE, SHIELDED, (12) CONDUCTOR #10, 12/C-#10 SH		5600'
285	X		CONTROL CABLE, (2) CONDUCTOR #6, 2/C-#6 SH		1500'
286	X		CONTROL CABLE, (3) CONDUCTOR #6, 3/C-#6 SH		2100'
287	X		POWER CABLE, (1) CONDUCTOR 500 MCM, 1/C-500		1000'
291			TERMINAL CONNECTORS, CONTROL CABLE, VARIOUS SIZES		1850
292			TERMINAL CONNECTORS, CONTROL CABLE, SHIELD		130
293			TERMINAL CONNECTORS, POWER CABLE, 500 MCM		18
294			CABLE MARKERS		1 LOT
300			CONDUIT, BELOW-GRADE, VARIOUS SIZES, SCHEDULE 40 PVC AND ASSOCIATED FITTINGS AND PULL WIRE		1 LOT
301			CONDUIT, STATION POWER RISERS, 90° ELBOW, 3-1/2" RIGID GALVANIZED STEEL, 40" MIN RADIUS		4
310			CONDUIT, ABOVE-GRADE, VARIOUS SIZES, RIGID GALVANIZED STEEL AND ASSOCIATED FITTINGS		1 LOT
311			CONDUIT, ABOVE-GRADE, VARIOUS SIZES, LIQUID-TIGHT FLEXIBLE AND ASSOCIATED FITTINGS		1 LOT
330			ANTI-CORROSION TAPE, FOR RIGID GALVANIZED STEEL INSTALLED BELOW GRADE		1 LOT
380	X		CABLE TRENCH ASSEMBLY	TRENWA	1 LOT
381	X		CABLE TRENCH GROUND CLAMPS	TRENWA	90
382			DRAIN TILE, 4" PERFORATED, HDPE, WITH COUPLINGS & ACCESSORIES AS NEEDED		630'
383			OUTLET, DRAIN TILE, 4", PREFABRICATED CMP, FLARED END, WITH RODENT GUARD		2
384			FENCE POST, MARKER FOR DRAIN TILE OUTLET		2
390			CONDUIT MARKER		9
400	X	FXL-56L-190-5K-W-U-Y-GR	FLOOD LIGHT, LED, 120-277 VAC, 187 WATT (400W MH EQUIVALENT)	HUBBELL	16
401	X	4024CM53	FLOOD LIGHT SLIP-FITTER, STEEL FOR 2" PIPE, 2 3/8" O.D. YOKE MOUNT	HUBBELL	16
402	X	6387	FLOOD LIGHT WALL BRACKET, 2" SLIP FITTER, GRAY	HOLOPHANE	16
500		FENCE	CHAIN-LINK FENCE SYSTEM		1184'
501		GATES	GATE, CHAIN-LINK DOUBLE GATE, 24' TOTAL WIDTH, WITH ONE PERSONNEL GATE		2

NOTES:
1. SEE PROJECT SPECIFICATIONS AND DETAIL DRAWINGS FOR FURTHER MATERIAL DETAILS AS NEEDED.
2. SUPPLIER SHALL BE RESPONSIBLE FOR PROVIDING OFM QUANTITIES AS REQUIRED TO COMPLETE THE PROJECT.
3. QUANTITIES OF CONTRACTOR-FURNISHED MATERIALS SHALL BE VERIFIED BY CONTRACTOR.
4. OWNER SHALL BE NOTIFIED OF ANY QUANTITIES THAT MAY BE SHOWN INCORRECTLY ON THIS DRAWING.

REGISTERED PROFESSIONAL ENGINEER — REG. NO. 10443 — PAUL D. KONECHNE — SOUTH DAKOTA

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly Registered Professional Engineer under the laws of the State of South Dakota.

By _____
Paul D. Konechne, P.E.

Registration Number 10443 Date: 01-18-19

DATE	DRAWN BY	NO.	APPROVED BY	REVISION DESCRIPTION
01-19	KLV	0	PJK	FOR CONSTRUCTION

BLACK HILLS ENERGY

WEST RAPID CITY SUBSTATION

MATERIAL LIST

DRAWN BY KLV DATE 01-19 DWG NO. WRC-C-380 REVISION 0

APPROVED BY PJK DATE 01-19

DGR ENGINEERING
ROCK RAPIDS, IOWA
(712) 472-2531

P:\04233115\DWG\WRC-C-380.DWG

BLACK HILLS ENERGY

WEST RAPID CITY 230KV TRANSMISSION LINE

DRAWING LIST

DRAWING #	DRAWING DESCRIPTION
DL-01	DRAWING LIST
	ROUTE MAP
RM-01	ROUTE MAP
	PLAN AND PROFILE DRAWINGS
PP-01	STR SUB DE 1 – STR 9
PP-02	STR 10 – STR 15
PP-03	STR L-SRC-19 – STR L-SRC-23
PP-04	STR SUB DE 2 – STR 3
	STRUCTURE DETAILS
SD-01-1	DCBP-230
SD-02-1	TCBP-230-69UB
SD-03-1	SCBP-230-2S
SD-04-1	DCBPRA-230-M1
SD-05-1	SCDE-230-M1
SD-06-1	DCDADE-230
SD-07-1	DCDADE-230-M1
SD-08-1	DCDADE-230-M2
SD-09-1	DT-01-230
	ASSEMBLY DETAILS
AD-01-1	T-4A,B,S, T-4C, T-4D(S)
AD-02-1	T-4F, T-4FC, T-4FD
AD-03-1	T-FDL, T-FSCS-M1, T-FSCS-M2, T-FSCS-M3
AD-04-1	T-S13, T-S14, T-2S15
AD-05-1	T-J13
AD-06-1	T-BP-S-230, T-HP-S-230, T-BP-S-230-CD, TD-2C
AD-07-1	T-CDE15, T-SDE15, T-CDE15-15EXT, T-CDE15-36EXT
AD-08-1	TM-9ST, TM-9SD, TM-9SSJ
AD-09-1	TM-101 & TM-103, TM-104
AD-10-1	DPR-EHS, DPR-OPGW, DPR-1272

DRAWING #	DRAWING DESCRIPTION
	LOAD AND DESIGN DETAILS
LD-01-1	STR 3, STR 5, DESIGN DETAILS
LD-01-2	STR 3, STR 5, LOAD TREES
LD-02-1	STR 7 – STR 14, DESIGN DETAILS
LD-02-2	STR 7 – STR 14, LOAD TREES
LD-03-1	STR L-SRC-20, DESIGN DETAILS
LD-03-2	STR L-SRC-20, LOAD TREES
LD-04-1	STR 2A, DESIGN DETAILS
LD-04-2	STR 2A, DESIGN DETAILS
LD-04-3	STR 2A, LOAD TREES
LD-05-1	STR 2B, DESIGN DETAILS
LD-05-2	STR 2B, DESIGN DETAILS
LD-05-3	STR 2B, LOAD TREES
LD-06-1	STR 1A, STR 1B, DESIGN DETAILS
LD-06-2	STR 1A, STR 1B, LOAD TREES
LD-07-1	STR 4, DESIGN DETAILS
LD-07-2	STR 4, LOAD TREES
LD-08-1	STR 6, DESIGN DETAILS
LD-08-2	STR 6, DESIGN DETAILS
LD-08-3	STR 6, DESIGN DETAILS
LD-08-4	STR 6, LOAD TREES
LD-08-5	STR 6, LOAD TREES
LD-09-1	STR 15, DESIGN DETAILS
LD-09-2	STR 15, DESIGN DETAILS
LD-09-3	STR 15, DESIGN DETAILS
LD-09-4	STR 15, LOAD TREES
LD-09-5	STR 15, LOAD TREES
	FOUNDATION DETAILS
FND-01-1	STR 1A, STR 1B, STR 2A, STR 2B, STR 4, STR 6, STR 15
	STAKING SHEETS
SS-01	STR SUB DE – STR L-SRC-23

DRAWING #	DRAWING DESCRIPTION
	PHASING DIAGRAM
PH-01	PHASING DIAGRAM
	SAG TABLES 1272 KCMIL 45/7 ACSR "BITTERN"
STC-01-1	STR SUB DE – STR 1A, STR SUB DE – STR 1B, STR 1A – STR 4, STR 1B – STR 4, STR 4 – STR 6, INITIAL
STC-01-2	STR 6 – STR 15, INITIAL
STC-02-1	STR 15 – STR L-SRC-20, STR 15 – STR L-SRC-22, FINAL
	SAG TABLES AFL CC-55/443 "DNO-4748" OPGW
STF-01-1	STR SUB DE – STR 1A, STR SUB DE – STR 1B, STR 1A – STR 4, STR 1B – STR 4, STR 4 – STR 6, INITIAL
STF-01-2	STR 6 – STR 15, INITIAL
	SAG TABLES 3/8" 7 STRAND EHS
STS-01-1	STR SUB DE – STR 1A, STR SUB DE – STR 1B, INITIAL
	SAG TABLES 3/8" 7 STRAND HS
STS-02-1	STR 15 – STR L-SRC-20, STR 15 – STR L-SRC-22, FINAL
	MATERIAL LIST
ML-01-1	LIST OF ASSEMBLIES
ML-02-1	PARTS LIST
	APPENDIX
	WEST RAPID CITY SUBSTATION REFERENCE DRAWINGS
WRC-C-101	GENERAL ARRANGEMENT
WRC-C-301	SECTION A TO LANGE
WRC-C-302	SECTION B TO SOUTH RAPID
WRC-C-303	SECTIONS C AND D
WRC-C-320	BUSS CONNECTION DETAILS
WRC-C-321	BUS CONNECTION DETAILS
WRC-C-380	MATERIAL LIST

1	REVISION
DESCRIPTION: MOVED STR 2A	
NAME: DATE: REG. NO.:	
PROJECT #: 10114217	ISSUE DATE: 11/15/2019
PROJECT MANAGER: J. ELLSWORTH	
DESIGN ENGINEER: J. PANKRATZ	
DRAWN BY: Z. JANSEN	

2	REVISION
DESCRIPTION: RECORD DRAWINGS	
NAME: DATE: REG. NO.:	
PROJECT #: 10114217	ISSUE DATE: 6/12/2020
PROJECT MANAGER: J. ELLSWORTH	
DESIGN ENGINEER: J. PANKRATZ	
DRAWN BY: Z. JANSEN	

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

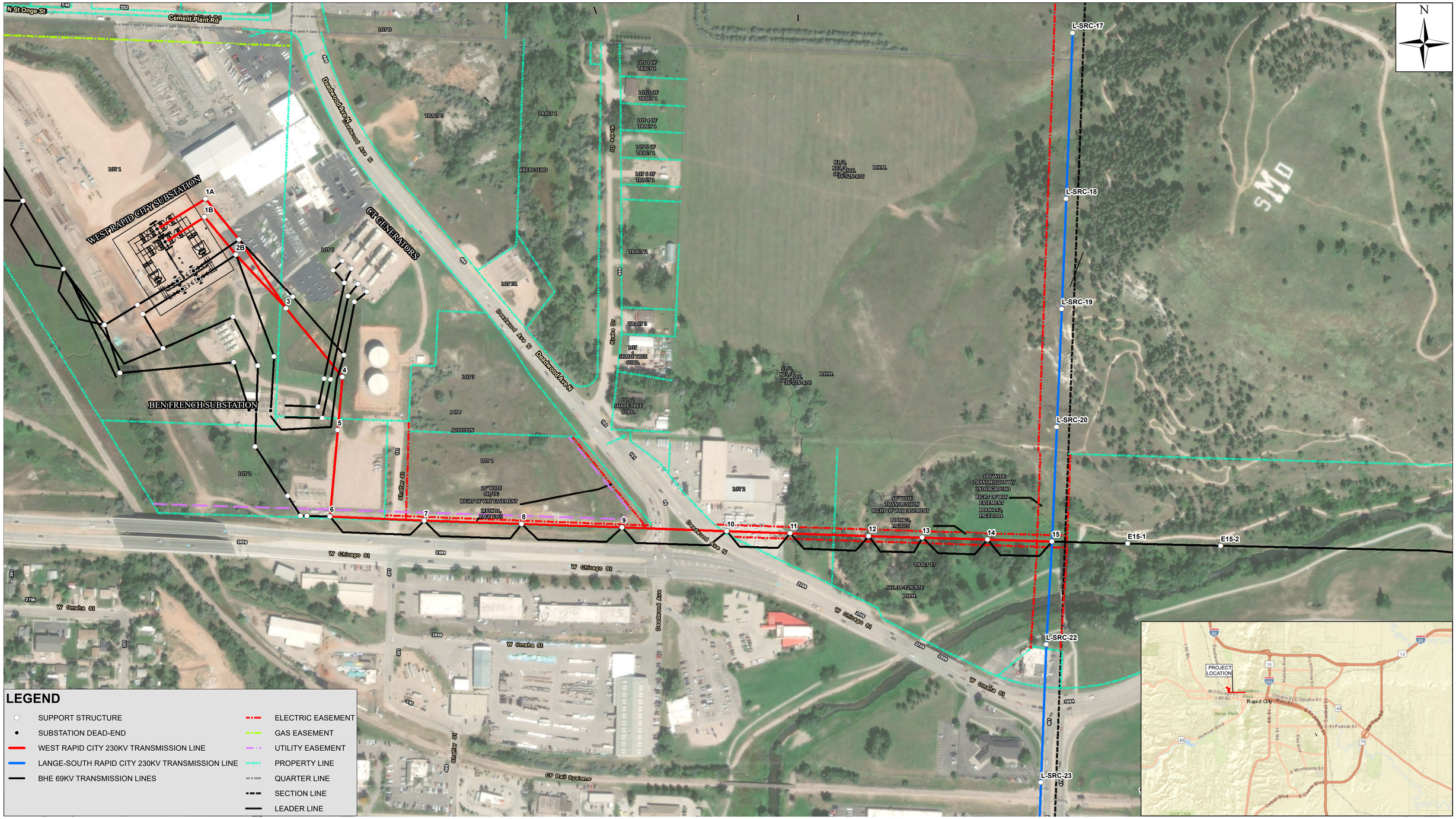
WEST RAPID CITY
230KV TRANSMISSION LINE

DRAWING LIST

0 1" 2"

FILENAME BHE-DL-01-01.DWG
SCALE NONE

SHEET **DL-01**



LEGEND

- SUPPORT STRUCTURE
- SUBSTATION DEAD-END
- WEST RAPID CITY 230KV TRANSMISSION LINE
- LANGE-SOUTH RAPID CITY 230KV TRANSMISSION LINE
- BHE 69KV TRANSMISSION LINES
- ELECTRIC EASEMENT
- GAS EASEMENT
- UTILITY EASEMENT
- PROPERTY LINE
- QUARTER LINE
- SECTION LINE
- LEADER LINE

Black Hills Energy — Improving life with energy

HDR

ISSUE	DATE	DESCRIPTION
2	06/12/2020	RECORD DRAWINGS
0	09/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CADD TECHNICIAN	Z. JANSEN
GIS TECHNICIAN	S.GRIFFIN
PROJECT NUMBER	10114217

BLACK HILLS POWER
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230kV TRANSMISSION LINE

ROUTE MAP

0 70 140 280 Feet

FILENAME: West Rapid City 230kV Line 22x34

SCALE: 1 inch = 150 feet

SHEET
OVERVIEW



PLAN NOTES:

- ● STRUCTURE
- —— ALIGNMENT
- — — ALIGNMENT OF ANOTHER LINE

NOTES:

1. [XXX] – EXISTING ASSEMBLY
2. *XXX – RETIREMENT ASSEMBLY
3. T[XXX] – TRANSFER UNIT ASSEMBLY
4. SHIELD WIRE SHOWN AT 60°F (CREEP)
5. CONDUCTOR SHOWN AT 212°F (MAX SAG)

PROFILE NOTES:

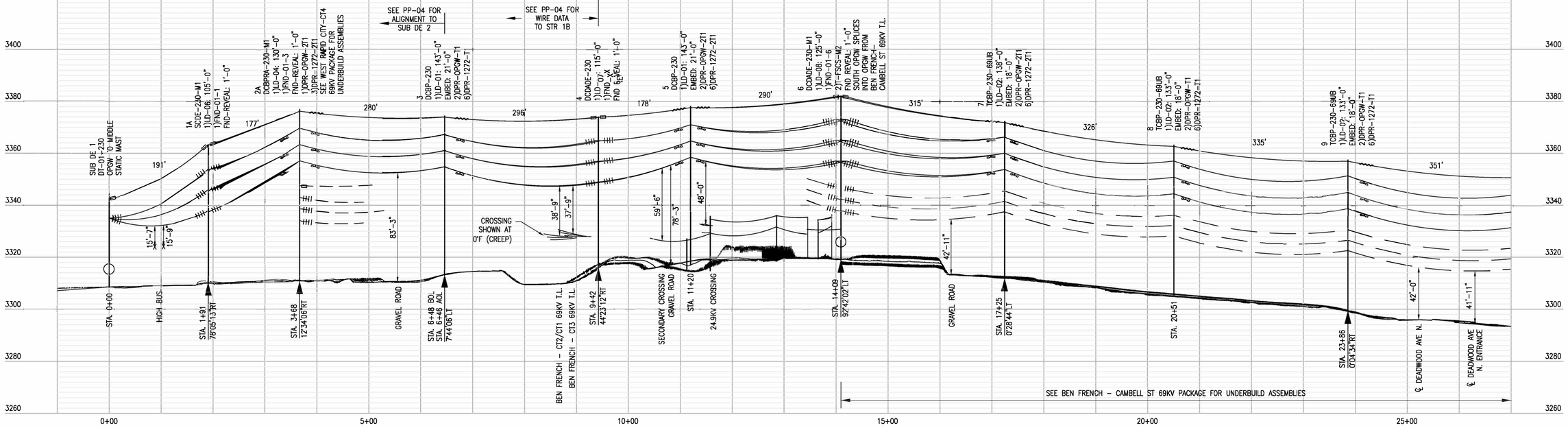
- CONDUCTOR DAMPER
- SHIELD DAMPER
- OPGW SPLICE

SHIELD: (1) AFL CC-55/443 "DNO-4748" OPGW, D.T. @ H.L.= 1000#, R.S.= 191'
SHIELD: (1) 3/8" 7 STRAND EHS, D.T. @ H.L.= 930#, R.S.= 191'
COND: (3) 1272 KCMIL 45/7 ACSR "BITTERN", D.T. @ H.L.= 2000#, R.S.= 191'

SHIELD: (1) AFL CC-55/443 "DNO-4748" OPGW, D.T. @ H.L.= 2840#, R.S.= 260'
COND: (3) 1272 KCMIL 45/7 ACSR "BITTERN", D.T. @ H.L.= 11345#, R.S.= 260'

SHIELD: (2) AFL CC-55/443 "DNO-4748" OPGW, D.T. @ H.L.= 2780#, R.S.= 250'
COND: (6) 1272 KCMIL 45/7 ACSR "BITTERN", D.T. @ H.L.= 11190#, R.S.= 250'

SHIELD: (2) AFL CC-55/443 "DNO-4748" OPGW, D.T. @ H.L.= 2995#, R.S.= 290'
COND: (6) 1272 KCMIL 45/7 ACSR "BITTERN", D.T. @ H.L.= 11620#, R.S.= 290'



ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

PLAN AND PROFILE

0 1" 2"

FILENAME BHE-PP-01-D-1.DWG
SCALE H:1"=100' V:1"=20'

SHEET **PP-01**



PLAN NOTES:

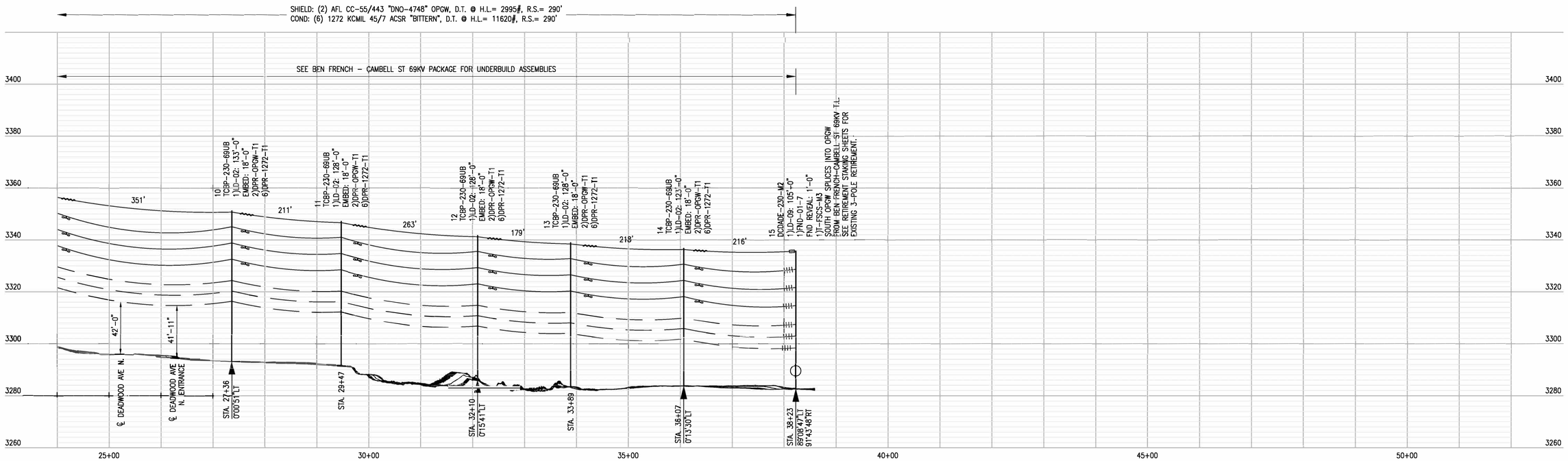
- ● STRUCTURE
- —— ALIGNMENT
- — — ALIGNMENT OF ANOTHER LINE

NOTES:

1. [XXX] – EXISTING ASSEMBLY
2. *XXX – RETIREMENT ASSEMBLY
3. T[XXX] – TRANSFER UNIT ASSEMBLY
4. SHIELD WIRE SHOWN AT 60°F (CREEP)
5. CONDUCTOR SHOWN AT 212°F (MAX SAG)

PROFILE NOTES:

- CONDUCTOR DAMPER
- SHIELD DAMPER
- OPGW SPLICE



ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

PLAN AND PROFILE

0 1" 2"

FILENAME BHE-PP-01-D-1.DWG
SCALE H:1"=100' V:1"=20'
SHEET PP-02



PLAN NOTES:

- ● STRUCTURE
- —— ALIGNMENT
- — — ALIGNMENT OF ANOTHER LINE

NOTES:

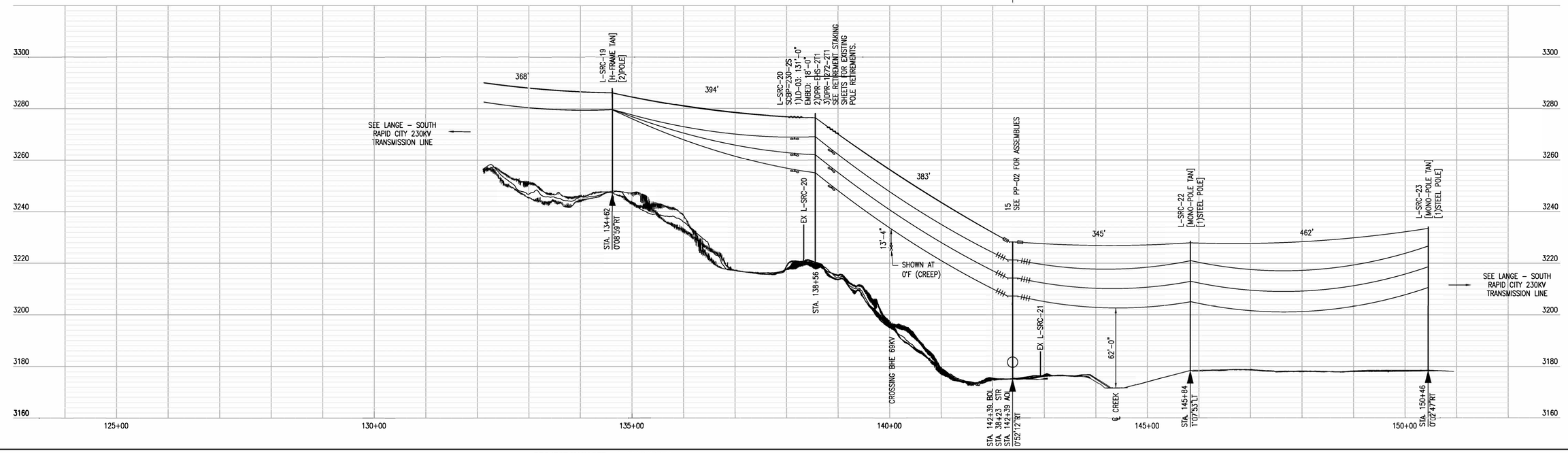
1. [XXX] – EXISTING ASSEMBLY
2. *XXX – RETIREMENT ASSEMBLY
3. T[XXX] – TRANSFER UNIT ASSEMBLY
4. SHIELD WIRE SHOWN AT 60°F (CREEP)
5. CONDUCTOR SHOWN AT 212°F (MAX SAG)

PROFILE NOTES:

- CONDUCTOR DAMPER
- SHIELD DAMPER
- OPGW SPLICE

SHIELD: (1) 3/8" 7 STRAND HS, D.T. @ H.L.= 4555#, R.S.= 922' (EAST)
SHIELD: (1) 3/8" 7 STRAND HS, D.T. @ H.L.= 4780#, R.S.= 922' (WEST)
COND: (3) 1272 KCMIL 45/7 ACSR "BITTERN", D.T. @ H.L.= 12910#, R.S.= 922'

SHIELD: (1) 3/8" 7 STRAND HS, D.T. @ H.L.= 3685#, R.S.= 448'
COND: (3) 1272 KCMIL 45/7 ACSR "BITTERN", D.T. @ H.L.= 12690#, R.S.= 448'



ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

PLAN AND PROFILE

0 1" 2"

FILENAME BHE-PP-01-D-1.DWG
SCALE H:1"=100' V:1"=20'
SHEET PP-03



PLAN NOTES:

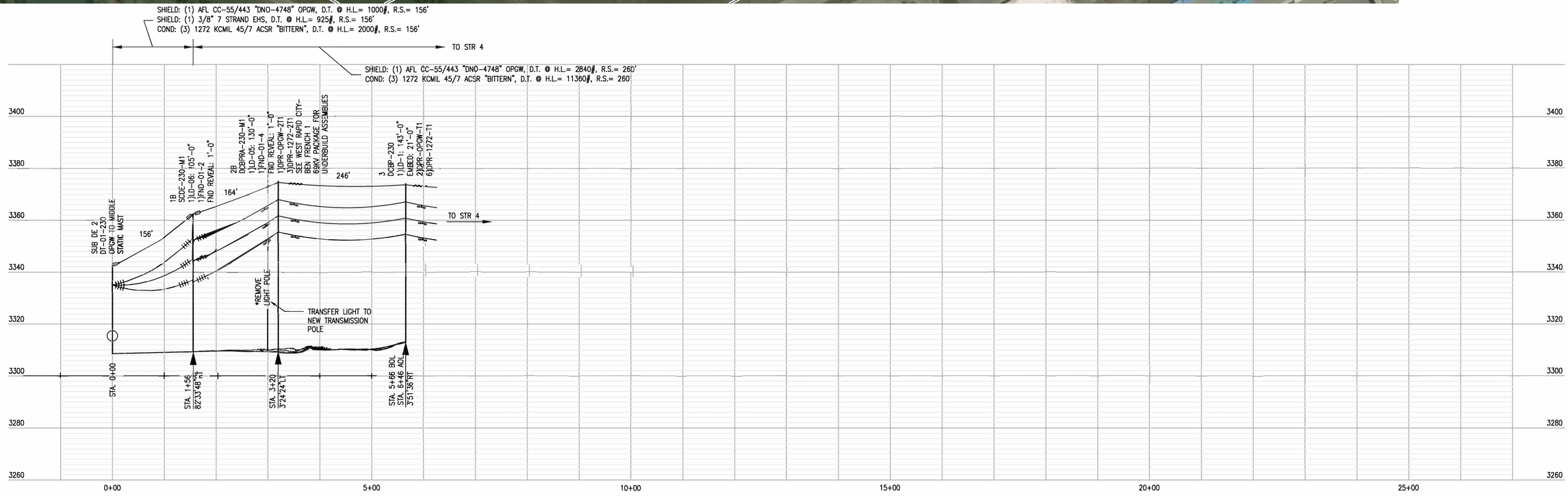
- ● STRUCTURE
- —— ALIGNMENT
- — — ALIGNMENT OF ANOTHER LINE

NOTES:

1. [XXX] – EXISTING ASSEMBLY
2. *XXX – RETIREMENT ASSEMBLY
3. T[XXX] – TRANSFER UNIT ASSEMBLY
4. SHIELD WIRE SHOWN AT 60°F (CREEP)
5. CONDUCTOR SHOWN AT 212°F (MAX SAG)

PROFILE NOTES:

- CONDUCTOR DAMPER
- SHIELD DAMPER
- OPGW SPLICE



ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

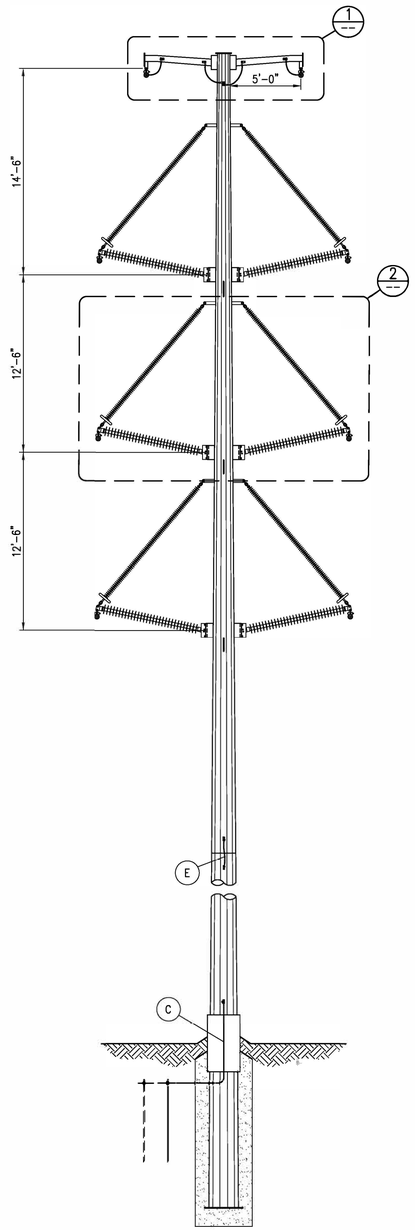
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

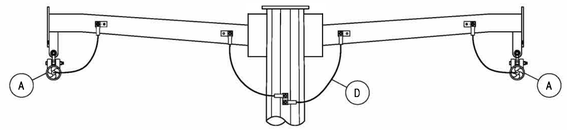
WEST RAPID CITY
230KV TRANSMISSION LINE

PLAN AND PROFILE

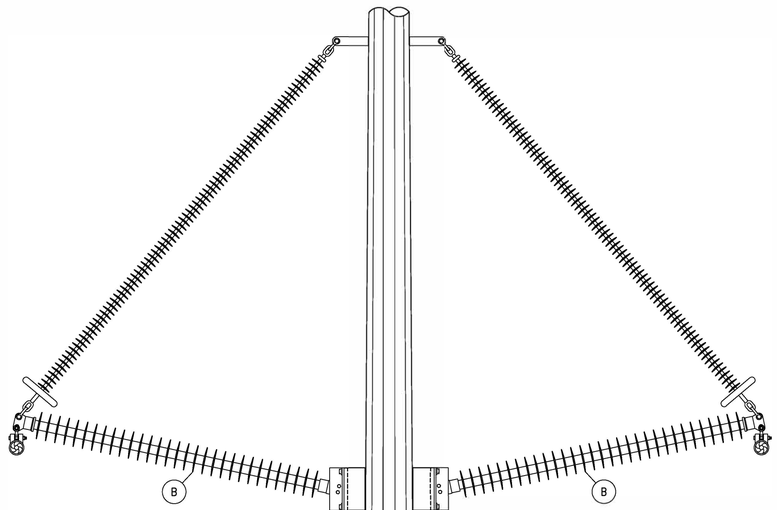
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FILENAME BHE-PP-01-D-1.DWG
SCALE H:1"=100' V:1"=20'
SHEET PP-04





DETAIL 1
SHIELD
SCALE: N.T.S.



DETAIL 2
CONDUCTOR
SCALE: N.T.S.

LIST OF ASSEMBLIES			
ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T-4SF	OPGW SHIELD WIRE SUSPENSION ASSEMBLY	2
B	T-BP-S-230	230KV BRACED POST ASSEMBLY - STEEL POLE	6
C	TM-9ST	STEEL POLE GROUNDING ASSEMBLY	1
D	TM-9SD-2	DOUBLE DAVIT ARM GROUNDING ASSEMBLY	1
E	TM-9SSJ	STEEL POLE SLIP JOINT GROUNDING	2

NOTES:

1. SEE LOAD AND DESIGN DRAWINGS FOR STEEL DESIGN DETAILS.
2. SEE STEEL POLE MANUFACTURING DRAWINGS FOR STEEL POLE DETAILS.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
230KV DOUBLE CIRCUIT BRACED POST TANGENT

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: DCBP-230

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

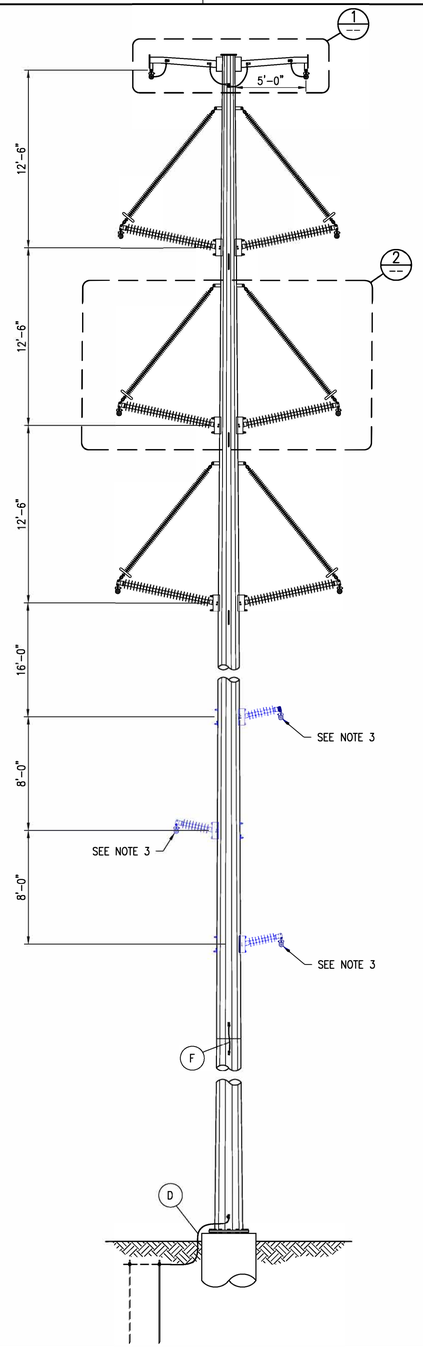
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

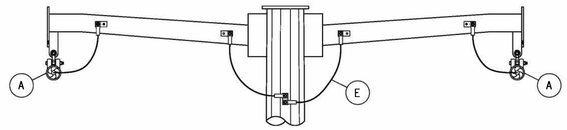
WEST RAPID CITY
230KV TRANSMISSION LINE

STRUCTURE DETAILS
230KV DOUBLE CIRCUIT
BRACED POST TANGENT

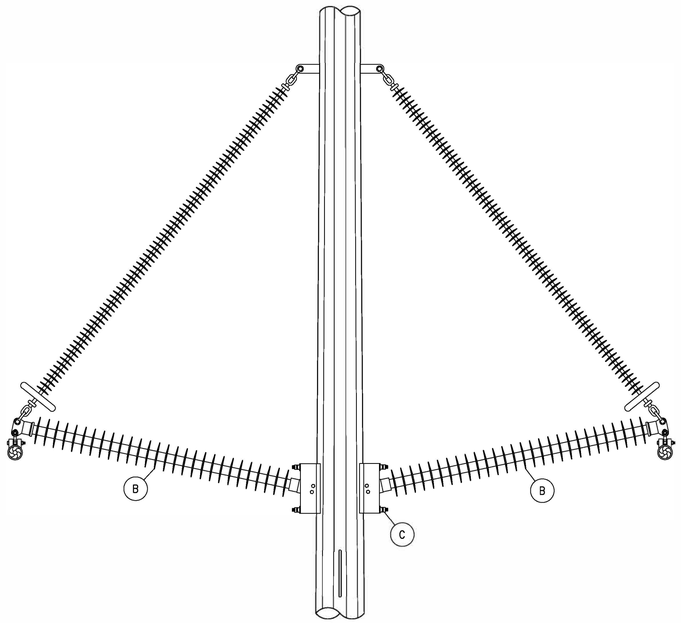
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FILENAME: BHE-SD-01-D-1.DWG
SCALE: 3/16"=1'-0"
SHEET: SD-01-1





DETAIL 1
SHIELD
SCALE: N.T.S.



DETAIL 2
CONDUCTOR
SCALE: N.T.S.

LIST OF ASSEMBLIES

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T-4SF	OPGW SHIELD WIRE SUSPENSION ASSEMBLY	2
B	T-BP-S-230-CD	230KV BRACED POST ASSEMBLY - STEEL POLE - COMPACT DESIGN	6
C	TD-2C	DOUBLE INSULATOR BASE TO POLE ASSEMBLY	3
D	TM-9ST	STEEL POLE GROUNDING ASSEMBLY	1
E	TM-9SD-2	DOUBLE DAVIT ARM GROUNDING ASSEMBLY	1
F	TM-9SSJ	STEEL POLE SLIP JOINT GROUNDING	2

NOTES:

1. SEE LOAD AND DESIGN DRAWINGS FOR STEEL POLE DETAILS.
2. SEE STEEL POLE MANUFACTURER DRAWINGS FOR STEEL POLE DETAILS.
3. BLUE ASSEMBLIES ARE CALLED OUT IN 69KV CONSTRUCTION PACKAGE. SEE BEN FRENCH - SOUTH RAPID CITY 69KV TERMINATIONS PACKAGE.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
230KV DOUBLE CIRCUIT BRACED POST TANGENT
W/ 69KV TRANSMISSION UNDERBUILD

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: TCBP-230-69UB

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

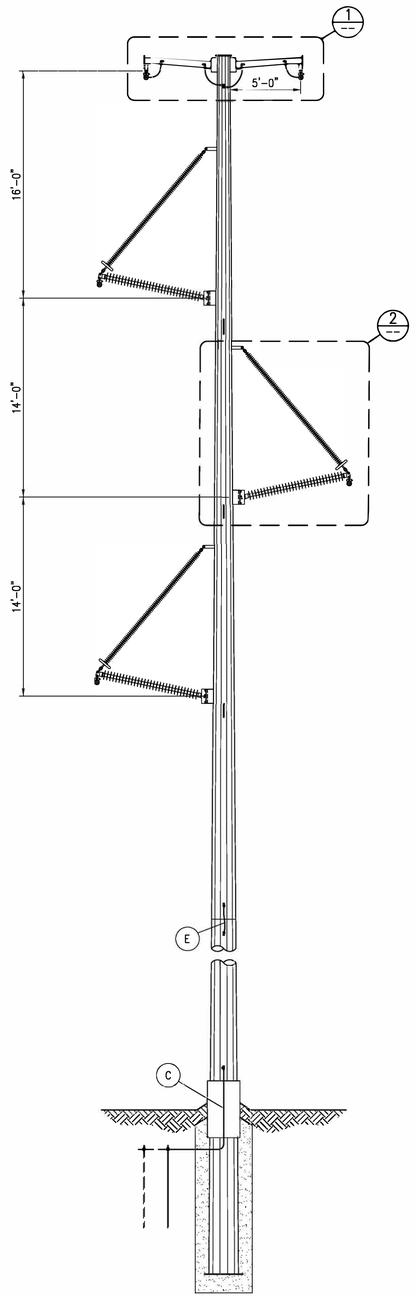
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

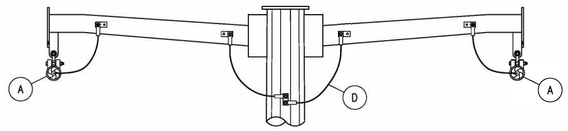
WEST RAPID CITY
230KV TRANSMISSION LINE

STRUCTURE DETAILS
230KV DOUBLE CIRCUIT
BRACED POST TANGENT
W/ 69KV UNDERBUILD

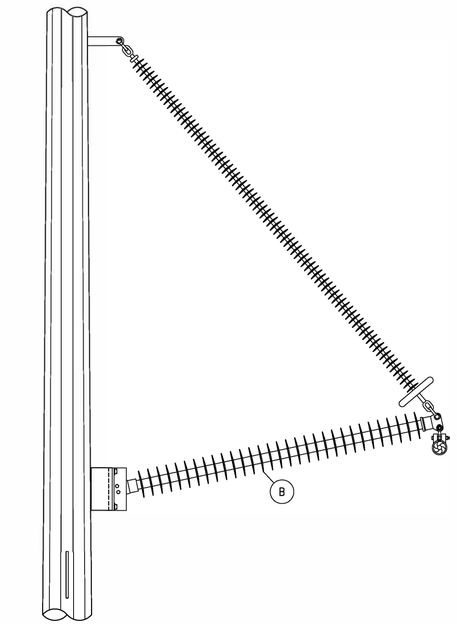
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SCALE: 3/16"=1'-0"
SHEET: SD-02-1





DETAIL 1
SHIELD
SCALE: N.T.S.



DETAIL 2
CONDUCTOR
SCALE: N.T.S.

LIST OF ASSEMBLIES			
ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T-4S	OHSW SUSPENSION ASSEMBLY	2
B	T-BP-S-230	230KV BRACED POST ASSEMBLY - STEEL POLE	3
C	TM-9ST	STEEL POLE GROUNDING ASSEMBLY	1
D	TM-9SD-2	DOUBLE DAVIT ARM GROUNDING ASSEMBLY	1
E	TM-9SSJ	STEEL POLE SLIP JOINT GROUNDING	2

NOTES:

1. SEE LOAD AND DESIGN DRAWINGS FOR STEEL DESIGN DETAILS.
2. SEE STEEL POLE MANUFACTURING DRAWINGS FOR STEEL POLE DETAILS.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
230KV SINGLE CIRCUIT BRACED POST TANGENT W/ TWO SHIELD WIRES

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: SCBP-230-2S

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

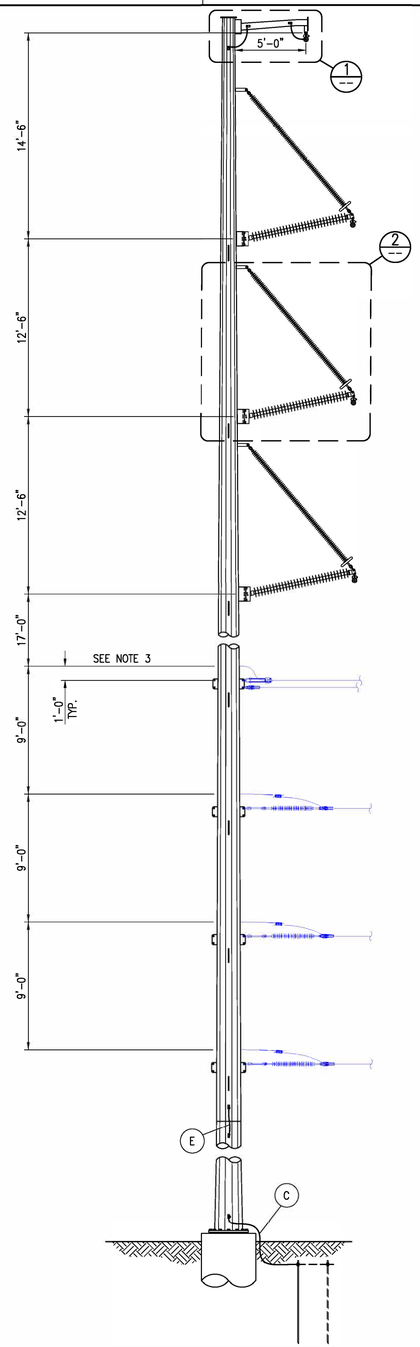
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

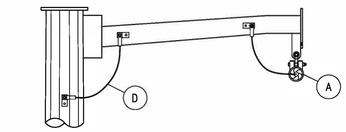
WEST RAPID CITY
230KV TRANSMISSION LINE

STRUCTURE DETAILS
230KV SINGLE CIRCUIT BRACED POST
TANGENT W/ TWO SHIELD WIRES

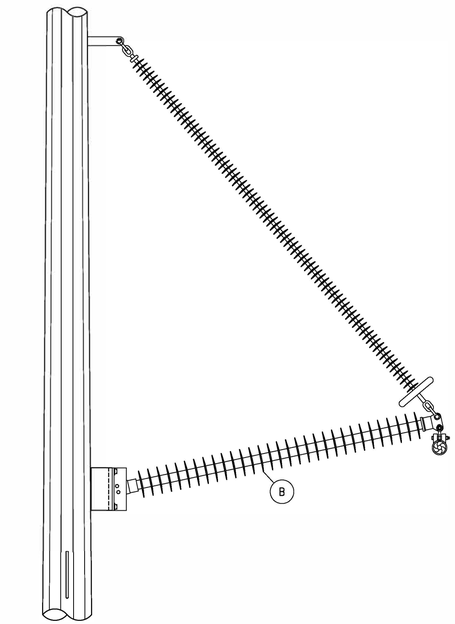
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FILENAME: BHE-SD-03-D-1.DWG
SCALE: 3/16"=1'-0"
SHEET: SD-03-1





DETAIL 1
SHIELD
SCALE: N.T.S.



DETAIL 2
CONDUCTOR
SCALE: N.T.S.

LIST OF ASSEMBLIES

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T-4SF	OPGW SHIELD WIRE SUSPENSION ASSEMBLY	1
B	T-BP-S-230	230KV BRACED POST ASSEMBLY - STEEL POLE	3
C	TM-9ST	STEEL POLE GROUNDING ASSEMBLY	1
D	TM-9SD-1	DAVIT ARM GROUNDING ASSEMBLY	1
E	TM-9SSJ	STEEL POLE SLIP JOINT GROUNDING	2

NOTES:

1. SEE LOAD AND DESIGN DRAWINGS FOR STEEL DESIGN DETAILS.
2. SEE STEEL POLE MANUFACTURING DRAWINGS FOR STEEL POLE DETAILS.
3. BLUE ASSEMBLIES ARE CALLED OUT IN 69KV CONSTRUCTION PACKAGE. SEE WEST RAPID CITY - CT4 69KV TRANSMISSION LINE AND WEST RAPID CITY - BEN FRENCH 1 69KV TRANSMISSION LINE PACKAGES.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
230KV DOUBLE CIRCUIT BRACED POST RUNNING ANGLE
W/ 69KV UNDERBUILD - NON-TYPICAL

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: DCBPRA-230-M1

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

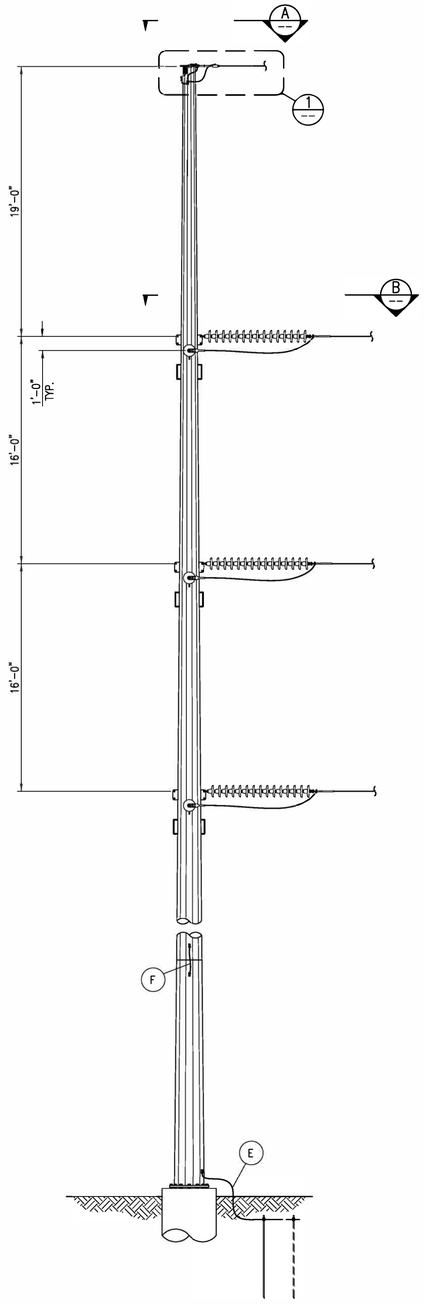
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

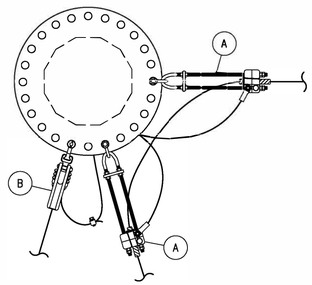
WEST RAPID CITY
230KV TRANSMISSION LINE

STRUCTURE DETAIL
230KV DOUBLE CIRCUIT BRACED POST
RUNNING ANGLE W/ 69KV UNDERBUILD

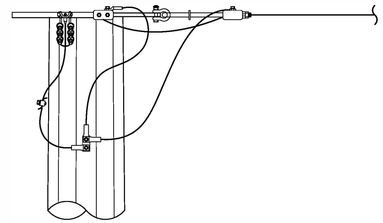
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SCALE: 3/16"=1'-0"
SHEET: SD-04-1

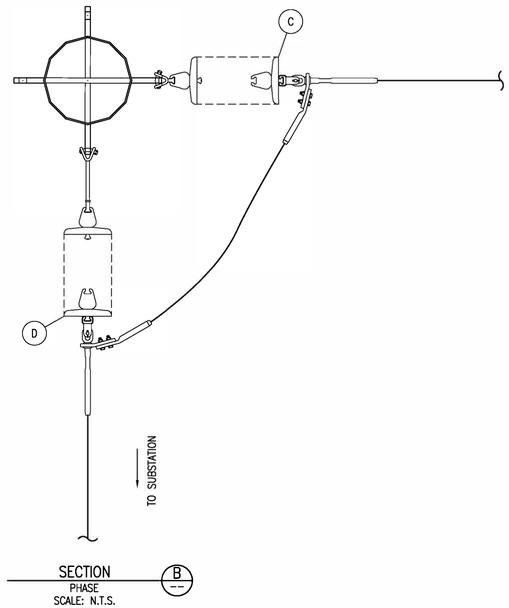




VIEW A
SHIELD
SCALE: N.T.S.



DETAIL 1
SHIELD GROUNDING
SCALE: N.T.S.



SECTION B
PHASE
SCALE: N.T.S.

LIST OF ASSEMBLIES

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T-4FDS	OPGW DEADEND ASSEMBLY - STEEL POLE	2
B	T-4DS	OHSW DEADEND ASSEMBLY - STEEL POLE	1
C	T-CDE15	CONDUCTOR DEADEND ASSEMBLY	3
D	T-CDE15-15EXT	CONDUCTOR DEADEND ASSEMBLY W/ EXT	3
E	TM-9ST	STEEL POLE GROUNDING ASSEMBLY	1
F	TM-9SSJ	STEEL POLE SLIP JOINT GROUNDING	1

NOTES:

1. SEE LOAD AND DESIGN DRAWINGS FOR STEEL DESIGN DETAILS.
2. SEE STEEL POLE MANUFACTURING DRAWINGS FOR STEEL POLE DETAILS.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
230KV SINGLE CIRCUIT DEADEND W/ THREE SHIELD WIRES
NON-TYPICAL

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: SCDE-230-M1

Black Hills Energy
Improving life with energy

HDR

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

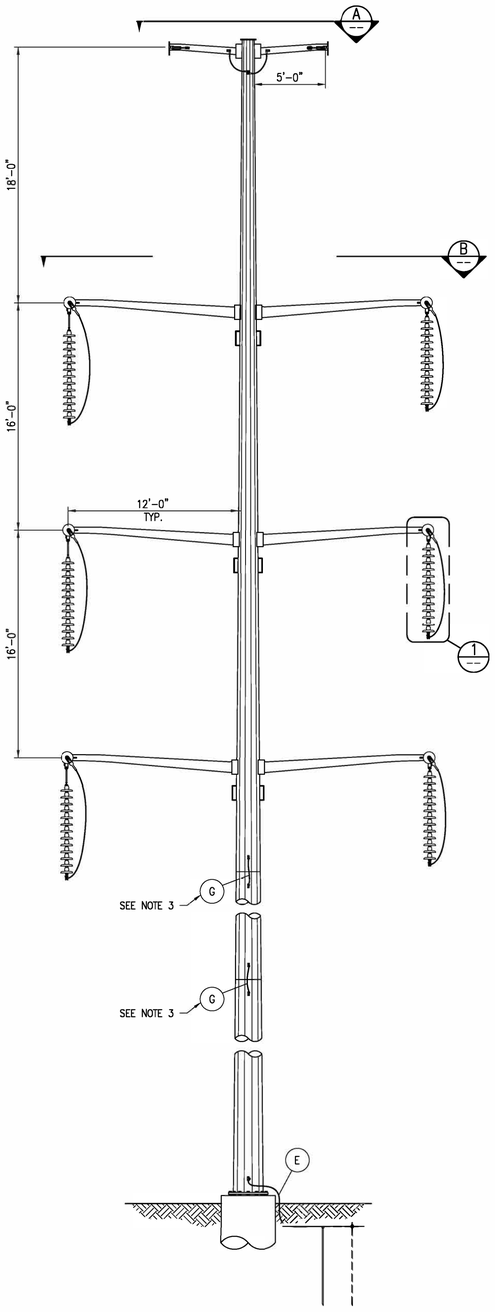
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

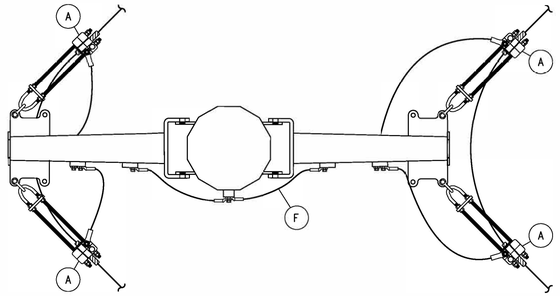
WEST RAPID CITY
230KV TRANSMISSION LINE

STRUCTURE DETAILS
230KV SINGLE CIRCUIT DEADEND
W/ THREE SHIELD WIRES

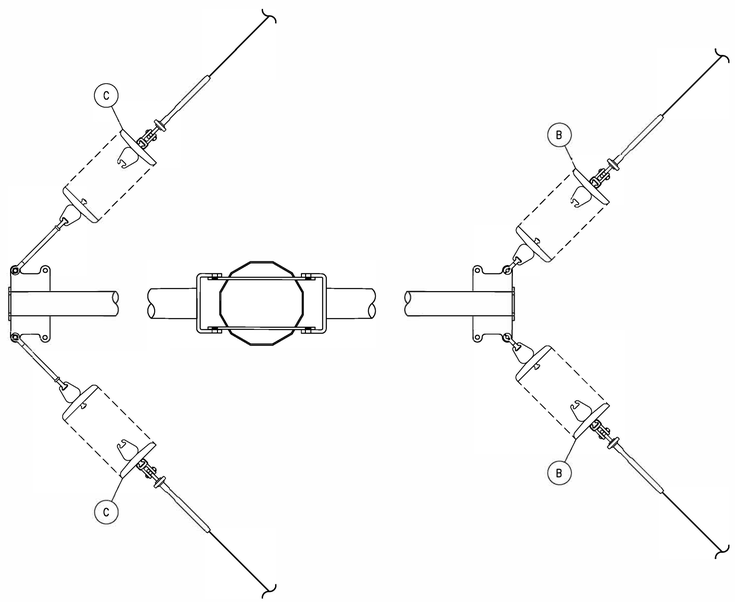
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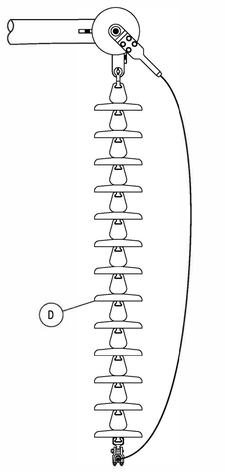




VIEW A
SHIELD
SCALE: N.T.S.



SECTION B
PHASE
SCALE: N.T.S.



DETAIL 1
JUMPER
SCALE: N.T.S.

LIST OF ASSEMBLIES

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T-4FDS	OPGW DEADEND ASSEMBLY - STEEL POLE	4
B	T-CDE15	CONDUCTOR DEADEND ASSEMBLY	6
C	T-CDE15-15EXT	CONDUCTOR DEADEND ASSEMBLY W/ EXT	6
D	T-J13	CONDUCTOR JUMPER ASSEMBLY	6
E	TM-9ST	STEEL POLE GROUNDING ASSEMBLY	1
F	TM-9SD-2	DOUBLE DAVIT ARM GROUNDING	1
G	TM-9SSJ	STEEL POLE SLIP JOINT GROUNDING	2

NOTES:

1. SEE LOAD AND DESIGN DRAWINGS FOR STEEL DESIGN DETAILS.
2. SEE STEEL POLE MANUFACTURING DRAWINGS FOR STEEL POLE DETAILS.
3. STEEL POLE SLIP JOINT GROUNDING NOT NEEDED IF POLE COMES WITH FLANGE JOINTS.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
230KV DOUBLE CIRCUIT DEADEND, SINGLE POLE WITH DAVIT ARMS

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: DCDADE-230

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

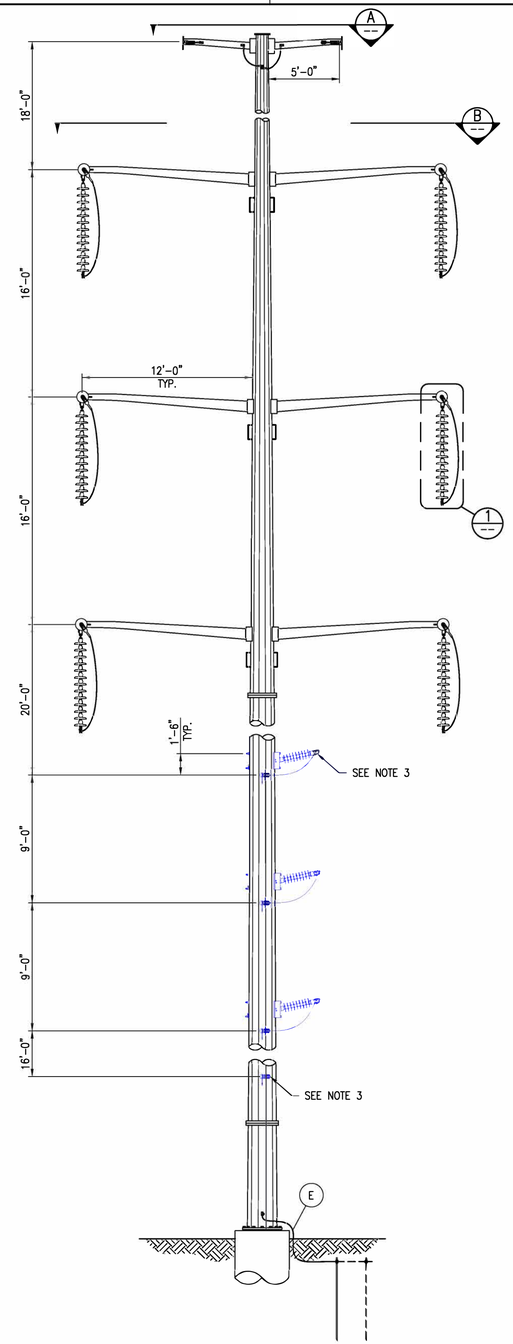
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

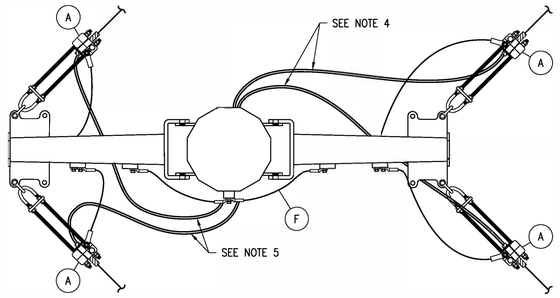
WEST RAPID CITY
230KV TRANSMISSION LINE

STRUCTURE DETAILS
230KV DOUBLE CIRCUIT DEADEND, SINGLE POLE WITH DAVIT ARMS

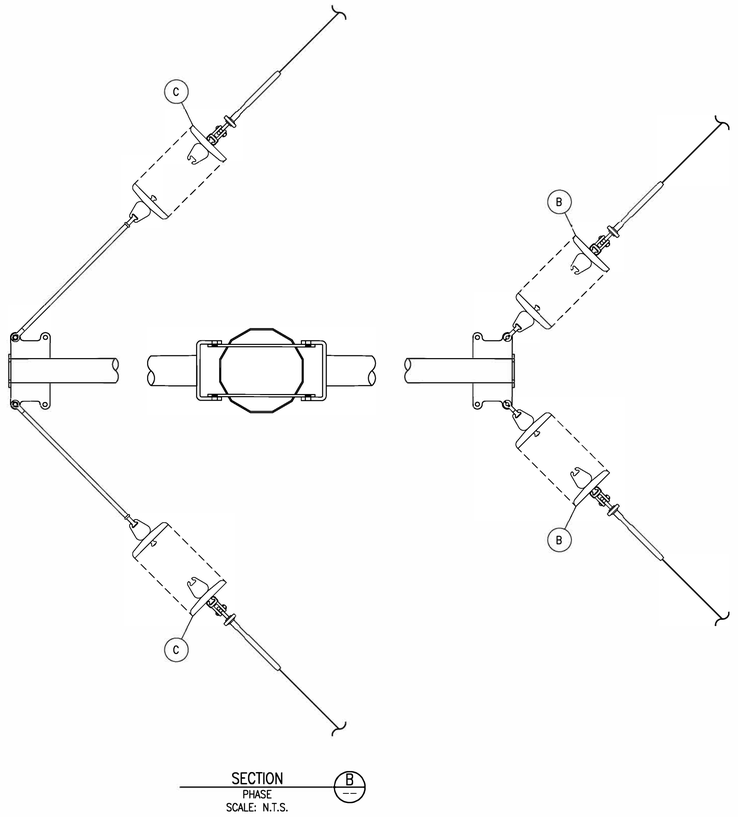
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SHEET: SD-06-1

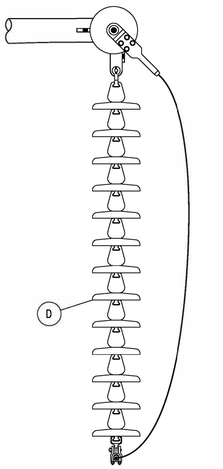




VIEW A
SHIELD
SCALE: N.T.S.



SECTION B
PHASE
SCALE: N.T.S.



DETAIL 1
JUMPER
SCALE: N.T.S.

LIST OF ASSEMBLIES

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T-4FDS	OPGW DEADEND ASSEMBLY - STEEL POLE	4
B	T-CDE15	CONDUCTOR DEADEND ASSEMBLY	6
C	T-CDE15-36EXT	CONDUCTOR DEADEND ASSEMBLY W/ EXT	6
D	T-J13	CONDUCTOR JUMPER ASSEMBLY	6
E	TM-9ST	STEEL POLE GROUNDING ASSEMBLY	1
F	TM-9SD-2	DOUBLE DAVIT ARM GROUNDING	1

NOTES:

1. SEE LOAD AND DESIGN DRAWINGS FOR STEEL DESIGN DETAILS.
2. SEE STEEL POLE MANUFACTURING DRAWINGS FOR STEEL POLE DESIGNS.
3. BLUE ASSEMBLIES ARE CALLED OUT IN 69KV CONSTRUCTION PACKAGE. SEE BEN FRENCH - CAMBELL ST 69KV TRANSMISSION LINE PACKAGE.
4. NORTHEAST OPGW SPLICE LOCATION.
5. SOUTHWEST OPGW SPLICE LOCATION. PORTION OF THE OPGW IS SPICED AND TIED INTO THE BEN FRENCH - CAMBELL ST 69KV TRANSMISSION LINE.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
230KV DOUBLE CIRCUIT DEADEND W/ TANGENT 69KV UNDERBUILD

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: DCDADE-230-M1

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

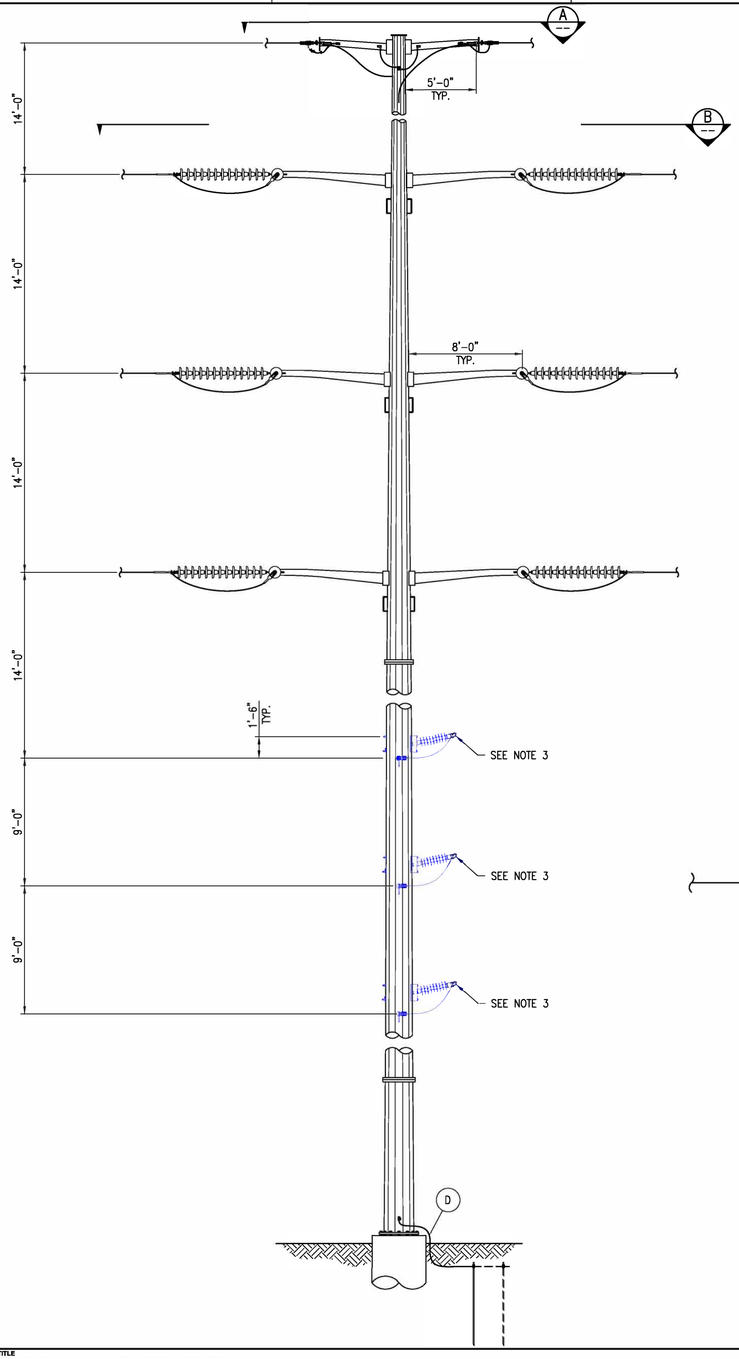
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

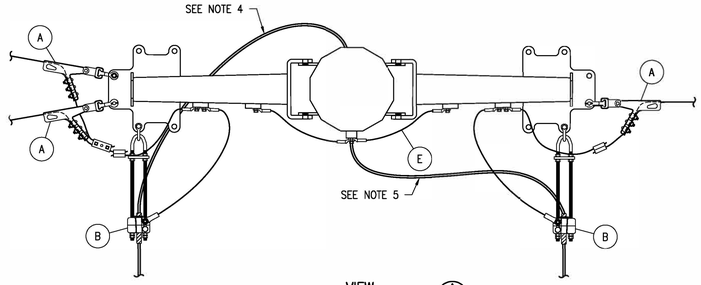
WEST RAPID CITY
230KV TRANSMISSION LINE

STRUCTURE DETAILS
230KV DOUBLE CIRCUIT DEADEND
W/ TANGENT 69KV UNDERBUILD

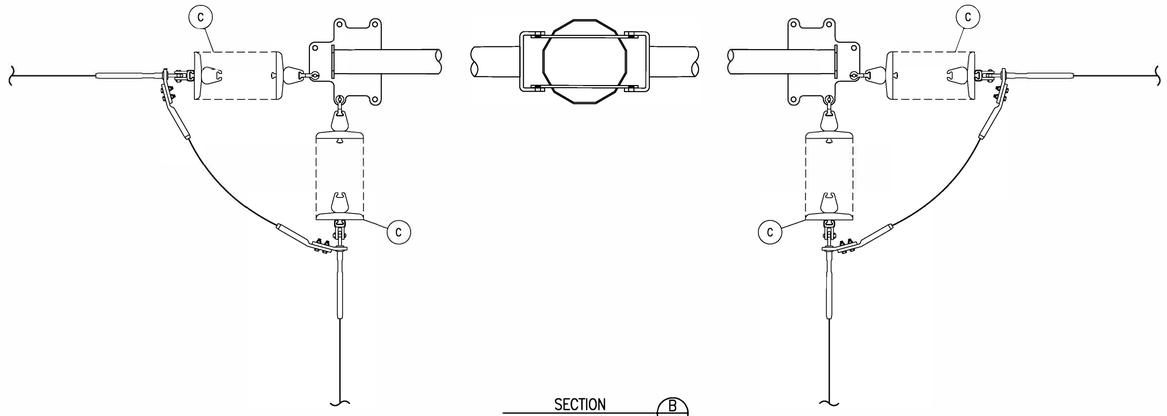
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FILENAME: BHE-SD-07-D-1.DWG
SCALE: 3/16"=1'-0"
SHEET: SD-07-1





VIEW A
SHIELD
SCALE: N.T.S.



SECTION B
PHASE
SCALE: N.T.S.

LIST OF ASSEMBLIES

ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T-4DS	OHSW DEADEND ASSEMBLY - STEEL POLE	3
B	T-4FDS	OPGW DEADEND ASSEMBLY - STEEL POLE	2
C	T-CDE15	CONDUCTOR DEADEND ASSEMBLY	12
D	TM-9ST	STEEL POLE GROUNDING ASSEMBLY	1
E	TM-9SD-2	DOUBLE DAVIT ARM GROUNDING	1

NOTES:

1. SEE LOAD AND DESIGN DRAWINGS FOR STEEL DESIGN DETAILS.
2. SEE STEEL POLE MANUFACTURING DRAWINGS FOR STEEL POLE DETAILS.
3. BLUE ASSEMBLIES ARE CALLED OUT IN 69KV CONSTRUCTION PACKAGE. SEE BEN FRENCH - CAMBELL ST. 69KV TRANSMISSION LINE PACKAGE.
4. NORTH OPGW TERMINATES FOR FUTURE INSTALLMENT OF OPGW NORTH ON THE LANGE - SOUTH RAPID CITY 230KV TRANSMISSION LINE.
5. SOUTH OPGW TERMINATES FOR FUTURE INSTALLMENT OF OPGW SOUTH ON THE LANGE - SOUTH RAPID CITY 230KV TRANSMISSION LINE. PORTION OF THE OPGW SPLICES AND TIES INTO THE BEN FRENCH - CAMBELL ST. 69KV TRANSMISSION LINE.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
230KV DOUBLE CIRCUIT DEADEND
W/ DEADEND 69KV UNDERBUILD

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: DCDADE-230-M2

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

STRUCTURE DETAILS
230KV DOUBLE CIRCUIT DEADEND
W/ DEADEND 69KV UNDERBUILD

0 1" 2"

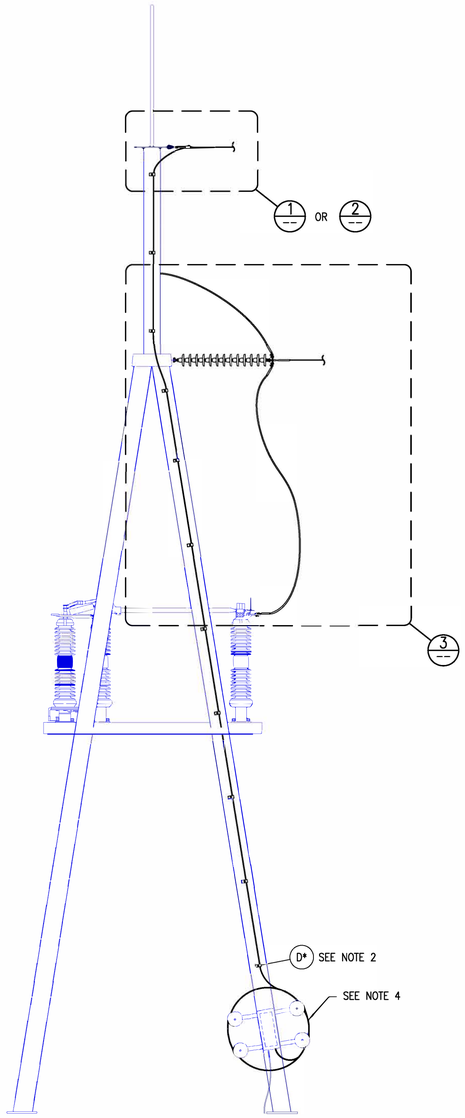
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SCALE: 3/16"=1'-0"
SHEET: SD-08-1

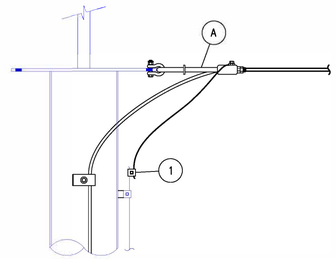
LIST OF ASSEMBLIES			
ITEM NO.	ASSEMBLY NO.	DESCRIPTION	QTY
A	T-4FDS	OPGW DEADEND ASSEMBLY - STEEL POLE	1
B	T-4D	OHSW DEADEND ASSEMBLY	1
C	T-SDE15	CONDUCTOR DEADEND ASSEMBLY	3
D*	N/A	DOWNLEAD CLAMPS	AS REQ'D*

NOTES:

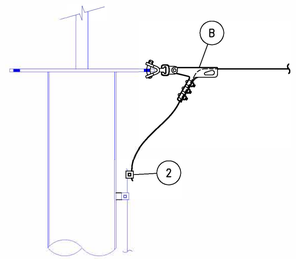
1. BLUE ASSEMBLIES ARE SUPPLIED AND INSTALLED BY THE SUBSTATION CONTRACTOR.
2. (*) ITEMS ARE SUPPLIED BY THE SUBSTATION CONTRACTOR AND INSTALLED BY THE TRANSMISSION CONTRACTOR. SEE WEST RAPID CITY SUBSTATION REFERENCE SHEETS IN APPENDIX.
3. MINIMUM BEND RADIUS FOR OPGW IS 9 INCHES.
4. COIL 50 FEET OF OPGW ON THE COIL BRACKET, CAP AND TAPE THE ENDS.
5. COORDINATE WITH SUBSTATION CONTRACTOR FOR PARTS SUPPLIED BY SUBSTATION.

LIST OF PARTS						
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N/A	CLAMP, SINGLE BOLT, #4 STR CU TO 4/0 AWG STR. CU	Q551	HUBBELL	LC1602	1
2	N/A	CLAMP, VISE TYPE, 3/8" EHS TO 4/0 AWG STR CU	Q552	HUBBELL	GA9040L55	1

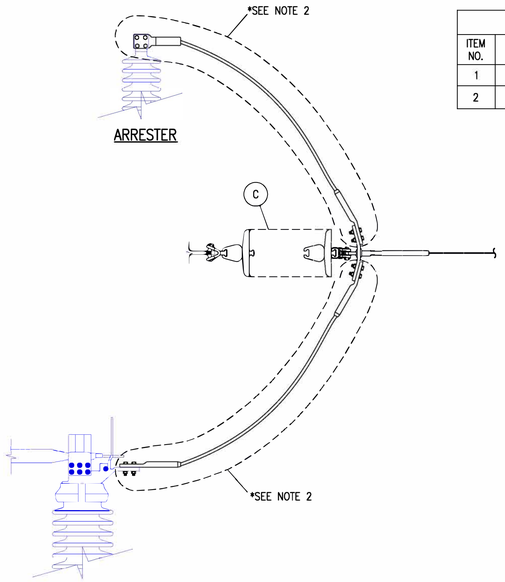




DETAIL 1
OPGW
SCALE: N.T.S.



DETAIL 2
OHSW
SCALE: N.T.S.



LINE SWITCH

DETAIL 3
PHASE
SCALE: N.T.S.

SHEET TITLE
TRANSMISSION LINE STRUCTURE
SUBSTATION DEADEND TOWER CONNECTION

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: DT-01-230

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

STRUCTURE DETAILS
SUBSTATION DEADEND TOWER CONNECTION

0 1" 2"

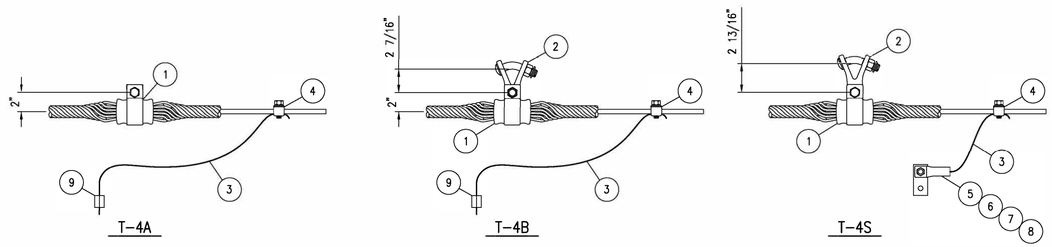
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SCALE: 3/16"=1'-0"
SHEET: **SD-09-1**

1	2	3	4	5	6	7	8

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4A QTY	T-4B QTY	T-4S QTY
1	40-7104	AGS SUSPENSION ASSY, 15K, 3/8" EHS	K400	PREFORMED	AGS-7104	1	1	1
2	48-5207	Y-CLEVIS - EYE, 90, 20K	H901	ANDERSON	YCS-05-90		1	1
3	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			2'	2'	6'
4	46-6810	CLAMP, SINGLE BOLT, VISE TYPE, 3/8" EHS TO #2 STR CU	Q550	HUBBELL	GA9020GLSS	1	1	1
5	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012			1
6	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207			1
7	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS			1
8	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD			1
9	36-0002	GROUND CLAMP, #2 STRANDED TO #4 SOLID	Q501	HOMAC	CC24	1	1	

*MAX. LINE ANGLE = 30°



OHSW SUSPENSION
3/8" EHS 7 STRAND GALV.

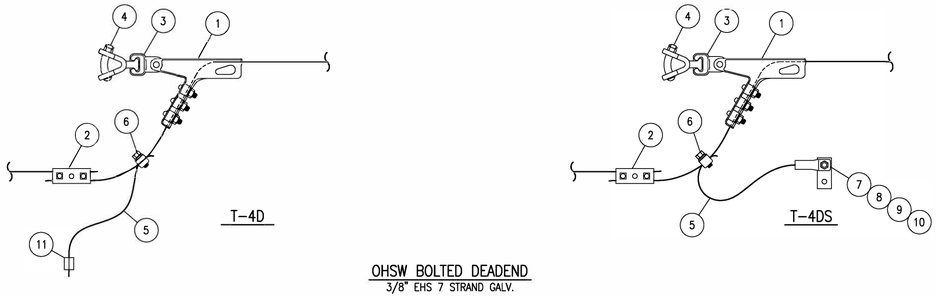
SHEET TITLE
TRANSMISSION ASSEMBLY
OHSW ATTACHMENT

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4A,B,S

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4D QTY	T-4DS QTY
1	44-4053	STRAIN CLAMP, DE, 20K, 3/8" EHS	L300	HUBBELL	SWDE55N	1	1
2	18-5816	CLAMP, 3-BOLT, 6" LONG, 5/8" BOLT, 5/16" - 1/2" RANGE	Q100	MACLEAN	J931	1	1
3	N.S.	SOCKET EYE, 18K, 1/2" WIDTH, 11/16" HOLE, 2-1/16" LENGTH	H102	HUBBELL	SA04	1	1
4	48-3054	Y-CLEVIS BALL, 30K	H500	HUBBELL	YBC30	1	1
5	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			2'	6'
6	46-6810	CLAMP, SINGLE BOLT, VISE TYPE, 3/8" EHS TO #2 STR CU	Q550	HUBBELL	GA9020GLSS	1	1
7	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012		1
8	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207		1
9	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS		1
10	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD		1
11	36-0002	GROUND CLAMP, #2 STRANDED TO #4 SOLID	Q501	HOMAC	CC24	1	

*ONE ITEM (2) WILL BE REQUIRED FOR EVERY TWO ASSEMBLIES



OHSW BOLTED DEADEND
3/8" EHS 7 STRAND GALV.

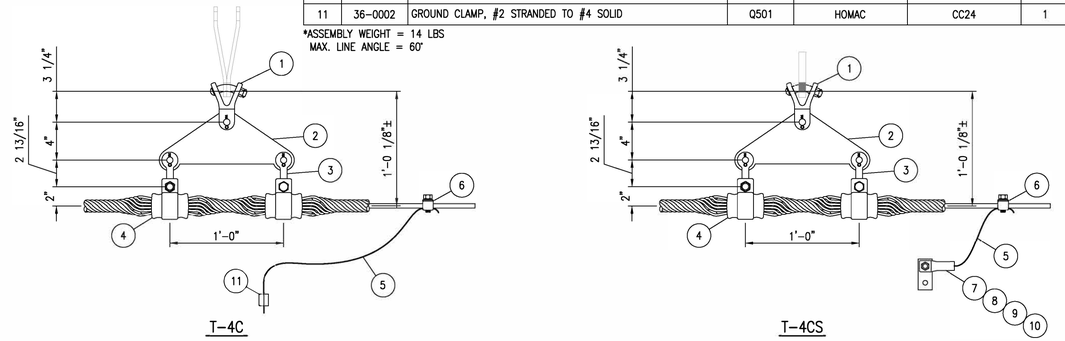
SHEET TITLE
TRANSMISSION ASSEMBLY
OHSW DEADEND

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4D(S)

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4C QTY	T-4CS QTY
1	48-5208	Y-CLEVIS, CLEVIS, 90, 3 1/4" LONG, 3/4" PIN, 30K	H801	HUBBELL	YCC3090	1	1
2	48-8510	AGS YOKE PLATE, 12" SPACING, 1/2" PLATE, 30K	H700	PREFORMED	YP-5907	1	1
3	48-5206	Y-CLEVIS, EYE, 20K	H900	ANDERSON	YCS-05	2	2
4	40-7804	AGS DOUBLE SUSPENSION ASSEMBLY, 15K, 3/8" EHS	K401	PREFORMED	AGS-7804	1	1
5	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			2'	6'
6	46-6810	CLAMP, SINGLE BOLT, VISE TYPE, 3/8" EHS TO #2 STR CU	Q550	HUBBELL	GA9020GLSS	1	1
7	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012		1
8	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207		1
9	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS		1
10	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD		1
11	36-0002	GROUND CLAMP, #2 STRANDED TO #4 SOLID	Q501	HOMAC	CC24	1	

*ASSEMBLY WEIGHT = 14 LBS
MAX. LINE ANGLE = 60°



OHSW DOUBLE SUSPENSION
3/8" EHS 7 STRAND GALV.

SHEET TITLE
TRANSMISSION ASSEMBLY
OHSW DOUBLE SUSPENSION

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4C

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

ASSEMBLY DETAILS
OHSW ASSEMBLIES

0 1" 2"

FILENAME BHE-AD-01-D-1.DWG
SCALE N.T.S.

SHEET
AD-01-1

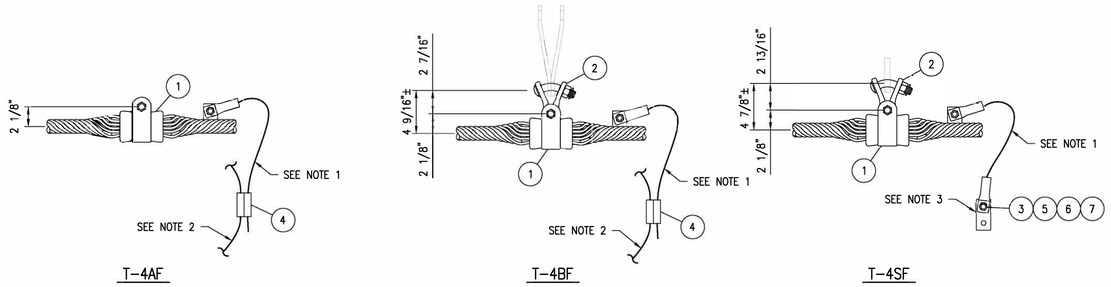
NOTES:

1. #4 STRANDED COPPER WITH CONNECTOR AND BOLTS. FURNISHED WITH ITEM 1.
2. WOOD POLE GROUND.
3. STEEL POLE NEMA PAD.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4AF QTY	T-4BF QTY	T-4SF QTY
1	N.S.	FIBERLIGN SUSPENSION ASSY, W/ GROUNDWIRE	J200	PREFORMED	4300104G	1	1	1
2	48-5207	Y-CLEVIS - EYE, 90, 20K	H901	ANDERSON	YCS-05-90		1	1
3	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012			1
4	N.S.	CONNECTOR, COMPRESSION #4 COPPER TO #4 COPPER	Q500	HOMAC	CC44	1	1	
5	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207			1
6	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS			1
7	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD			1

*MAX. LINE ANGLE = 30°



T-4AF T-4BF T-4SF

OPGW SUSPENSION
0.443" OPGW CABLE

SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW ATTACHMENT

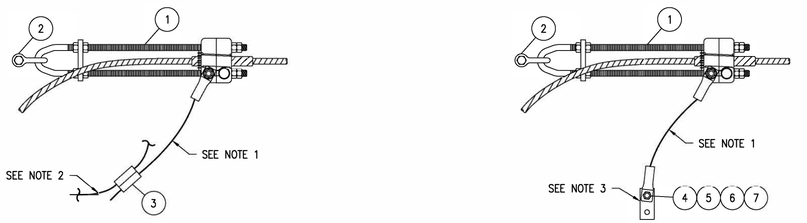
REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4F

NOTES:

1. #4 STRANDED COPPER WITH CONNECTOR AND BOLTS. FURNISHED WITH ITEM 1.
2. WOOD POLE GROUND.
3. STEEL POLE NEMA PAD.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4FDW QTY	T-4FDS QTY
1	N.S.	FIBER OPTIC DEADEND, 18" U-BOLT (48 FIBER), W/GROUNDWIRE	J300	PREFORMED	2801303G	1	1
2	N.S.	ANCHOR, SHACKLE, 3" LONG, 3/4" DIA., 7/8" DIA. PIN, 35K LBS	H602	HUGHES	2865-B3	1	1
3	N.S.	CONNECTOR, COMPRESSION #4 COPPER TO #4 COPPER	Q500	HOMAC	CC44	1	
4	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012		1
5	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207		1
6	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS		1
7	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD		1



T-4FDW T-4FDS

OPGW DEADEND
0.443" OPGW CABLE

SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW DEADEND

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4FD

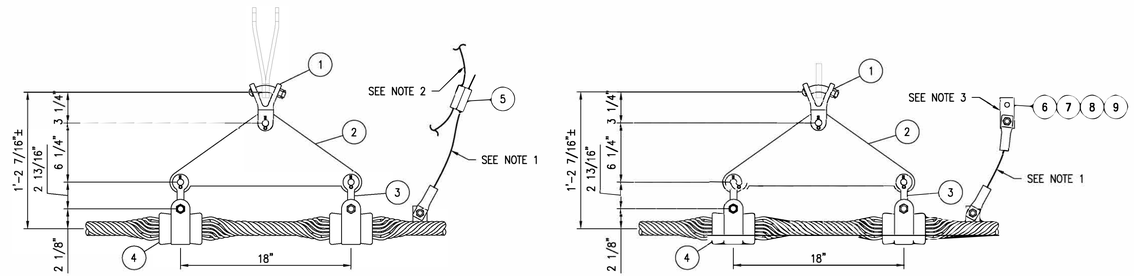
NOTES:

1. #4 STRANDED COPPER WITH CONNECTOR AND BOLTS. FURNISHED WITH ITEM 1.
2. WOOD POLE GROUND.
3. STEEL POLE NEMA PAD.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-4FC QTY	T-4FCS QTY
1	48-5208	Y-CLEVIS, CLEVIS, 90, 3 1/4" LONG, 3/4" PIN, 30K	H801	HUBBELL	YCC3090	1	
2	48-8510	AGS YOKE PLATE, 18" SPACING, 1/2" PLATE, 30K	H702	HUGHES	AS2585-Z	1	1
3	48-5206	Y-CLEVIS, EYE, 20K	H900	ANDERSON	YCS-05	2	2
4	N.S.	FIBERLIGN DOUBLE SUSPENSION ASSY, W/ GROUNDWIRE	J201	PREFORMED	4300204G	1	1
5	N.S.	CONNECTOR, COMPRESSION #4 COPPER TO #4 COPPER	Q500	HOMAC	CC44	1	
6	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012		1
7	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207		1
8	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS		1
9	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD		1

*MAX. LINE ANGLE = 60°



T-4FC T-4FCS

OPGW DOUBLE SUSPENSION
0.433" OPGW CABLE

SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW DOUBLE SUSPENSION

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-4FC

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

ASSEMBLY DETAILS
OPGW ASSEMBLIES

0 1" 2"

FILENAME BHE-AD-02-D-1.DWG
SCALE N.T.S.

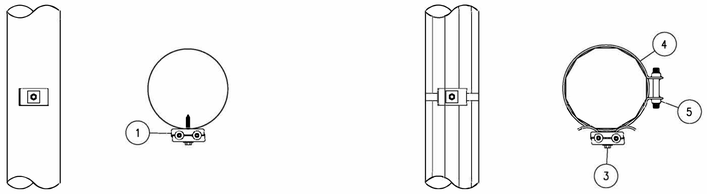
SHEET
AD-02-1

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T-FDL-W QTY	T-FDL-S1 QTY	T-FDL-S2 QTY
1	N.S.	DOWNLEAD CUSHION KIT 0.443 OPGW W/ HARDWARE FOR WOOD POLE	J401	PREFORMED	8003041-H1	1	–	–
2	N.S.	DOWNLEAD CUSHION KIT, 0.443" OPGW W/ 1/2" -13 X 3" MOUNTING KIT	J403	PREFORMED	8003041-H3	–	–	1
3	N.S.	DOWNLEAD CUSHION KIT, 0.443" OPGW W/ BANDING BRACKET	J402	PREFORMED	8003041-B1	–	1	–
4	N.S.	BOLT-A-BAND, 3/4" X REQ'D LENGTH	J950	ALUMA-FORM	3/4-201-SSB-100	–	10'	–
5	N.S.	BUCKLE, BANDING, FOR 3/4" BANDING	J951	ALUMA-FORM	BAB-38	–	1	–

NOTES:

1. OPGW CONTINUOUS TO SPLICE BOX.
2. UNIT CONSISTS OF ONE DOWNLEAD CUSHION INSTALLED. SPECIFIC QUANTITY REQUIRED WILL VARY WITH STRUCTURE HEIGHT.



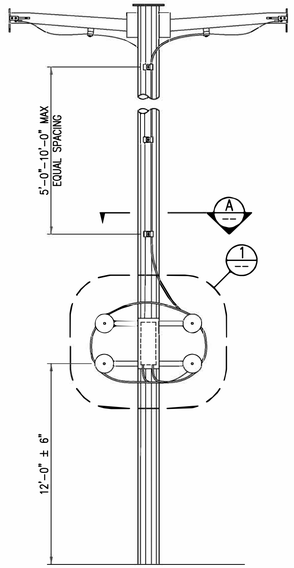
T-FDL-W
WOOD POLE

T-FDL-S1
STEEL POLE-BANDED

T-FDL-S2
STEEL POLE – BOLTED

SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW DOWNLEAD

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-FDL

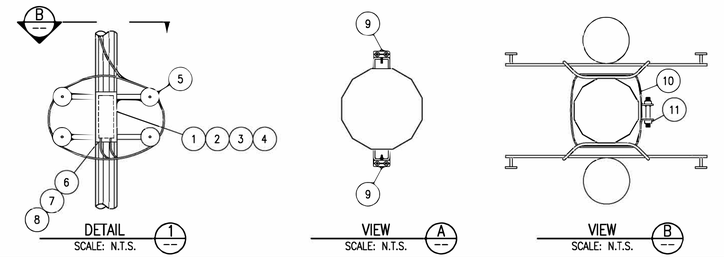


LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	6" X 22" COYOTE CLOSURE KIT W/ 6 PORT END PLATE	J510	PREFORMED	8006659	2
2	N.S.	SPLICE TRAY KIT, 36 COUNT TRAY	J600	PREFORMED	80805514	4
3	N.S.	VERTICAL MOUNTING BRACKET KIT	J502	PREFORMED	8003472	2
4	N.S.	COYOTE DEFENDER FOR 6"X 22" CLOSURE	J511	PREFORMED	8003492	2
5	N.S.	VERTICAL CABLE STORAGE ASSEMBLY	J501	PREFORMED	8003569	2
6	N.S.	CLOSURE END PLATE GROMMETS, 7/8" PORT, 0.443" OPGW	J700	PREFORMED	8003597	4
7	N.S.	FUTURE CABLE PORT KIT, 7/8" PORT	J720	PREFORMED	8003371	4
8	N.S.	GROMMET PLUG, 3/4" PORT, QTY 2	J730	PREFORMED	80806037	2
9	N.S.	DOWNLEAD CUSHION KIT, 0.443 OPGW W/ 1/2"-13 X 3" MOUNTING KIT	J403	PREFORMED	8003041-H3	28
10	N.S.	BOLT-A-BAND, 3/4" X REQ'D LENGTH	J950	ALUMA-FORM	3/4-201-SSB-100	60'
11	N.S.	BUCKLE, BANDING, FOR 3/4" BANDING	J951	ALUMA-FORM	BAB-38	2

NOTES:

1. OPGW CONTINUOUS TO SPLICE BOX.
2. COIL 50 FEET OF OPGW AROUND COIL BRACKET ON DOWNLEAD.



SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW SPLICE CASE - STEEL POLE
DOUBLE CIRCUIT - TWO SPLICE CASES

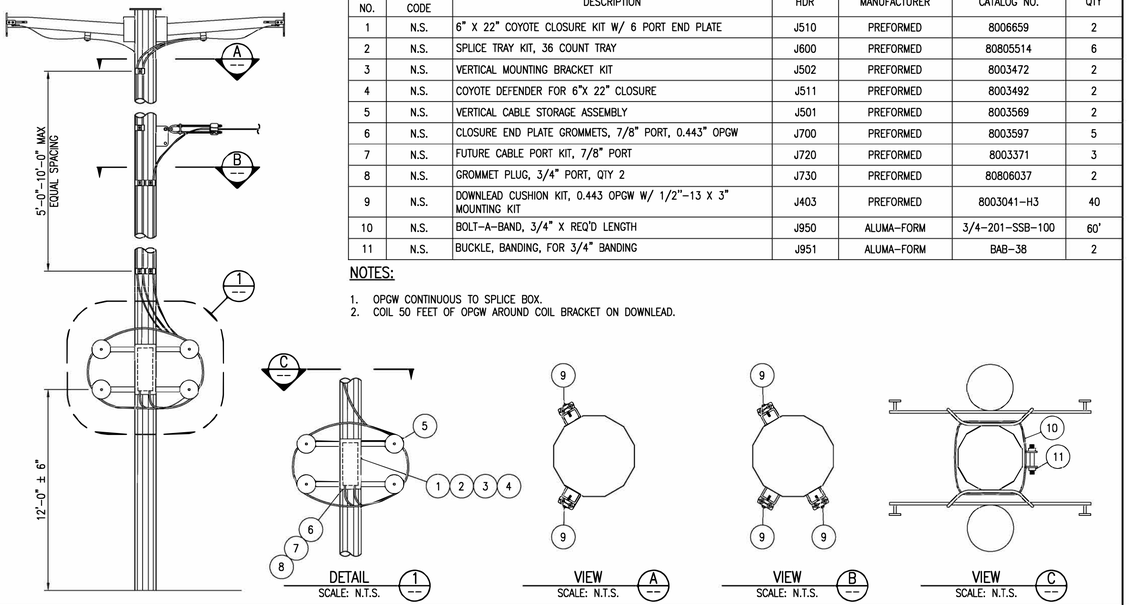
REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-FSCS-M1

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	6" X 22" COYOTE CLOSURE KIT W/ 6 PORT END PLATE	J510	PREFORMED	8006659	2
2	N.S.	SPLICE TRAY KIT, 36 COUNT TRAY	J600	PREFORMED	80805514	6
3	N.S.	VERTICAL MOUNTING BRACKET KIT	J502	PREFORMED	8003472	2
4	N.S.	COYOTE DEFENDER FOR 6"X 22" CLOSURE	J511	PREFORMED	8003492	2
5	N.S.	VERTICAL CABLE STORAGE ASSEMBLY	J501	PREFORMED	8003569	2
6	N.S.	CLOSURE END PLATE GROMMETS, 7/8" PORT, 0.443" OPGW	J700	PREFORMED	8003597	5
7	N.S.	FUTURE CABLE PORT KIT, 7/8" PORT	J720	PREFORMED	8003371	3
8	N.S.	GROMMET PLUG, 3/4" PORT, QTY 2	J730	PREFORMED	80806037	2
9	N.S.	DOWNLEAD CUSHION KIT, 0.443 OPGW W/ 1/2"-13 X 3" MOUNTING KIT	J403	PREFORMED	8003041-H3	40
10	N.S.	BOLT-A-BAND, 3/4" X REQ'D LENGTH	J950	ALUMA-FORM	3/4-201-SSB-100	60'
11	N.S.	BUCKLE, BANDING, FOR 3/4" BANDING	J951	ALUMA-FORM	BAB-38	2

NOTES:

1. OPGW CONTINUOUS TO SPLICE BOX.
2. COIL 50 FEET OF OPGW AROUND COIL BRACKET ON DOWNLEAD.



SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW SPLICE CASE - STEEL POLE
DOUBLE CIRCUIT - TWO SPLICE CASES

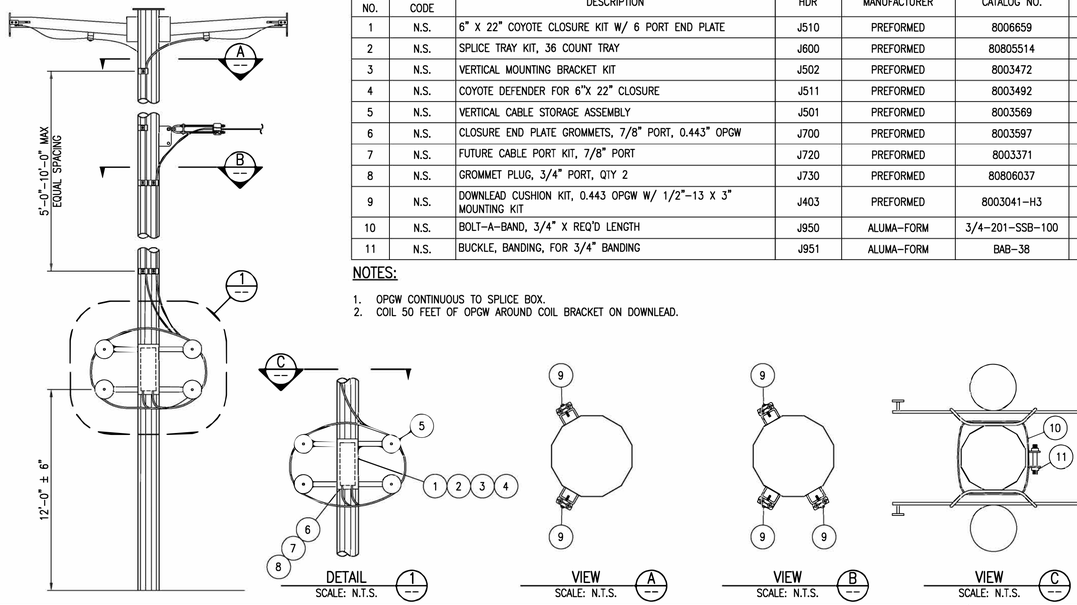
REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-FSCS-M2

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	6" X 22" COYOTE CLOSURE KIT W/ 6 PORT END PLATE	J510	PREFORMED	8006659	2
2	N.S.	SPLICE TRAY KIT, 36 COUNT TRAY	J600	PREFORMED	80805514	6
3	N.S.	VERTICAL MOUNTING BRACKET KIT	J502	PREFORMED	8003472	2
4	N.S.	COYOTE DEFENDER FOR 6"X 22" CLOSURE	J511	PREFORMED	8003492	2
5	N.S.	VERTICAL CABLE STORAGE ASSEMBLY	J501	PREFORMED	8003569	2
6	N.S.	CLOSURE END PLATE GROMMETS, 7/8" PORT, 0.443" OPGW	J700	PREFORMED	8003597	3
7	N.S.	FUTURE CABLE PORT KIT, 7/8" PORT	J720	PREFORMED	8003371	5
8	N.S.	GROMMET PLUG, 3/4" PORT, QTY 2	J730	PREFORMED	80806037	2
9	N.S.	DOWNLEAD CUSHION KIT, 0.443 OPGW W/ 1/2"-13 X 3" MOUNTING KIT	J403	PREFORMED	8003041-H3	40
10	N.S.	BOLT-A-BAND, 3/4" X REQ'D LENGTH	J950	ALUMA-FORM	3/4-201-SSB-100	60'
11	N.S.	BUCKLE, BANDING, FOR 3/4" BANDING	J951	ALUMA-FORM	BAB-38	2

NOTES:

1. OPGW CONTINUOUS TO SPLICE BOX.
2. COIL 50 FEET OF OPGW AROUND COIL BRACKET ON DOWNLEAD.



SHEET TITLE
TRANSMISSION ASSEMBLY
OPGW SPLICE CASE - STEEL POLE
DOUBLE CIRCUIT - TWO SPLICE CASES

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
T-FSCS-M3

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

ASSEMBLY DETAILS
OPGW SPLICE DETAILS

0 1" 2"

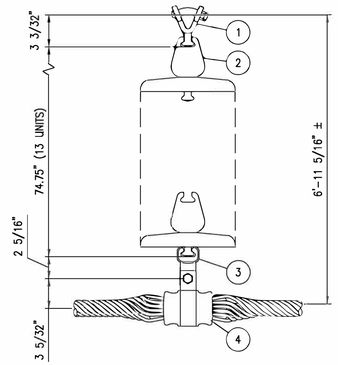
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SCALE N.T.S.

SHEET
AD-03-1

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48-3054	Y-CLEVIS, BALL, 30K	H500	HUBBELL	YBC30	1
2	48-0027	GLASS INSULATOR, 22K LB, M&E, ANSI CL 52-3, 10" X 5 3/4"	I100	SEDIVER	N100/146	13
3	42-7020	AGS SOCKET EYE, 25K, 1-1/16"	H100	PREFORMED	SE-5154	1
4	N.S.	AGS SUSPENSION ASSEMBLY, 25K, 1272 ACSR 45/7 "BITTERN"	K580	PREFORMED	AGS-5139	1

*ASSEMBLY WEIGHT = 131 LBS



CONDUCTOR SUSPENSION
1272 KCMIL 45/7 ACSR "BITTERN"
MAX. LINE ANGLE = 30°

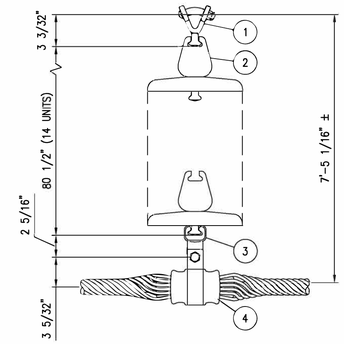
SHEET TITLE
TRANSMISSION ASSEMBLY
CONDUCTOR SUSPENSION ATTACHMENT
13 BELL GLASS

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: T-S13

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48-3054	Y-CLEVIS, BALL, 30K	H500	HUBBELL	YBC30	1
2	48-0027	GLASS INSULATOR, 22K LB, M&E, ANSI CL 52-3, 10" X 5 3/4"	I100	SEDIVER	N100/146	14
3	42-7020	AGS SOCKET EYE, 25K, 1-1/16"	H100	PREFORMED	SE-5154	1
4	N.S.	AGS SUSPENSION ASSEMBLY, 25K, 1272 ACSR - 45/7 "BITTERN"	K580	PREFORMED	AGS-5139	1

*ASSEMBLY WEIGHT = 140 LBS



CONDUCTOR SUSPENSION
1272 KCMIL 45/7 ACSR "BITTERN"
MAX. LINE ANGLE = 30°

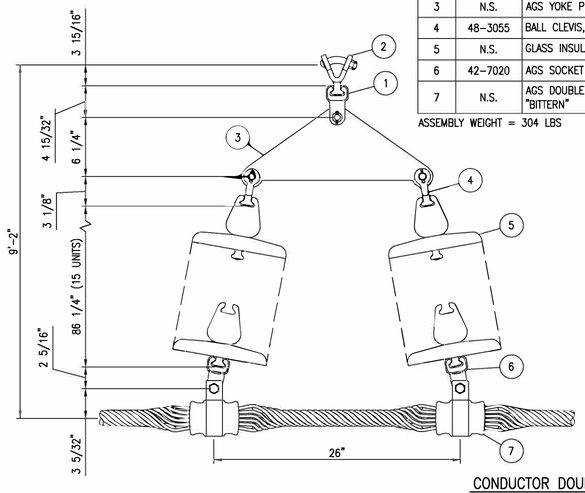
SHEET TITLE
TRANSMISSION ASSEMBLY
CONDUCTOR SUSPENSION ATTACHMENT
14 BELL GLASS

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: T-S14

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	SOCKET CLEVIS, 4 15/32" LONG, 15/16" CLEVIS, ANSI 52-8 & 11, 50K	H201	HUBBELL	SC50L	1
2	N.S.	Y-CLEVIS BALL 50K	H501	HUBBELL	YBC50	1
3	N.S.	AGS YOKE PLATE, 18" SPACING, 5/8" PLATE, 40K	H701	PREFORMED	YP-5908	1
4	48-3055	BALL CLEVIS, 30K	H550	HUBBELL	BC30	2
5	N.S.	GLASS INSULATOR, 30K LB M&E, ANSI CL 52-5, 10" X 5 3/4"	I102	SEDIVER	N14/146	30
6	42-7020	AGS SOCKET EYE, 25K, 1-1/16"	H100	PREFORMED	SE-5154	2
7	N.S.	AGS DOUBLE SUSPENSION ASSY., 50K, 1272 ACSR 45/7 "BITTERN"	K581	PREFORMED	AGS-5840	1

ASSEMBLY WEIGHT = 304 LBS



CONDUCTOR DOUBLE SUSPENSION
1272 KCMIL 45/7 ACSR "BITTERN"
MAX. LINE ANGLE = 60°

SHEET TITLE
TRANSMISSION ASSEMBLIES
CONDUCTOR SUSPENSION ATTACHMENT
15 GLASS BELLS

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: T-2S15

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

ASSEMBLY DETAILS
TANGENT CONDUCTOR ASSEMBLIES
GLASS
1272 ACSR 45/7 "BITTERN"

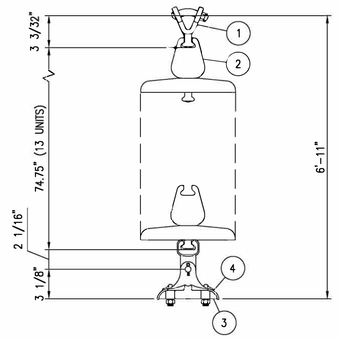
0 1" 2"

FILENAME: BHE-AD-04-D-1.DWG
SCALE: N.T.S.
SHEET: AD-04-1

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	48-3054	Y-CLEVIS, BALL, 30K	H500	HUBBELL	YBC30	1
2	48-0027	GLASS INSULATOR, 22K LB, M&E, ANSI CL 52-3, 10" X 5 3/4"	I100	SEDIVER	N100/146	13
3	N.S.	SUSPENSION CLAMP, 1.00" - 1.47" RANGE, W/ SOCKET, 25K	K104	HUBBELL	HAS-147-S	1
4	N.S.	INHIBITOR, RUST (NO-OX-ID), 1 PT CAN, GRADE "A"	O102	SANCHEM INC	NO-OX-ID "A" SPECIAL	0.06

*ASSEMBLY WEIGHT = 120.5 LBS



JUMPER SUPPORT

SHEET TITLE
TRANSMISSION ASSEMBLY
JUMPER SUPPORT
13 BELL GLASS

REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
T-J13

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

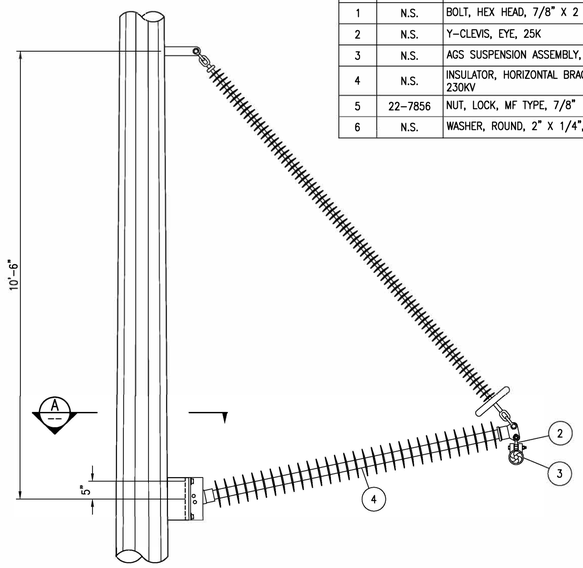
ASSEMBLY DETAILS
JUMPER CONDUCTOR ASSEMBLIES
GLASS
1272 KCMIL 45/7 ACSR "BITTERN"

0 1" 2"

FILENAME BHE-AD-05-D-1.DWG
SCALE N.T.S.
SHEET **AD-05-1**

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	BOLT, HEX HEAD, 7/8" X 2 1/2"	B772.5	HUGHES	HB82-1/2-2	4
2	N.S.	Y-CLEVIS, EYE, 25K	H903	PREFORMED	YC-5209	1
3	N.S.	AGS SUSPENSION ASSEMBLY, 25K, 1272 ACSR - 45/7 "BITTERN"	K580	PREFORMED	AGS-5139	1
4	N.S.	INSULATOR, HORIZONTAL BRACED POST ASSEMBLY, FLAT BASE, 230KV	I280	HUBBELL	BLP080F12000	1
5	22-7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	4
6	N.S.	WASHER, ROUND, 2" X 1/4", 15/16" HOLE	W410	HUGHES	RW2-80	8



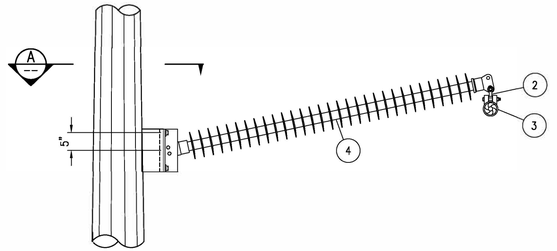
SECTION A

SHEET TITLE
TRANSMISSION ASSEMBLY
230KV BRACED POST ASSEMBLY - STEEL POLE
1272 ACSR - 45/7 "BITTERN"

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: T-BP-S-230

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	BOLT, HEX HEAD, 7/8" X 2 1/2"	B772.5	HUGHES	HB82-1/2-2	4
2	N.S.	Y-CLEVIS, EYE, 90, 25K	H903	PREFORMED	YC-5209	1
3	N.S.	AGS SUSPENSION ASSEMBLY, 25K, 1272 ACSR - 45/7 "BITTERN"	K580	PREFORMED	AGS-5139	1
4	N.S.	INSULATOR, HORIZONTAL POST, FLAT BASE, 230KV	I281	HUBBELL	P250080S0030	1
5	22-7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	4
6	N.S.	WASHER, ROUND, 2" X 1/4", 15/16" HOLE	W410	HUGHES	RW2-80	8



SECTION A

SHEET TITLE
TRANSMISSION ASSEMBLY
230KV HORIZONTAL POST ASSEMBLY - STEEL POLE
1272 ACSR - 45/7 "BITTERN"

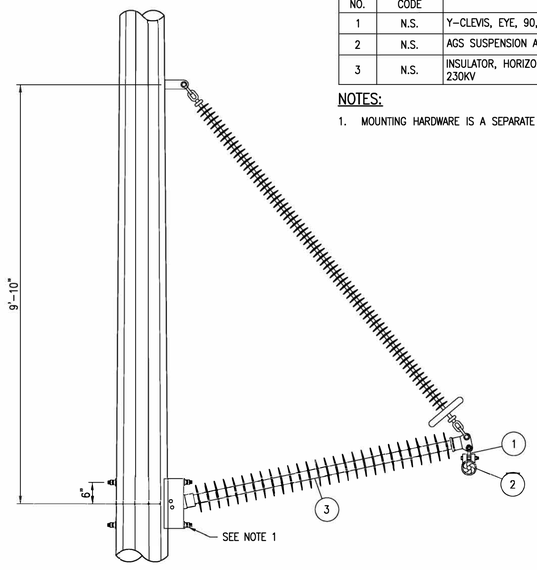
REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: T-HP-S-230

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	Y-CLEVIS, EYE, 90, 25K	H903	PREFORMED	YC-5209	1
2	N.S.	AGS SUSPENSION ASSEMBLY, 25K, 1272 ACSR - 45/7 "BITTERN"	K580	PREFORMED	AGS-5139	1
3	N.S.	INSULATOR, HORIZONTAL BRACED POST ASSEMBLY, GAIN BASE, 230KV	I282	HUBBELL	BLP075G12000	1

NOTES:

1. MOUNTING HARDWARE IS A SEPARATE ASSEMBLY. SEE TD-1C OR TD-2C ASSEMBLIES.



SHEET TITLE
TRANSMISSION ASSEMBLY
230KV BRACED POST ASSEMBLY - STEEL POLE - COMPACT DESIGN
1272 ACSR - 45/7 "BITTERN"

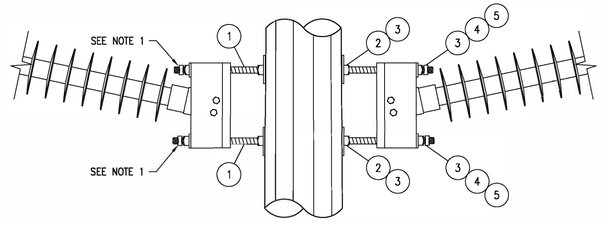
REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: T-BP-S-230-CD

NOTES:

1. ONE (1) STICK OF 7/8" X 10'-0" THREADED ROD PER INSULATOR ATTACHMENT. CUT TO LENGTH.

LIST OF MATERIALS

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	ROD, FULL THREADED, 7/8" X 120", ASTM A307 GRADE B	D17120	PORTLAND BOLT	13919-10'	1
2	N.S.	WASHER, SQUARE, 4" X 1/4", 15/16" HOLE	W322	HUGHES	SW4-80	4
3	47-0242	NUT, SQUARE, 7/8"	N107	HUGHES	N80	8
4	22-7856	NUT, LOCK, MF TYPE, 7/8"	N407	HUGHES	MF80	4
5	N.S.	WASHER, ROUND, 2" X 1/4", 15/16" HOLE	W410	HUGHES	RW2-80	4



SHEET TITLE
TRANSMISSION ASSEMBLY
DOUBLE INSULATOR BASE TO POLE ASSEMBLY
STEEL POLE

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: TD-2C

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

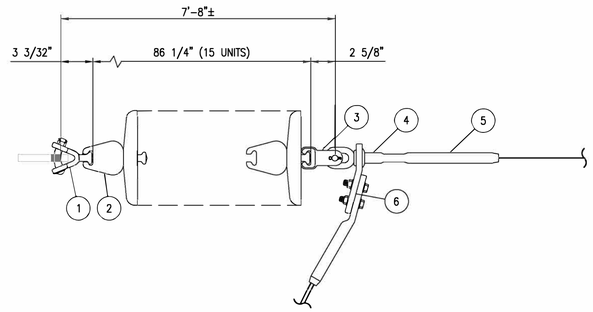
ASSEMBLY DETAILS
POST INSULATOR ASSEMBLIES
1272 KCMIL 45/7 ACSR "BITTERN"

0 1" 2"

FILENAME: BHE-AD-06-D-1.DWG
SCALE: N.T.S.
SHEET: AD-06-1

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	Y-CLEVIS, BALL, 30K	H500	HUBBELL	YBC30	1
2	N.S.	GLASS INSULATOR, 30K LB, M&E, ANSI CL 52-5, 10" X 5 3/4"	I102	SEDIVER	N14/146	15
3	N.S.	SOCKET CLEVIS, 30K	H200	HUBBELL	SC30	1
4	N.S.	COMPRESSION DEADEND ASSY., W/15' TERMINAL, "BITTERN"	L403	AFL	VES-153	1
5	N.S.	INHIBITOR, FILLER COMPOUND, GRITTED, COMPRESSION CONNECTIONS, 8 oz.	O100	HUBBELL	VSG8B	0.6
6	N.S.	INHIBITOR, FILLER COMPOUND, NON-GRITTED, PAD TO PAD, 8 OZ	O101	HUBBELL	VS8B	0.15

ASSEMBLY WEIGHT = 151 LBS



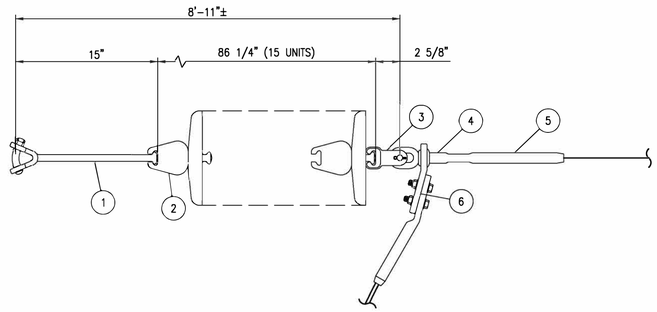
CONDUCTOR COMPRESSION DEADEND
1272 KCMIL 45/7 ACSR "BITTERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
CONDUCTOR COMPRESSION DEADEND - HIGH STRENGTH
15 BELL GLASS

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: T-CDE15

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	HOT LINK EXTENSION, Y-CLEVIS, BALL, 15" LENGTH, 30K LBS	H401	HUBBELL	HYBC3015	1
2	N.S.	GLASS INSULATOR, 30K LB, M&E, ANSI CL 52-5, 10" X 5 3/4"	I102	SEDIVER	N14/146	15
3	N.S.	SOCKET CLEVIS, 30K	H200	HUBBELL	SC30	1
4	N.S.	COMPRESSION DEADEND ASSY., W/15' TERMINAL, "BITTERN"	L403	AFL	VES-153	1
5	N.S.	INHIBITOR, FILLER COMPOUND, GRITTED, COMPRESSION CONNECTIONS, 8 oz.	O100	HUBBELL	VSG8B	0.6
6	N.S.	INHIBITOR, FILLER COMPOUND, NON-GRITTED, PAD TO PAD, 8 OZ	O101	HUBBELL	VS8B	0.15

ASSEMBLY WEIGHT = 155 LBS



CONDUCTOR COMPRESSION DEADEND W/ 15" EXTENSION
1272 KCMIL 45/7 ACSR "BITTERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
CONDUCTOR COMPRESSION DEADEND W/ 15" EXTENSION - HIGH STRENGTH
15 BELL GLASS

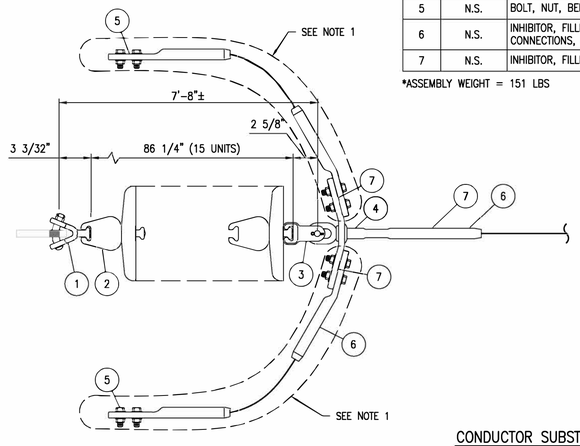
REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: T-CDE15-15EXT

NOTE:

1. JUMPERS AND TERMINALS SUPPLIED BY SUBSTATION, INSTALLED BY TRANSMISSION. SEE WEST RAPID CITY SUBSTATION REFERENCE SHEETS IN APPENDIX.

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	Y-CLEVIS, BALL, 30K	H500	HUBBELL	YBC30	1
2	N.S.	GLASS INSULATOR, 30K LB, M&E, ANSI CL 52-5, 10" X 5 3/4"	I102	SEDIVER	N14/146	15
3	N.S.	SOCKET CLEVIS, 30K	H200	HUBBELL	SC30	1
4	N.S.	COMPRESSION DEADEND ASSY., DOUBLE TONGUE, W/15' TERMINAL, "BITTERN"	L503	AFL	VED-153	1
5	N.S.	BOLT, NUT, BELLEVILLE, FLAT, STAINLESS STEEL ASSEMBLY	B606	CMC	SBA20-50	8
6	N.S.	INHIBITOR, FILLER COMPOUND, GRITTED, COMPRESSION CONNECTIONS, 8 oz.	O100	HUBBELL	VSG8B	1.5
7	N.S.	INHIBITOR, FILLER COMPOUND, NON-GRITTED, PAD TO PAD, 8 OZ	O101	HUBBELL	VS8B	0.6

*ASSEMBLY WEIGHT = 151 LBS



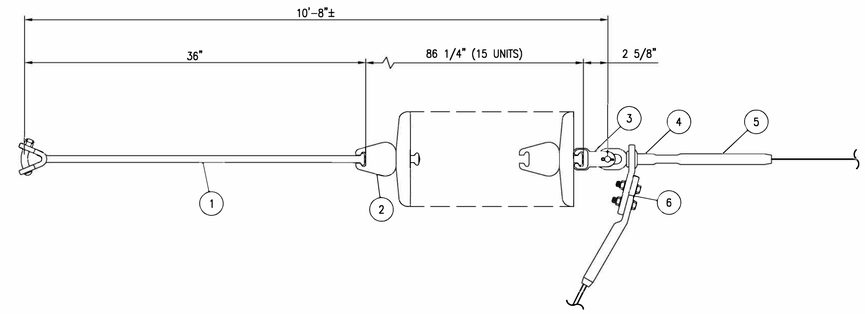
CONDUCTOR SUBSTATION DEADEND
1272 KCMIL 45/7 ACSR "BITTERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
CONDUCTOR SUBSTATION DEADEND - HIGH STRENGTH
15 BELL GLASS

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: T-SDE15

ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	HOT LINK EXTENSION, Y-CLEVIS, BALL, 36" LENGTH, 30K LBS	H402	HUBBELL	HYBC3036	1
2	N.S.	GLASS INSULATOR, 30K LB, M&E, ANSI CL 52-5, 10" X 5 3/4"	I102	SEDIVER	N14/146	15
3	N.S.	SOCKET CLEVIS, 30K	H200	HUBBELL	SC30	1
4	N.S.	COMPRESSION DEADEND ASSY., W/15' TERMINAL, "BITTERN"	L403	AFL	VES-153	1
5	N.S.	INHIBITOR, FILLER COMPOUND, GRITTED, COMPRESSION CONNECTIONS, 8 oz.	O100	HUBBELL	VSG8B	0.6
6	N.S.	INHIBITOR, FILLER COMPOUND, NON-GRITTED, PAD TO PAD, 8 OZ	O101	HUBBELL	VS8B	0.15

ASSEMBLY WEIGHT = 155 LBS



CONDUCTOR COMPRESSION DEADEND W/ 36" EXTENSION
1272 KCMIL 45/7 ACSR "BITTERN"

SHEET TITLE
TRANSMISSION ASSEMBLY
CONDUCTOR COMPRESSION DEADEND W/ 36" EXTENSION - HIGH STRENGTH
15 BELL GLASS

REFERENCE SHEET: 1 OF 1
EXHIBIT NUMBER: T-CDE15-36EXT

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

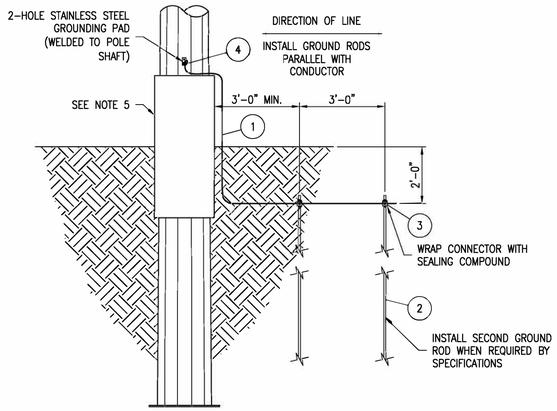
ASSEMBLY DETAILS
DEADEND CONDUCTOR ASSEMBLIES
GLASS
1272 KCMIL 45/7 ACSR "BITTERN"

0 1" 2"

FILENAME: BHE-AD-07-D-1.DWG
SCALE: N.T.S.

SHEET: AD-07-1

LIST OF MATERIALS						
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			10'
2	46-0588	ROD, GROUND, 5/8" X 8'-0", COPPERCLAD	P500	GALVAN	6260G13	1
3	46-0058	CLAMP, GROUND ROD, 0.128 TO 0.460 RANGE, 5/8" ROD	P701	CHANCE	C2030344	1
4	N.S.	CLAMP, VISE TYPE, LIGHTNING ARRESTOR GROUND, #2 STRANDED	P820	HUBBELL	GC207	1



STEEL POLE GROUNDING DETAIL
SCALE: N.T.S.

SPECIFICATIONS FOR DRIVEN GROUND ROD INSTALLATION:

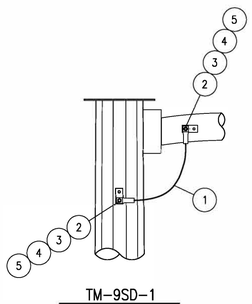
1. INSTALL 8'-0" OF GROUND ROD AND TEST THE RESISTANCE LEVEL. WHEN RESISTANCE IS 25Ω OR LESS, NO ADDITIONAL STEPS ARE NEEDED.
2. IF RESISTANCE IS 25Ω OR GREATER, INSTALL AN ADDITIONAL 8'-0" OF GROUND ROD AS SHOWN:
   - TEST RESISTANCE WITH 1ST ROD CONNECTED TO 2ND ROD WITH #2 CU FOR COMBINED PARALLEL RESISTANCE VALUE. RECORD RESISTANCE VALUE.
3. AFTER DRIVING TWO (2) GROUND RODS AS NOTED ABOVE AND THE COMBINED RESISTANCE IS 25Ω OR GREATER, THE ELECTRICAL ENGINEERING DEPARTMENT SHOULD BE CONSULTED FOR FURTHER ACTION.
4. BOND STATIC WIRE TO POLE GROUND, USE FARGO CONNECTOR (ITEM #5).
5. GROUNDING THE SAME FOR STEEL POLE ON CONCRETE PIER FOUNDATIONS.

SHEET TITLE
TRANSMISSION ASSEMBLY
STEEL POLE GROUNDING

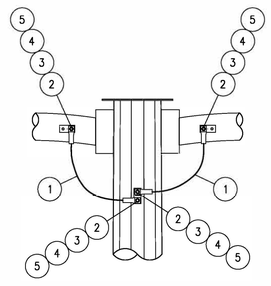
REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
TM-9ST

LIST OF MATERIALS							
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	9SD-1	9SD-2
1	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			5'	10'
2	N.S.	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	M500	HUBBELL	VHCL1012	2	4
3	N.S.	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	B614	FASTENAL	70207	2	4
4	N.S.	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	B603	BURNDY	50FWSS	2	4
5	N.S.	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	B605	BURNDY	50SWSSMD	2	4



TM-9SD-1
SINGLE DAVIT GROUNDING
SCALE: N.T.S.



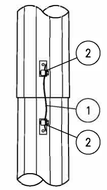
TM-9SD-2
DOUBLE DAVIT GROUNDING
SCALE: N.T.S.

SHEET TITLE
TRANSMISSION ASSEMBLY
STEEL POLE DAVIT ARM GROUNDING

REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
TM-9SD

LIST OF MATERIALS						
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY
1	N.S.	WIRE, COPPER, #2 STRANDED, CLASS B	C902			4'
2	N.S.	CLAMP, VISE TYPE, LIGHTNING ARRESTOR GROUND, #2 STRANDED	P820	HUBBELL	GC207	2



TM-9SSJ
SLIP JOINT
SCALE: N.T.S.

SHEET TITLE
TRANSMISSION ASSEMBLY
STEEL POLE SLIP JOINT GROUNDING

REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
TM-9SSJ

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

ASSEMBLY DETAILS
GROUNDING ASSEMBLIES

0 1" 2"

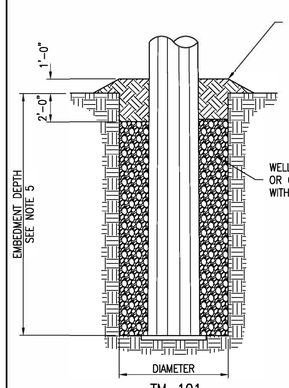
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SCALE N.T.S.

SHEET
AD-08-1

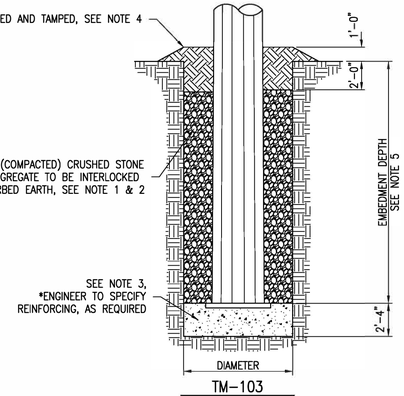
POLE STABILITY FOUNDATION
IMPORTED GRANULAR BACKFILL

TYPE	STR	POLE HT.–CL.	EMBEDMENT DEPTH (FT)	DIAMETER (FT)	POLE WIDTH (FT)	POLE WEIGHT (LB)	APPROX. QTY. CUBIC YDS. (10% + 4 FT)
DCBP–230	3, 5	134'–0"	21	6.0*	4.83	–	7.0
TCBP–230–69UB	7	138'–0"	18	6.5*	5.41	–	6.0
TCBP–230–69UB	8, 9, 10	133'–0"	18	6.5*	5.41	–	6.0
TCBP–230–69UB	11, 12, 13	128'–0"	18	6.5*	5.41	–	6.0
TCBP–230–69UB	14	123'–0"	18	6.5*	5.41	–	6.0
SCBP–230	L–SRC–20	131'–0"	18	6.0*	4.83	–	5.9

(*) HOLE DIAMTER AS NEEDED TO TAMP ALL THE WAY AROUND THE POLE.



TM–101
IMPORTED BACKFILL
SCALE: N.T.S.



TM–103
IMPORTED BACKFILL AND BEARING REINFORCEMENT
SCALE: N.T.S.

GRADATION FOR IMPORTED GRANULAR BACKFILL	
SIZE OF GRAVEL OR CRUSHED STONE	SIZE OF MESH (IN)
100% BY WEIGHT TO PASS 1" SCREEN	1.00
60%–90% BY WEIGHT TO PASS 1/2" SCREEN	0.500
40%–60% BY WEIGHT TO PASS NO. 4 SCREEN	0.187
25%–50% BY WEIGHT TO PASS NO. 8 SCREEN	0.0937
20%–40% BY WEIGHT TO PASS NO. 16 SCREEN	0.0469
15%–30% BY WEIGHT TO PASS NO. 40 SCREEN	0.0165

IMPORTANT

EACH POLE SHALL BE BACKFILLED FROM BOTTOM TO TOP BY ONE LABORER SHOVELING FILL AND TWO OTHERS USING PNEUMATIC TAMPERS.

NOTES:

1. GRADATION FOR IMPORTED BACKFILL IS SHOWN IN THE TABLE. THE AGGREGATE SHALL BE WELL MIXED IN A STOCK PILE, AND PNEUMATICALLY PLACED AND TAMPED IN 6–INCH LIFTS.
2. THE SPECIFICATION FOR AGGREGATE GIVEN IN THE TABLE IS MINIMUM. IN AREAS WHERE SMALLER FINES ARE AVAILABLE AT COMPARABLE COST, IT IS RECOMMENDED THAT THE ENGINEER SPECIFY SMALLER FINES.
3. CONCRETE SHALL BE 2000 PSI HIGH EARLY STRENGTH CONCRETE. IT SHALL BE DEPOSITED IN A MANNER WHICH WILL PREVENT SEGREGATION OF THE AGGREGATE AND CEMENT. CARE SHOULD BE TAKEN TO AVOID GETTING DIRT MIXED WITH THE CONCRETE. THE POLE SHALL NOT BE SET UNTIL THE CONCRETE BEARING BASE HAS ATTAINED SUFFICIENT STRENGTH TO SUPPORT THE POLE. DURING THE PLACEMENT OF POLE, AVOID BUMPING CONCRETE BASE.
4. WELL TAMPED NATIVE BACKFILL SHOULD BE PLACED AROUND THE POLE AS SHOWN
5. SEE STRUCTURE DRAWINGS FOR EMBEDMENT DEPTHS.

SHEET TITLE
TRANSMISSION ASSEMBLY
POLE STABILITY FOUNDATION

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TM-101 & TM-103

NOTES:

1. FILL ANNULAR SPACES BETWEEN CULVERT AND HOLE WITH COMPACTED NATIVE SOIL OR SAND.
2. DRILL HOLE TO RUN #4 COPPER GROUNDING THROUGH CULVERT.
3. LEAN CONCRETE BACKFILL MAY BE USED AS FLOWABLE BACKFILL WHERE GRANULAR FILL PLACEMENT IS NO LONGER ECONOMICAL.
4. CHANGED CONDITIONS: THE SOIL CONDITIONS FOR EACH STRUCTURE EXCAVATION SHALL BE MONITORED DURING CONSTRUCTION FOR POSSIBLE CHANGE IN APPLICATION. IF A CHANGE IN BACKFILL IS DESIRED THE ENGINEER SHALL BE CONTACTED.

SPECIFICATION FOR CULVERT SELECT BACKFILL:

1. BACKFILL MATERIAL

GRADATION TYPE "A"

3 1/2"	–	100% PASSING (MAX. SIZE)	2 1/2"	–	25% TO 60% PASSING
3"	–	70% TO 80% PASSING	1 1/2"	–	0% TO 5% PASSING (MINIMUM SIZE)

APPLICATIONS:
A) WET – CAVING CONDITION (CULVERT) WITH SATURATED GRANULAR OR COHESIVE SOILS.

THIS GRADATION IS SUITABLE WHEN BACKFILL MUST BE PLACED IN A POLE EXCAVATION BELOW THE WATER TABLE WHERE CASING OF THE HOLE IS NECESSARY TO PREVENT SOIL CAVING.

MATERIAL MAY BE PLACED DIRECTLY THROUGH THE WATER AND COMPACTED AS MUCH AS PRACTICAL FOR EACH GIVEN SITE.

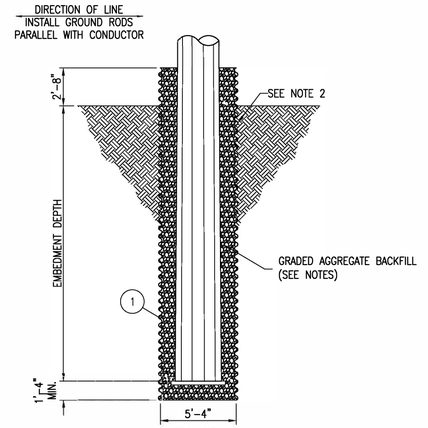
GRADATION TYPE "B"

2"	–	100%	3/4"	–	0% TO 20%
1 1/2"	–	70% TO 80%	3/8"	–	0% TO 10%
1"	–	30% TO 75%	NO. 4	–	0% TO 5%

APPLICATIONS:
A) WET AND CAVING CONDITION (CULVERT) WITH SATURATED GRANULAR OR COHESIVE SOILS.
B) DRY AND CAVING CONDITION (CULVERT) WITH SANDY SOILS.
C) DRY CONDITION (NO CULVERT) WITH DENSE MOIST GRANULAR SOILS OR STIFF COHESIVE MATERIALS.

THIS GRADATION IS SUITABLE FOR WET AND DRY CONDITIONS AS LISTED ABOVE, COMPACTION REQUIREMENTS ARE SIMILAR TO THOSE SPECIFIED FOR GRADATION "A".

LIST OF MATERIAL						
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	QTY.
1	N.S.	CULVERT, HELICAL, 4'–0" X REQ'D LENGTH	0200			1



TM–104
DIRECT EMBED CULVERT DETAIL
SCALE: N.T.S.

SHEET TITLE
TRANSMISSION ASSEMBLY
POLE STABILITY FOUNDATION

REFERENCE SHEET
1 OF 1
EXHIBIT NUMBER
TM-104

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

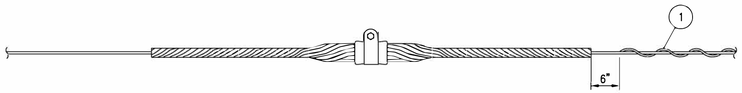
ASSEMBLY DETAILS
POLE STABILITY ASSEMBLIES

0 1" 2"

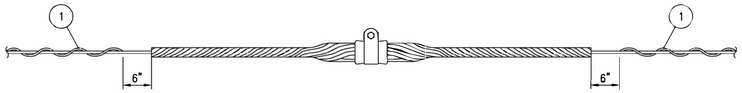
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SCALE N.T.S.

SHEET
AD-09-1

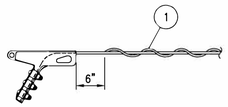
LIST OF MATERIALS								
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T1 QTY	2T1 QTY	D1 QTY
1	N.S.	SPIRAL VIBRATION DAMPER, 0.327" – 0.461" RANGE	S110	PREFORMED	5050104	1	2	1



DPR–EHS–T1



DPR–EHS–2T1



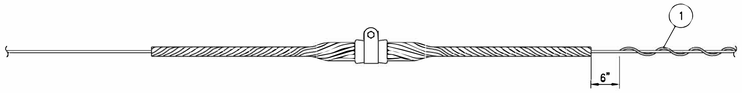
DPR–EHS–D1

SHEET TITLE
TRANSMISSION ASSEMBLY
DAMPER - 3/8" EHS

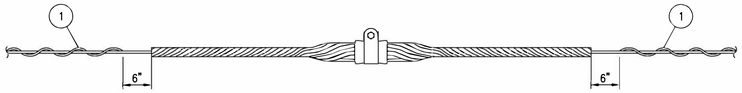
REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
DPR-EHS

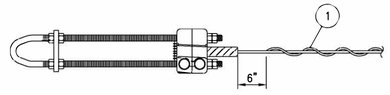
LIST OF MATERIALS								
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T1 QTY	2T1 QTY	D1 QTY
1	N.S.	SPIRAL VIBRATION DAMPER, 0.327" – 0.461" RANGE	S110	PREFORMED	5050104	1	2	1



DPR–OPGW–T1



DPR–OPGW–2T1



DPR–OPGW–D1

SHEET TITLE
TRANSMISSION ASSEMBLY
DAMPER - OPGW

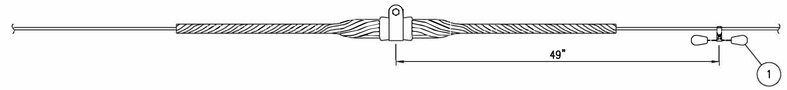
REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
DPR-OPGW

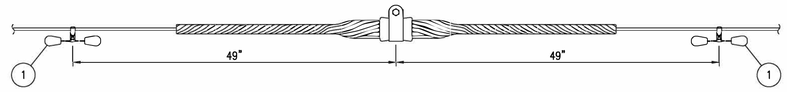
LIST OF MATERIALS									
ITEM NO.	BHE CODE	DESCRIPTION	HDR	MANUFACTURER	CATALOG NO.	T1 QTY	2T1 QTY	D1 QTY	D2 QTY
1	N.S.	DAMPER, DOGBONE, 1272 ACSR	S151	HUBBELL	6071513	1	2	1	2

NOTES:

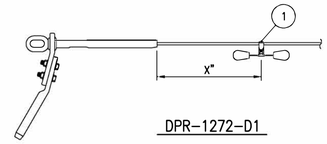
1. FIRST DAMPER AT SUSPENSION SPAN ENDS SHALL BE LOCATED FROM CENTER OF DAMPER CLAMP TO THE SUSPENSION SUPPORT PER REFERENCED DIMENSION.
2. THE ORIENTATION OF THE WEIGHTS ALONG THE CONDUCTOR IS OPTIONAL. (I.E. WHETHER THE LARGE WEIGHT IS TOWARD THE TOWER OR TOWARD THE SPAN. ORIENT THE DAMPER FOR EASY ACCESS TO THE BOLT AND TO OBTAIN VISUAL ASSURANCE OF POSITIVE CONDUCTOR SEATING.
3. FOLLOW MANUFACTURER'S INSTALLATION INSTRUCTIONS IN DELIVERY BOX.
4. SEE SAG TABLES FOR INSTALLATION DIRECTION ON THE LINE.



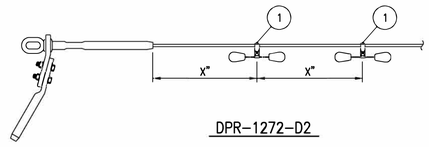
DPR–1272–T1



DPR–1272–2T1



DPR–1272–D1



DPR–1272–D2

SHEET TITLE
TRANSMISSION ASSEMBLY
DAMPER - 795 ACSR

REFERENCE SHEET
1 OF 1

EXHIBIT NUMBER
DPR-1272

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

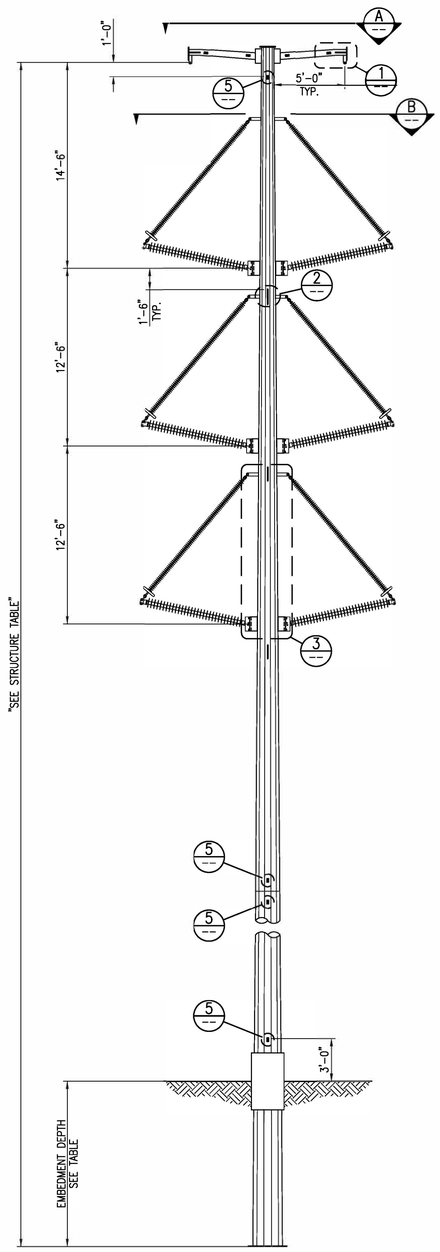
WEST RAPID CITY
230KV TRANSMISSION LINE

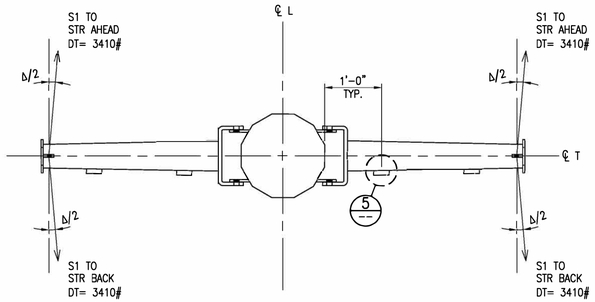
ASSEMBLY DETAILS
DAMPER ASSEMBLIES

0 1" 2"

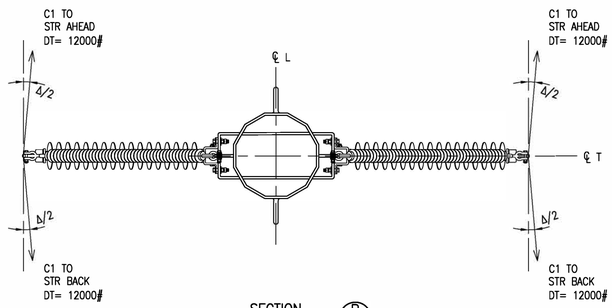
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SCALE N.T.S.

SHEET
AD-10-1

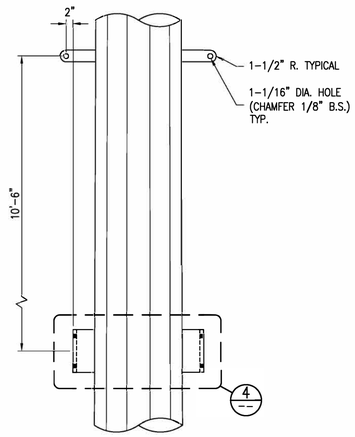




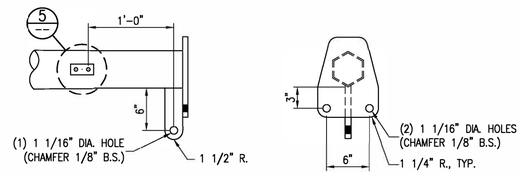
VIEW A
SHIELD ORIENTATION
SCALE: N.T.S.



SECTION B
CONDUCTOR ORIENTATION
SCALE: N.T.S.



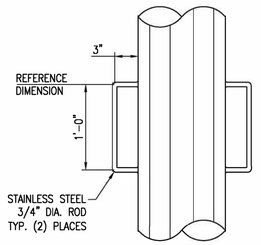
DETAIL 3
BRACED POST ATTACHMENT
SCALE: N.T.S.



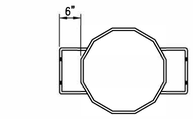
FRONT VIEW

SIDE VIEW

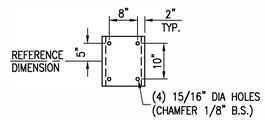
DETAIL 1
SHIELD WIRE VANGS
SCALE: N.T.S.



DETAIL 2
GROUNDING LOOP
SCALE: N.T.S.



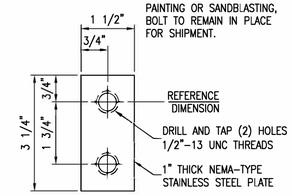
TOP VIEW



SIDE VIEW

DETAIL 4
HORIZONTAL POST ATTACHMENT
SCALE: N.T.S.

NOTE:
PLUG WITH 1/2"ø X 3/4" MACHINE BOLT BEFORE PAINTING OR SANDBLASTING, BOLT TO REMAIN IN PLACE FOR SHIPMENT.



DETAIL 5
GROUNDING PAD
SCALE: N.T.S.

GENERAL NOTES

MAXIMUM SHIELD WIRE VANG THICKNESS = 3/4"
MAXIMUM CONDUCTOR VANG THICKNESS = 1"
LOAD TREE VALUES ARE ULTIMATE, INCLUDE OVERLOAD FACTORS, AND ARE SHOWN IN POUNDS.

DESIGN CRITERIA

(S1) SHIELD WIRE IS AFL CC-55/443 "DNO-4748" OPGW, MAXIMUM TENSION AT NESC HEAVY LOADING: 3410# R.S.= 400'
(C1) CONDUCTOR IS 1272 KCMIL 45/7 ACSR "BITTERN" MAXIMUM TENSION AT NESC HEAVY LOADING: 12000# R.S.= 400'

WIND SPAN: 400'
WEIGHT SPAN: 600' AT NESC HEAVY LOADING
HEIGHT OF STR.: SEE TABLE
DESIGN MAXIMUM ANGLE (A): 2°00'00"

SPECIFICATIONS

1. POLES TO BE DESIGNED PER SECTION 33 71 16.23 TUBULAR STEEL POLES SPECIFICATIONS.
2. ALL STEEL TO BE WEATHERING STEEL.
3. POLES TO HAVE EITHER SLIP JOINTS OR BOLTED FLANGE TYPE SPLICES, WHICHEVER IS MORE COST EFFECTIVE.
   A. IF SLIP JOINTS ARE USED, INSTALL GROUND PADS (DETAIL 5) ABOVE AND BELOW THE SLIP JOINT.
4. THE CIRCLED LOADINGS SHOWN IN LOAD TREES CONVEY THE ADDITIONAL VERTICAL LOAD THAT WILL BE APPLIED TO THE STRUCTURE BY LINE PERSONNEL DURING CONSTRUCTION AND MAINTENANCE OPERATIONS.
   A. IT IS REQUIRED THAT ALL CONDUCTOR ATTACHMENT SUPPORTS BE DESIGNED TO MEET THIS REQUIREMENT. HOWEVER, AS THE LOADING WILL BE APPLIED TO ONLY ONE PHASE AT ANY GIVEN TIME, THE SHAFT MAY BE DESIGNED FOR ITS APPLICATION AT A SINGLE CONTROLLING PHASE LOCATION TO BE DETERMINED BY THE STEEL MANUFACTURER.

DEFLECTION

SEE TUBULAR STEEL POLE SPECIFICATION FOR DEFLECTION OF THE SHAFT UNDER LOAD CASE V.

STRUCTURE TABLE		
STR #	HEIGHT	EMBEDMENT DEPTH
3	143'-0"	21'-0"
5	143'-0"	21'-0"

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

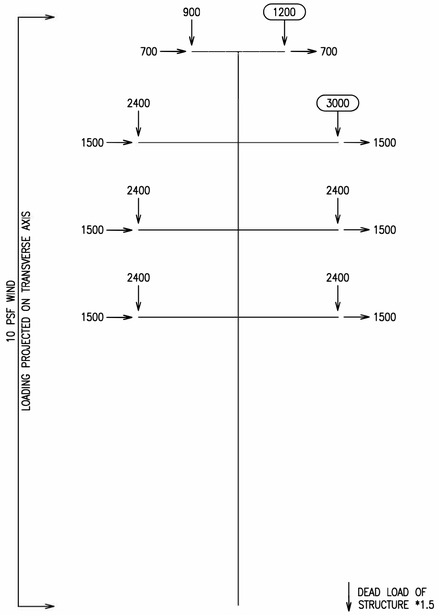
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

LOAD & DESIGN DETAIL
DCBP-230
STR 3 AND STR 5

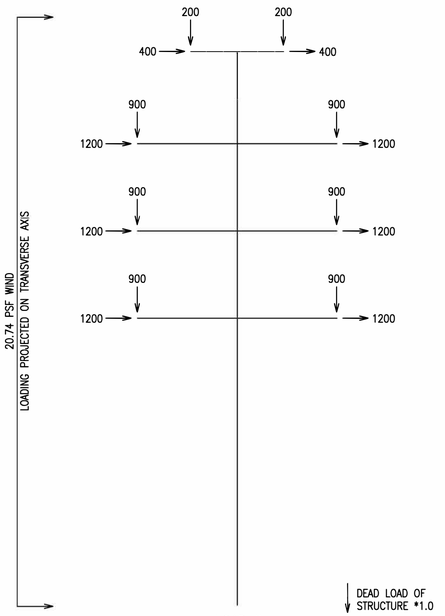
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SCALE 3/16"=1'-0"
SHEET **LD-01-1**



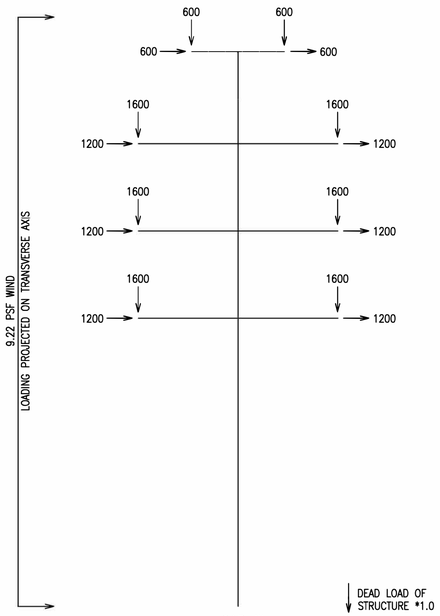
LOAD I

NESC HEAVY LOADING – RULE 250B
ALL WIRES INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 4 PSF WIND @ 0°F



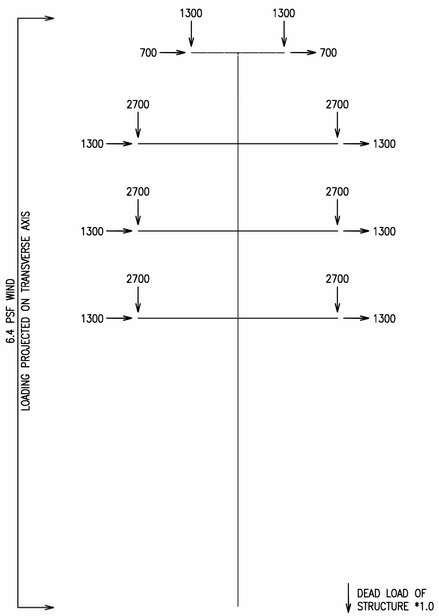
LOAD II

NESC EXTREME HIGH WIND – RULE 250C
ALL WIRES INTACT
NO ICE, 20.74 PSF WIND @ 60°F



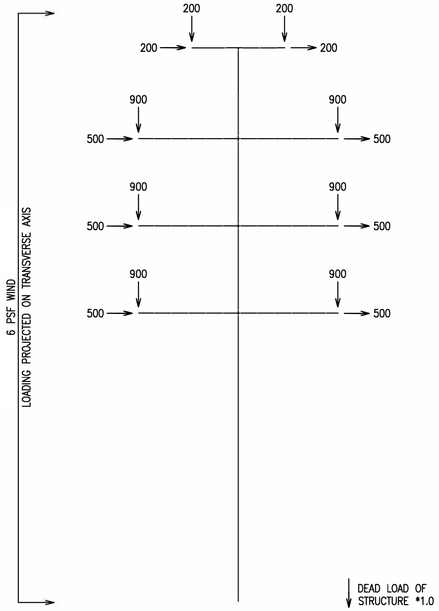
LOAD III

NESC CONCURRENT ICE/WIND – RULE 250D
ALL WIRES INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 9.22 PSF WIND @ 15°F



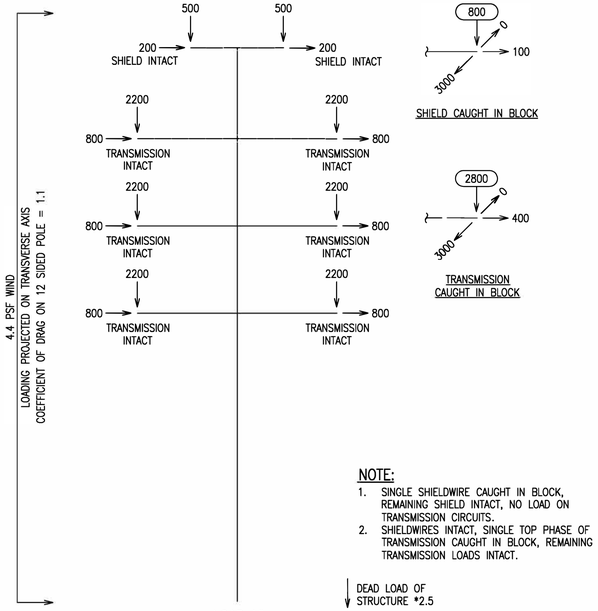
LOAD IV

BHE CONCURRENT ICE/WIND
ALL WIRES INTACT
1.0" RADIAL ICE @ 57 LBS/FT³, 6.4 PSF WIND @ 0°F



LOAD V

DEFLECTION LIMIT
ALL WIRES INTACT
NO ICE, 6 PSF WIND @ 60°F

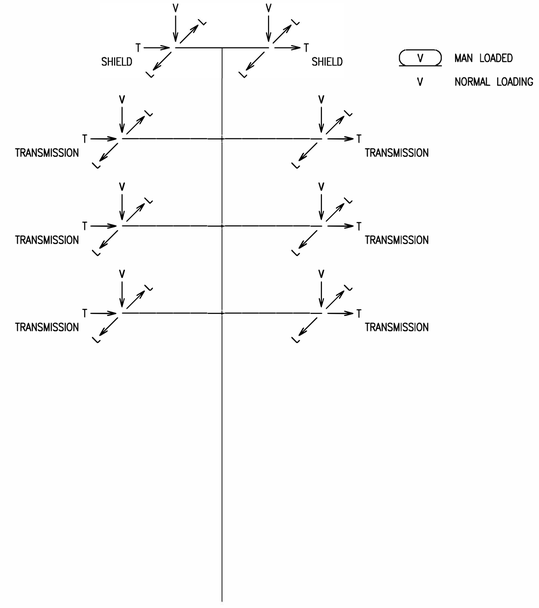


LOAD VI

CONSTRUCTION LOADING
SEE NOTE
NO ICE, 4 PSF WIND @ 20°F

NOTE:

1. SINGLE SHIELDWIRE CAUGHT IN BLOCK, REMAINING SHIELD INTACT, NO LOAD ON TRANSMISSION CIRCUITS.
2. SHIELDWIRES INTACT, SINGLE TOP PHASE OF TRANSMISSION CAUGHT IN BLOCK, REMAINING TRANSMISSION LOADS INTACT.



TYPICAL

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

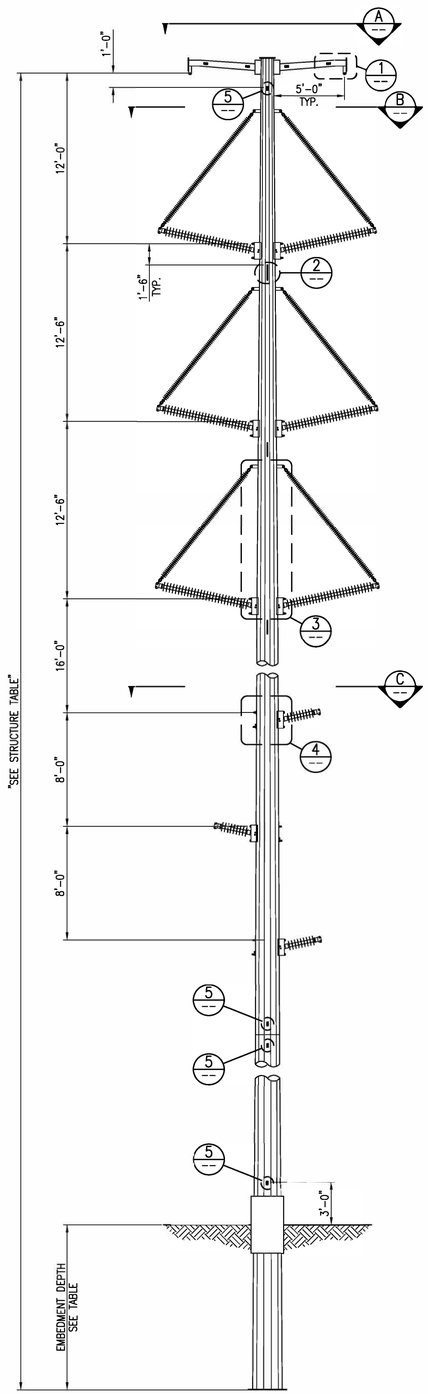
WEST RAPID CITY
230KV TRANSMISSION LINE

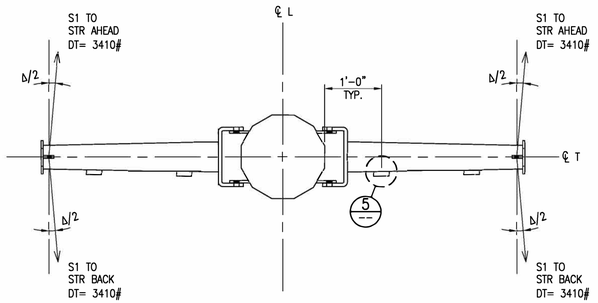
LOAD & DESIGN DETAIL
DCBP-230
STR 3 AND STR 5

0 1" 2"

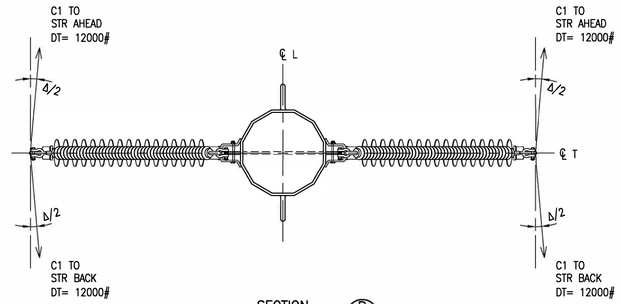
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SCALE 3/16"=1'-0"

SHEET
LD-01-2

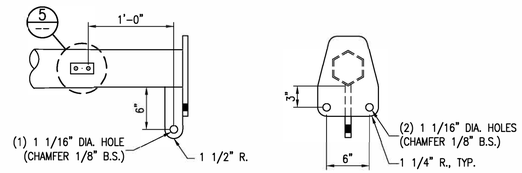




VIEW A
SHIELD ORIENTATION
SCALE: N.T.S.



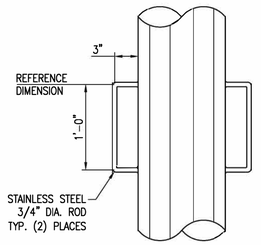
SECTION B
CONDUCTOR ORIENTATION
SCALE: N.T.S.



FRONT VIEW

SIDE VIEW

DETAIL 1
SHIELD WIRE VANGS
SCALE: N.T.S.



DETAIL 2
GROUNDING LOOP
SCALE: N.T.S.

GENERAL NOTES

MAXIMUM SHIELD WIRE VANG THICKNESS = 3/4"
MAXIMUM CONDUCTOR VANG THICKNESS = 1"
LOAD TREE VALUES ARE ULTIMATE, INCLUDE OVERLOAD FACTORS, AND ARE SHOWN IN POUNDS.

DESIGN CRITERIA

(S1) SHIELD WIRE IS AFL CC-55/443 "DNO-4748" OPGW, MAXIMUM TENSION AT NESC HEAVY LOADING: 3410# R.S.= 400'
(C1) CONDUCTOR IS 1272 KCMIL 45/7 ACSR "BITTERN" MAXIMUM TENSION AT NESC HEAVY LOADING: 12000# R.S.= 400'
(D1) UNDERBUILD IS 795 KCMIL 45/7 ACSR "TERN", MAXIMUM TENSION AT NESC HEAVY LOADING: 7565# R.S.= 400'

WIND SPAN: 400'
WEIGHT SPAN: 600' AT NESC HEAVY LOADING
HEIGHT OF STR.: SEE TABLE
DESIGN MAXIMUM ANGLE (A): 2°00'00"

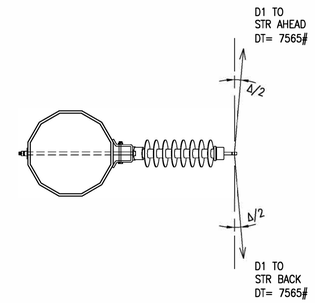
SPECIFICATIONS

1. POLES TO BE DESIGNED PER SECTION 33 71 16.23 TUBULAR STEEL POLES SPECIFICATIONS.
2. ALL STEEL TO BE WEATHERING STEEL.
3. POLES TO HAVE EITHER SLIP JOINTS OR BOLTED FLANGE TYPE SPLICES, WHICHEVER IS MORE COST EFFECTIVE.
   A. IF SLIP JOINTS ARE USED, INSTALL GROUND PADS (DETAIL 5) ABOVE AND BELOW THE SLIP JOINT.
4. THE CIRCLED LOADINGS SHOWN IN LOAD TREES CONVEY THE ADDITIONAL VERTICAL LOAD THAT WILL BE APPLIED TO THE STRUCTURE BY LINE PERSONNEL DURING CONSTRUCTION AND MAINTENANCE OPERATIONS.
   A. IT IS REQUIRED THAT ALL CONDUCTOR ATTACHMENT SUPPORTS BE DESIGNED TO MEET THIS REQUIREMENT. HOWEVER, AS THE LOADING WILL BE APPLIED TO ONLY ONE PHASE AT ANY GIVEN TIME, THE SHAFT MAY BE DESIGNED FOR ITS APPLICATION AT A SINGLE CONTROLLING PHASE LOCATION TO BE DETERMINED BY THE STEEL MANUFACTURER.

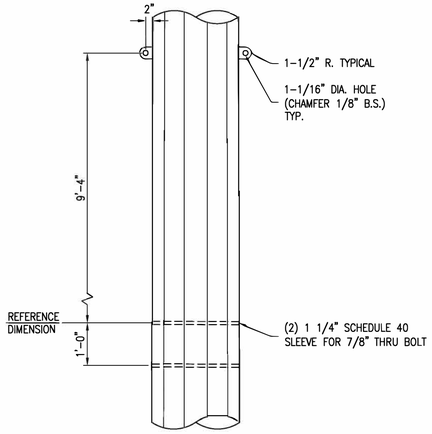
DEFLECTION

SEE TUBULAR STEEL POLE SPECIFICATION FOR DEFLECTION OF THE SHAFT UNDER LOAD CASE V.

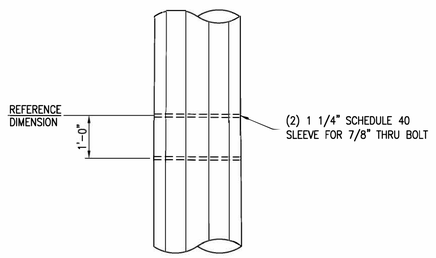
STRUCTURE TABLE		
STR #	HEIGHT	EMBEDMENT DEPTH
7	138'-0"	18'-0"
8	133'-0"	18'-0"
9	133'-0"	18'-0"
10	133'-0"	18'-0"
11	128'-0"	18'-0"
12	128'-0"	18'-0"
13	128'-0"	18'-0"
14	123'-0"	18'-0"



SECTION C
CONDUCTOR ORIENTATION
SCALE: N.T.S.

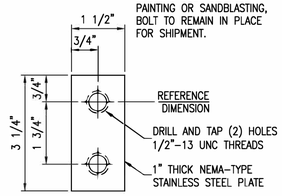


DETAIL 3
BRACED POST ATTACHMENT
SCALE: N.T.S.



DETAIL 4
HORIZONTAL POST ATTACHMENT
SCALE: N.T.S.

NOTE:
PLUG WITH 1/2"ø X 3/4" MACHINE BOLT BEFORE PAINTING OR SANDBLASTING, BOLT TO REMAIN IN PLACE FOR SHIPMENT.



DETAIL 5
GROUNDING PAD
SCALE: N.T.S.

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

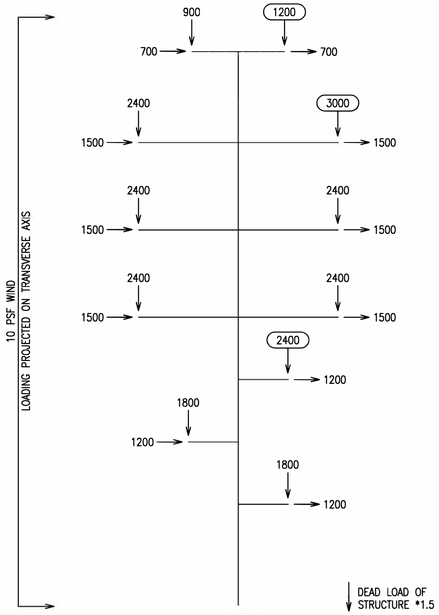
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

LOAD & DESIGN DETAIL
TCBP-230-69UB
STR 7 - STR 14

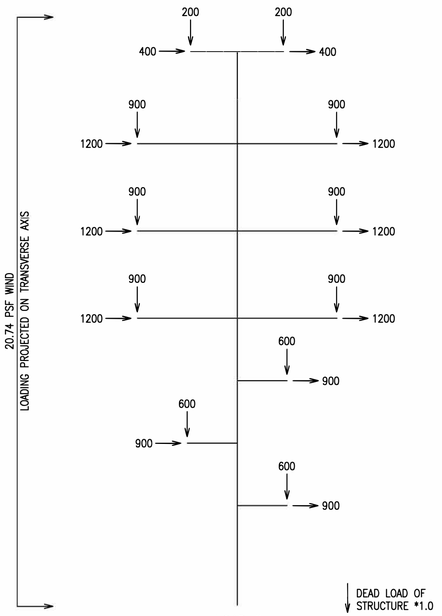
0 1" 2"

FILENAME BHE-LD-02-D-1.DWG
SCALE 3/16"=1'-0"
SHEET LD-02-1



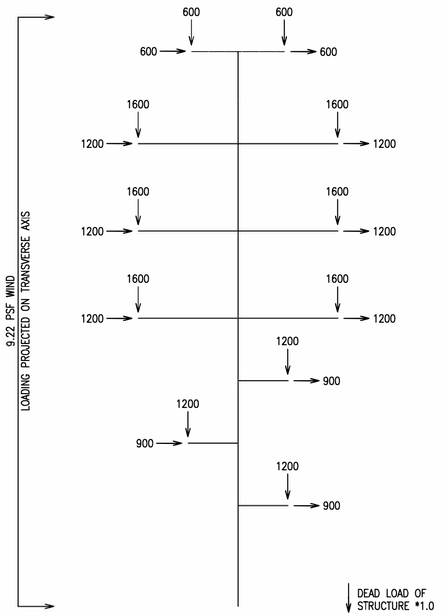
LOAD I

NESC HEAVY LOADING – RULE 250B
ALL WIRES INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 4 PSF WIND @ 0°F



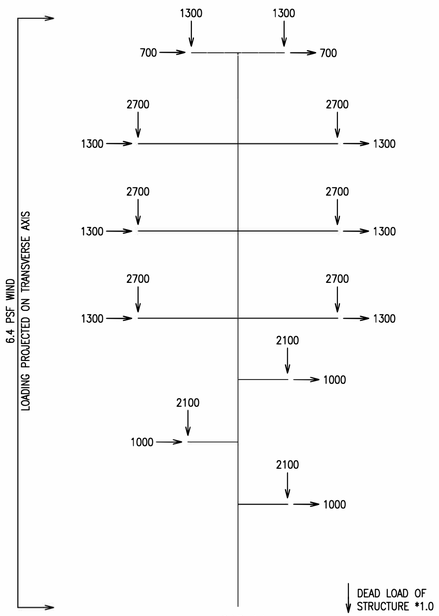
LOAD II

NESC EXTREME HIGH WIND – RULE 250C
ALL WIRES INTACT
NO ICE, 20.74 PSF WIND @ 60°F



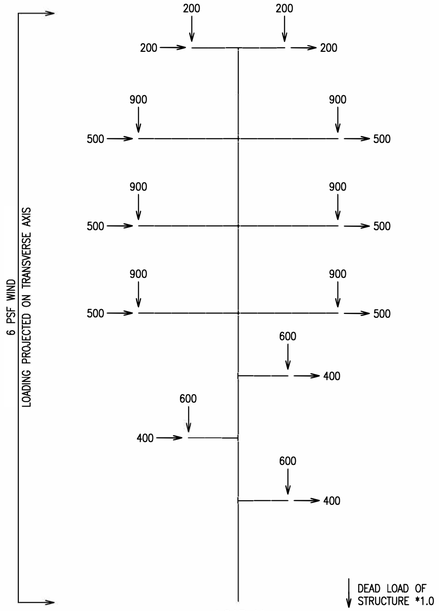
LOAD III

NESC CONCURRENT ICE/WIND – RULE 250D
ALL WIRES INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 9.22 PSF WIND @ 15°F



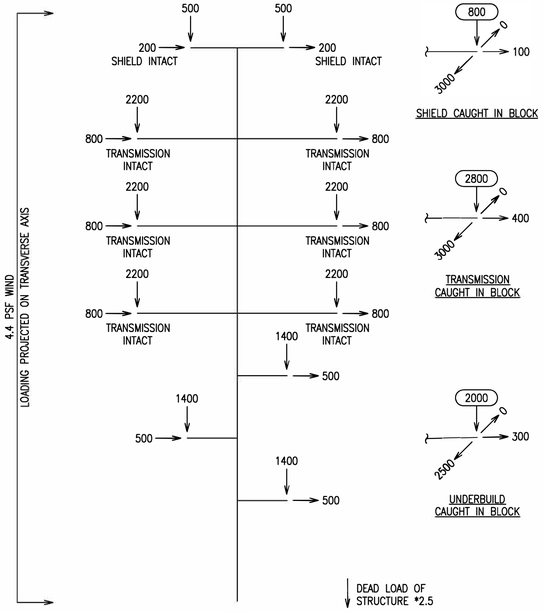
LOAD IV

BHE CONCURRENT ICE/WIND
ALL WIRES INTACT
1.0" RADIAL ICE @ 57 LBS/FT³, 6.4 PSF WIND @ 0°F



LOAD V

DEFLECTION LIMIT
ALL WIRES INTACT
NO ICE, 6 PSF WIND @ 60°F

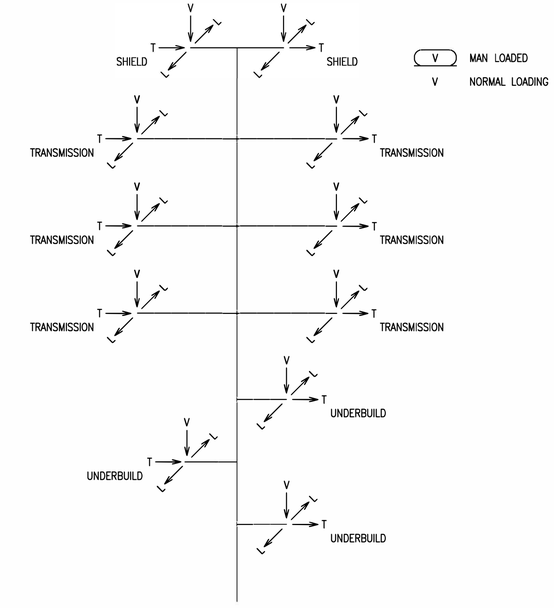


LOAD VI

CONSTRUCTION LOADING
SEE NOTE
NO ICE, 4 PSF WIND @ 20°F

NOTE:

1. SINGLE SHIELDWIRE CAUGHT IN BLOCK, REMAINING SHIELD INTACT, NO LOAD TRANSMISSION AND UNDERBUILD CIRCUITS.
2. SHIELDWIRES INTACT, SINGLE TOP PHASE OF TRANSMISSION CAUGHT IN BLOCK, REMAINING TRANSMISSION LOADS INTACT. NO LOAD UNDERBUILD CIRCUITS.
3. SHIELDWIRES AND TRANSMISSION INTACT, SINGLE TOP PHASE OF UNDERBUILD CAUGHT IN BLOCK. REMAINING UNDERBUILD LOADS INTACT.



TYPICAL

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

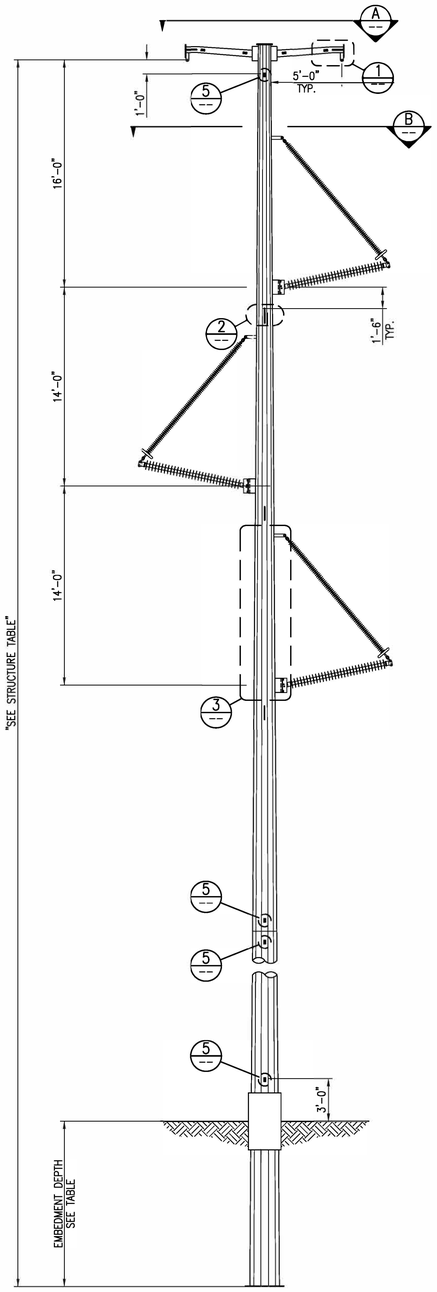
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

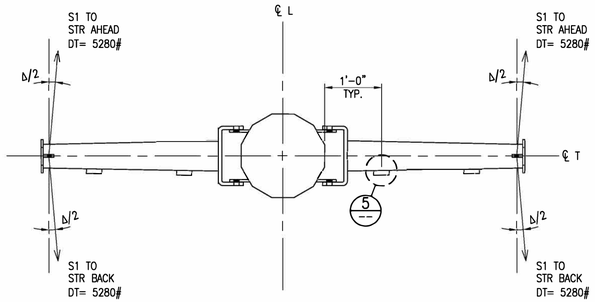
WEST RAPID CITY
230KV TRANSMISSION LINE

LOAD & DESIGN DETAIL
TCBP-230-69UB
STR 7 - STR 14

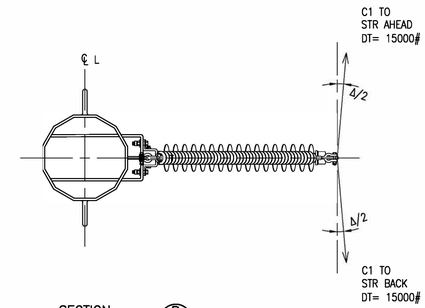
0 1" 2"

FILENAME BHE-LD-02-D-2.DWG
SCALE 3/16"=1'-0"
SHEET LD-02-2

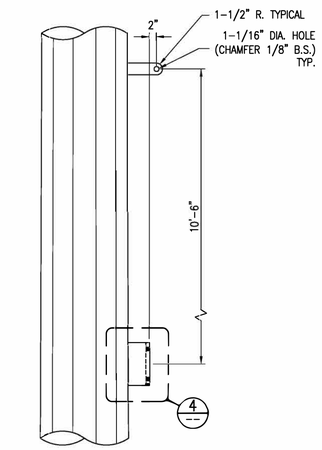




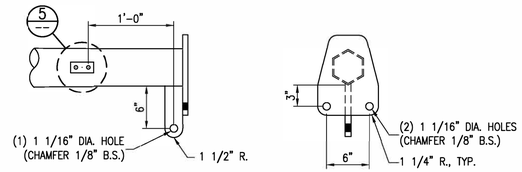
VIEW
SHIELD ORIENTATION
SCALE: N.T.S.
A



SECTION
CONDUCTOR ORIENTATION
SCALE: N.T.S.
B



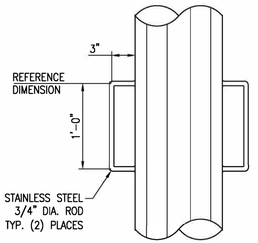
DETAIL
BRACED POST ATTACHMENT
SCALE: N.T.S.
3



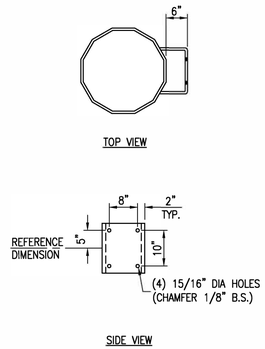
FRONT VIEW

SIDE VIEW

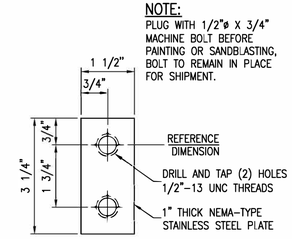
DETAIL
SHIELD WIRE VANGS
SCALE: N.T.S.
1



DETAIL
GROUNDING LOOP
SCALE: N.T.S.
2



DETAIL
HORIZONTAL POST ATTACHMENT
SCALE: N.T.S.
4



DETAIL
GROUNDING PAD
SCALE: N.T.S.
5

GENERAL NOTES

MAXIMUM SHIELD WIRE VANG THICKNESS = 3/4"
MAXIMUM CONDUCTOR VANG THICKNESS = 1"
LOAD TREE VALUES ARE ULTIMATE, INCLUDE OVERLOAD FACTORS, AND ARE SHOWN IN POUNDS.

DESIGN CRITERIA

(S1) SHIELD WIRE IS AFL CC-55/443 "DNO-4748" OPGW, MAXIMUM TENSION AT NESC HEAVY LOADING: 5280# R.S.= 1000'
(C1) CONDUCTOR IS 1272 KCMIL 45/7 ACSR "BITTERN" MAXIMUM TENSION AT NESC HEAVY LOADING: 15000# R.S.= 1000'

WIND SPAN: 1000'
WEIGHT SPAN: 1500' AT NESC HEAVY LOADING
HEIGHT OF STR.: SEE TABLE
DESIGN MAXIMUM ANGLE (A): 2°00'00"

SPECIFICATIONS

1. POLES TO BE DESIGNED PER SECTION 33 71 16.23 TUBULAR STEEL POLES SPECIFICATIONS.
2. ALL STEEL TO BE WEATHERING STEEL.
3. POLES TO HAVE EITHER SLIP JOINTS OR BOLTED FLANGE TYPE SPLICES, WHICHEVER IS MORE COST EFFECTIVE.
   A. IF SLIP JOINTS ARE USED, INSTALL GROUND PADS (DETAIL 5) ABOVE AND BELOW THE SLIP JOINT.
4. THE CIRCLED LOADINGS SHOWN IN LOAD TREES CONVEY THE ADDITIONAL VERTICAL LOAD THAT WILL BE APPLIED TO THE STRUCTURE BY LINE PERSONNEL DURING CONSTRUCTION AND MAINTENANCE OPERATIONS.

A. IT IS REQUIRED THAT ALL CONDUCTOR ATTACHMENT SUPPORTS BE DESIGNED TO MEET THIS REQUIREMENT. HOWEVER, AS THE LOADING WILL BE APPLIED TO ONLY ONE PHASE AT ANY GIVEN TIME, THE SHAFT MAY BE DESIGNED FOR ITS APPLICATION AT A SINGLE CONTROLLING PHASE LOCATION TO BE DETERMINED BY THE STEEL MANUFACTURER.

DEFLECTION

SEE TUBULAR STEEL POLE SPECIFICATION FOR DEFLECTION OF THE SHAFT UNDER LOAD CASE V.

STRUCTURE TABLE		
STR #	HEIGHT	EMBEDMENT DEPTH
L-SRC-20	131'-0"	18'-0"

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

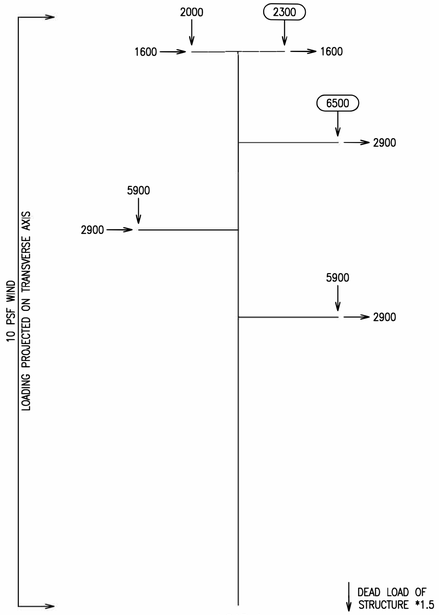
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

LOAD & DESIGN DETAIL
SCBP-230-2S
STR L-SRC-20

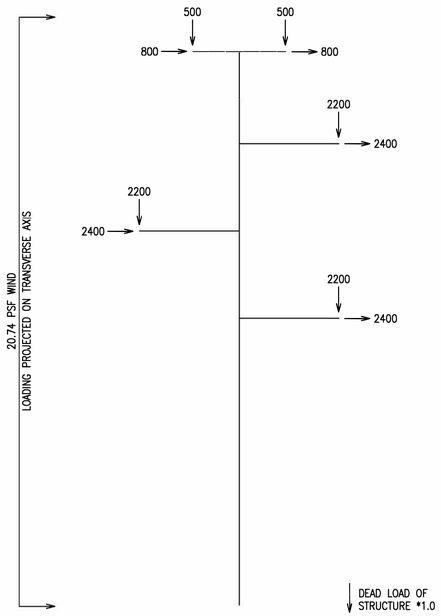
0 1" 2"

FILENAME BHE-LD-03-D-1.DWG
SCALE 3/16"=1'-0"
SHEET **LD-03-1**



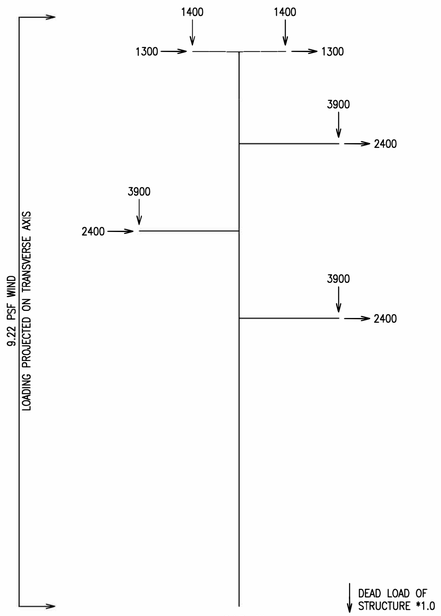
LOAD I

NESC HEAVY LOADING – RULE 250B
ALL WIRES INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 4 PSF WIND @ 0°F



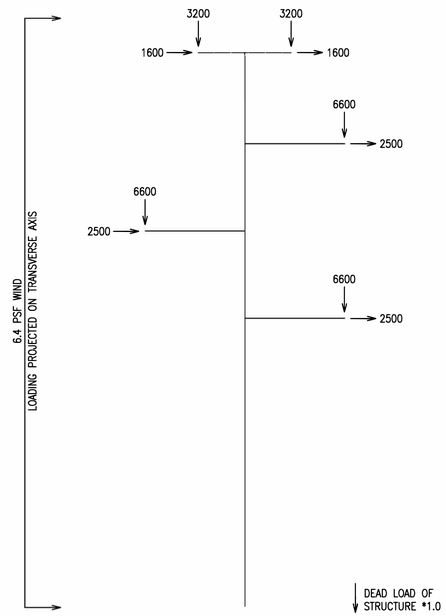
LOAD II

NESC EXTREME HIGH WIND – RULE 250C
ALL WIRES INTACT
NO ICE, 20.74 PSF WIND @ 60°F



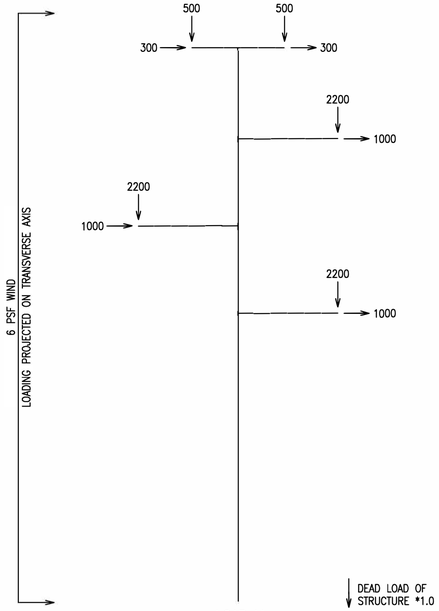
LOAD III

NESC CONCURRENT ICE/WIND – RULE 250D
ALL WIRES INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 9.22 PSF WIND @ 15°F



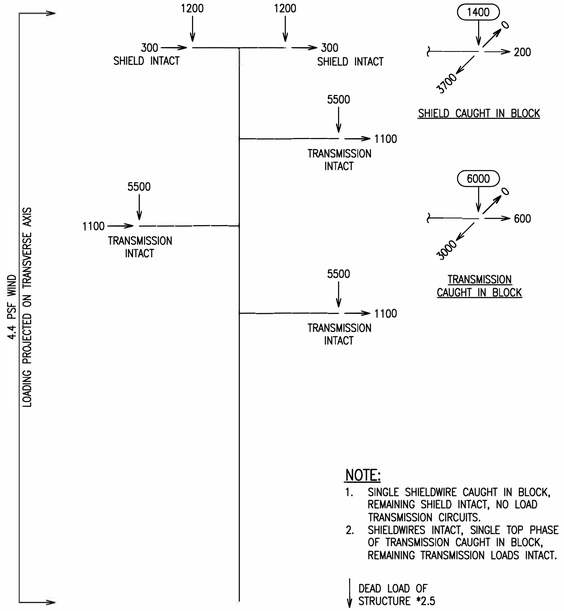
LOAD IV

BHE CONCURRENT ICE/WIND
ALL WIRES INTACT
1.0" RADIAL ICE @ 57 LBS/FT³, 6.4 PSF WIND @ 0°F



LOAD V

DEFLECTION LIMIT
ALL WIRES INTACT
NO ICE, 6 PSF WIND @ 60°F

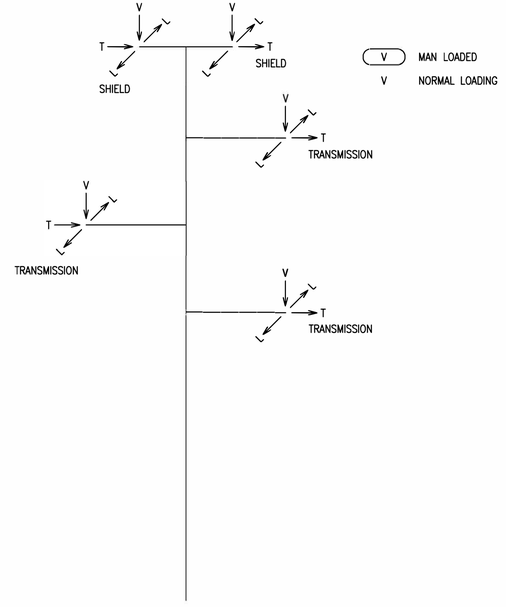


NOTE:

1. SINGLE SHIELDWIRE CAUGHT IN BLOCK, REMAINING SHIELD INTACT, NO LOAD TRANSMISSION CIRCUITS.
2. SHIELDWIRES INTACT, SINGLE TOP PHASE OF TRANSMISSION CAUGHT IN BLOCK, REMAINING TRANSMISSION LOADS INTACT.

LOAD VI

CONSTRUCTION LOADING
SEE NOTE
NO ICE, 4 PSF WIND @ 20°F



TYPICAL

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

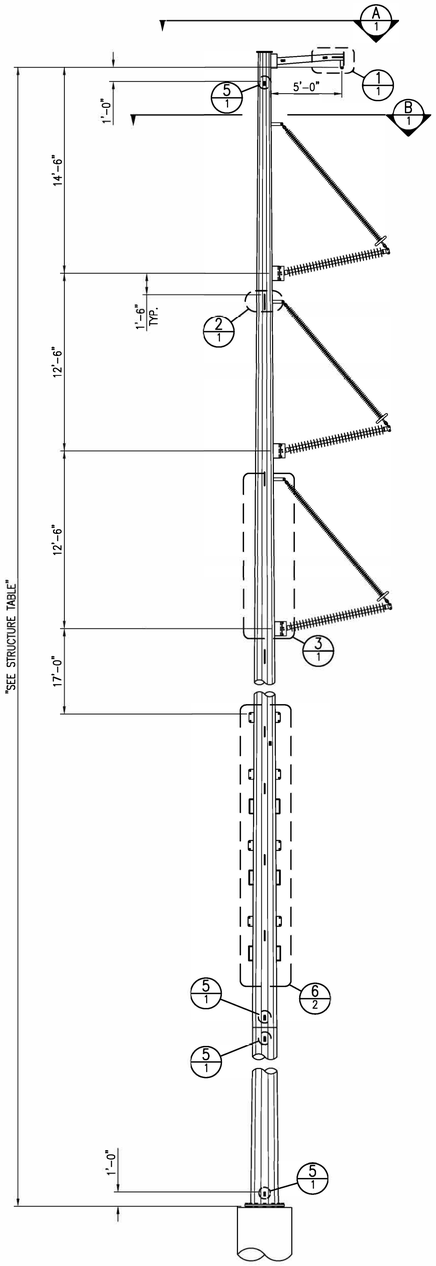
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

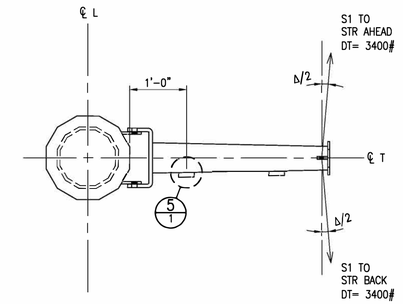
WEST RAPID CITY
230KV TRANSMISSION LINE

LOAD & DESIGN DETAIL
SCBP-230-2S
STR L-SRC-20

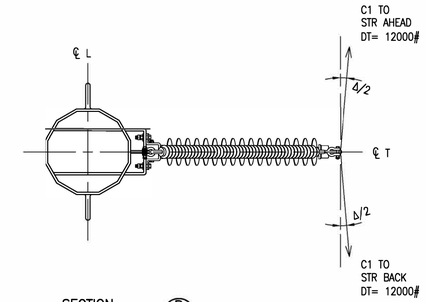
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FILENAME: BHE-LD-03-D-2.DWG
SCALE: 3/16"=1'-0"
SHEET: LD-03-2

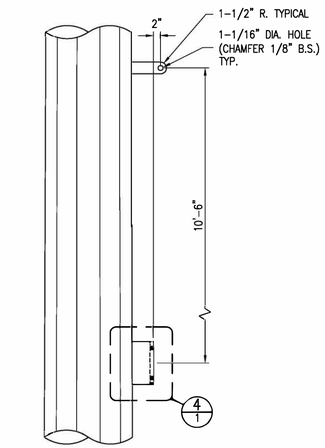




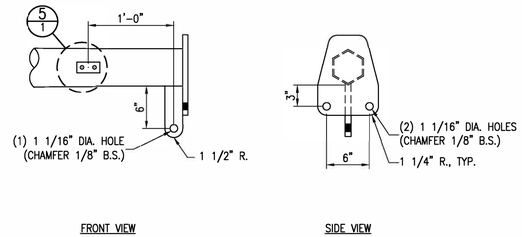
VIEW
SHIELD ORIENTATION
SCALE: N.T.S.
A 1



SECTION
CONDUCTOR ORIENTATION
SCALE: N.T.S.
B 1



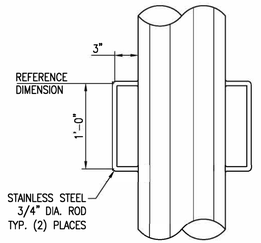
DETAIL
BRACED POST ATTACHMENT
SCALE: N.T.S.
3 1



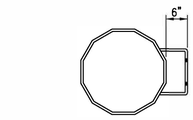
FRONT VIEW

SIDE VIEW

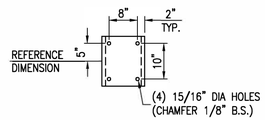
DETAIL
SHIELD WIRE VANG
SCALE: N.T.S.
1 1



DETAIL
GROUNDING LOOP
SCALE: N.T.S.
2 1



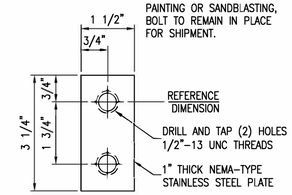
TOP VIEW



SIDE VIEW

DETAIL
HORIZONTAL POST ATTACHMENT
SCALE: N.T.S.
4 1

NOTE:
PLUG WITH 1/2"ø X 3/4" MACHINE BOLT BEFORE PAINTING OR SANDBLASTING, BOLT TO REMAIN IN PLACE FOR SHIPMENT.



DETAIL
GROUNDING PAD
SCALE: N.T.S.
5 1

GENERAL NOTES

MAXIMUM SHIELD WIRE VANG THICKNESS = 3/4"
MAXIMUM CONDUCTOR VANG THICKNESS = 1"
LOAD TREE VALUES ARE ULTIMATE, INCLUDE OVERLOAD FACTORS, AND ARE SHOWN IN POUNDS.

DESIGN CRITERIA

(S1) 230KV SHIELD WIRE IS AFL CC-55/443 "DNO-4748" OPGW, MAXIMUM TENSION AT NESC HEAVY LOADING: 3400# R.S.= 400'
(C1) 230KV CONDUCTOR IS 1272 KCMIL 45/7 ACSR "BITTERN" MAXIMUM TENSION AT NESC HEAVY LOADING: 12000# R.S.= 400'
(S2) 69KV SHIELD WIRE IS AFL CC-55/443 "DNO-4748" OPGW, MAXIMUM TENSION AT NESC HEAVY LOADING: 1500# R.S.= 200'
(S3) 69KV SHIELD WIRE IS AFL CC-55/443 "DNO-4748" OPGW, MAXIMUM TENSION AT NESC HEAVY LOADING: 3285# R.S.= 400'
(D1) 69KV CONDUCTOR IS 795 KCMIL 45/7 ACSR "TERN", MAXIMUM TENSION AT NESC HEAVY LOADING: 2000#, R.S.= 200'
(D2) 69KV CONDUCTOR IS 795 KCMIL 45/7 ACSR "TERN", MAXIMUM TENSION AT NESC HEAVY LOADING: 7565#, R.S.= 400'

230KV
WIND SPAN: 400'
WEIGHT SPAN: 1200' AT NESC HEAVY LOADING
69KV
WIND SPAN TO STR 2A-1: 200'
WIND SPAN TO SUB DE: 100'
WEIGHT SPAN TO STR 2A-1: 300' AT NESC HEAVY LOADING
WEIGHT SPAN TO SUB DE: 200' AT NESC HEAVY LOADING

HEIGHT OF STR.: SEE TABLE
DESIGN MAXIMUM ANGLE (Δ): 6°00'00"

SPECIFICATIONS

1. POLES TO BE DESIGNED PER SECTION 33 71 16.23 TUBULAR STEEL POLES SPECIFICATIONS.
2. ALL STEEL TO BE WEATHERING STEEL.
3. POLES TO HAVE EITHER SLIP JOINTS OR BOLTED FLANGE TYPE SPLICES, WHICHEVER IS MORE COST EFFECTIVE.
   A. IF SLIP JOINTS ARE USED, INSTALL GROUND PADS (DETAIL 5) ABOVE AND BELOW THE SLIP JOINT.
4. STRUCTURES SHALL BE DESIGNED ASSUMING DRILLED PIER TYPE FOUNDATION.
5. THE CIRCLED LOADINGS SHOWN IN LOAD TREES CONVEY THE ADDITIONAL VERTICAL LOAD THAT WILL BE APPLIED TO THE STRUCTURE BY LINE PERSONNEL DURING CONSTRUCTION AND MAINTENANCE OPERATIONS.
   A. IT IS REQUIRED THAT ALL CONDUCTOR ATTACHMENT SUPPORTS BE DESIGNED TO MEET THIS REQUIREMENT. HOWEVER, AS THE LOADING WILL BE APPLIED TO ONLY ONE PHASE AT ANY GIVEN TIME, THE SHAFT MAY BE DESIGNED FOR ITS APPLICATION AT A SINGLE CONTROLLING PHASE LOCATION TO BE DETERMINED BY THE STEEL MANUFACTURER.

DEFLECTION

SEE TUBULAR STEEL POLE SPECIFICATION FOR DEFLECTION OF THE SHAFT UNDER LOAD CASE V.

STRUCTURE TABLE	
STR #	HEIGHT
2A	130'-0"

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

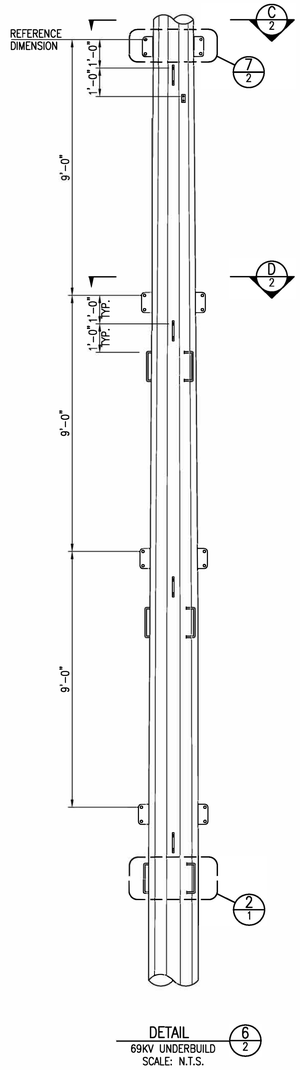
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

LOAD & DESIGN DETAIL
DCBPRA-230-M1
STR 2A

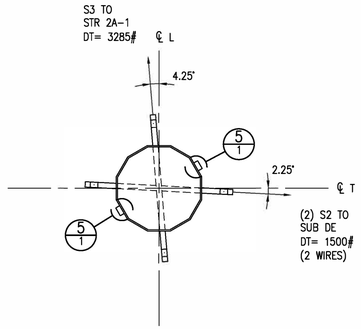
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SCALE 3/16"=1'-0"
SHEET LD-04-1



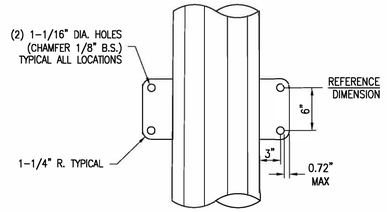
DETAIL
69KV UNDERBUILD
SCALE: N.T.S.

6
2



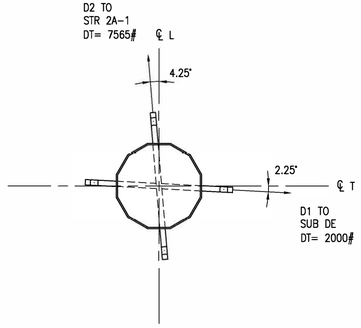
SECTION
69KV SHIELD ORIENTATION
SCALE: N.T.S.

C
2



DETAIL
69KV SHIELD & CONDUCTOR
VANGS
SCALE: N.T.S.

7
2



SECTION
69KV CONDUCTOR ORIENTATION
SCALE: N.T.S.

D
2

			PROJECT MANAGER J. ELLSWORTH
			PROJECT ENGINEER J. PANKRATZ
			DESIGN ENGINEER J. PANKRATZ
			CAD TECHNICIAN Z. JANSEN
2	6/12/2020	RECORD DRAWINGS	
0	9/11/2019	ISSUED FOR CONSTRUCTION	E. O. R. J. BRUNNER
ISSUE	DATE	DESCRIPTION	PROJECT NUMBER 10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

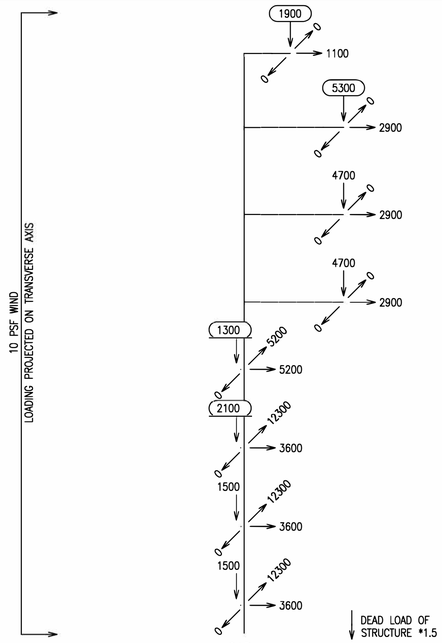
WEST RAPID CITY
230KV TRANSMISSION LINE

LOAD & DESIGN DETAIL
DCBPRA-230-M1
STR 2A

0 1" 2"

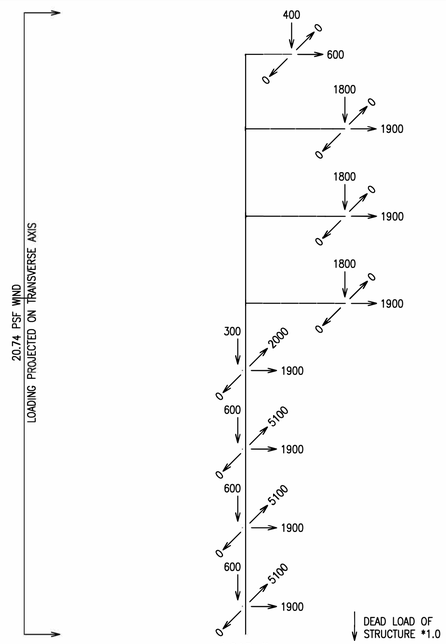
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SCALE 3/16"=1'-0"

SHEET
LD-04-2



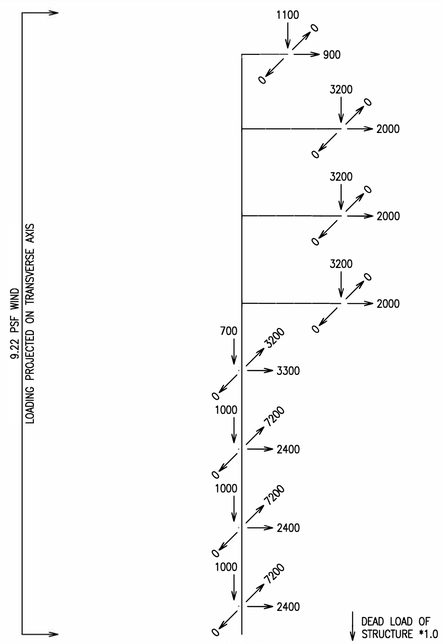
LOAD I

NESC HEAVY LOADING – RULE 250B
ALL WIRES INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 4 PSF WIND @ 0°F



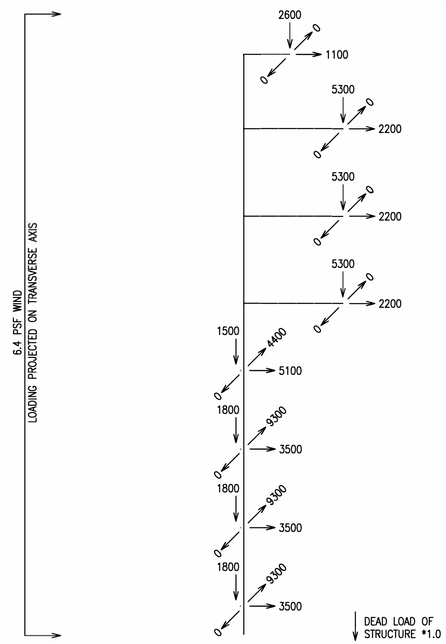
LOAD II

NESC EXTREME HIGH WIND – RULE 250C
ALL WIRES INTACT
NO ICE, 20.74 PSF WIND @ 60°F



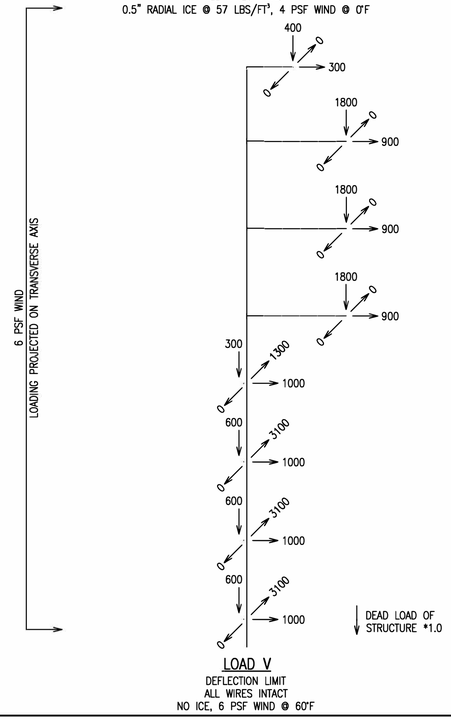
LOAD III

NESC CONCURRENT ICE/WIND – RULE 250D
ALL WIRES INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 9.22 PSF WIND @ 15°F



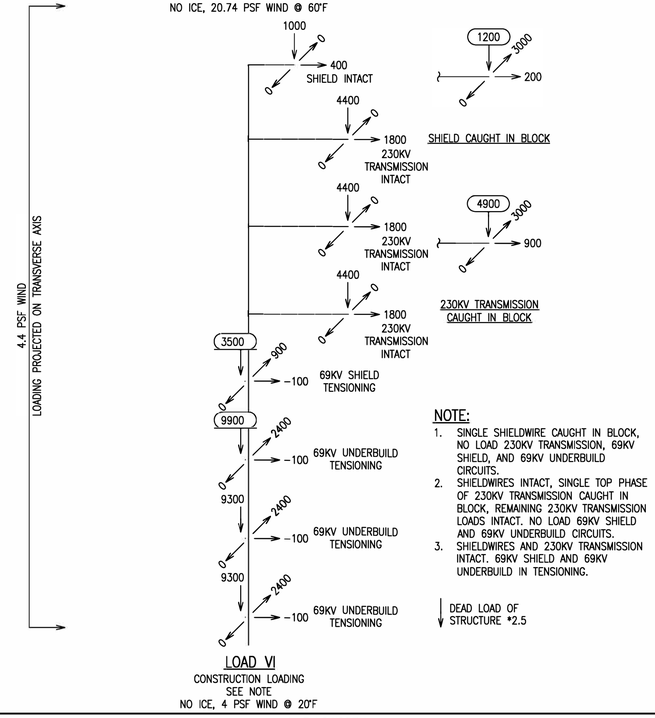
LOAD IV

BHE CONCURRENT ICE/WIND
ALL WIRES INTACT
1.0" RADIAL ICE @ 57 LBS/FT³, 6.4 PSF WIND @ 0°F



LOAD V

DEFLECTION LIMIT
ALL WIRES INTACT
NO ICE, 6 PSF WIND @ 60°F

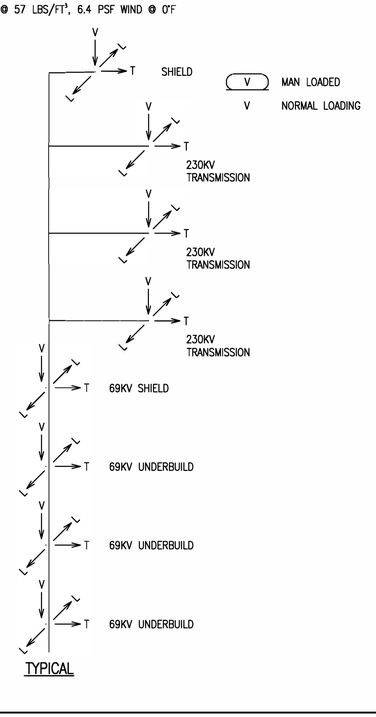


LOAD VI

CONSTRUCTION LOADING
SEE NOTE
NO ICE, 4 PSF WIND @ 20°F

NOTE:

1. SINGLE SHIELDWIRE CAUGHT IN BLOCK, NO LOAD 230KV TRANSMISSION, 69KV SHIELD, AND 69KV UNDERBUILD CIRCUITS.
2. SHIELDWIRES INTACT, SINGLE TOP PHASE OF 230KV TRANSMISSION CAUGHT IN BLOCK, REMAINING 230KV TRANSMISSION LOADS INTACT. NO LOAD 69KV SHIELD AND 69KV UNDERBUILD CIRCUITS.
3. SHIELDWIRES AND 230KV TRANSMISSION INTACT. 69KV SHIELD AND 69KV UNDERBUILD IN TENSIONING.



TYPICAL

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

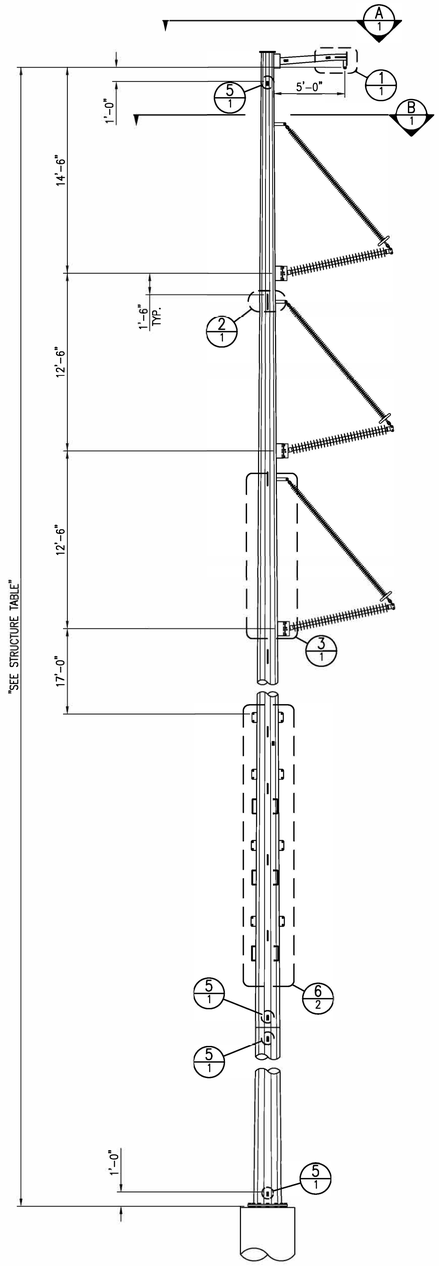
WEST RAPID CITY
230KV TRANSMISSION LINE

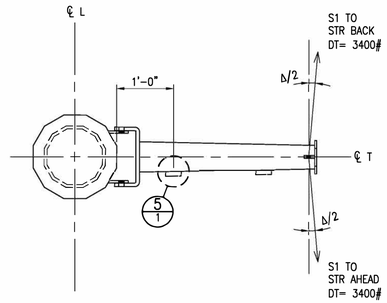
LOAD & DESIGN DETAIL
DCBPRA-230-M1
STR 2A

0 1" 2"

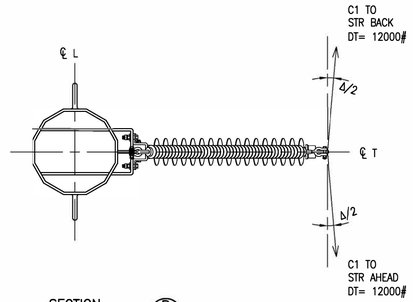
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SCALE 3/16"=1'-0"

SHEET **LD-04-3**

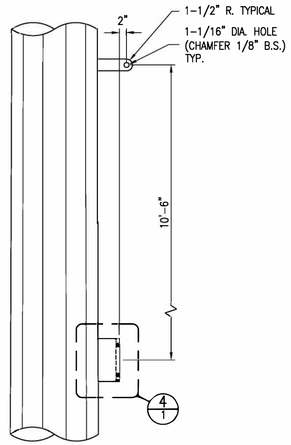




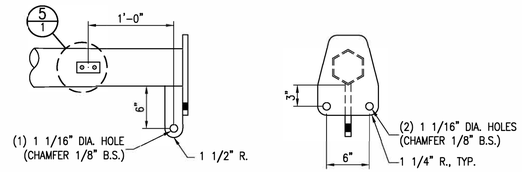
VIEW
SHIELD ORIENTATION
SCALE: N.T.S.
A
1



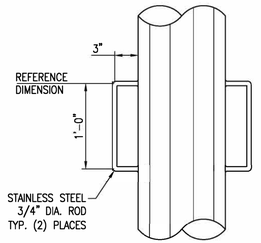
SECTION
CONDUCTOR ORIENTATION
SCALE: N.T.S.
B
1



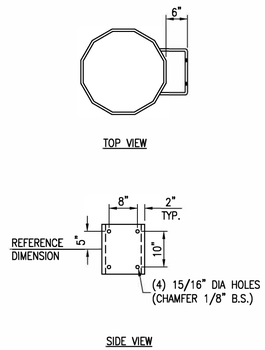
DETAIL
BRACED POST ATTACHMENT
SCALE: N.T.S.
3
1



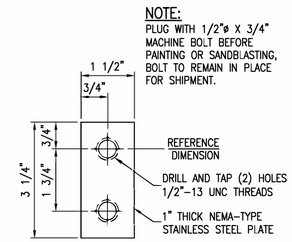
DETAIL
SHIELD WIRE VANG
SCALE: N.T.S.
1
1



DETAIL
GROUNDING LOOP
SCALE: N.T.S.
2
1



DETAIL
HORIZONTAL POST ATTACHMENT
SCALE: N.T.S.
4
1



DETAIL
GROUNDING PAD
SCALE: N.T.S.
5
1

GENERAL NOTES

MAXIMUM SHIELD WIRE VANG THICKNESS = 3/4"
MAXIMUM CONDUCTOR VANG THICKNESS = 1"
LOAD TREE VALUES ARE ULTIMATE, INCLUDE OVERLOAD FACTORS, AND ARE SHOWN IN POUNDS.

DESIGN CRITERIA

(S1) 230KV SHIELD WIRE IS AFL CC-55/443 "DNO-4748" OPGW, MAXIMUM TENSION AT NESC HEAVY LOADING: 3400# R.S.= 400'
(C1) 230KV CONDUCTOR IS 1272 KCMIL 45/7 ACSR "BITTERN" MAXIMUM TENSION AT NESC HEAVY LOADING: 12000# R.S.= 400'
(S2) 69KV SHIELD WIRE IS AFL CC-55/443 "DNO-4748" OPGW, MAXIMUM TENSION AT NESC HEAVY LOADING: 1500# R.S.= 200'
(S3) 69KV SHIELD WIRE IS AFL CC-55/443 "DNO-4748" OPGW, MAXIMUM TENSION AT NESC HEAVY LOADING: 3285# R.S.= 400'
(D1) 69KV CONDUCTOR IS 795 KCMIL 45/7 ACSR "TERN", MAXIMUM TENSION AT NESC HEAVY LOADING: 2000#, R.S.= 200'
(D2) 69KV CONDUCTOR IS 795 KCMIL 45/7 ACSR "TERN", MAXIMUM TENSION AT NESC HEAVY LOADING: 7565#, R.S.= 400'

230KV
WIND SPAN: 400'
WEIGHT SPAN: 1200' AT NESC HEAVY LOADING
69KV
WIND SPAN TO STR 2B-1: 200'
WIND SPAN TO SUB DE: 100'
WEIGHT SPAN TO STR 2B-1: 300' AT NESC HEAVY LOADING
WEIGHT SPAN TO SUB DE: 200' AT NESC HEAVY LOADING

HEIGHT OF STR.: SEE TABLE
DESIGN MAXIMUM ANGLE (Δ): 4°00'00"

SPECIFICATIONS

1. POLES TO BE DESIGNED PER SECTION 33 71 16.23 TUBULAR STEEL POLES SPECIFICATIONS.
2. ALL STEEL TO BE WEATHERING STEEL.
3. POLES TO HAVE EITHER SLIP JOINTS OR BOLTED FLANGE TYPE SPLICES, WHICHEVER IS MORE COST EFFECTIVE.
   A. IF SLIP JOINTS ARE USED, INSTALL GROUND PADS (DETAIL 5) ABOVE AND BELOW THE SLIP JOINT.
4. STRUCTURES SHALL BE DESIGNED ASSUMING DRILLED PIER TYPE FOUNDATION.
5. THE CIRCLED LOADINGS SHOWN IN LOAD TREES CONVEY THE ADDITIONAL VERTICAL LOAD THAT WILL BE APPLIED TO THE STRUCTURE BY LINE PERSONNEL DURING CONSTRUCTION AND MAINTENANCE OPERATIONS.
   A. IT IS REQUIRED THAT ALL CONDUCTOR ATTACHMENT SUPPORTS BE DESIGNED TO MEET THIS REQUIREMENT. HOWEVER, AS THE LOADING WILL BE APPLIED TO ONLY ONE PHASE AT ANY GIVEN TIME, THE SHAFT MAY BE DESIGNED FOR ITS APPLICATION AT A SINGLE CONTROLLING PHASE LOCATION TO BE DETERMINED BY THE STEEL MANUFACTURER.

DEFLECTION

SEE TUBULAR STEEL POLE SPECIFICATION FOR DEFLECTION OF THE SHAFT UNDER LOAD CASE V.

STRUCTURE TABLE	
STR #	HEIGHT
2B	130'-0"

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

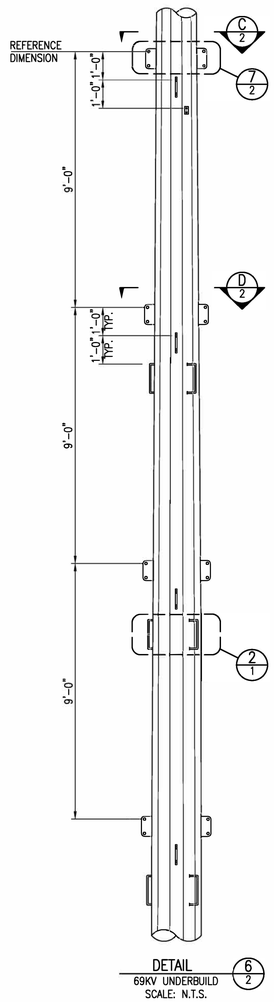
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

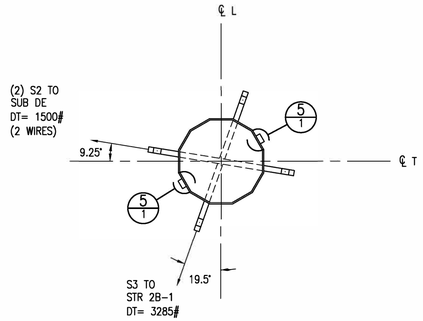
LOAD & DESIGN DETAIL
DCBPRA-230-M1
STR 2B

0 1" 2"

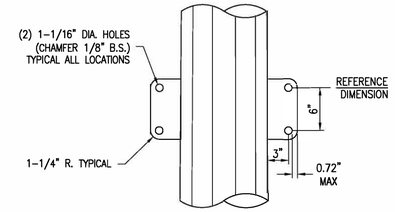
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SCALE 3/16"=1'-0"
SHEET LD-05-1



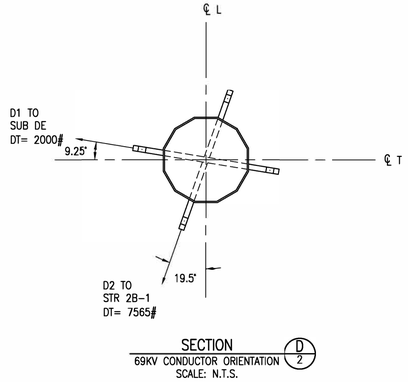
DETAIL
69KV UNDERBUILD 6/2
SCALE: N.T.S.



SECTION
69KV SHIELD ORIENTATION C/2
SCALE: N.T.S.



DETAIL
69KV SHIELD & CONDUCTOR VANGS 7/2
SCALE: N.T.S.



SECTION
69KV CONDUCTOR ORIENTATION D/2
SCALE: N.T.S.

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

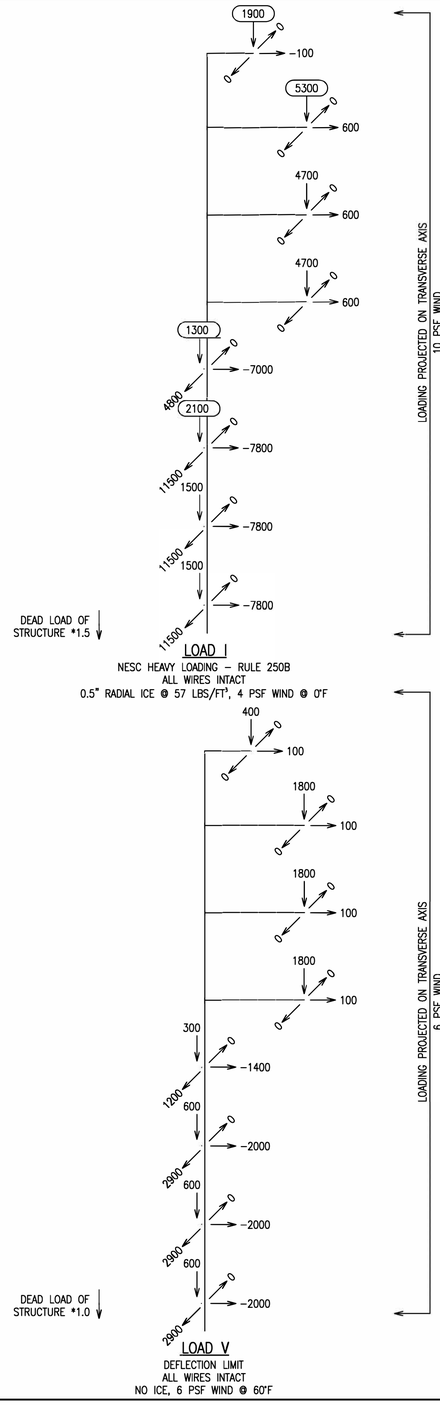
WEST RAPID CITY
230KV TRANSMISSION LINE

LOAD & DESIGN DETAIL
DCBPRA-230-M1
STR 2B

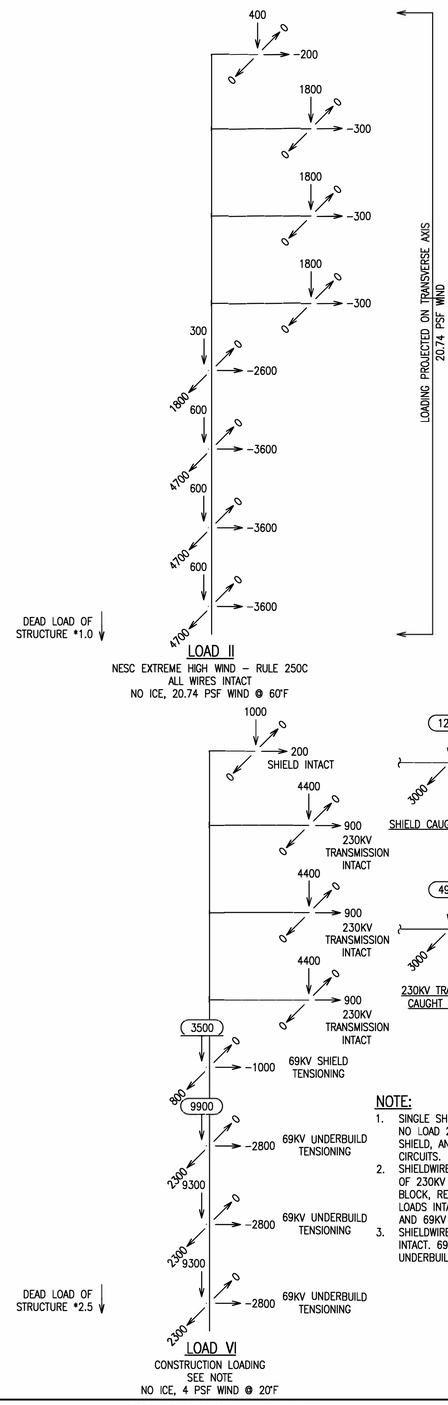
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SCALE 3/16"=1'-0"

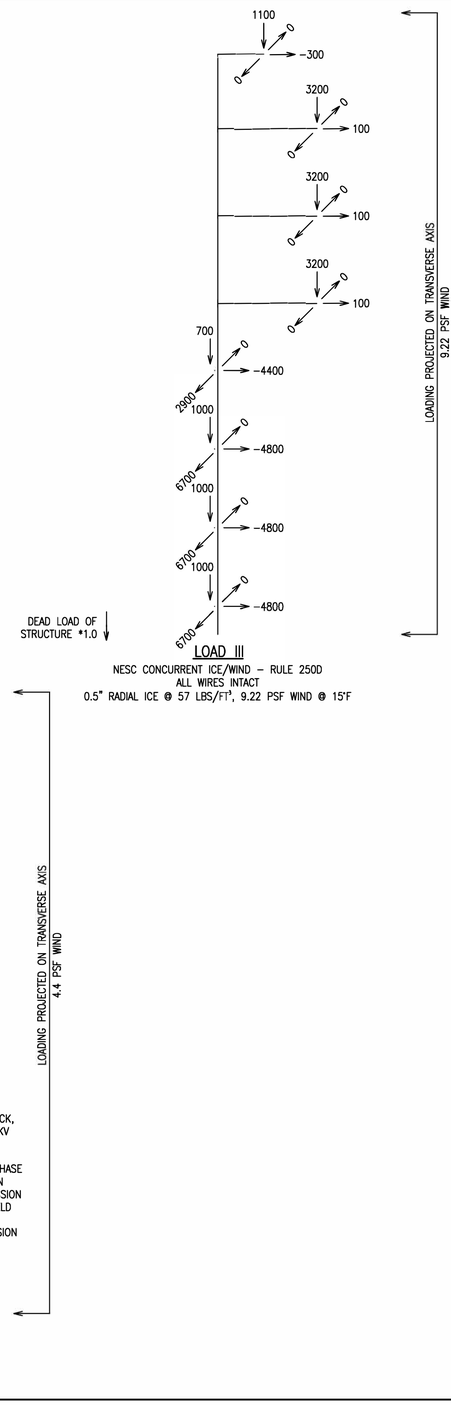
SHEET **LD-05-2**



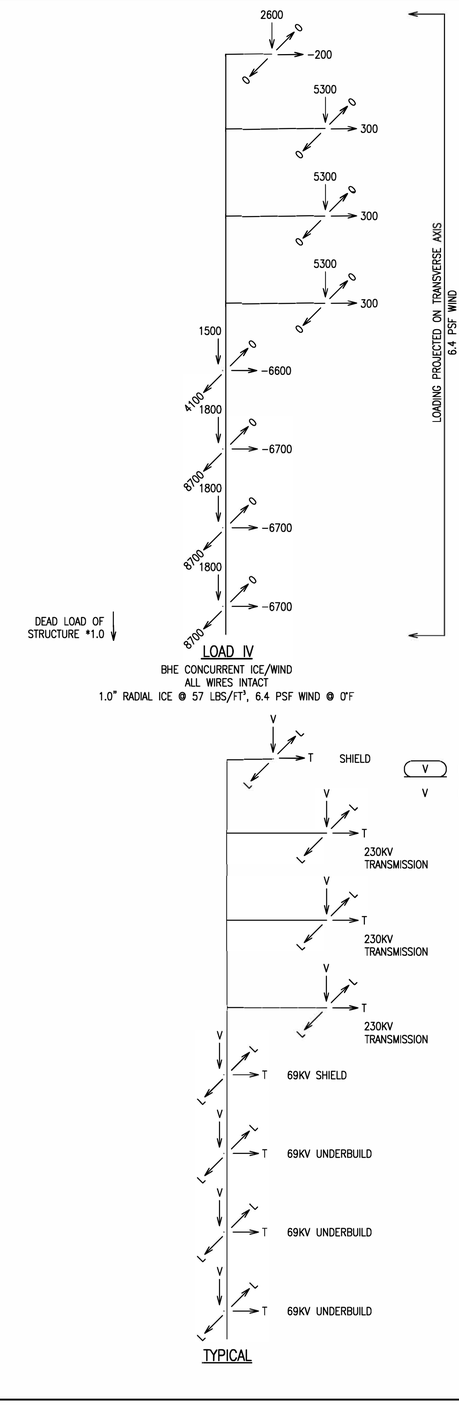
LOAD I
NESC HEAVY LOADING – RULE 250B
ALL WIRES INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 4 PSF WIND @ 0°F



LOAD II
NESC EXTREME HIGH WIND – RULE 250C
ALL WIRES INTACT
NO ICE, 20.74 PSF WIND @ 60°F



LOAD III
NESC CONCURRENT ICE/WIND – RULE 250D
ALL WIRES INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 9.22 PSF WIND @ 15°F



LOAD IV
BHE CONCURRENT ICE/WIND
ALL WIRES INTACT
1.0" RADIAL ICE @ 57 LBS/FT³, 6.4 PSF WIND @ 0°F

LOAD V
DEFLECTION LIMIT
ALL WIRES INTACT
NO ICE, 6 PSF WIND @ 60°F

NOTE:
1. SINGLE SHIELDWIRE CAUGHT IN BLOCK, NO LOAD 230KV TRANSMISSION, 69KV SHIELD, AND 69KV UNDERBUILD CIRCUITS.
2. SHIELDWIRES INTACT, SINGLE TOP PHASE OF 230KV TRANSMISSION CAUGHT IN BLOCK, REMAINING 230KV TRANSMISSION LOADS INTACT. NO LOAD 69KV SHIELD AND 69KV UNDERBUILD CIRCUITS.
3. SHIELDWIRES AND 230KV TRANSMISSION INTACT. 69KV SHIELD AND 69KV UNDERBUILD IN TENSIONING.

LOAD VI
CONSTRUCTION LOADING
SEE NOTE
NO ICE, 4 PSF WIND @ 20°F

TYPICAL

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

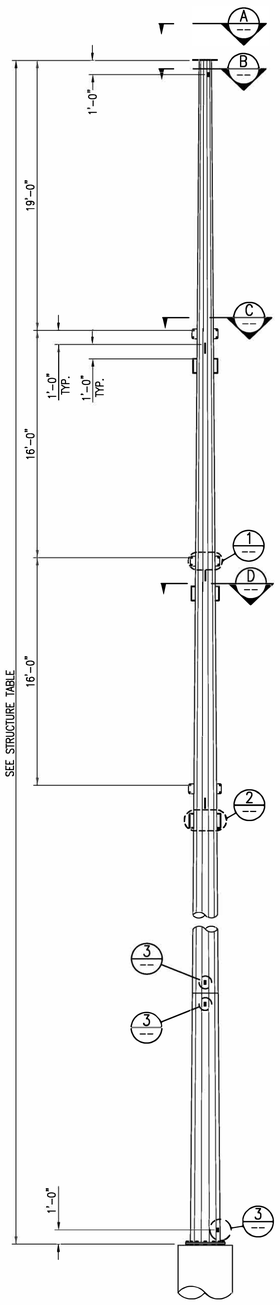
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

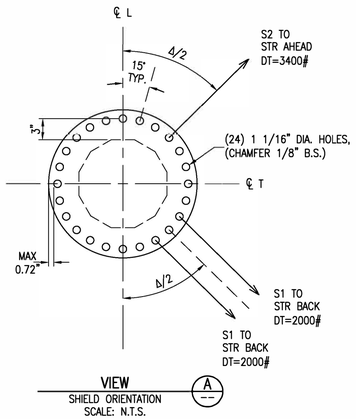
LOAD & DESIGN DETAIL
DCBPRA-230-M1
STR 2B

0 1" 2"

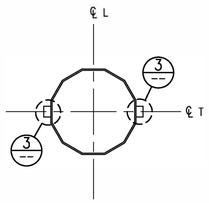
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SCALE 3/16"=1'-0"
SHEET **LD-05-3**



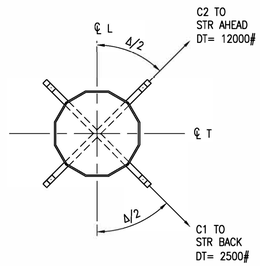
ELEVATION VIEW



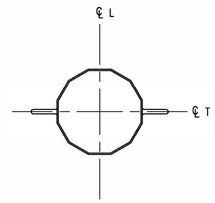
VIEW A — SHIELD ORIENTATION
SCALE: N.T.S.



SECTION B — SHIELD NEMA PAD ORIENTATION
SCALE: N.T.S.



SECTION C — CONDUCTOR ORIENTATION
SCALE: N.T.S.



SECTION D — GROUND LOOP ORIENTATION
SCALE: N.T.S.

DETAIL 1 — CONDUCTOR VANGS
SCALE: N.T.S.

DETAIL 2 — GROUNDING LOOP
SCALE: N.T.S.

NOTE:
PLUG WITH 1/2"ø X 3/4" MACHINE BOLT BEFORE PAINTING OR SANDBLASTING, BOLT TO REMAIN IN PLACE FOR SHIPMENT.

DETAIL 3 — GROUNDING PAD
SCALE: N.T.S.

GENERAL NOTES

MAXIMUM SHIELD WIRE VANG THICKNESS = 3/4"
MAXIMUM CONDUCTOR VANG THICKNESS = 1"
LOAD TREE VALUES ARE ULTIMATE, INCLUDE OVERLOAD FACTORS, AND ARE SHOWN IN POUNDS.

DESIGN CRITERIA

(S1) SHIELD WIRE IS AFL CC-55/443, MAXIMUM TENSION AT NESC HEAVY LOADING: 2000# R.S.= 200'
(S2) SHIELD WIRE IS AFL CC-55/443 "DNO-4748" OPGW, MAXIMUM TENSION AT NESC HEAVY LOADING: 3400# R.S.= 400'
(C1) CONDUCTOR IS 1272 KCMIL 45/7 ACSR "BITTERN" MAXIMUM TENSION AT NESC HEAVY LOADING: 2500# R.S.= 200'
(C2) CONDUCTOR IS 1272 KCMIL 45/7 ACSR "BITTERN" MAXIMUM TENSION AT NESC HEAVY LOADING: 12000# R.S.= 400'

WIND SPAN: 300'
WEIGHT SPAN: 600' AT NESC HEAVY LOADING
HEIGHT OF STR.: SEE STRUCTURE TABLE
ACTUAL ANGLE (Δ): 82°30'00"
DESIGN MAXIMUM ANGLE: 90°00'00"

SPECIFICATIONS

1. POLES TO BE DESIGNED PER SECTION 33 71 16.23 TUBULAR STEEL POLE SPECIFICATIONS.
2. ALL STEEL TO BE WEATHERING STEEL.
3. POLES TO HAVE EITHER SLIP JOINTS OR BOLTED FLANGE TYPE SPLICES, WHICHEVER IS MORE COST EFFECTIVE.
   A. IF SLIP JOINTS ARE USED, INSTALL GROUND PADS (DETAIL 3) ABOVE AND BELOW THE SLIP JOINT.
4. STRUCTURE SHALL BE DESIGNED ASSUMING DRILLED PIER TYPE FOUNDATION.
5. THE CIRCLED LOADINGS SHOWN IN LOAD TREES CONVEY THE ADDITIONAL VERTICAL LOAD THAT WILL BE APPLIED TO THE STRUCTURE BY LINE PERSONNEL DURING CONSTRUCTION AND MAINTENANCE OPERATIONS.
   A. IT IS REQUIRED THAT ALL CONDUCTOR ATTACHMENT SUPPORTS BE DESIGNED TO MEET THIS REQUIREMENT. HOWEVER, AS THE LOADING WILL BE APPLIED TO ONLY ONE PHASE AT ANY GIVEN TIME, THE SHAFT MAY BE DESIGNED FOR ITS APPLICATION AT A SINGLE CONTROLLING PHASE LOCATION TO BE DETERMINED BY THE STEEL MANUFACTURER.

DEFLECTION

SEE TUBULAR STEEL POLE SPECIFICATION FOR DEFLECTION OF THE SHAFT UNDER LOAD CASE V.

STRUCTURE TABLE	
STR #	HEIGHT
1A	105'-0"
1B	105'-0"

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

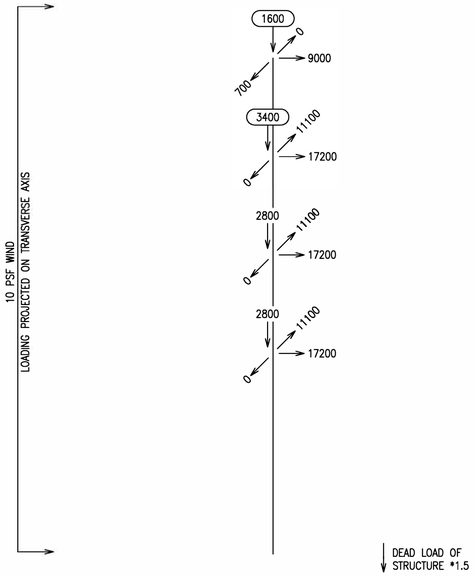
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

LOAD & DESIGN DETAIL
SCDE-230-M1
STR 1A AND STR 1B

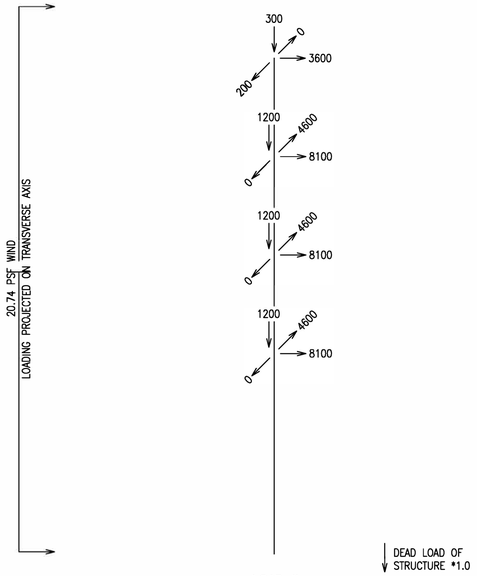
0 1" 2"

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SCALE: 3/16"=1'-0"
SHEET: **LD-06-1**



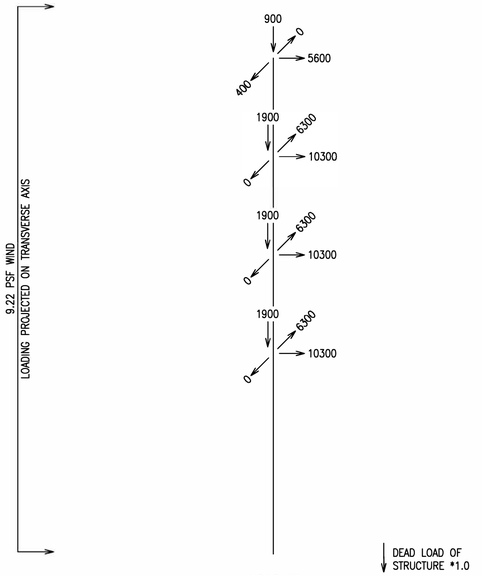
LOAD I

NESC HEAVY LOADING – RULE 250B
ALL WIRES INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 4 PSF WIND @ 0°F



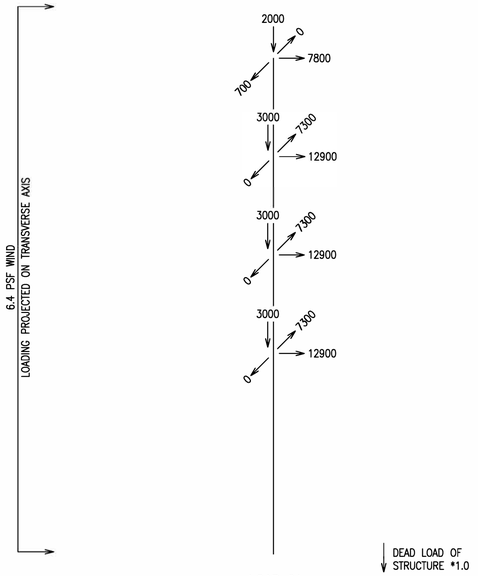
LOAD II

NESC EXTREME HIGH WIND – RULE 250C
ALL WIRES INTACT
NO ICE, 20.74 PSF WIND @ 60°F



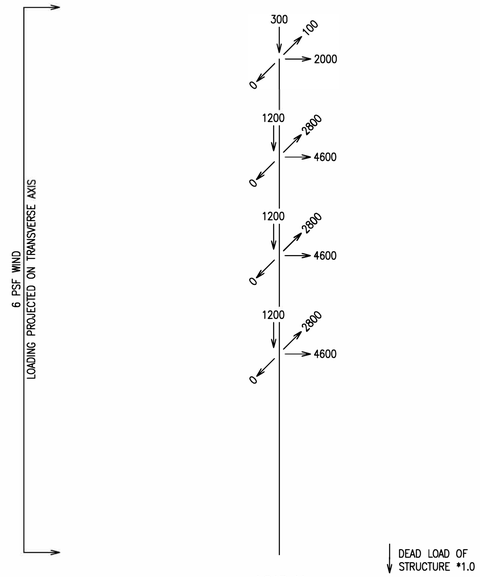
LOAD III

NESC CONCURRENT ICE/WIND – RULE 250D
ALL WIRES INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 9.22 PSF WIND @ 15°F



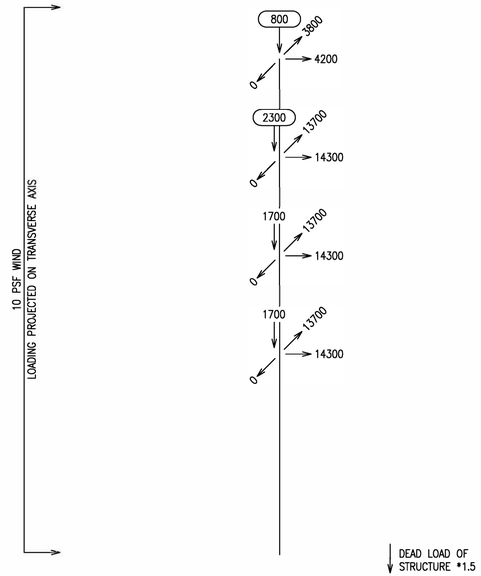
LOAD IV

BHE CONCURRENT ICE/WIND
ALL WIRES INTACT
1.0" RADIAL ICE @ 57 LBS/FT³, 6.4 PSF WIND @ 0°F



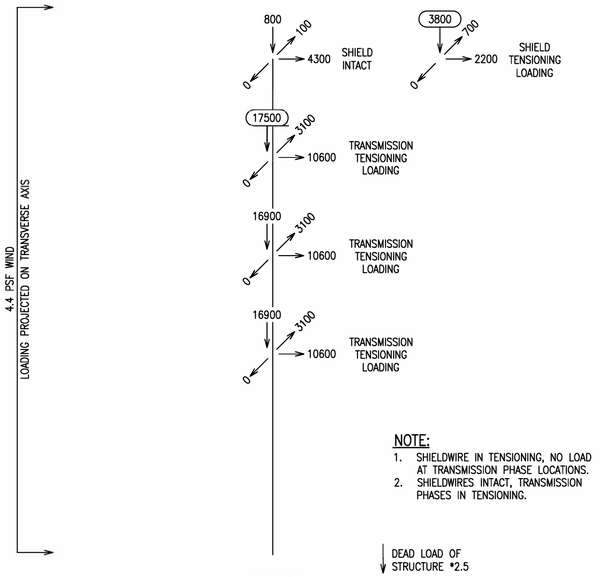
LOAD V

DEFLECTION LIMIT
ALL WIRES INTACT
NO ICE, 6 PSF WIND @ 60°F



LOAD VI

TERMINAL
AHEAD SPAN INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 4 PSF WIND @ 0°F

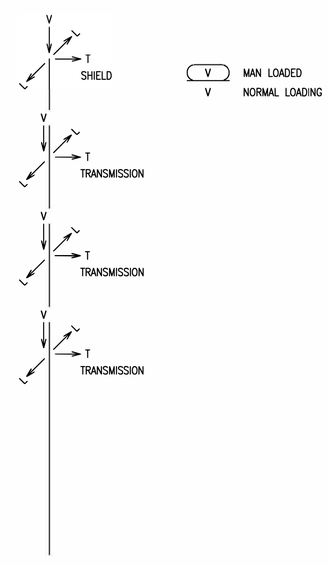


LOAD VII

CONSTRUCTION LOADING
SEE NOTE
NO ICE, 4 PSF WIND @ 20°F

NOTE:

1. SHIELDWIRE IN TENSIONING, NO LOAD AT TRANSMISSION PHASE LOCATIONS.
2. SHIELDWIRES INTACT, TRANSMISSION PHASES IN TENSIONING.



TYPICAL

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

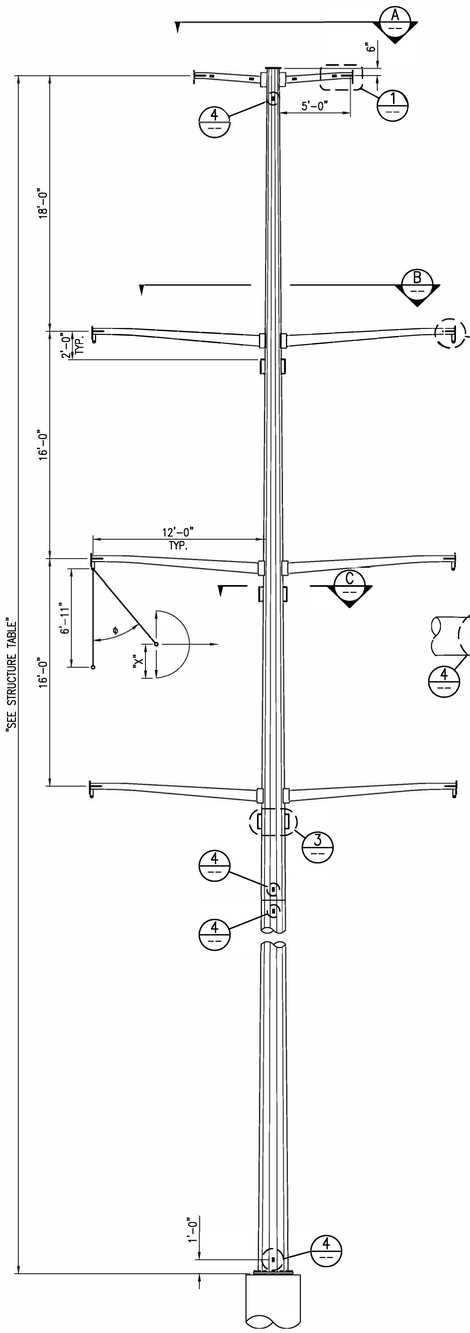
WEST RAPID CITY
230KV TRANSMISSION LINE

LOAD & DESIGN DETAIL
SCDE-230-M1
STR 1A AND STR 1B

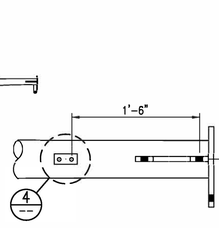
0 1" 2"

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SCALE 3/16"=1'-0"

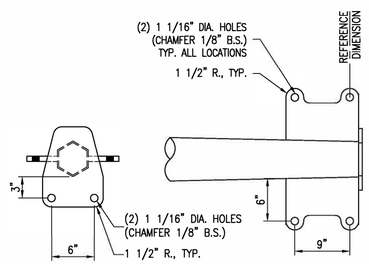
SHEET LD-06-2



FRONT VIEW

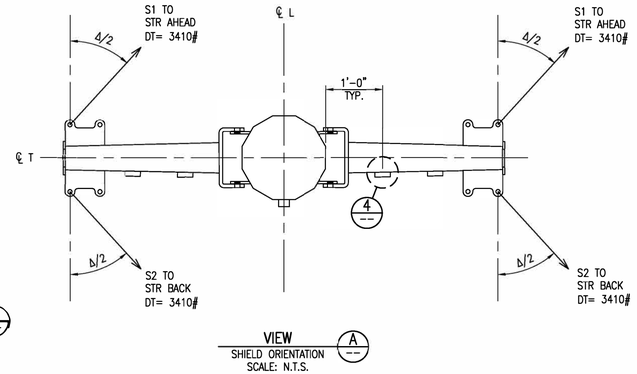


SIDE VIEW

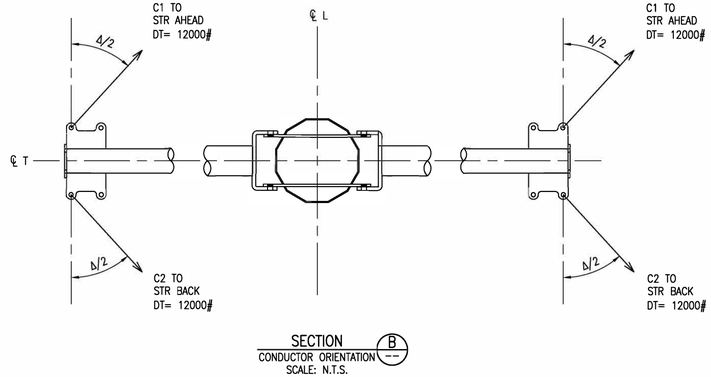


TOP VIEW

DETAIL 1
SHIELD WIRE VANGS
SCALE: N.T.S.

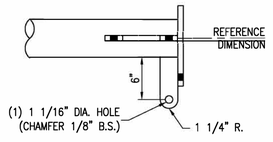


VIEW A
SHIELD ORIENTATION
SCALE: N.T.S.

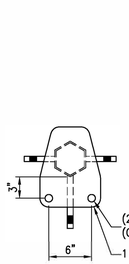


SECTION B
CONDUCTOR ORIENTATION
SCALE: N.T.S.

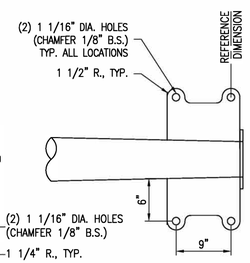
FRONT VIEW



SIDE VIEW



TOP VIEW



DETAIL 2
CONDUCTOR VANGS
SCALE: N.T.S.

GENERAL NOTES

MAXIMUM SHIELD WIRE VANG THICKNESS = 3/4"
MAXIMUM CONDUCTOR VANG THICKNESS = 1"
LOAD TREE VALUES ARE ULTIMATE, INCLUDE OVERLOAD FACTORS, AND ARE SHOWN IN POUNDS.

DESIGN CRITERIA

(S1) SHIELD WIRE IS AFL CC-55/443 "DNO-4748" OPGW, MAXIMUM TENSION AT NESC HEAVY LOADING: 3410# R.S.= 400'
(S2) SHIELD WIRE IS AFL CC-55/443 "DNO-4748" OPGW, MAXIMUM TENSION AT NESC HEAVY LOADING: 3410# R.S.= 400'
(C1) CONDUCTOR IS 1272 KCMIL 45/7 ACSR "BITTERN" MAXIMUM TENSION AT NESC HEAVY LOADING: 12000# R.S.= 400'
(C2) CONDUCTOR IS 1272 KCMIL 45/7 ACSR "BITTERN" MAXIMUM TENSION AT NESC HEAVY LOADING: 12000# R.S.= 400'

WIND SPAN: 400'
WEIGHT SPAN: 800' AT NESC HEAVY LOADING
HEIGHT OF STR.: SEE TABLE
DESIGN MAXIMUM ANGLE (Δ): 50°00'00"

SPECIFICATIONS

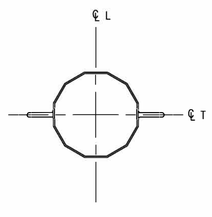
1. POLES TO BE DESIGNED PER SECTION 33 71 16.23 TUBULAR STEEL POLE SPECIFICATIONS.
2. ALL STEEL TO BE WEATHERING STEEL.
3. POLES TO HAVE EITHER SLIP JOINTS OR BOLTED FLANGE TYPE SPLICES, WHICHEVER IS MORE COST EFFECTIVE.
   A. IF SLIP JOINTS ARE USED. INSTALL GROUND PADS (DETAIL 4) ABOVE AND BELOW THE SLIP JOINT.
4. STRUCTURE SHALL BE DESIGNED ASSUMING DRILLED PIER TYPE FOUNDATION.
5. THE CIRCLED LOADINGS SHOWN IN LOAD TREES CONVEY THE ADDITIONAL VERTICAL LOAD THAT WILL BE APPLIED TO THE STRUCTURE BY LINE PERSONNEL DURING CONSTRUCTION AND MAINTENANCE OPERATIONS.
   A. IT IS REQUIRED THAT ALL CONDUCTOR ATTACHMENT SUPPORTS BE DESIGNED TO MEET THIS REQUIREMENT. HOWEVER, AS THE LOADING WILL BE APPLIED TO ONLY ONE PHASE AT ANY GIVEN TIME, THE SHAFT MAY BE DESIGNED FOR ITS APPLICATION AT A SINGLE CONTROLLING PHASE LOCATION TO BE DETERMINED BY THE STEEL MANUFACTURER.

DEFLECTION

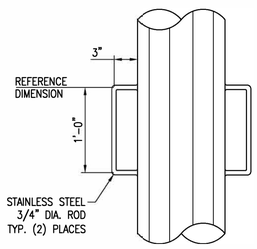
SEE TUBULAR STEEL POLE SPECIFICATION FOR DEFLECTION OF THE SHAFT UNDER LOAD CASE V.

INSULATOR SWING TABLE		
LOAD CASE	SWING ANGLE ϕ	AIR GAP "X"
NO WIND	24°	79"
6 PSF WIND	50°	54"
14.63 PSF WIND	76°	20"

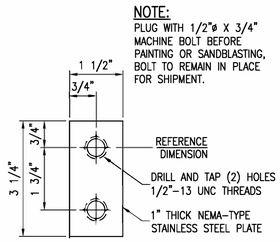
STRUCTURE TABLE	
STR #	HEIGHT
4	115'-0"



SECTION C
GROUND LOOP ORIENTATION
SCALE: N.T.S.



DETAIL 3
GROUNDING LOOP
SCALE: N.T.S.



DETAIL 4
GROUNDING PAD
SCALE: N.T.S.

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

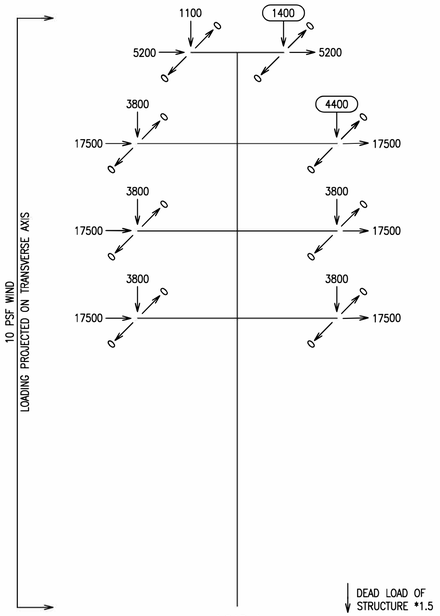
WEST RAPID CITY
230KV TRANSMISSION LINE

LOAD & DESIGN DETAIL
DCDADE-230
STR 4

0 1" 2"

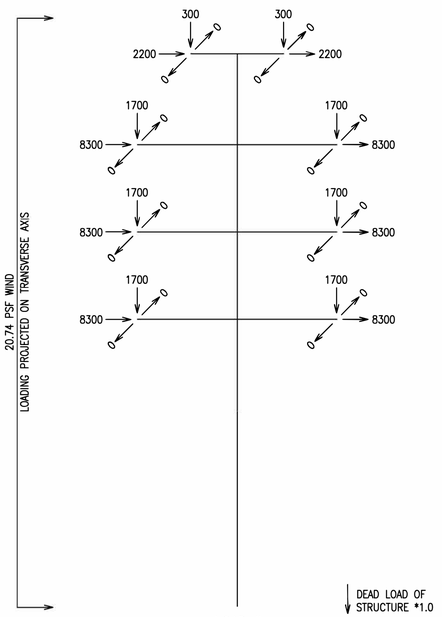
FILENAME BHE-LD-07-D-1.DWG
SCALE 3/16"=1'-0"

SHEET
LD-07-1



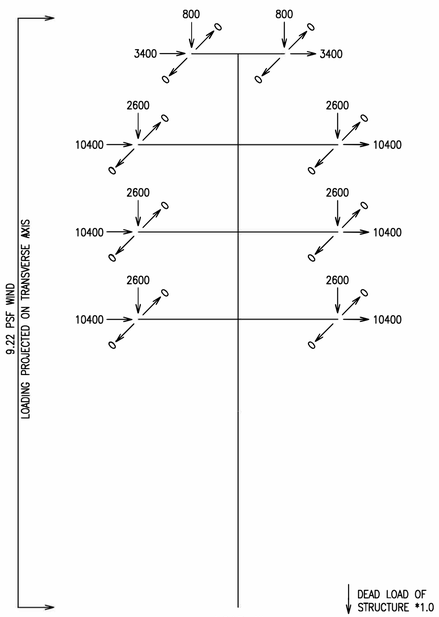
LOAD I

NESC HEAVY LOADING – RULE 250B
ALL WIRES INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 4 PSF WIND @ 0°F



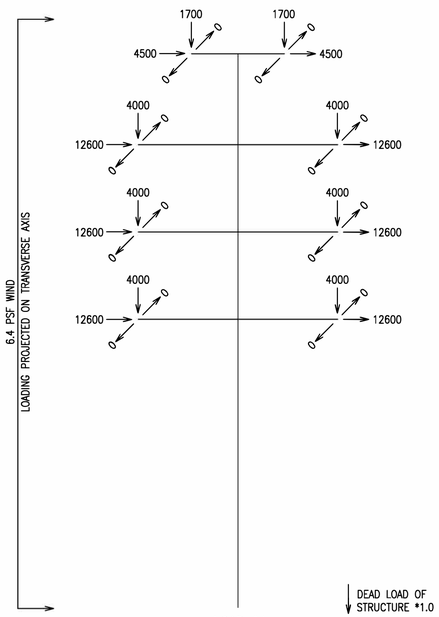
LOAD II

NESC EXTREME HIGH WIND – RULE 250C
ALL WIRES INTACT
NO ICE, 20.74 PSF WIND @ 60°F



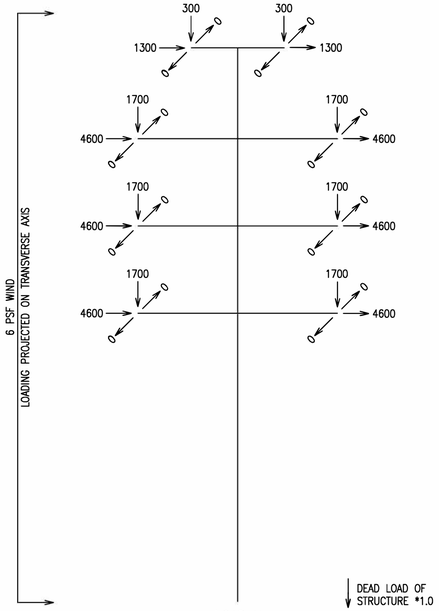
LOAD III

NESC CONCURRENT ICE/WIND – RULE 250D
ALL WIRES INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 9.22 PSF WIND @ 15°F



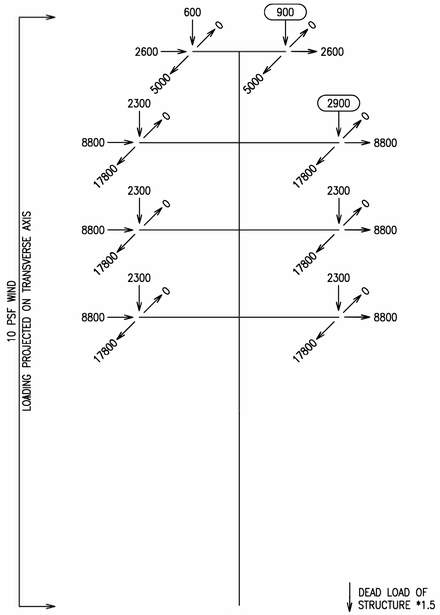
LOAD IV

BHE CONCURRENT ICE/WIND
ALL WIRES INTACT
1.0" RADIAL ICE @ 57 LBS/FT³, 6.4 PSF WIND @ 0°F



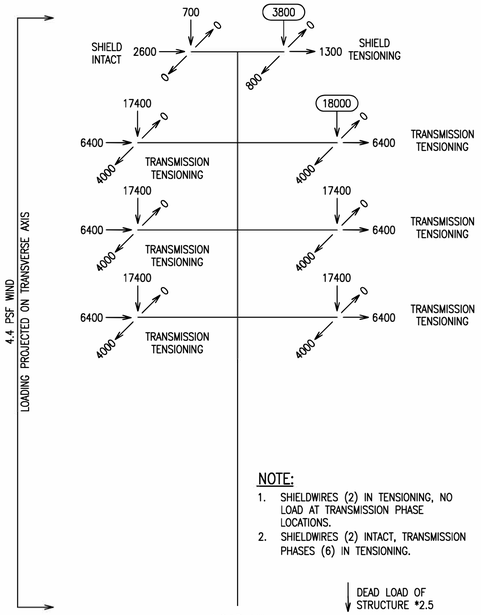
LOAD V

DEFLECTION LIMIT
ALL WIRES INTACT
NO ICE, 6 PSF WIND @ 60°F



LOAD VI

TERMINAL
BACK SPANS INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 4 PSF WIND @ 0°F

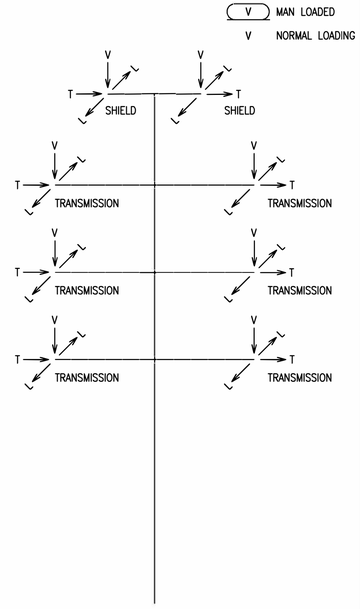


LOAD VII

CONSTRUCTION LOADING
SEE NOTE
NO ICE, 4 PSF WIND @ 20°F

NOTE:

1. SHIELDWIRES (2) IN TENSIONING, NO LOAD AT TRANSMISSION PHASE LOCATIONS.
2. SHIELDWIRES (2) INTACT, TRANSMISSION PHASES (6) IN TENSIONING.



TYPICAL

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
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DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

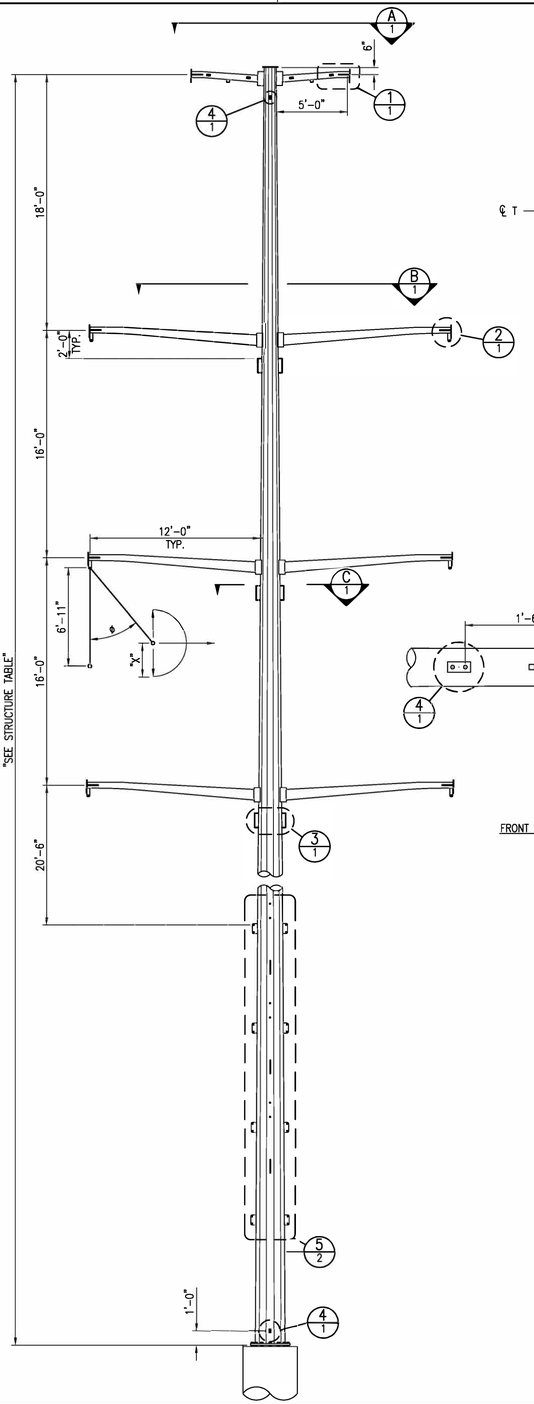
WEST RAPID CITY
230KV TRANSMISSION LINE

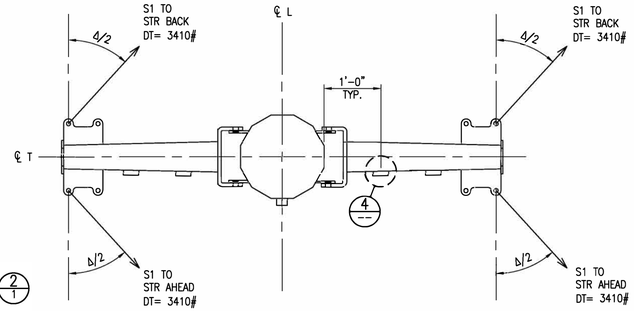
LOAD & DESIGN DETAIL
DCDADE-230
STR 4

0 1" 2"

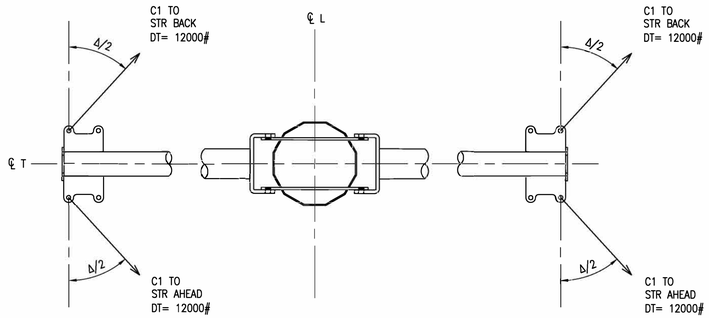
FILENAME BHE-LD-07-D-2.DWG
SCALE 3/16"=1'-0"

SHEET
LD-07-2





VIEW
SHIELD ORIENTATION
SCALE: N.T.S.
A 1



SECTION
CONDUCTOR ORIENTATION
SCALE: N.T.S.
B 1

GENERAL NOTES

MAXIMUM SHIELD WIRE VANG THICKNESS = 3/4"
MAXIMUM CONDUCTOR VANG THICKNESS = 1"
MAXIMUM DISTRIBUTION VANG THICKNESS = 3/4"
LOAD TREE VALUES ARE ULTIMATE, INCLUDE OVERLOAD FACTORS, AND ARE SHOWN IN POUNDS.

DESIGN CRITERIA

(S1) SHIELD WIRE IS AFL CC-55/443 "DNO-4748" OPGW, MAXIMUM TENSION AT NESC HEAVY LOADING: 3410# R.S.= 400'
(C1) CONDUCTOR IS 1272 KCMIL 45/7 ACSR "BITTERN" MAXIMUM TENSION AT NESC HEAVY LOADING: 12000# R.S.= 400'
(D1) UNDERBUILD IS 795 KCMIL 45/7 ACSR "TERN" MAXIMUM TENSION AT NESC HEAVY LOADING: 7575# R.S.= 400'
(D2) UNDERBUILD IS 795 KCMIL 45/7 ACSR "TERN" MAXIMUM TENSION AT NESC HEAVY LOADING: 6980# R.S.= 300'
(O1) OPGW WIRE IS AFL CC-55/443 "DNO-4748" OPGW, MAXIMUM TENSION AT NESC HEAVY LOADING: 2000# R.S.= 300'

230KV
WIND SPAN: 400'
WEIGHT SPAN: 800' AT NESC HEAVY LOADING
69KV UNDERBUILD
WIND SPAN: 200' (AHEAD), 200' (BACK)
WEIGHT SPAN: 400' (AHEAD), 300' (BACK) AT NESC HEAVY LOADING

HEIGHT OF STR.: SEE TABLE
ACTUAL ANGLE (Δ): 92°30'00"
DESIGN MAXIMUM ANGLE: 94°00'00"

SPECIFICATIONS

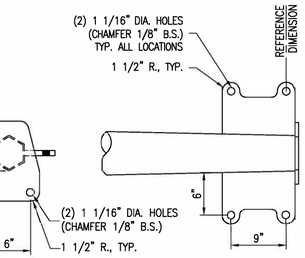
1. POLES TO BE DESIGNED PER SECTION 33 71 16.23 TUBULAR STEEL POLE SPECIFICATIONS.
2. ALL STEEL TO BE WEATHERING STEEL.
3. POLE TO HAVE BOLTED FLANGE TYPE SPLICES.
4. STRUCTURE SHALL BE DESIGNED ASSUMING DRILLED PIER TYPE FOUNDATION.
5. THE CIRCLED LOADINGS SHOWN IN LOAD TREES CONVEY THE ADDITIONAL VERTICAL LOAD THAT WILL BE APPLIED TO THE STRUCTURE BY LINE PERSONNEL DURING CONSTRUCTION AND MAINTENANCE OPERATIONS.
   A. IT IS REQUIRED THAT ALL CONDUCTOR ATTACHMENT SUPPORTS BE DESIGNED TO MEET THIS REQUIREMENT. HOWEVER, AS THE LOADING WILL BE APPLIED TO ONLY ONE PHASE AT ANY GIVEN TIME, THE SHAFT MAY BE DESIGNED FOR ITS APPLICATION AT A SINGLE CONTROLLING PHASE LOCATION TO BE DETERMINED BY THE STEEL MANUFACTURER.
6. SEE DETAIL 8 SHEET 3 FOR OPGW DOWNLEAD DETAILS.

DEFLECTION

SEE TUBULAR STEEL POLE SPECIFICATION FOR DEFLECTION OF THE SHAFT UNDER LOAD CASE V.

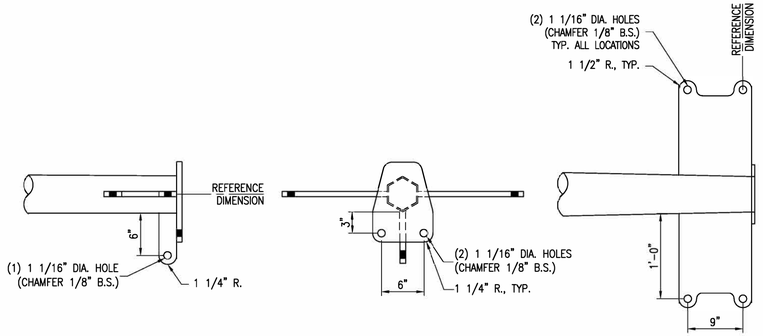
INSULATOR SWING TABLE		
LOAD CASE	SWING ANGLE ø	AIR GAP "X"
NO WIND	24°	79"
6 PSF WIND	50°	54"
14.63 PSF WIND	76°	20"

STRUCTURE TABLE	
STR #	HEIGHT
6	125'-0"



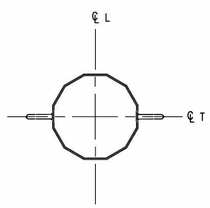
FRONT VIEW | SIDE VIEW | TOP VIEW

DETAIL
SHIELD WIRE VANGS
SCALE: N.T.S.
1 1

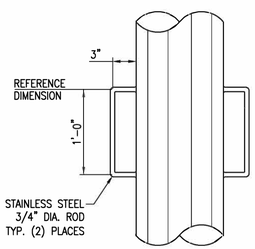


FRONT VIEW | SIDE VIEW | TOP VIEW

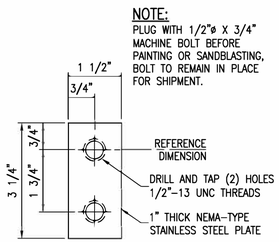
DETAIL
CONDUCTOR VANGS
SCALE: N.T.S.
2 1



SECTION
GROUND LOOP ORIENTATION
SCALE: N.T.S.
C 1



DETAIL
GROUNDING LOOP
SCALE: N.T.S.
3 1



DETAIL
GROUNDING PAD
SCALE: N.T.S.
4 1

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
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PROJECT MANAGER	J. ELLSWORTH
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DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

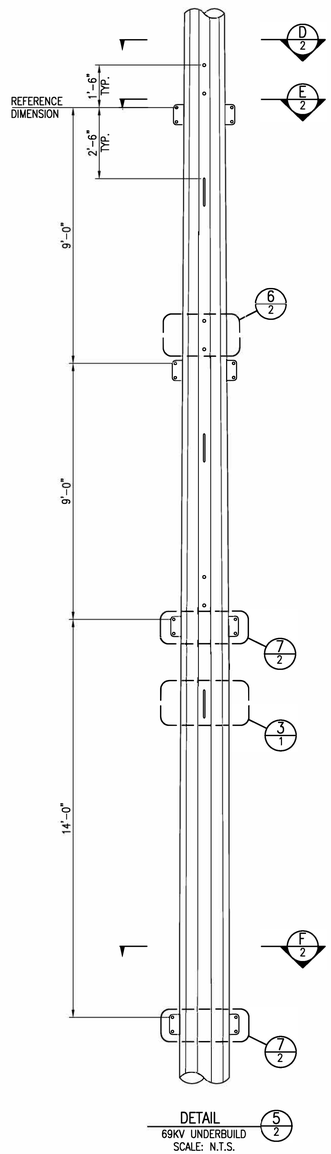
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

LOAD & DESIGN DETAIL
DCDADE-230-230-M1
STR 6

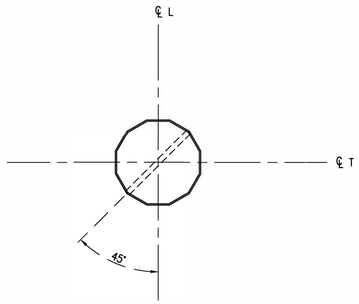
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FILENAME BHE-LD-08-D-1.DWG
SCALE 3/16"=1'-0"
SHEET LD-08-1



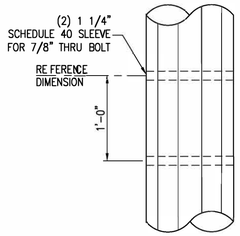
DETAIL
69KV UNDERBUILD
SCALE: N.T.S.

5 2



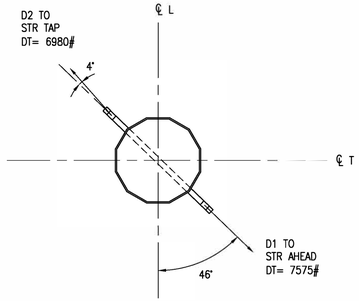
SECTION
69KV JUMPER ORIENTATION
SCALE: N.T.S.

D 2



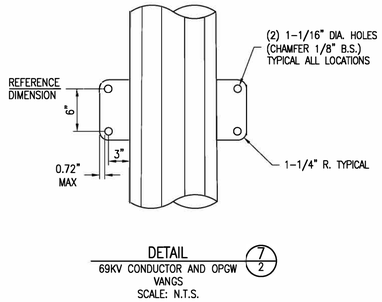
DETAIL
69KV JUMPER ATTACHMENT
SCALE: N.T.S.

6 2



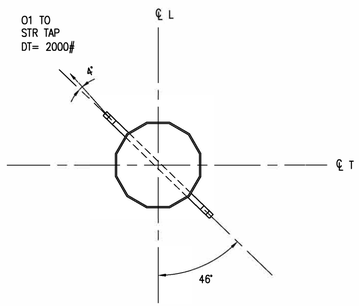
SECTION
69KV CONDUCTOR ORIENTATION
SCALE: N.T.S.

E 2



DETAIL
69KV CONDUCTOR AND OPGW VANGS
SCALE: N.T.S.

7 2



SECTION
69KV OPGW ORIENTATION
SCALE: N.T.S.

F 2

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
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DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

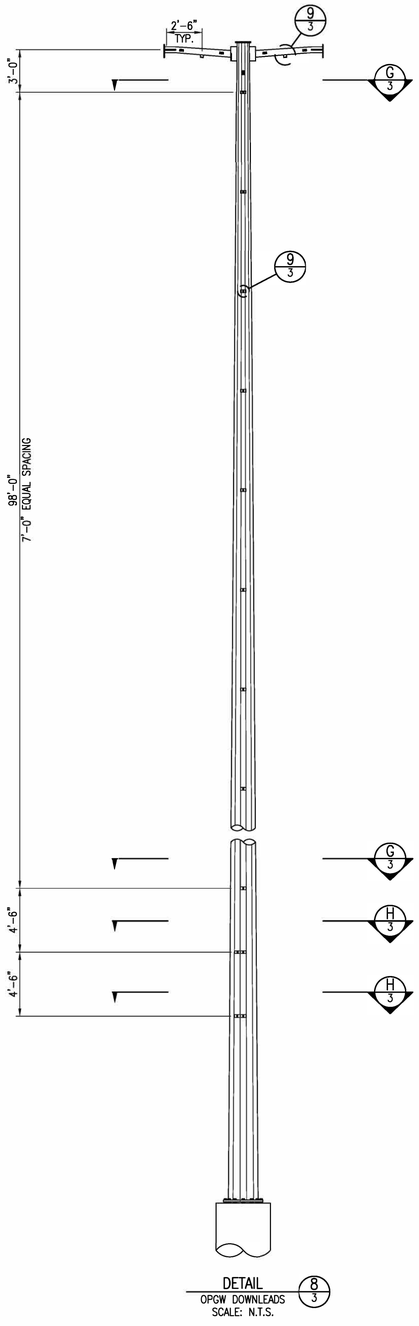
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

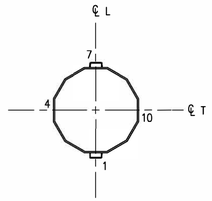
LOAD & DESIGN DETAIL
DCDADE-230-230-M1
STR 6

0 1" 2"

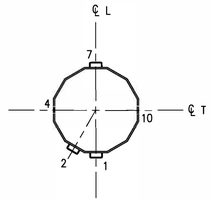
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SCALE: 3/16"=1'-0"
SHEET: LD-08-2



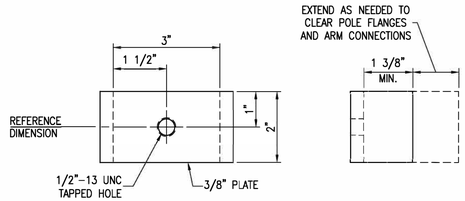
DETAIL 8/3
OPGW DOWNLEADS
SCALE: N.T.S.



SECTION G/3
OPGW DOWNLEAD ORIENTATION
SCALE: N.T.S.



SECTION H/3
OPGW DOWNLEAD ORIENTATION
SCALE: N.T.S.



SECTION 9/3
OPGW DOWNLEAD BRACKET
SCALE: N.T.S.

ISSUE	DATE	DESCRIPTION
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PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

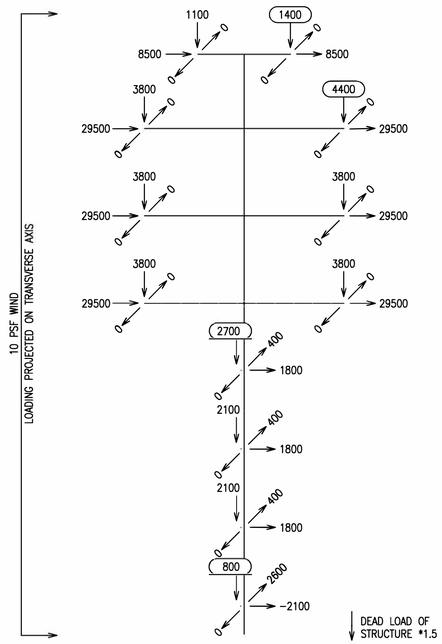
WEST RAPID CITY
230KV TRANSMISSION LINE

LOAD & DESIGN DETAIL
DCDADE-230-230-M1
STR 6

0 1" 2"

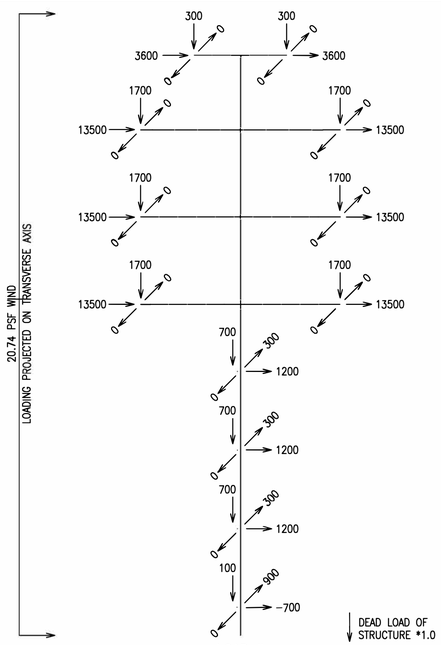
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SCALE 3/16"=1'-0"

SHEET **LD-08-3**



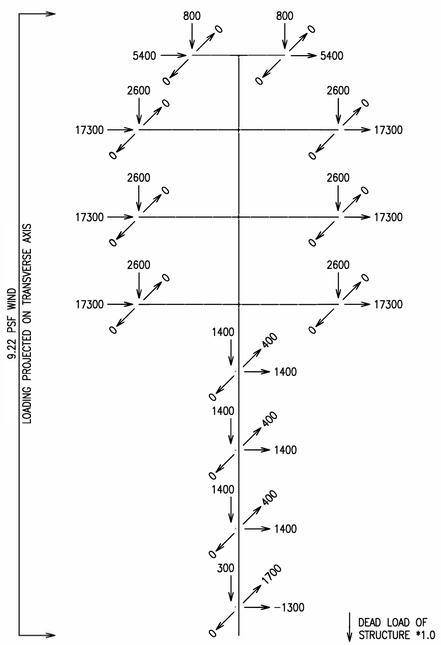
LOAD I

NESC HEAVY LOADING – RULE 250B
ALL WIRES INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 4 PSF WIND @ 0°F



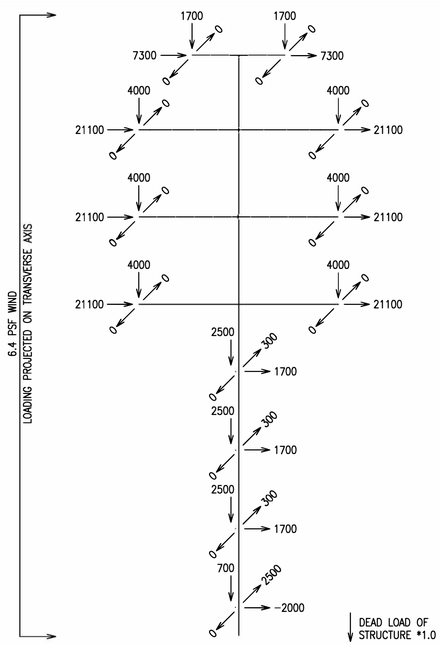
LOAD II

NESC EXTREME HIGH WIND – RULE 250C
ALL WIRES INTACT
NO ICE, 20.74 PSF WIND @ 60°F



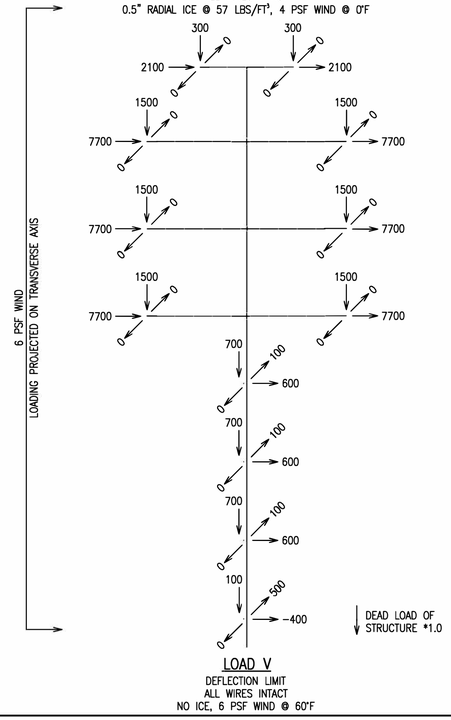
LOAD III

NESC CONCURRENT ICE/WIND – RULE 250D
ALL WIRES INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 9.22 PSF WIND @ 15°F



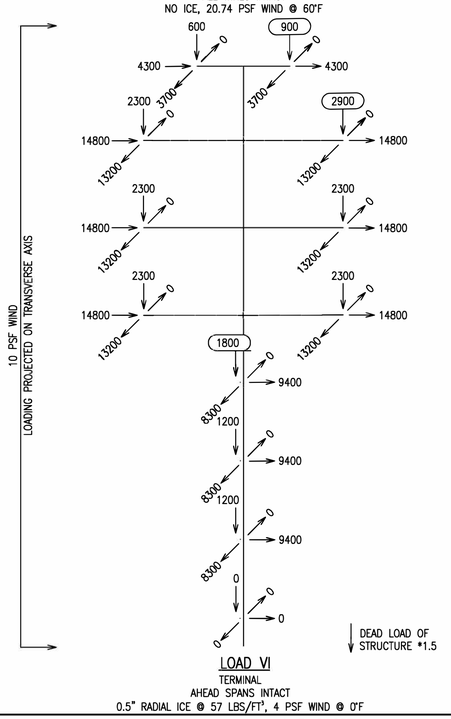
LOAD IV

BHE CONCURRENT ICE/WIND
ALL WIRES INTACT
1.0" RADIAL ICE @ 57 LBS/FT³, 6.4 PSF WIND @ 0°F



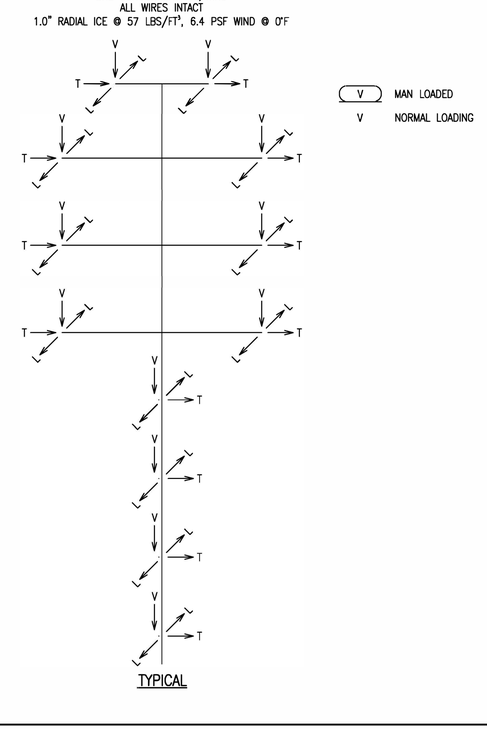
LOAD V

DEFLECTION LIMIT
ALL WIRES INTACT
NO ICE, 6 PSF WIND @ 60°F



LOAD VI

TERMINAL
AHEAD SPANS INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 4 PSF WIND @ 0°F



ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

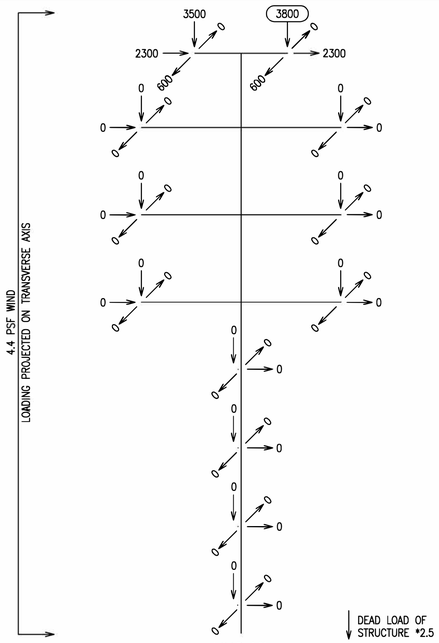
WEST RAPID CITY
230KV TRANSMISSION LINE

LOAD & DESIGN DETAIL
DCDADE-230-230-M1
STR 6

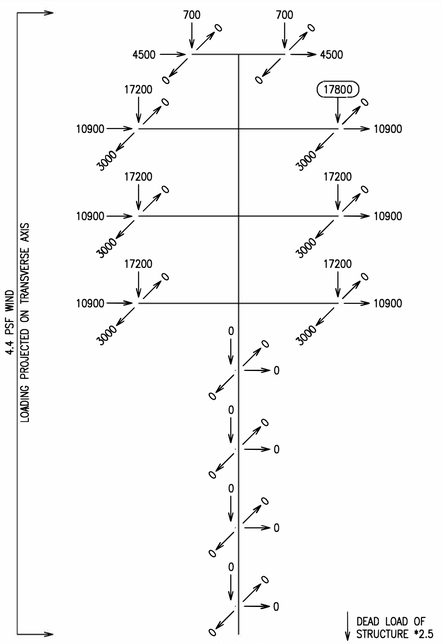
0 1" 2"

FILENAME BHE-LD-08-D-4.DWG
SCALE 3/16"=1'-0"

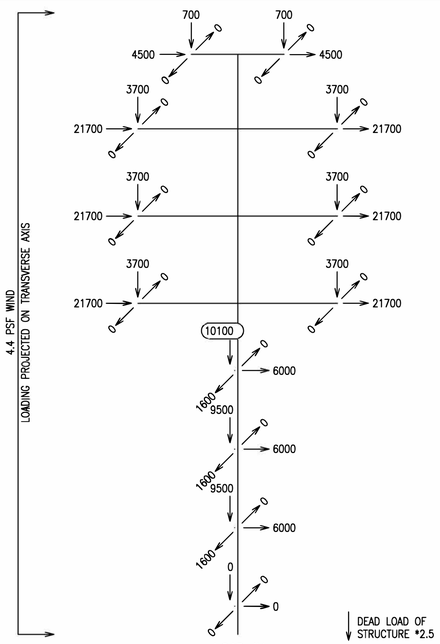
SHEET **LD-08-4**



LOAD VII
CONSTRUCTION LOADING 1
SHIELD TENSIONING
NO ICE, 4 PSF WIND @ 20°F



LOAD VIII
CONSTRUCTION LOADING 2
230KV CONDUCTOR TENSIONING
NO ICE, 4 PSF WIND @ 20°F



LOAD IX
CONSTRUCTION LOADING 3
UNDERBUILD CONDUCTOR TENSIONING
NO ICE, 4 PSF WIND @ 20°F

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

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DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

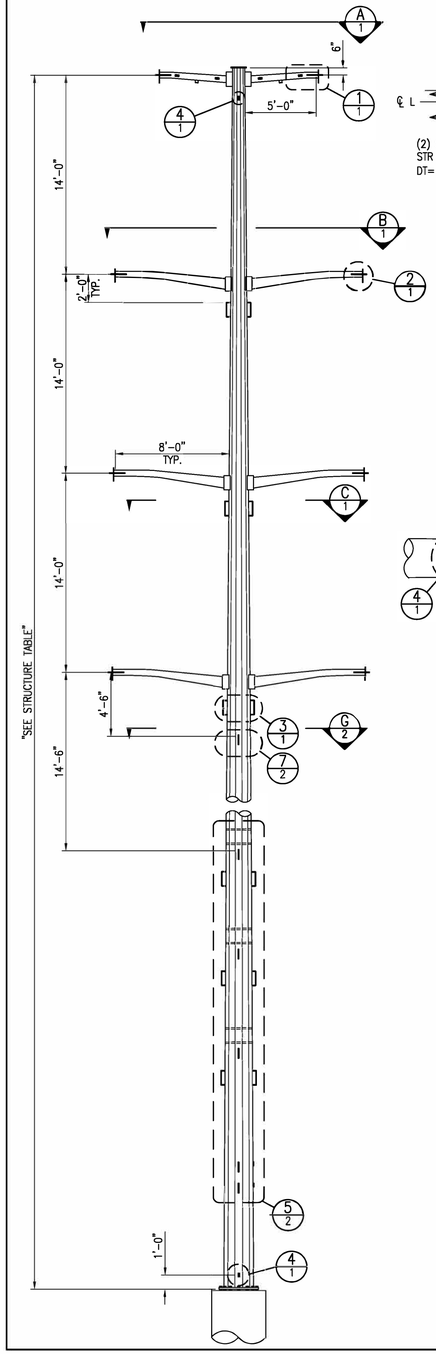
WEST RAPID CITY
230KV TRANSMISSION LINE

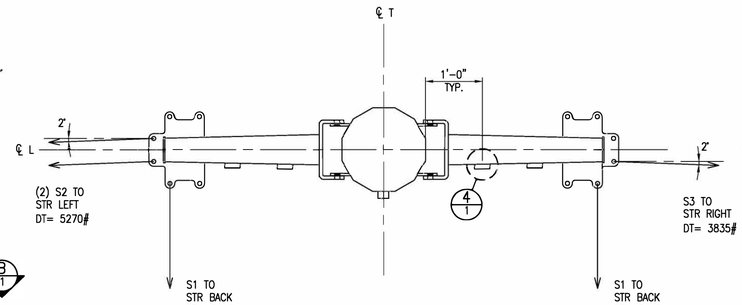
LOAD & DESIGN DETAIL
DCDADE-230-230-M1
STR 6

0 1" 2"

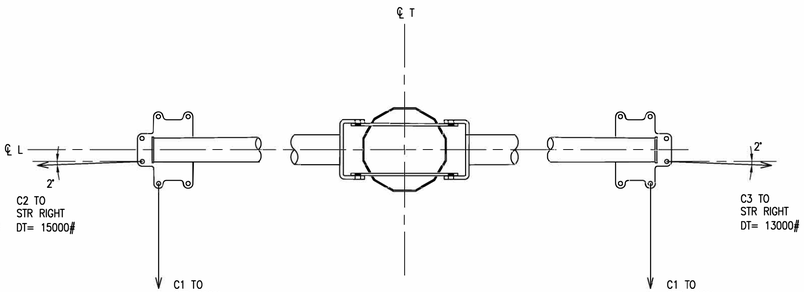
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SCALE 3/16"=1'-0"

SHEET
LD-08-5

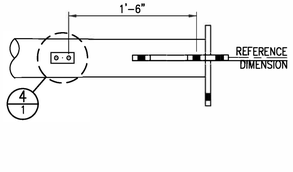




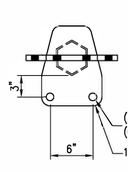
VIEW
SHIELD ORIENTATION
SCALE: N.T.S.
A 1



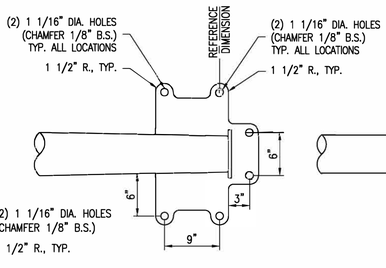
SECTION
CONDUCTOR
ORIENTATION
SCALE: N.T.S.
B 1



FRONT VIEW

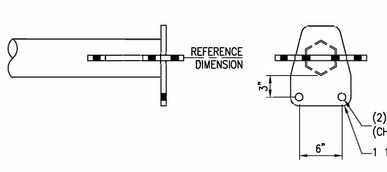


SIDE VIEW



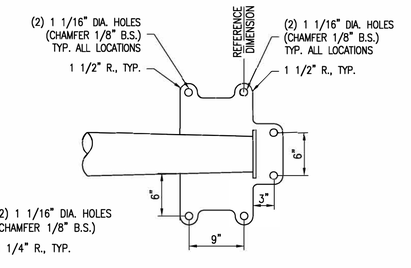
TOP VIEW

DETAIL
SHIELD WIRE VANGS
SCALE: N.T.S.
1 1



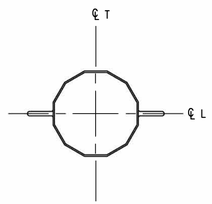
FRONT VIEW

SIDE VIEW

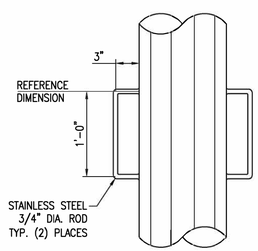


TOP VIEW

DETAIL
CONDUCTOR VANGS
SCALE: N.T.S.
2 1

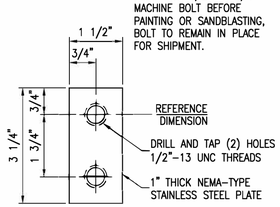


SECTION
GROUND LOOP
ORIENTATION
SCALE: N.T.S.
C 1



DETAIL
GROUNDING LOOP
SCALE: N.T.S.
3 1

NOTE:
PLUG WITH 1/2"ø X 3/4"
MACHINE BOLT BEFORE
PAINTING OR SANDBLASTING,
BOLT TO REMAIN IN PLACE
FOR SHIPMENT.



DETAIL
GROUNDING PAD
SCALE: N.T.S.
4 1

GENERAL NOTES

MAXIMUM SHIELD WIRE VANG THICKNESS = 3/4"
MAXIMUM CONDUCTOR VANG THICKNESS = 1"
LOAD TREE VALUES ARE ULTIMATE, INCLUDE OVERLOAD FACTORS, AND ARE SHOWN IN POUNDS.

DESIGN CRITERIA

(S1) SHIELD WIRE IS AFL CC-55/443 "DNO-4748" OPGW, MAXIMUM TENSION AT NESC HEAVY LOADING: 3410# R.S.= 400'
(S2) SHIELD WIRE IS AFL CC-55/443 "DNO-4748" OPGW, MAXIMUM TENSION AT NESC HEAVY LOADING: 5270# R.S.= 1000'
(S3) SHIELD WIRE IS AFL CC-55/443 "DNO-4748" OPGW, MAXIMUM TENSION AT NESC HEAVY LOADING: 3835# R.S.= 500'
(C1) CONDUCTOR IS 1272 KCMIL 45/7 ACSR "BITTERN" MAXIMUM TENSION AT NESC HEAVY LOADING: 12000# R.S.= 400'
(C2) CONDUCTOR IS 1272 KCMIL 45/7 ACSR "BITTERN" MAXIMUM TENSION AT NESC HEAVY LOADING: 15000# R.S.= 1000'
(C3) CONDUCTOR IS 1272 KCMIL 45/7 ACSR "BITTERN" MAXIMUM TENSION AT NESC HEAVY LOADING: 13000# R.S.= 500'
(S4) SHIELD WIRE IS 3/8" 7 STRAND EHS, MAXIMUM TENSION AT NESC HEAVY LOADING: 2980# R.S.= 400'
(D1) UNDERBUILD IS 795 KCMIL 45/7 ACSR "TERN" MAXIMUM TENSION AT NESC HEAVY LOADING: 7575# R.S.= 400'
(D2) UNDERBUILD IS 795 KCMIL 45/7 ACSR "TERN" MAXIMUM TENSION AT NESC HEAVY LOADING: 7575# R.S.= 400'
(O1) OPGW IS AFL CC-55/443 "DNO-4748" OPGW, MAXIMUM TENSION AT NESC HEAVY LOADING: 3200# R.S.= 400'

230KV
BACK WIND SPAN: 200'
WEIGHT SPAN: 400' AT NESC HEAVY LOADING

LEFT WIND SPAN: 500'
WEIGHT SPAN: 600' AT NESC HEAVY LOADING

RIGHT WIND SPAN: 250'
WEIGHT SPAN: 400' AT NESC HEAVY LOADING

69KV UNDERBUILD
BACK WIND SPAN: 200'
WEIGHT SPAN: 400' AT NESC HEAVY LOADING

AHEAD WIND SPAN: 200'
WEIGHT SPAN: 400' AT NESC HEAVY LOADING

HEIGHT OF STR.: SEE TABLE

SPECIFICATIONS

1. POLES TO BE DESIGNED PER SECTION 33 71 13.23 TUBULAR STEEL POLE SPECIFICATIONS.
2. ALL STEEL TO BE WEATHERING STEEL.
3. POLE TO HAVE BOLTED FLANGE TYPE SPLICES.
4. STRUCTURE SHALL BE DESIGNED ASSUMING DRILLED PIER TYPE FOUNDATION.
5. THE CIRCLED LOADINGS SHOWN IN LOAD TREES CONVEY THE ADDITIONAL VERTICAL LOAD THAT WILL BE APPLIED TO THE STRUCTURE BY LINE PERSONNEL DURING CONSTRUCTION AND MAINTENANCE OPERATIONS.
   A. IT IS REQUIRED THAT ALL CONDUCTOR ATTACHMENT SUPPORTS BE DESIGNED TO MEET THIS REQUIREMENT. HOWEVER, AS THE LOADING WILL BE APPLIED TO ONLY ONE PHASE AT ANY GIVEN TIME, THE SHAFT MAY BE DESIGNED FOR ITS APPLICATION AT A SINGLE CONTROLLING PHASE LOCATION TO BE DETERMINED BY THE STEEL MANUFACTURER.
6. SEE DETAIL 8 SHEET 3 FOR OPGW DOWNLEAD DETAILS.

DEFLECTION

SEE TUBULAR STEEL POLE SPECIFICATION FOR DEFLECTION OF THE SHAFT UNDER LOAD CASE V AND VI.

STRUCTURE TABLE	
STR #	HEIGHT
15	105'-0"

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
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E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

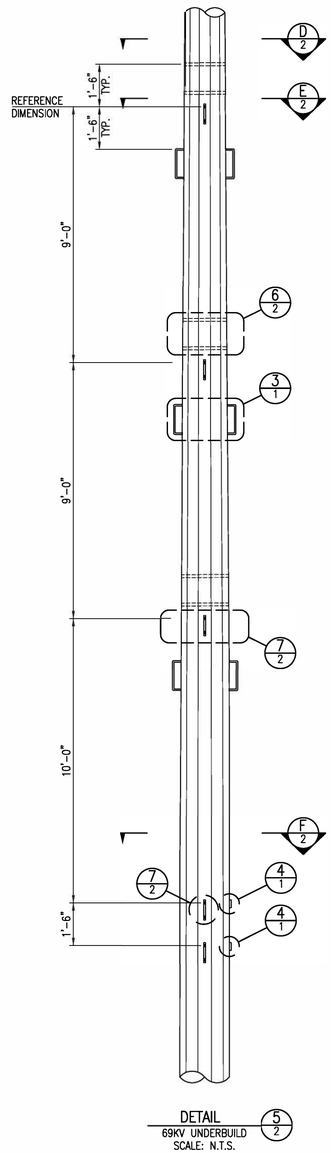
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

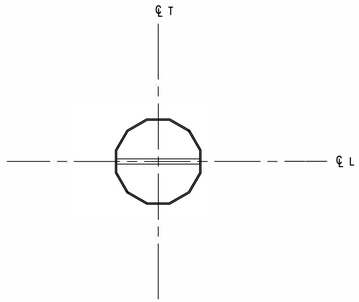
LOAD & DESIGN DETAIL
DCDADE-230-230-M2
STR 15

0 1" 2"

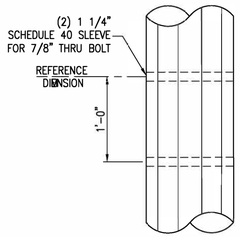
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SCALE 3/16"=1'-0"
SHEET LD-09-1



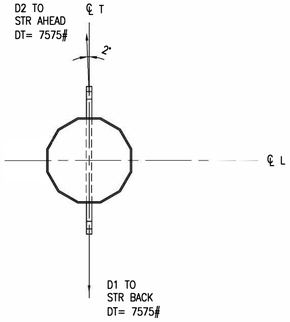
DETAIL
69KV UNDERBUILD
SCALE: N.T.S.
5
2



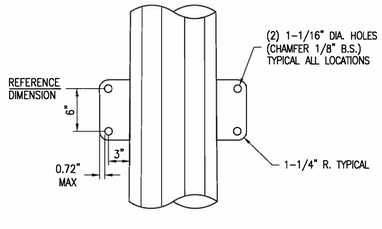
SECTION
69KV JUMPER ORIENTATION
SCALE: N.T.S.
D
2



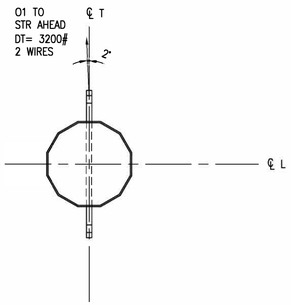
DETAIL
69KV JUMPER ATTACHMENT
SCALE: N.T.S.
6
2



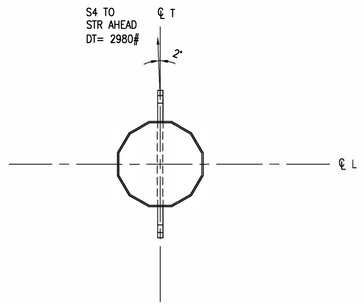
SECTION
69KV CONDUCTOR ORIENTATION
SCALE: N.T.S.
E
2



DETAIL
69KV CONDUCTOR, SHIELD AND
OPGW VANGS
SCALE: N.T.S.
7
2



SECTION
69KV OPGW ORIENTATION
SCALE: N.T.S.
F
2



SECTION
69KV SHIELD ORIENTATION
SCALE: N.T.S.
G
2

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E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

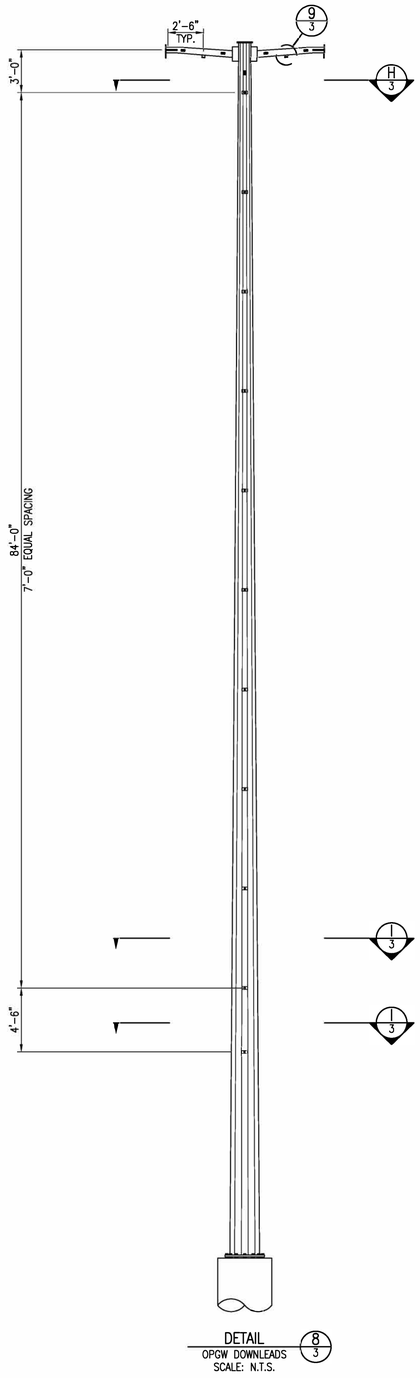
BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

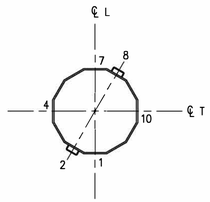
LOAD & DESIGN DETAIL
DCDADE-230-230-M2
STR 15

0 1" 2"

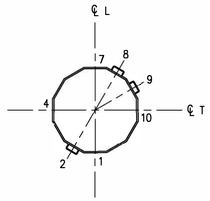
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SHEET LD-09-2



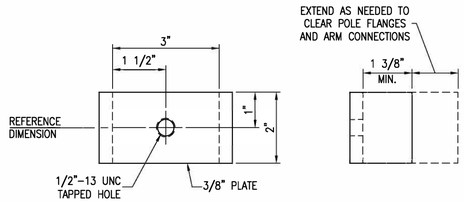
DETAIL 8/3
OPGW DOWNLEADS
SCALE: N.T.S.



SECTION H/3
OPGW DOWNLEAD
ORIENTATION
SCALE: N.T.S.



SECTION I/3
OPGW DOWNLEAD
ORIENTATION
SCALE: N.T.S.



SECTION 9/3
OPGW DOWNLEAD
BRACKET
SCALE: N.T.S.

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

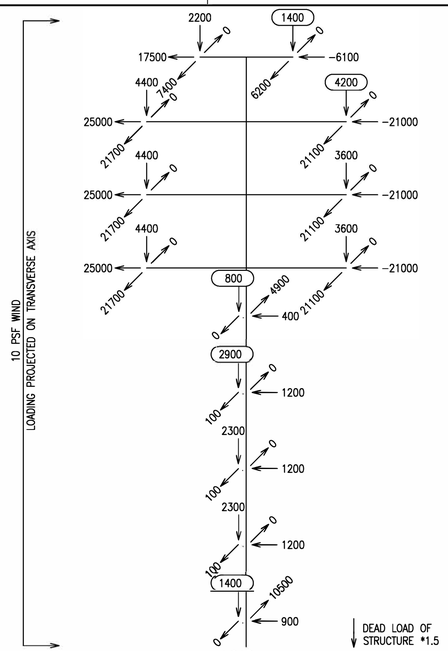
WEST RAPID CITY
230KV TRANSMISSION LINE

LOAD & DESIGN DETAIL
DCDADE-230-230-M2
STR 15

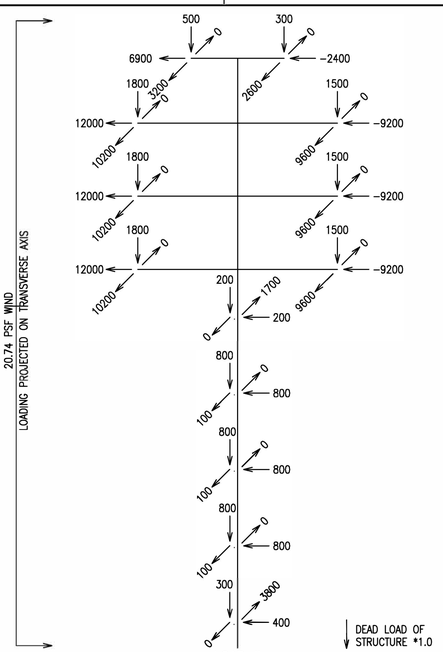
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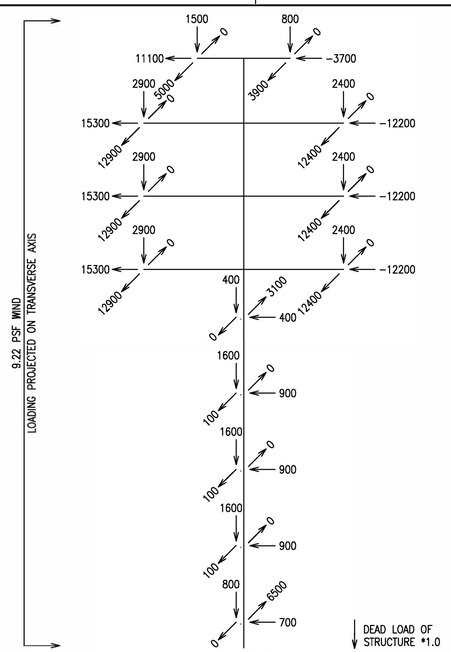
SHEET **LD-09-3**



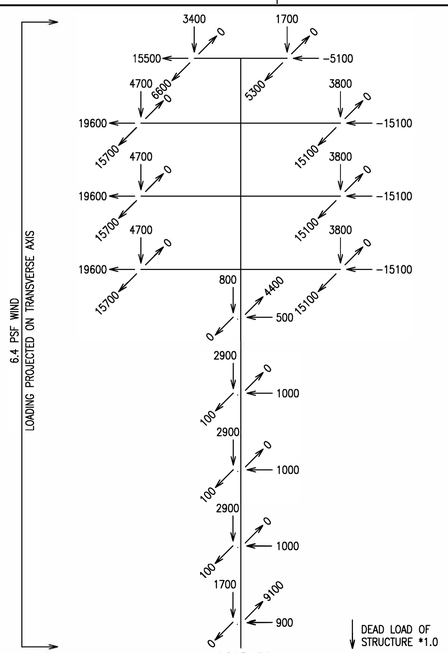
LOAD I
NESC HEAVY LOADING – RULE 250B
ALL WIRES INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 4 PSF WIND @ 0°F



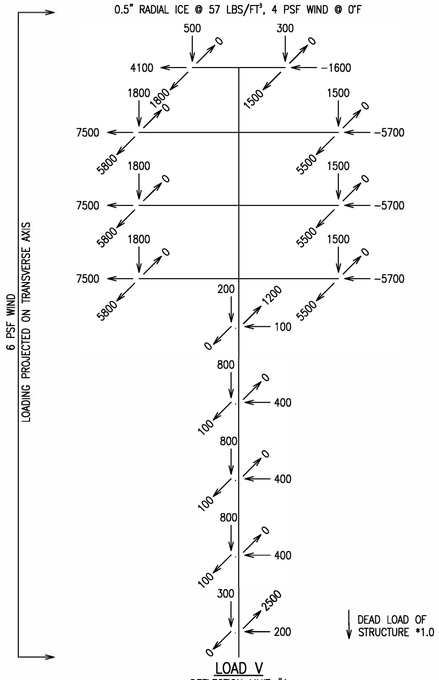
LOAD II
NESC EXTREME HIGH WIND – RULE 250C
ALL WIRES INTACT
NO ICE, 20.74 PSF WIND @ 60°F



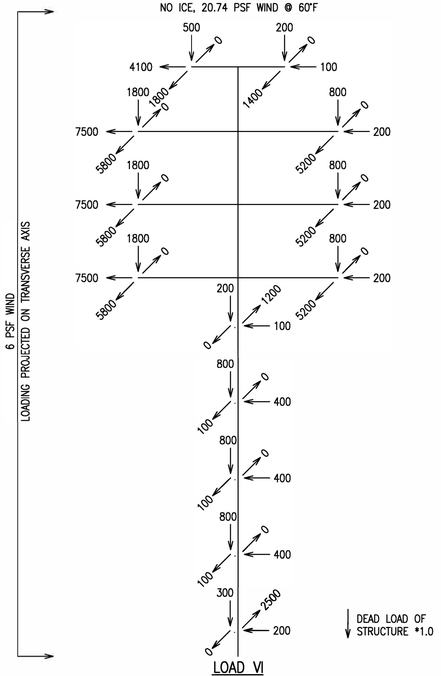
LOAD III
NESC CONCURRENT ICE/WIND – RULE 250D
ALL WIRES INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 9.22 PSF WIND @ 15°F



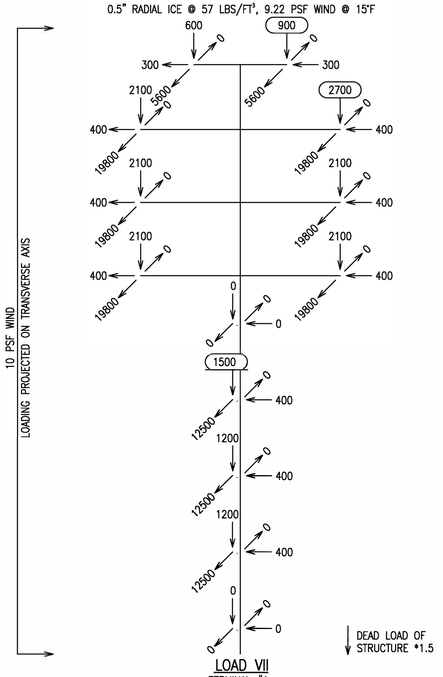
LOAD IV
BHE CONCURRENT ICE/WIND
ALL WIRES INTACT
1.0" RADIAL ICE @ 57 LBS/FT³, 6.4 PSF WIND @ 0°F



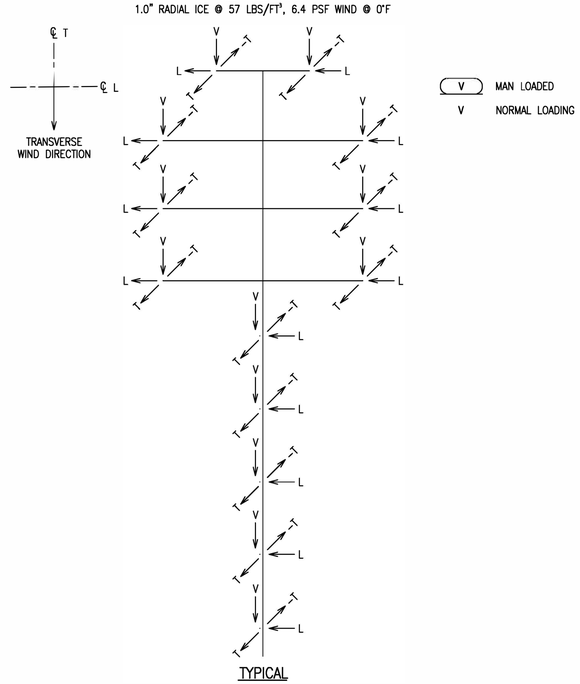
LOAD V
DEFLECTION LIMIT #1
ALL WIRES INTACT
NO ICE, 6 PSF WIND @ 60°F



LOAD VI
DEFLECTION LIMIT #2
ALL WIRES INTACT EXCEPT 230KV RIGHT
NO ICE, 6 PSF WIND @ 60°F



LOAD VII
TERMINAL #1
BACK SPANS INTACT
0.5" RADIAL ICE @ 57 LBS/FT³, 4 PSF WIND @ 0°F



TYPICAL

		PROJECT MANAGER	J. ELLSWORTH
		PROJECT ENGINEER	J. PANKRATZ
		DESIGN ENGINEER	J. PANKRATZ
		CAD TECHNICIAN	Z. JANSEN
2	6/12/2020 RECORD DRAWINGS		
0	9/11/2019 ISSUED FOR CONSTRUCTION	**E. O. R.**	J. BRUNNER
ISSUE	**DATE** **DESCRIPTION**	**PROJECT NUMBER**	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

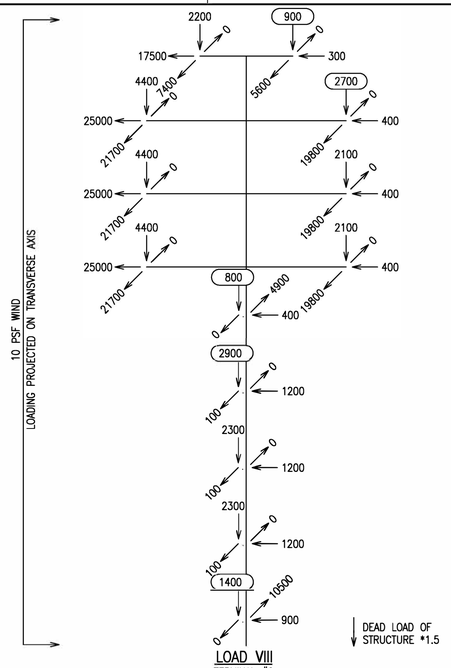
WEST RAPID CITY
230KV TRANSMISSION LINE

LOAD & DESIGN DETAIL
DCDADE-230-230-M2
STR 15

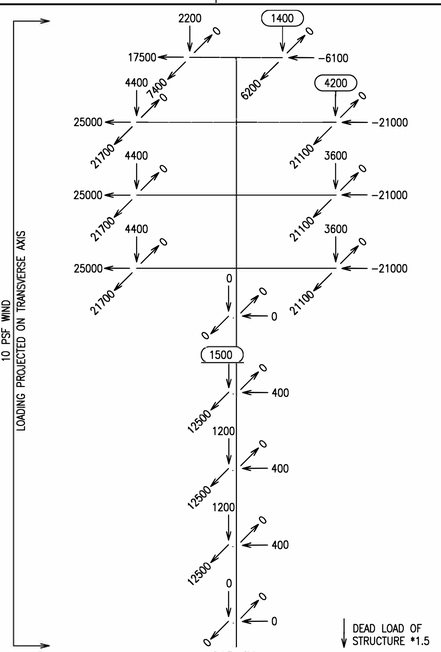
0 1" 2"

FILENAME BHE-LD-09-D-4.DWG
SCALE 3/16"=1'-0"

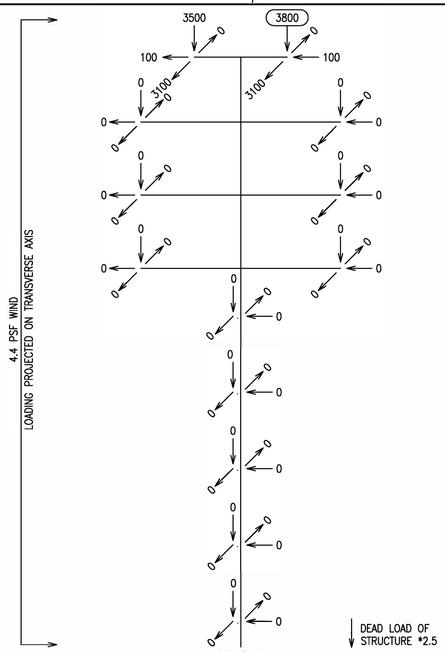
SHEET **LD-09-4**



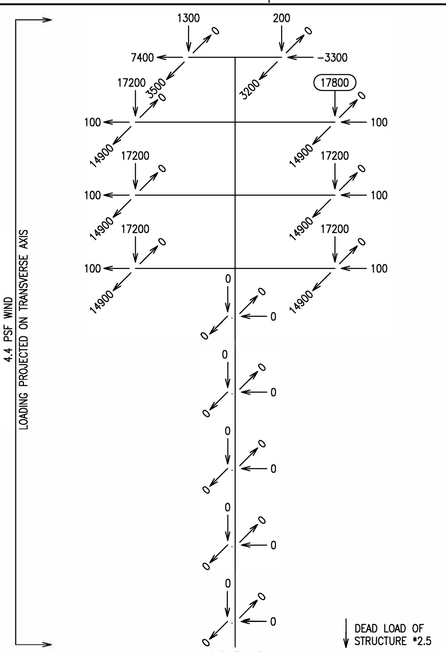
LOAD VIII
TERMINAL #2
ALL SPANS INTACT EXCEPT 230KV RIGHT
0.5" RADIAL ICE @ 57 LBS/FT³, 4 PSF WIND @ 0°F



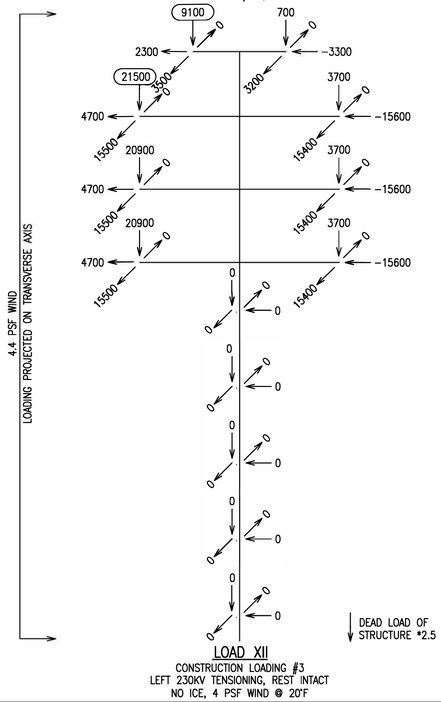
LOAD IX
TERMINAL #3
NO UNDERBUILD AHEAD SPANS
0.5" RADIAL ICE @ 57 LBS/FT³, 4 PSF WIND @ 0°F



LOAD X
CONSTRUCTION LOADING #1
SHIELD TENSIONING
NO ICE, 4 PSF WIND @ 20°F



LOAD XI
CONSTRUCTION LOADING #2
230KV CONSTRUCTION LOADING
NO ICE, 4 PSF WIND @ 20°F



LOAD XII
CONSTRUCTION LOADING #3
LEFT 230KV TENSIONING, REST INTACT
NO ICE, 4 PSF WIND @ 20°F

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

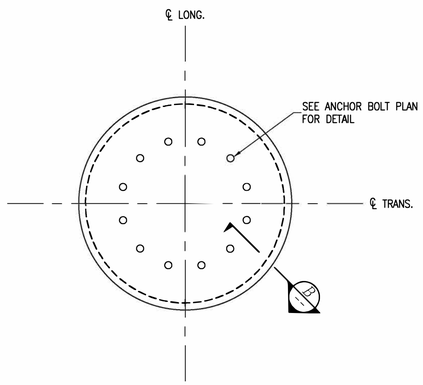
WEST RAPID CITY
230KV TRANSMISSION LINE

LOAD & DESIGN DETAIL
DCDADE-230-230-M2
STR 15

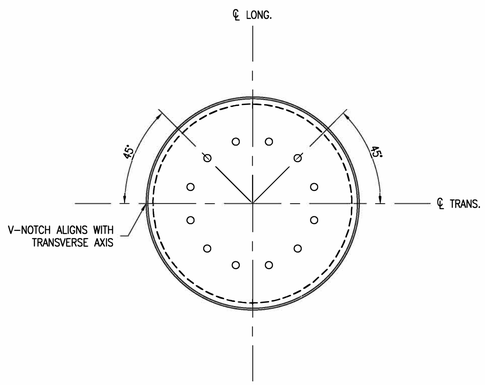
0 1" 2"

FILENAME BHE-LD-09-D-5.DWG
SCALE 3/16"=1'-0"

SHEET
LD-09-5



PIER PLAN VIEW
ROUND CAP



ANCHOR BOLT PLAN (TYP.)
SEE STEEL MANUFACTURER DRAWINGS FOR ANCHOR BOLT DETAIL

FOUNDATION DATA

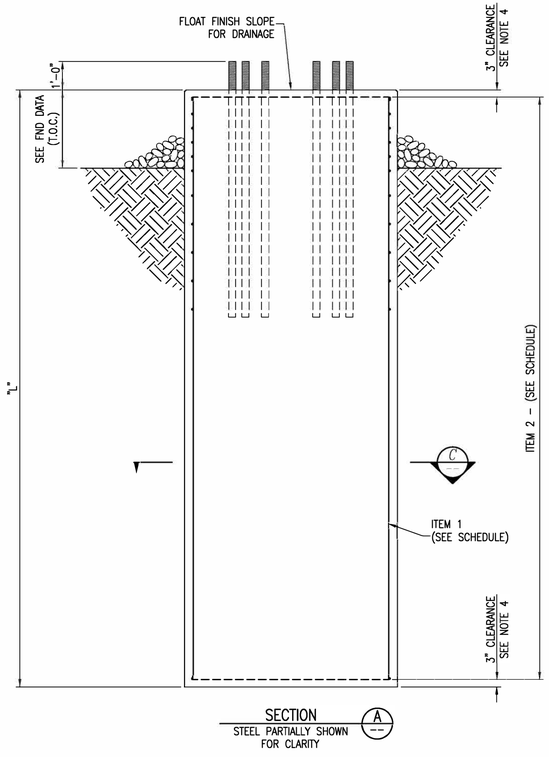
FOUNDATION	STRUCTURE INFORMATION				PIER DESIGN LOADS			ANCHOR BOLTS	PIER DATA								
FND-01	NUMBER	DRAWING	DESCRIPTION	LINE ANGLE (Δ)	MOMENT (FT-K)	AXIAL (K)	SHEAR (K)	DRAWING NUMBER	T.O.C. ELEVATION ABOVE GROUND	L	B	NEAT LINE (*) CONCRETE (CY)	ITEM	SIZE	QTY	LENGTH PER PIECE	ITEM 2 SPACING	SHAPE
FND-01-1	1A	SCDE-230-M1	105'-0" OVERALL HEIGHT SINGLE POLE DEADEND	82°52'59" RT	5348.1	40.9	72.5	–	1'-0"	22.0	8.0	41.0	1	11	24	21'-6"	–	STRAIGHT
													2	6	26	26'-1"	12"	90° RING O.D.
FND-01-2	1B	SCDE-230-M1	105'-0" OVERALL HEIGHT SINGLE POLE DEADEND	82°33'48" LT	5348.1	40.9	72.5	–	1'-0"	22.0	8.0	41.0	1	11	24	21'-6"	–	STRAIGHT
													2	6	26	26'-1"	12"	90° RING O.D.
FND-01-3	2A	DCBPRA-230-M1	130'-0" OVERALL HEIGHT SINGLE POLE DEADEND	12°34'06" RT	3646.0	58.0	52.1	–	1'-0"	20.0	7.5	32.7	1	11	21	19'-6"	–	STRAIGHT
													2	6	24	24'-6"	12"	84" RING O.D.
FND-01-4	2B	DCBPRA-230-M1	130'-0" OVERALL HEIGHT SINGLE POLE DEADEND	3°24'24" RT	2997.8	46.5	50.9	–	1'-0"	20.0	6.5	24.6	1	11	16	19'-6"	–	STRAIGHT
													2	6	24	21'-4"	12"	72" RING O.D.
FND-01-5	4	DCDADE-230	115'-0" OVERALL HEIGHT SINGLE POLE DEADEND	44°23'12" RT	11326.6	74.2	133.0	–	1'-0"	30.0	9.0	70.7	1	11	41	29'-6"	–	STRAIGHT
													2	6	42	29'-3"	9"	102" RING O.D.
FND-01-6	6	DCDADE-230-M1	125'-0" OVERALL HEIGHT SINGLE POLE DEADEND	90°42'02" LT	19323.3	117.4	204.3	–	1'-6"	42.5	10.0	123.6	1	11	59	42'-0"	–	STRAIGHT
													2	6	47	32'-5"	12"	114" RING O.D.
FND-01-7	15	DCDADE-230-M2	105'-0" OVERALL HEIGHT SINGLE POLE DEADEND	89°08'47" LT	13711.7	90.4	162.7	–	1'-6"	31.5	9.5	82.7	1	11	44	31'-0"	–	STRAIGHT
													2	6	44	30'-10"	9"	108" RING O.D.

NOTES:

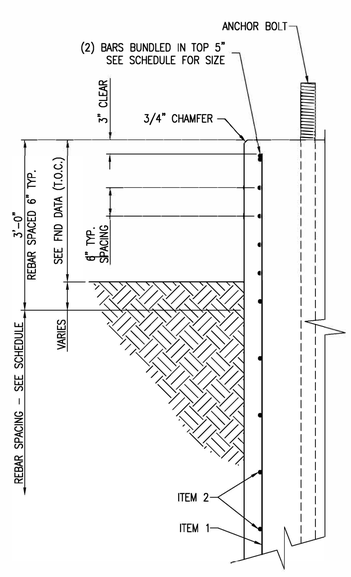
1. *ANCHOR BOLTS PROVIDED BY MANUFACTURER.
2. (*) NEAT LINE BASED ON MINIMUM DIMENSIONS.
3. O.D. = OUTSIDE DIAMETER OF ITEM 2 REBAR.
4. CLEAR DIMENSION SHALL BE MEASURED FROM THE OUTSIDE FACE OF PRINCIPAL REINFORCING.

GENERAL NOTES:

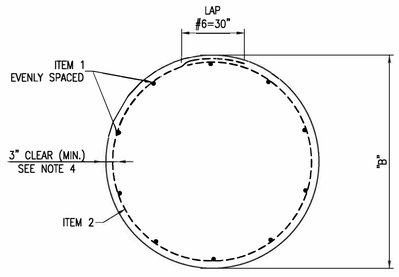
- REINFORCING STEEL SHALL CONFORM TO ASTM A-615 GRADE 60. ALL CLEAR DIMENSIONS MEASURED FROM OUTSIDE EDGE OF REINFORCING STEEL.
- CONCRETE: READY MIX CONCRETE SHALL CONFORM TO ASTM C-94.
  - A. CONCRETE STRENGTH: (MINIMUM 28 DAY COMPRESSIVE STRENGTH)
    CONCRETE PLACED IN DRY CONDITION – 4500 P.S.I.
    CONCRETE PLACED BELOW WATER TABLE USING TREMIE PIPE METHOD – 5000 P.S.I.
  - B. ENTRAINED AIR: PROVIDE AIR ENTRAINMENT IN CONCRETE RESULTING IN A TOTAL AIR CONTENT BY VOLUME OF 6% ± 1% PER ASTM C-260.
  - C. AGGREGATE: SHALL CONFORM TO ASTM C-33. MAXIMUM AGGREGATE SIZE THROUGHOUT SHALL BE 1 1/2".
  - D. SLUMP: SHALL BE 6-7 INCHES FOR CONCRETE.
  - E. WATER/ CEMENT RATIO: 0.45 MAX.
  - F. VIBRATION OF CONCRETE: SHALL BE LIMITED TO THE TOP TEN FEET OF THE FOUNDATION FOR CONCRETE PLACED BY THE TREMIE METHOD.
- SOIL OR ROCK CONDITIONS: WHERE SOIL DEPTHS, DEPTHS TO BEDROCK, OR THE CONDITIONS OF SOIL OR BEDROCK DIFFER FROM THAT SHOWN ON THE BORINGS, THE FOUNDATIONS ENGINEER SHALL BE CONTACTED.
- SEE SPECIFICATIONS AND DOCUMENTATION FOR EXCAVATION AND CONCRETE REQUIREMENTS.
- ALL PIERS SHALL BE FORMED FROM TOP OF FOUNDATION TO ONE FOOT BELOW GRADE BEFORE CONCRETE IS PLACED TO COMPLETE THE PIER.
- **GYPSUM PRESENT IN BORINGS. IN NO CASE SHALL PIERS TERMINATE IN A GYPSUM LAYER. IF THIS SHOULD OCCUR CONTACT ENGINEER.**



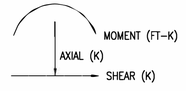
SECTION A
STEEL PARTIALLY SHOWN FOR CLARITY



SECTION B
FOUNDATION CAP
SCALE: N.T.S.



SECTION C
FOUNDATION
SCALE: N.T.S.



PIER DESIGN LOADS
SCALE: N.T.S.

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	N. VLAHOS
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

FOUNDATION DETAILS

0 1" 2"

FILENAME	BHE-FND-01-01.DWG
SCALE	NONE
SHEET	FND-01-1

STRUCTURE DATA											TRANSMISSION ASSEMBLIES			COMMENTS
STR. #	STATION (FT)	AHEAD SPAN	LINE ANGLE				STR TYPE	POLE H&C	FND	FND REVEAL	OPGW SPLICE	SHIELD DAMPER	COND. DAMPER	
SUB DE	0+00	191					DT-01-230				SPLICE BY SUBSTATION			OPGW TO MIDDLE STATIC MAST
1A	1+91	177	78°	05'	13"	RT	SCDE-230-M1	1)LD-06: 105'-0"	1)FND-01-1	1'-0"				
2A	3+68	280	12°	34'	06"	RT	DCBPRA-230-M1	1)LD-04: 130'-0"	1)FND-01-3	1'-0"		1)DPR-OPGW-2T1	3)DPR-1272-2T1	SEE WEST RAPID CITY - CT4 69KV PACKAGE FOR UNDERBUILD ASSEMBLIES.
3	6+48 BOL 6+46 AOL	296	7°	44'	06"	LT	SEE STR 3 BELOW	SEE STR 3 BELOW	SEE STR 3 BELOW	SEE STR 3 BELOW		SEE STR 3 BELOW	SEE STR 3 BELOW	
SUB DE	0+00	156					DT-01-230				SPLICE BY SUBSTATION			OPGW TO MIDDLE STATIC MAST
1B	1+56	164	82°	33'	48"	RT	SCDE-230-M1	1)LD-06: 105'-0"	1)FND-01-2	1'-0"				
2B	3+20	246	3°	24'	24"	LT	DCBPRA-230-M1	1)LD-05: 130'-0"	1)FND-01-4	1'-0"		1)DPR-OPGW-2T1	3)DPR-1272-2T1	SEE WEST RAPID CITY - BEN FRENCH 1 69KV PACKAGE FOR UNDERBUILD ASSEMBLIES.
3	5+66 BOL 6+46 AOL	296	3°	51'	36"	RT	SEE STR 3 BELOW	SEE STR 3 BELOW	SEE STR 3 BELOW	SEE STR 3 BELOW		SEE STR 3 BELOW	SEE STR 3 BELOW	
3	6+46	296	7°	44'	06"	LT	DCBP-230	1)LD-01: 143'-0"	EMBED: 21'-0"			2)DPR-OPGW-T1	6)DPR-1272-T1	
4	9+42	178	44°	23'	12"	RT	DCDADE-230	1)LD-07: 115'-0"	1)FND-01-5	1'-0"				
5	11+20	290					DCBP-230	1)LD-01: 143'-0"	EMBED: 21'-0"			2)DPR-OPGW-2T1	6)DPR-1272-2T1	
6	14+09	315	92°	42'	02"	LT	DCDADE-230-M1	1)LD-08: 125'-0"	1)FND-01-6	1'-0"	1)T-FSCS-M2			SOUTH OPGW SPLICES INTO OPGW FROM BEN FRENCH - CAMBELL ST 69KV T.L.
7	17+25	326		28'	44"	LT	TCBP-230-69UB	1)LD-02: 138'-0"	EMBED: 18'-0"			2)DPR-OPGW-2T1	6)DPR-1272-2T1	
8	20+51	335					TCBP-230-69UB	1)LD-02: 133'-0"	EMBED: 18'-0"			2)DPR-OPGW-T1	6)DPR-1272-T1	
9	23+86	351		04'	34"	RT	TCBP-230-69UB	1)LD-02: 133'-0"	EMBED: 18'-0"			2)DPR-OPGW-T1	6)DPR-1272-T1	
10	27+36	211			51"	LT	TCBP-230-69UB	1)LD-02: 133'-0"	EMBED: 18'-0"			2)DPR-OPGW-T1	6)DPR-1272-T1	
11	29+47	263					TCBP-230-69UB	1)LD-02: 128'-0"	EMBED: 18'-0"			2)DPR-OPGW-T1	6)DPR-1272-T1	
12	32+10	179		15'	41"	LT	TCBP-230-69UB	1)LD-02: 128'-0"	EMBED: 18'-0"			2)DPR-OPGW-T1	6)DPR-1272-T1	
13	33+89	218					TCBP-230-69UB	1)LD-02: 128'-0"	EMBED: 18'-0"			2)DPR-OPGW-T1	6)DPR-1272-T1	
14	36+07	216		13'	30"	LT	TCBP-230-69UB	1)LD-02: 123'-0"	EMBED: 18'-0"			2)DPR-OPGW-T1	6)DPR-1272-T1	
15	38+23		89° 91°	08' 43'	47" 48"	LT RT	DCDADE-230-M2	1)LD-09: 105'-0"	1)FND-01-7	1'-0"	1)T-FSCS-M3			SEE RETIREMENT STAKING SHEETS FOR EXISTING 3-POLE RETIREMENT. SOUTH OPGW SPLICES INTO OPGW FROM BEN FRENCH - CAMBELL ST 69KV T.L.
L-SRC-18	130+94	368					[H-FRAME TAN]	[2)POLE]						
L-SRC-19	134+62	394		08'	59"	RT	[H-FRAME TAN]	[2)POLE]						
L-SRC-20	138+56	383					SCBP-230-2S	1)LD-03: 131'-0"	EMBED: 18'-0"			2)DPR-EHS-2T1	6)DPR-1272-2T1	SEE RETIREMENT STAKING SHEETS FOR EXISTING POLE RETIREMENT.
15	142+39 BOL 38+23 WRC 142+39 AOL	345		52'	12"	RT	SEE STR 15 ABOVE	SEE STR 15 ABOVE	SEE STR 15 ABOVE	SEE STR 15 ABOVE	SEE STR 15 ABOVE			SEE STR 15 ABOVE.
L-SRC-22	145+84	462	1°	07'	53"	LT	[MONO-POLE TAN]	[1)STEEL POLE]						
L-SRC-23	150+46	332		02'	47"	RT	[MONO-POLE TAN]	[1)STEEL POLE]						

SEE BEN FRENCH – CAMBELL ST 69KV PACKAGE FOR UNDERBUILD ASSEMBLIES.

NOTES:

XXX NEW
[XXX] EXISTING
*XXX RETIRE

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

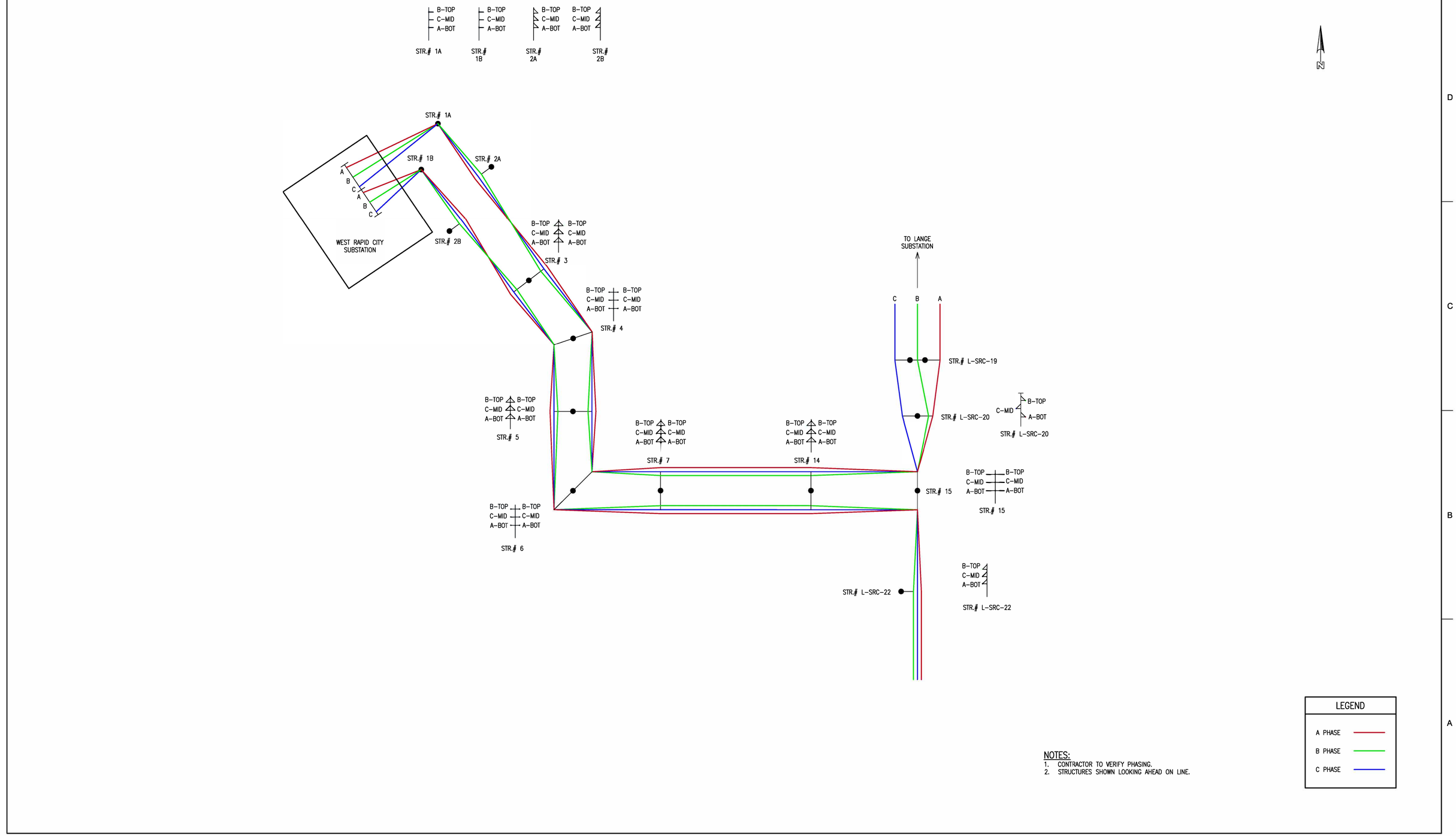
WEST RAPID CITY
230KV TRANSMISSION LINE

STAKING SHEETS

0 1" 2"

FILENAME BHE-SS-01-D-1.DWG
SCALE NONE

SHEET **SS-01**



LEGEND

- A PHASE
- B PHASE
- C PHASE

NOTES:
1. CONTRACTOR TO VERIFY PHASING.
2. STRUCTURES SHOWN LOOKING AHEAD ON LINE.

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

Black Hills Energy
Improving life with energy

HDR

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

PHASING DIAGRAM

0 1" 2"

FILENAME BHE–PH–01–D–1.DWG
SCALE N.T.S.

SHEET **PH-01**

INITIAL SAG TABLE			1272 KCMIL 45/7 ACSR "BITTERN" 2000# @ NESC HEAVY LOADING														SUB DE to 1A														
			SAG FT														3RD WAVE TIME SEC.														
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
SUB DE	191	191	6.62	6.75	6.88	6.99	7.11	7.21	7.33	7.43	7.52	7.63	7.73	7.84	7.93	8.03	8.09	7.70	7.77	7.84	7.91	7.98	8.03	8.10	8.15	8.20	8.26	8.31	8.37	8.42	8.47	8.51	
SUB-PHASE TENS. LBS			980	962	944	928	912	900	886	874	863	850	840	828	819	809	802																SUBTOTAL DAMPERS NEEDED:0

INITIAL SAG TABLE			1272 KCMIL 45/7 ACSR "BITTERN" 2000# @ NESC HEAVY LOADING														SUB DE to 1B														
			SAG FT														3RD WAVE TIME SEC.														
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
SUB DE	156	156	4.23	4.36	4.49	4.61	4.72	4.83	4.93	5.03	5.13	5.22	5.32	5.41	5.51	5.60	5.64	6.15	6.25	6.33	6.42	6.50	6.57	6.64	6.71	6.77	6.84	6.90	6.96	7.02	7.08	7.11	
SUB-PHASE TENS. LBS			1015	984	958	933	911	890	872	855	838	823	808	794	780	768	762																SUBTOTAL DAMPERS NEEDED:0

INITIAL SAG TABLE			1272 KCMIL 45/7 ACSR "BITTERN" 11345# @ NESC HEAVY LOADING														1A to 4														
			SAG FT														3RD WAVE TIME SEC.														
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
1A	260	177	0.49	0.52	0.56	0.60	0.65	0.71	0.78	0.85	0.94	1.05	1.16	1.28	1.41	1.54	1.68	2.10	2.16	2.24	2.62	2.41	2.52	2.63	2.76	2.91	3.06	3.22	3.39	3.55	3.71	3.87	
2A		280	1.23	1.30	1.39	1.50	1.62	1.77	1.93	2.13	2.35	2.61	2.89	3.20	3.52	3.85	4.18	3.31	3.42	3.53	3.66	3.81	3.97	4.16	4.36	4.59	4.83	5.09	5.35	5.61	5.87	6.12	3)DPR-1272-2T1
3		296	1.41	1.50	1.61	1.73	1.87	2.03	2.23	2.45	2.71	3.01	3.33	3.69	4.05	4.43	4.82	3.55	3.67	3.79	3.93	4.09	4.27	4.47	4.68	4.92	5.18	5.46	5.74	6.02	6.30	6.57	3)DPR-1272-T1 AOL
SUB-PHASE TENS. LBS			11457	10768	10072	9358	8659	7957	7262	6599	5971	5386	4859	4392	3993	3653	3360																SUBTOTAL DAMPERS NEEDED:9

INITIAL SAG TABLES			1272 KCMIL 45/7 ACSR "BITTERN" 11360# @ NESC HEAVY LOADING														1B to 4														
			SAG FT														3RD WAVE TIME SEC.														
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
1B	260	164	0.42	0.45	0.48	0.52	0.56	0.61	0.67	0.73	0.81	0.90	1.00	1.10	1.21	1.32	1.44	1.94	2.00	2.07	2.15	2.24	2.33	2.44	2.56	2.69	2.83	2.98	3.14	3.29	3.44	3.59	
2B		246	0.94	1.00	1.07	1.15	1.24	1.35	1.48	1.63	1.80	2.00	2.21	2.45	2.69	2.95	3.20	2.90	2.99	3.09	3.21	3.33	3.48	3.64	3.82	4.01	4.23	4.45	4.68	4.91	5.13	5.35	3)DPR-1272-2T1
3		296	1.32	1.41	1.51	1.62	1.75	1.91	2.09	2.30	2.54	2.82	3.12	3.46	3.80	4.16	4.52	3.44	3.55	3.67	3.81	3.96	4.13	4.32	4.54	4.77	5.02	5.29	5.56	5.83	6.10	6.36	3)DPR-1272-T1 AOL
SUB-PHASE TENS. LBS			11457	10768	10072	9358	8659	7957	7262	6599	5971	5386	4859	4392	3993	3653	3360																SUBTOTAL DAMPERS NEEDED:9

INITIAL SAG TABLES			1272 KCMIL 45/7 ACSR "BITTERN" 11190# @ NESC HEAVY LOADING														4 to 6 (EAST CIRCUIT)														
			SAG FT														3RD WAVE TIME SEC.														
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
4	250	178	0.46	0.49	0.52	0.56	0.61	0.66	0.72	0.80	0.88	0.98	1.09	1.21	1.33	1.47	1.60	2.03	2.09	2.16	2.24	2.33	2.43	2.54	2.67	2.81	2.96	3.12	3.29	3.45	3.62	3.78	
5		290	1.38	1.47	1.57	1.69	1.82	1.98	2.17	2.39	2.65	2.94	3.27	3.63	4.01	4.41	4.81	3.51	3.62	3.74	3.88	4.04	4.21	4.41	4.63	4.87	5.13	5.41	5.70	5.99	6.28	6.56	3)DPR-1272-2T1
SUB-PHASE TENS. LBS			11591	10904	10200	9489	8771	8059	7366	6681	6043	5435	4890	4404	3987	3628	3328																SUBTOTAL DAMPERS NEEDED:6

INITIAL SAG TABLES			1272 KCMIL 45/7 ACSR "BITTERN" 11190# @ NESC HEAVY LOADING														4 to 6 (WEST CIRCUIT)														
			SAG FT														3RD WAVE TIME SEC.														
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
4	250	178	0.52	0.55	0.59	0.63	0.68	0.74	0.81	0.89	0.99	1.10	1.22	1.36	1.50	1.65	1.79	2.15	2.21	2.29	2.37	2.47	2.57	2.69	2.83	2.97	3.13	3.30	3.48	3.66	3.84	4.01	
5		290	1.20	1.28	1.36	1.47	1.59	1.73	1.89	2.08	2.30	2.56	2.84	3.16	3.49	3.83	4.18	3.28	3.38	3.49	3.62	3.77	3.93	4.11	4.31	4.54	4.78	5.04	5.31	5.59	5.86	6.11	3)DPR-1272-2T1
SUB-PHASE TENS. LBS			11591	10904	10200	9489	8771	8059	7366	6681	6043	5435	4890	4404	3987	3628	3328																SUBTOTAL DAMPERS NEEDED:6

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

INITIAL SAG TABLES
1272 KCMIL 45/7 ACSR "BITTERN"

0 1" 2"

FILENAME BHE-STC-01-D-1.DWG
SCALE NONE
SHEET STC-01-1

INITIAL SAG TABLE			1272 KCMIL 45/7 ACSR "BITTERN" 11620# @ NESC HEAVY LOADING														6 to 15 (SOUTH CIRCUIT)													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
6	290	315	1.60	1.70	1.81	1.94	2.09	2.26	2.46	2.68	2.95	3.24	3.56	3.91	4.28	4.66	5.04	3.78	3.90	4.02	4.16	4.32	4.49	4.69	4.90	5.13	5.38	5.64	5.92	6.19	6.45	6.71	
7		326	1.62	1.72	1.83	1.96	2.11	2.28	2.48	2.71	2.98	3.28	3.60	3.96	4.33	4.71	5.10	3.80	3.92	4.04	4.18	4.34	4.52	4.71	4.93	5.16	5.41	5.67	5.95	6.22	6.49	6.75	3)DPR-1272-2T1
8		335	1.71	1.81	1.93	2.07	2.23	2.41	2.62	2.86	3.14	3.46	3.80	4.18	4.57	4.97	5.38	3.91	4.02	4.15	4.30	4.46	4.64	4.84	5.06	5.30	5.56	5.83	6.11	6.39	6.67	6.94	3)DPR-1272-T1 AOL
9		351	1.87	1.98	2.11	2.26	2.44	2.64	2.87	3.14	3.44	3.79	4.16	4.57	5.00	5.44	5.89	4.09	4.21	4.35	4.50	4.67	4.86	5.07	5.30	5.55	5.82	6.10	6.39	6.69	6.97	7.26	3)DPR-1272-T1 AOL
10		211	0.67	0.72	0.76	0.82	0.88	0.95	1.04	1.13	1.24	1.37	1.50	1.65	1.80	1.96	2.13	2.46	2.53	2.61	2.70	2.81	2.92	3.04	3.18	3.33	3.50	3.66	3.84	4.02	4.19	4.36	3)DPR-1272-T1 AOL
11		263	1.05	1.11	1.19	1.27	1.37	1.48	1.61	1.76	1.93	2.12	2.33	2.57	2.81	3.05	3.30	3.06	3.15	3.26	3.37	3.50	3.64	3.79	3.97	4.16	4.36	4.57	4.79	5.01	5.23	5.44	3)DPR-1272-T1 AOL
12		179	0.49	0.52	0.55	0.59	0.64	0.69	0.75	0.82	0.90	0.99	1.08	1.19	1.30	1.42	1.54	2.09	2.15	2.22	2.30	2.38	2.48	2.59	2.71	2.83	2.97	3.11	3.27	3.42	3.56	3.71	3)DPR-1272-T1 AOL
13		218	0.72	0.77	0.82	0.87	0.94	1.02	1.11	1.21	1.33	1.46	1.61	1.77	1.93	2.10	2.27	2.54	2.62	2.70	2.79	2.90	3.02	3.15	3.29	3.45	3.62	3.79	3.97	4.16	4.33	4.51	3)DPR-1272-T1 AOL
14		216	0.70	0.75	0.79	0.85	0.92	0.99	1.08	1.18	1.30	1.43	1.57	1.72	1.88	2.05	2.22	2.51	2.58	2.67	2.76	2.86	2.98	3.11	3.25	3.40	3.57	3.74	3.92	4.10	4.28	4.45	3)DPR-1272-T1 AOL
SUB-PHASE TENS. LBS			11805	11123	10445	9750	9048	8364	7688	7032	6411	5826	5304	4824	4411	4055	3746																SUBTOTAL DAMPERS NEEDED:27

INITIAL SAG TABLE			1272 KCMIL 45/7 ACSR "BITTERN" 11620# @ NESC HEAVY LOADING														6 to 15 (NORTH CIRCUIT)													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
6	290	315	1.41	1.49	1.59	1.70	1.83	1.98	2.16	2.36	2.59	2.85	3.13	3.44	3.76	4.09	4.43	3.55	3.65	3.77	3.90	4.05	4.21	4.39	4.60	4.81	5.05	5.29	5.55	5.80	6.05	6.30	
7		326	1.62	1.72	1.83	1.96	2.11	2.28	2.48	2.71	2.98	3.28	3.60	3.96	4.33	4.71	5.10	3.80	3.92	4.04	4.18	4.34	4.52	4.71	4.93	5.16	5.41	5.67	5.95	6.22	6.49	6.75	3)DPR-1272-2T1
8		335	1.71	1.81	1.93	2.07	2.23	2.41	2.62	2.86	3.14	3.46	3.80	4.18	4.57	4.97	5.38	3.91	4.02	4.15	4.30	4.46	4.64	4.84	5.06	5.30	5.56	5.83	6.11	6.39	6.67	6.94	3)DPR-1272-T1 AOL
9		351	1.87	1.98	2.11	2.26	2.44	2.64	2.87	3.14	3.44	3.79	4.16	4.57	5.00	5.44	5.89	4.09	4.21	4.35	4.50	4.67	4.86	5.07	5.30	5.55	5.82	6.10	6.39	6.69	6.97	7.26	3)DPR-1272-T1 AOL
10		211	0.67	0.72	0.76	0.82	0.88	0.95	1.04	1.13	1.24	1.37	1.50	1.65	1.80	1.96	2.12	2.46	2.53	2.61	2.70	2.81	2.92	3.04	3.18	3.33	3.50	3.66	3.84	4.02	4.19	4.36	3)DPR-1272-T1 AOL
11		263	1.05	1.11	1.18	1.27	1.37	1.48	1.61	1.76	1.93	2.12	2.33	2.57	2.81	3.05	3.30	3.06	3.15	3.26	3.37	3.50	3.64	3.79	3.97	4.16	4.36	4.57	4.79	5.01	5.22	5.44	3)DPR-1272-T1 AOL
12		179	0.49	0.52	0.55	0.59	0.64	0.69	0.75	0.82	0.90	0.99	1.08	1.19	1.30	1.42	1.54	2.09	2.15	2.22	2.30	2.38	2.48	2.59	2.70	2.83	2.97	3.11	3.27	3.42	3.56	3.71	3)DPR-1272-T1 AOL
13		218	0.72	0.77	0.81	0.87	0.94	1.02	1.11	1.21	1.33	1.46	1.60	1.76	1.93	2.10	2.27	2.54	2.62	2.70	2.79	2.90	3.02	3.15	3.29	3.45	3.61	3.79	3.97	4.15	4.33	4.51	3)DPR-1272-T1 AOL
14		216	0.70	0.75	0.80	0.85	0.92	0.99	1.08	1.18	1.30	1.43	1.57	1.72	1.88	2.05	2.22	2.51	2.59	2.67	2.76	2.87	2.98	3.11	3.25	3.41	3.57	3.74	3.93	4.11	4.28	4.45	3)DPR-1272-T1 AOL
SUB-PHASE TENS. LBS			11805	11123	10445	9750	9048	8364	7688	7032	6411	5826	5304	4824	4411	4055	3746																SUBTOTAL DAMPERS NEEDED:27

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

INITIAL SAG TABLES

1272 KCMIL 45/7 ACSR "BITTERN"

0 1" 2"

FILENAME BHE-STC-01-D-2.DWG

SCALE NONE

SHEET **STC-01-2**

FINAL SAG TABLE			1272 KCMIL 45/7 ACSR "BITTERN" 12910# INITIAL @ NESC HEAVY LOADING														15 to L-SRC-20													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
15	922	383	3.80	3.91	4.03	4.14	4.25	4.35	4.46	4.56	4.66	4.77	4.86	4.96	5.06	5.15	5.25	5.83	5.92	6.00	6.08	6.16	6.24	6.31	6.39	6.46	6.53	6.60	6.66	6.73	6.79	6.85	
L-SRC-20																																	3)DPR-1272-2T1
SUB-PHASE TENS. LBS			6775	6579	6394	6225	6064	5917	5777	5645	5521	5403	5293	5189	5089	4996	4906																SUBTOTAL DAMPERS NEEDED:6

FINAL SAG TABLE			1272 KCMIL 45/7 ACSR "BITTERN" 12690# @ NESC HEAVY LOADING														15 to L-SRC-22													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
15	448	345	2.08	2.27	2.48	2.71	2.94	3.19	3.44	3.69	3.95	4.20	4.45	4.69	4.93	5.16	5.39	4.32	4.51	4.71	4.92	5.13	5.34	5.55	5.75	5.94	6.13	6.31	6.48	6.64	6.79	6.94	
SUB-PHASE TENS. LBS			9730	8917	8166	7492	6890	6357	5895	5487	5135	4829	4562	4322	4114	3929	3764																SUBTOTAL DAMPERS NEEDED:0

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

FINAL SAG TABLES

1272 KCMIL 45/7 ACSR "BITTERN"

0 1" 2"

FILENAME BHE-STC-02-D-1.DWG
SCALE NONE

SHEET **STC-02-1**

INITIAL SAG TABLE			AFL CC-55/443 "DNO-4748" OPGW 1000# @ NESC HEAVY LOADING														SUB DE to 1A														
			SAG FT														3RD WAVE TIME SEC.														
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
SUB DE	191	191	5.71	5.81	5.91	6.01	6.10	6.19	6.29	6.38	6.47	6.56	6.65	6.73	6.82	6.90	6.99	7.15	7.21	7.27	7.33	7.39	7.44	7.50	7.55	7.60	7.66	7.71	7.76	7.81	7.86	7.91	
SUB-PHASE TENS. LBS			241	237	233	229	225	222	219	215	213	210	207	204	202	199	197																SUBTOTAL DAMPERS NEEDED:0

INITIAL SAG TABLE			AFL CC-55/443 "DNO-4748" OPGW 1000# @ NESC HEAVY LOADING														SUB DE to 1B														
			SAG FT														3RD WAVE TIME SEC.														
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
SUB DE	156	156	3.60	3.71	3.81	3.91	4.00	4.10	4.19	4.28	4.37	4.46	4.55	4.63	4.72	4.80	4.88	5.68	5.76	5.83	5.91	5.98	6.06	6.12	6.19	6.25	6.32	6.38	6.44	6.49	6.55	6.60	
SUB-PHASE TENS. LBS			257	250	243	237	231	226	221	216	212	207	204	200	196	193	190																SUBTOTAL DAMPERS NEEDED:0

INITIAL SAG TABLE			AFL CC-55/443 "DNO-4748" OPGW 2840# @ NESC HEAVY LOADING														1A to 4														
			SAG FT														3RD WAVE TIME SEC.														
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
1A	260	177	0.54	0.58	0.61	0.66	0.70	0.75	0.81	0.88	0.95	1.02	1.10	1.19	1.28	1.37	1.46	2.20	2.27	2.34	2.42	2.51	2.60	2.70	2.80	2.91	3.02	3.14	3.26	3.38	3.50	3.61	
2A		280	1.35	1.44	1.53	1.64	1.75	1.88	2.03	2.18	2.36	2.55	2.75	2.96	3.18	3.41	3.65	3.48	3.58	3.70	3.83	3.96	4.10	4.26	4.42	4.59	4.77	4.96	5.15	5.34	5.52	5.71	1)DPR-OPGW-2T1
3		296	1.52	1.62	1.73	1.85	1.98	2.12	2.29	2.46	2.66	2.87	3.10	3.34	3.59	3.85	4.11	3.69	3.81	3.93	4.06	4.20	4.36	4.52	4.70	4.88	5.07	5.26	5.47	5.67	5.87	6.07	1)DPR-OPGW-T1 AOL
SUB-PHASE TENS. LBS			2124	1999	1875	1754	1638	1525	1415	1314	1217	1127	1045	969	902	842	787																SUBTOTAL DAMPERS NEEDED:3

INITIAL SAG TABLE			AFL CC-55/443 "DNO-4748" OPGW 2840# @ NESC HEAVY LOADING														1B to 4														
			SAG FT														3RD WAVE TIME SEC.														
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
1B	260	164	0.46	0.49	0.52	0.56	0.60	0.64	0.69	0.75	0.81	0.87	0.94	1.01	1.09	1.17	1.25	2.03	2.10	2.17	2.24	2.32	2.40	2.49	2.59	2.69	2.79	2.90	3.01	3.12	3.23	3.34	
2B		245	1.03	1.10	1.17	1.25	1.34	1.44	1.55	1.67	1.81	1.95	2.10	2.27	2.44	2.61	2.79	3.04	3.14	3.24	3.35	3.46	3.59	3.73	3.87	4.02	4.18	4.34	4.50	4.67	4.83	5.00	1)DPR-OPGW-2T1
3		296	1.48	1.58	1.68	1.80	1.92	2.07	2.23	2.40	2.59	2.79	3.01	3.25	3.49	3.74	4.00	3.64	3.75	3.88	4.01	4.15	4.30	4.46	4.63	4.81	5.00	5.19	5.39	5.59	5.78	5.98	1)DPR-OPGW-T1 AOL
SUB-PHASE TENS. LBS			2124	1999	1875	1754	1638	1525	1415	1314	1217	1127	1045	969	902	842	787																SUBTOTAL DAMPERS NEEDED:3

INITIAL SAG TABLE			AFL CC-55/443 "DNO-4748" OPGW 2780# @ NESC HEAVY LOADING														4 to 6 (EAST OPGW)														
			SAG FT														3RD WAVE TIME SEC.														
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
4	250	178	0.55	0.58	0.62	0.67	0.71	0.77	0.83	0.89	0.96	1.04	1.13	1.22	1.31	1.41	1.51	2.22	2.28	2.36	2.44	2.53	2.62	2.72	2.82	2.94	3.05	3.18	3.30	3.43	3.55	3.68	
5		290	1.38	1.47	1.56	1.67	1.79	1.93	2.07	2.24	2.42	2.62	2.83	3.06	3.30	3.54	3.79	3.51	3.62	3.74	3.87	4.00	4.15	4.31	4.47	4.65	4.84	5.03	5.23	5.43	5.63	5.82	1)DPR-OPGW-2T1
SUB-PHASE TENS. LBS			2143	2015	1888	1767	1648	1533	1423	1319	1219	1127	1043	966	895	833	779																SUBTOTAL DAMPERS NEEDED:2

INITIAL SAG TABLE			AFL CC-55/443 "DNO-4748" OPGW 2780# @ NESC HEAVY LOADING														4 to 6 (WEST OPGW)														
			SAG FT														3RD WAVE TIME SEC.														
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
4	250	178	0.52	0.55	0.59	0.63	0.68	0.73	0.78	0.85	0.92	0.99	1.07	1.16	1.25	1.34	1.43	2.16	2.23	2.30	2.38	2.46	2.55	2.65	2.75	2.86	2.98	3.09	3.22	3.34	3.46	3.58	
5		290	1.47	1.56	1.67	1.78	1.91	2.06	2.21	2.39	2.58	2.80	3.02	3.26	3.52	3.78	4.05	3.63	3.74	3.86	3.99	4.14	4.29	4.45	4.62	4.81	5.00	5.20	5.40	5.61	5.82	6.02	1)DPR-OPGW-2T1
SUB-PHASE TENS. LBS			2143	2015	1888	1767	1648	1533	1423	1319	1219	1127	1043	966	895	833	779																SUBTOTAL DAMPERS NEEDED:2

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

INITIAL SAG TABLES
AFL CC-55/443 "DNO-4748" OPGW

0 1" 2"

FILENAME BHE-STF-01-D-1.DWG
SCALE NONE
SHEET STF-01-1

INITIAL SAG TABLE			AFL CC-55/443 "DNO-4748" OPGW 2995# @ NESC HEAVY LOADING														6 to 15 (NORTH OPGW)													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
6	290	315	1.60	1.69	1.80	1.92	2.05	2.19	2.34	2.52	2.70	2.90	3.11	3.34	3.57	3.82	4.06	3.78	3.89	4.01	4.14	4.28	4.42	4.58	4.74	4.92	5.09	5.28	5.46	5.65	5.84	6.02	
7		326	1.76	1.87	1.99	2.12	2.26	2.42	2.59	2.78	2.99	3.21	3.44	3.69	3.95	4.22	4.48	3.97	4.09	4.22	4.35	4.50	4.65	4.81	4.99	5.17	5.35	5.55	5.74	5.94	6.14	6.33	1)DPR-OPGW-2T1
8		335	1.86	1.97	2.10	2.24	2.39	2.55	2.73	2.93	3.15	3.38	3.63	3.89	4.17	4.45	4.73	4.08	4.20	4.33	4.47	4.62	4.78	4.94	5.12	5.31	5.50	5.70	5.90	6.11	6.31	6.51	1)DPR-OPGW-T1 AOL
9		351	2.04	2.16	2.30	2.45	2.61	2.79	2.99	3.21	3.45	3.70	3.98	4.26	4.56	4.87	5.18	4.27	4.40	4.53	4.68	4.83	5.00	5.17	5.36	5.55	5.76	5.96	6.17	6.39	6.60	6.81	1)DPR-OPGW-T1 AOL
10		211	0.74	0.78	0.83	0.88	0.94	1.01	1.08	1.16	1.25	1.34	1.44	1.54	1.65	1.76	1.87	2.56	2.64	2.72	2.81	2.90	3.00	3.11	3.22	3.34	3.46	3.58	3.71	3.84	3.97	4.09	1)DPR-OPGW-T1 AOL
11		263	1.14	1.21	1.29	1.37	1.47	1.57	1.68	1.80	1.94	2.08	2.23	2.39	2.56	2.73	2.91	3.20	3.29	3.40	3.50	3.62	3.74	3.87	4.02	4.16	4.31	4.47	4.63	4.79	4.95	5.10	1)DPR-OPGW-T1 AOL
12		179	0.53	0.56	0.60	0.64	0.68	0.73	0.78	0.84	0.90	0.97	1.04	1.11	1.19	1.27	1.35	2.18	2.24	2.32	2.39	2.47	2.55	2.64	2.74	2.84	2.94	3.05	3.15	3.26	3.37	3.48	1)DPR-OPGW-T1 AOL
13		218	0.79	0.83	0.89	0.94	1.01	1.08	1.15	1.24	1.33	1.43	1.53	1.65	1.76	1.88	2.00	2.65	2.73	2.82	2.91	3.00	3.10	3.21	3.33	3.45	3.58	3.70	3.84	3.97	4.10	4.23	1)DPR-OPGW-T1 AOL
14		216	0.77	0.81	0.87	0.92	0.99	1.05	1.13	1.21	1.30	1.40	1.50	1.61	1.72	1.84	1.95	2.62	2.70	2.78	2.87	2.97	3.07	3.18	3.29	3.41	3.53	3.66	3.79	3.92	4.05	4.18	1)DPR-OPGW-T1 AOL
SUB-PHASE TENS. LBS			2203	2079	1954	1835	1719	1609	1501	1398	1302	1212	1129	1054	984	922	867																SUBTOTAL DAMPERS NEEDED:9

INITIAL SAG TABLE			AFL CC-55/443 "DNO-4748" OPGW 2995# @ NESC HEAVY LOADING														6 to 15 (SOUTH OPGW)													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
6	290	315	1.69	1.80	1.91	2.03	2.17	2.32	2.49	2.67	2.87	3.08	3.31	3.54	3.79	4.05	4.31	3.89	4.01	4.13	4.27	4.41	4.56	4.72	4.89	5.07	5.25	5.44	5.63	5.83	6.02	6.21	
7		326	1.76	1.87	1.99	2.12	2.26	2.42	2.59	2.78	2.99	3.21	3.44	3.69	3.95	4.22	4.49	3.97	4.09	4.22	4.35	4.50	4.65	4.81	4.99	5.17	5.36	5.55	5.75	5.94	6.14	6.33	1)DPR-OPGW-2T1
8		335	1.86	1.97	2.10	2.24	2.39	2.55	2.73	2.93	3.15	3.38	3.63	3.89	4.17	4.45	4.73	4.08	4.20	4.33	4.47	4.62	4.78	4.94	5.12	5.31	5.50	5.70	5.90	6.11	6.31	6.51	1)DPR-OPGW-T1 AOL
9		351	2.04	2.16	2.30	2.45	2.61	2.79	2.99	3.21	3.45	3.70	3.98	4.26	4.56	4.87	5.18	4.27	4.40	4.53	4.68	4.83	5.00	5.17	5.36	5.55	5.76	5.96	6.17	6.39	6.60	6.81	1)DPR-OPGW-T1 AOL
10		211	0.74	0.78	0.83	0.88	0.94	1.01	1.08	1.16	1.25	1.34	1.44	1.54	1.65	1.76	1.87	2.56	2.64	2.72	2.81	2.90	3.00	3.11	3.22	3.34	3.46	3.58	3.71	3.84	3.97	4.09	1)DPR-OPGW-T1 AOL
11		263	1.14	1.21	1.29	1.37	1.47	1.57	1.68	1.80	1.94	2.08	2.23	2.39	2.56	2.74	2.91	3.20	3.29	3.40	3.50	3.62	3.74	3.88	4.02	4.16	4.31	4.47	4.63	4.79	4.95	5.10	1)DPR-OPGW-T1 AOL
12		179	0.53	0.56	0.60	0.64	0.68	0.73	0.78	0.84	0.90	0.97	1.04	1.11	1.19	1.27	1.35	2.18	2.25	2.32	2.39	2.47	2.55	2.64	2.74	2.84	2.94	3.05	3.15	3.26	3.37	3.48	1)DPR-OPGW-T1 AOL
13		218	0.79	0.83	0.89	0.94	1.01	1.08	1.15	1.24	1.33	1.43	1.53	1.65	1.76	1.88	2.00	2.65	2.73	2.82	2.91	3.00	3.10	3.21	3.33	3.45	3.58	3.71	3.84	3.97	4.10	4.23	1)DPR-OPGW-T1 AOL
14		216	0.77	0.81	0.87	0.92	0.98	1.05	1.13	1.21	1.30	1.40	1.50	1.61	1.72	1.84	1.95	2.62	2.70	2.78	2.87	2.97	3.07	3.18	3.29	3.41	3.53	3.66	3.79	3.92	4.05	4.18	1)DPR-OPGW-T1 AOL
SUB-PHASE TENS. LBS			2203	2079	1954	1835	1719	1609	1501	1398	1302	1212	1129	1054	984	922	867																SUBTOTAL DAMPERS NEEDED:9

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

INITIAL SAG TABLES

AFL CC-55/443 "DNO-4748" OPGW

0 1" 2"

FILENAME BHE-STF-01-D-2.DWG

SCALE NONE

SHEET **STF-01-2**

INITIAL SAG TABLE			3/8" 7 STRAND EHS 930# @ NESC HEAVY LOADING														SUB DE to 1A														
			SAG FT														3RD WAVE TIME SEC.														
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
SUB DE	191	191	5.92	5.99	6.07	6.14	6.22	6.29	6.36	6.44	6.50	6.58	6.65	6.71	6.78	6.85	6.92	7.28	7.32	7.37	7.41	7.46	7.50	7.54	7.59	7.63	7.67	7.71	7.75	7.79	7.83	7.87	
SUB-PHASE TENS. LBS			217	214	212	209	207	204	202	200	198	195	193	191	190	188	186																SUBTOTAL DAMPERS NEEDED:0

INITIAL SAG TABLE			3/8" 7 STRAND EHS 925# @ NESC HEAVY LOADING														SUB DE to 1B														
			SAG FT														3RD WAVE TIME SEC.														
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
SUB DE	156	156	3.79	3.87	3.95	4.02	4.10	4.17	4.24	4.31	4.38	4.46	4.52	4.59	4.66	4.72	4.79	5.82	5.88	5.94	6.00	6.05	6.11	6.16	6.21	6.26	6.31	6.36	6.41	6.45	6.50	6.55	
SUB-PHASE TENS. LBS			228	224	219	215	211	208	204	201	197	194	191	188	186	183	181																SUBTOTAL DAMPERS NEEDED:0

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

INITIAL SAG TABLES

3/8" 7 STRAND EHS

0 1" 2"

FILENAME BHE-STS-01-D-1.DWG

SCALE NONE

SHEET **STS-01-1**

FINAL SAG TABLE			3/8" 7 STRAND HS 4780# @ NESC HEAVY LOADING														15 to L-SRC-20 (WEST OHGW)													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
15	922	383	2.80	2.87	2.93	3.00	3.07	3.14	3.21	3.27	3.34	3.41	3.48	3.54	3.61	3.68	3.75	5.00	5.06	5.12	5.18	5.24	5.30	5.35	5.41	5.47	5.52	5.58	5.63	5.68	5.74	5.79	
L-SRC-20																																	1)DPR-EHS-2T1
SUB-PHASE TENS. LBS			1785	1743	1703	1663	1627	1592	1558	1526	1495	1465	1436	1409	1382	1357	1333																SUBTOTAL DAMPERS NEEDED:2

FINAL SAG TABLE			3/8" 7 STRAND HS 4555# @ NESC HEAVY LOADING														15 to L-SRC-20 (EAST OHGW)													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
15	922	383	3.20	3.27	3.33	3.40	3.47	3.54	3.60	3.67	3.73	3.80	3.86	3.93	3.99	4.06	4.12	5.35	5.41	5.46	5.52	5.57	5.62	5.68	5.73	5.78	5.83	5.88	5.93	5.98	6.02	6.07	
L-SRC-20																																	1)DPR-EHS-2T1
SUB-PHASE TENS. LBS			1561	1528	1498	1468	1440	1413	1387	1362	1338	1315	1293	1272	1251	1232	1212																SUBTOTAL DAMPERS NEEDED:2

FINAL SAG TABLE			3/8" 7 STRAND HS 3685# @ NESC HEAVY LOADING														15 to L-SRC-22													
			SAG FT														3RD WAVE TIME SEC.													
STR #	RULING SPAN FT	AHEAD SPAN FT	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	-20 F	-10 F	0 F	10 F	20 F	30 F	40 F	50 F	60 F	70 F	80 F	90 F	100 F	110 F	120 F	VIBRATION DAMPER PLACEMENT
15	448	345	1.64	1.72	1.79	1.87	1.96	2.05	2.15	2.26	2.36	2.49	2.62	2.74	2.88	3.02	3.16	3.83	3.92	4.00	4.10	4.19	4.29	4.39	4.49	4.60	4.72	4.84	4.95	5.08	5.20	5.32	
SUB-PHASE TENS. LBS			2378	2279	2180	2085	1993	1903	1814	1731	1653	1572	1495	1424	1357	1295	1237																SUBTOTAL DAMPERS NEEDED:0

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

FINAL SAG TABLES

3/8" 7 STRAND HS

0 1" 2"

FILENAME BHE-STS-02-D-1.DWG

SCALE NONE

SHEET **STS-02-1**

		DCBP-230	TCBP-230-69UB	SCBP-230-25	DCBPRA-230-M1	SCDE-230-M1	DCDADE-230	DCDADE-230-M1	DCDADE-230-M2	DT-01-230	T-FSCS-M2	T-FSCS-M3	DPR-EHS-2T1	DPR-OPGW-T1	DPR-OPGW-2T1	DPR-1272-T1	DPR-1272-2T1	3/8" EHS	DNO-4748	1272 ACSR	3/8 HS SPLICE	1272 ACSR SPLICE	EXTRA
	QTY:	2	8	1	2	2	1	1	1	2	1	1	2	16	6	48	24	700	9600	26250	1	9	1
ASSEMBLY NO.	QTY																						
T-4S	2			2																			
T-4D	2									1													
T-4DS	5					1			3														
T-4SF	22	2	2		1																		
T-4FDS	16					2	4	4	2	1													
T-FSCS-M2	1										1												
T-FSCS-M3	1											1											
T-J13	12						6	6															
T-BP-S-230	21	6		3	3																		
T-BP-S-230-CD	48		6																				
TD-2C	24		3																				
T-CDE15	30					3	6	6	12														
T-SDE15	6									3													
T-CDE15-15EXT	12					3	6																
T-CDE15-36EXT	6							6															
TM-9ST	18	1	1	1	1	1	1	1	1														
TM-9SD-1	2				1																		
TM-9SD-2	14	1	1	1			1	1	1														
TM-9SSJ	30	2	2	2	2	1	2																
DPR-EHS-2T1	2												1										
DPR-OPGW-T1	16													1									
DPR-OPGW-2T1	6														1								
DPR-1272-T1	48															1							
DPR-1272-2T1	24																1						
3/8" EHS	700																	1					
DNO-4748	9600																		1				
1272 ACSR	26250																			1			
3/8 HS SPLICE	1																				1		
1272 ACSR SPLICE	9																					1	
Q551	2									1													
Q552	2									1													

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

WEST RAPID CITY
230KV TRANSMISSION LINE

MATERIAL LIST
LIST OF ASSEMBLIES

0 1" 2"

FILENAME BHE-ML-01-D-1.DWG
SCALE NONE

SHEET **ML-01-1**

ITEM NO.	QTY	DESCRIPTION	MANUFACTURER	MANUFACTURER PART #	CLIENT #	T-4S	T-4D	T-4DS	T-4SF	T-4HDS	T-FSCS-M2	T-FSCS-M3	T-J13	T-BPS-230	T-BPS-230-CD	TD-2C	T-CDE15	T-SDE15	T-CDE15-15EXT	T-CDE15-36EXT	TM-9ST	TM-9SD-1	TM-9SD-2	TM-9SSJ	DPR-EHS-2T1	DPR-ORGW-T1	DPR-ORGW-2T1	DPR-1272-T1	DPR-1272-2T1	3/8" EHS	DNO-4748	1272 ACSR	3/8 EHS SPLICE	1272 ACSR SPLICE	QS51	QS52	EXTRA
					QTY:	2	2	5	22	16	1	1	12	21	48	24	30	6	12	6	18	2	14	30	2	16	6	48	24	700	9600	26250	1	9	2	2	1
B603	105	WASHER, ROUND FLAT, STAINLESS STEEL, 1/2"	BURNDY	50 FWSS	N.S.	1		1	1	1												2	4														
B605	105	WASHER, SPLIT LOCK, STAINLESS STEEL, 1/2"	BURNDY	50 SWSSMD	N.S.	1		1	1	1												2	4														
B606	48	BOLT, NUT, BELLEVILLE, FLAT, STAINLESS STEEL, ASSEMBLY	CMC	SBA20-50	N.S.													8																			
B614	105	BOLT, STAINLESS STEEL, 1/2" X 1 1/4"	FASTENAL	70207	N.S.	1		1	1	1												2	4														
B772.5	84	BOLT, HEX HEAD, 7/8" X 2 1/2"	HUGHES	HB82-1/2-2	N.S.									4																							
C110	26250	CONDUCTOR, 1272 KCMIL ACSR, 45/7 "BITTERN"	SOUTHWIRE		N.S.																										1						
C800	700	WIRE, GALVANIZED, 7 STEEL STRAND, 3/8" EHS	MITCHELL		N.S.																								1								
C902	492	WIRE, COPPER, #2 STRANDED, CLASS B	SOUTHWIRE		N.S.	6		6													10	5	10	4													
D17120	24	ROD, FULL THREADED, 7/8" X 120", ASTM A307 GRADE B	PORTLAND BOLT	13919-10'	N.S.											1																					
H102	7	SOCKET EYE, 18K, 1/2" WIDTH, 11/16" HOLE, 2-1/16" LENGTH	HUBBELL	SA04	N.S.		1	1																													
H200	54	SOCKET CLEVIS, 30K	HUBBELL	SC30	N.S.												1	1	1	1																	
H401	12	HOT LINK EXTENSION, Y-CLEVIS,BALL, 15" LONG, 30K LBS	HUBBELL	HYBC3015	N.S.														1																		
H402	6	HOT LINK EXTENSION, Y-CLEVIS,BALL, 36" LONG, 30K LBS	HUBBELL	HYBC3036	N.S.															1																	
H500	55	Y-CLEVIS BALL, 30K	HUBBELL	YBC30	48-3054		1	1					1				1	1																			
H602	16	ANCHOR, SHACKLE, 3" LONG, 3/4" DIA., 7/8" DIA. PIN, 35K LBS	HUGHES	2865-B3	N.S.					1																											
H901	24	Y-CLEVIS, EYE, 90, 20K	ANDERSON	YCS-05-90	48-5207	1			1																												
H903	69	Y-CLEVIS, EYE, 25K	PREFORMED	YC-5209	N.S.									1	1																						
I100	156	GLASS INSULATOR, 22K LB, M&E, ANSI CL 52-3, 10" X 5 3/4"	SEDIVER	N100/146	480027								13																								
I102	810	GLASS INSULATOR, 30K LB, M&E, ANSI CL 52-5, 10" X 5 3/4"	SEDIVER	N14/146	480028												15	15	15	15																	
I280	21	INSULATOR, HORIZONTAL BRACED POST ASSEMBLY, FLAT BASE, 230KV	HUBBELL	BLP080F12000	N.S.									1																							
I282	48	INSULATOR, HORIZONTAL BRACED POST ASSEMBLY, GAIN BASE, 230KV	HUBBELL	BLP075G12000	N.S.										1																						
J100	9600	AFL CC-55/443 "DNO-4748" OPGW	AFL	DNO-4748	N.S.																									1							
J200	22	FIBERLIGN SUSPENSION ASSY. W/ GROUNDWIRE	PREFORMED	4300104G	N.S.				1																												
J300	16	FIBER OPTIC DEADEND, 18" U-BOLT (48 FIBER), W/ GROUND WIRE	PREFORMED	2801303G	N.S.					1																											
J403	80	DOWNLEAD CUSHION KIT, 0.443 OPGW W/ 1/2"-13 X 3" MOUNTING KIT	PREFORMED	8003041-H3	N.S.						40	40																									
J501	4	VERTICAL CABLE STORAGE ASSEMBLY	PREFORMED	8003569	N.S.						2	2																									
J502	4	VERTICAL MOUNTING BRACKET KIT	PREFORMED	8003472	N.S.						2	2																									
J510	4	6" X 22" COYOTE CLOSURE KIT W/ 6 PORT END PLATE	PREFORMED	8006659	N.S.						2	2																									
J511	4	COYOTE DEFENDER FOR 6" X 22" CLOSURE	PREFORMED	8003492	N.S.						2	2																									
J600	12	SPLICE TRAY KIT, 36 COUNT TRAY	PREFORMED	80805514	N.S.						6	6																									
J700	8	CLOSURE END PLATE GROMMETS, 7/8" PORT, 0.443"	PREFORMED	8003597	N.S.						5	3																									
J720	8	FUTURE CABLE PORT KIT, 7/8" PORT	PREFORMED	8003371	N.S.						3	5																									
J730	4	GROMMET PLUG, 3/4" PORT, QTY 2	PREFORMED	80806037	N.S.						2	2																									
J950	120	BOLT-A-BAND 3/4" X REQ'D LENGTH	PREFORMED	BAB-38XX	N.S.						60	60																									
J951	4	BUCKLE, BANDING, FOR 3/4" BANDING	PREFORMED	BAB-38	N.S.						2	2																									
K104	12	SUSPENSION CLAMP, 1.00"-1.47" RANGE, W/ SOCKET, 25K	HUBBELL	HAS-147-S	N.S.								1																								
K400	2	AGS SUSPENSION ASSEMBLY, 15K, 3/8" EHS	PREFORMED	AGS-7104	40-7104	1																															
K580	69	AGS SUSPENSION ASSEMBLY, 25K, 1272 ACSR-45/7 "BITTERN"	PREFORMED	AGS-5139	N.S.									1	1																						
L300	7	STRAIN CLAMP, DE, 20K, 3/8" EHS	HUBBELL	SWDE55N	44-4053		1	1																													
L403	48	COMPRESSION DEADEND ASSY. W/ 15° TERMINAL, "BITTERN"	AFL	VES-153	N.S.												1		1	1																	
L503	6	COMPRESSION DEADEND ASSY, DOUBLE TONGUE, W/ 15° TERMINAL "BITTERN	AFL	VED-153	N.S.													1																			
M203	9	SPLICE, COMPRESSION, CONVENTIONAL 2-DIE, 1272 45/7 ACSR "BITTERN	HUBBELL	TJA5118	N.S.																													1			
M300	1	SPLICE, COMPRESSION, 3/8" EHS	HUBBELL	811425	N.S.																												1				
M500	105	COMPRESSION TERMINAL, COPPER, #6 - 1/0 AWG STRANDED	HUBBELL	VHCL1012	N.S.	1		1	1	1												2	4														
N107	192	NUT, SQUARE, 7/8"	HUGHES	N80	47-0242										8																						
N407	180	NUT, LOCK, MF TYPE, 7/8"	HUGHES	MF80	22-7856									4		4																						
O100	48.6	INHIBITOR, FILLER COMPOUND, GRITTED, COMPRESSION CONNECTIONS, 8 oz.	HUBBELL	VS68B	N.S.												0.60	1.50	0.60	0.60														1.2			
O101	10.8	INHIBITOR, FILLER COMPOUND, NON-GRITTED, PAD TO PAD, 8 OZ	HUBBELL	VS8B	N.S.												0.15	0.60	0.15	0.15																	
O102	0.72	INHIBITOR, RUST (NO-OX-ID), 1 PT CAN, GRADE "A" (FOR CLAMP)	SANCHEM INC	NO-OX-ID "A" SPECIAL	N.S.								0.06																								
P500	18	ROD, GROUND, 5/8" X 8'-0", COPPERCLAD	GALVAN	6260G13	46-0588																1																
P701	18	CLAMP, GROUND ROD, 0.128 TO 0.460 RANGE, 5/8" ROD	CHANCE	C2030344	46-0058																1																
P820	78	CLAMP, VISE TYPE, LIGHTNING ARRESTOR GROUND, #2 STRANDED	HUBBELL	GC207	N.S.																1			2													
Q100	7	CLAMP, 3-BOLT, 6" LONG, 5/8" BOLT, 5/16" - 1/2" RANGE	MACLEAN	J931	18-5816		1	1																													
Q550	7	CLAMP, SINGLE BOLT, VISE TYPE, 3/8" EHS TO #2 STR CU	HUBBELL	GA9020GLSS	46-6810	1		1																													
Q551	2	CLAMP, SINGLE BOLT, #4 STR CU TO 4/0 AWG STR. CU	HUBBELL	LC1602	N.S.																														1		
Q552	2	CLAMP, VISE TYPE, 3/8 EHS TO 4/0 AWG STR CU	HUBBELL	GA9040L55	N.S.																															1	
S110	32	SPIRAL VIBRATION DAMPER, 0.327" - 0.461" RANGE	PREFORMED	5050104	N.S.																				2	1	2										
S151	96	DAMPER, DOG BONE, 1272 ACSR	HUBBELL	60715-13	N.S.																							1	2								
W322	96	WASHER, SQUARE, 4" X 1/4", 15/16" HOLE	HUGHES	SW4-80	N.S.										4																						
W410	264	WASHER, ROUND, 2" X 1/4", 15/16" HOLE	HUGHES	RW2-80	N.S.									8		4																						

ISSUE	DATE	DESCRIPTION
2	6/12/2020	RECORD DRAWINGS
0	9/11/2019	ISSUED FOR CONSTRUCTION

PROJECT MANAGER	J. ELLSWORTH
PROJECT ENGINEER	J. PANKRATZ
DESIGN ENGINEER	J. PANKRATZ
CAD TECHNICIAN	Z. JANSEN
E. O. R.	J. BRUNNER
PROJECT NUMBER	10114217

BLACK HILLS ENERGY
RAPID CITY, SOUTH DAKOTA

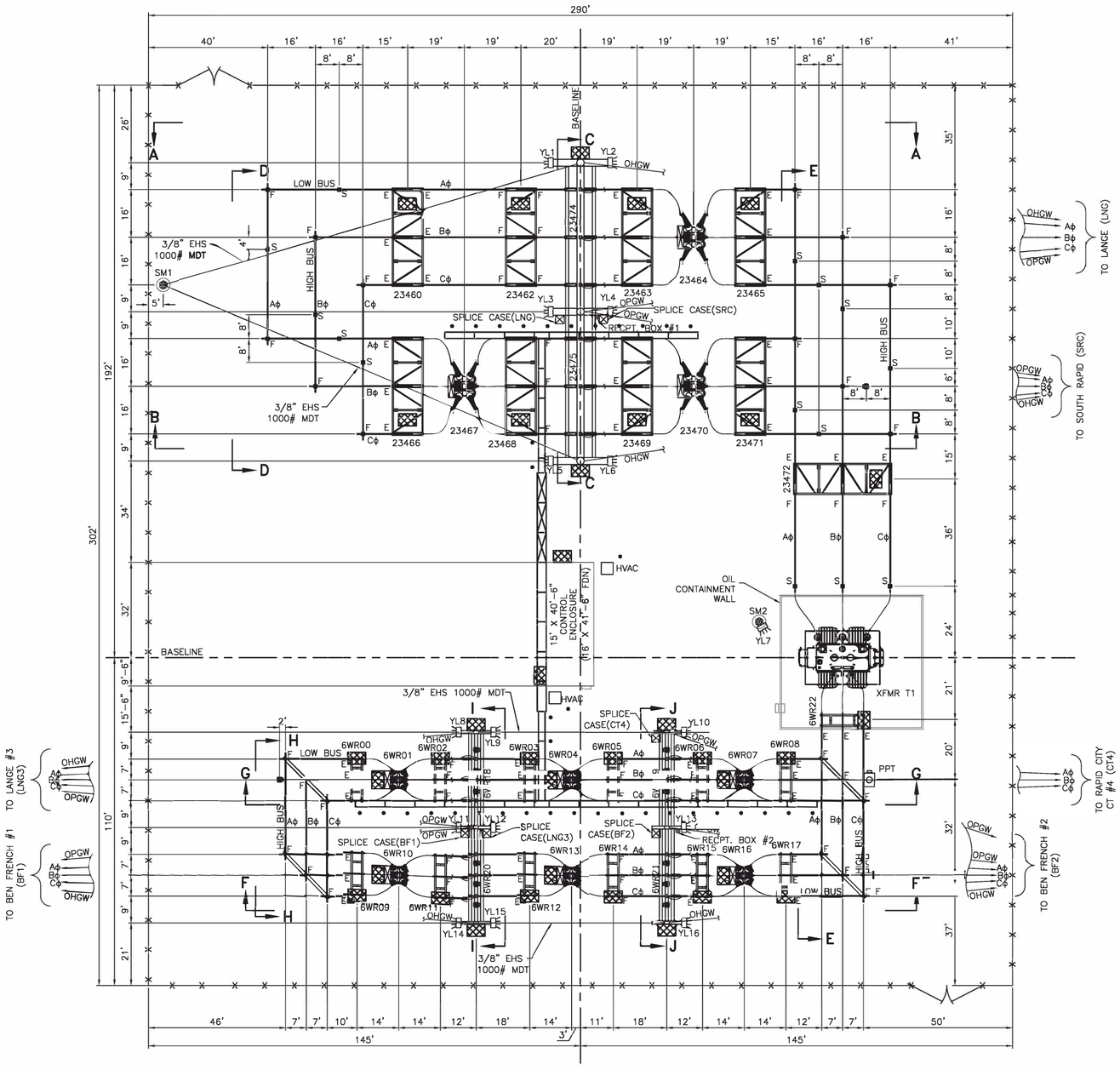
WEST RAPID CITY
230KV TRANSMISSION LINE

MATERIAL LIST
PARTS LIST

0 1" 2"

FILENAME BHE-ML-02-D-1.DWG
SCALE NONE

SHEET **ML-02-1**



NOTES:

1. 230 kV LOW AND HIGH BUS SHALL BE 3–1/2" AL IPS, SCH. 40, 6063–T6 ALUM. ALLOY WITH 795 ACSR "DRAKE" DAMPENING CABLE.
2. 230 kV BREAKER JUMPERS SHALL BE MADE OF DOUBLE 1272 AAC "NARCISSUS" CONDUCTORS.
3. 230 kV TRANSFORMER JUMPERS SHALL BE MADE OF SINGLE 1272 AAC "NARCISSUS" CONDUCTORS.
4. 69 kV BUS SHALL BE 3–1/2" AL IPS, SCH. 40, 6063–T6 ALUM. ALLOY WITH 795 ACSR "DRAKE" DAMPENING CABLE.
5. 69 kV BREAKER JUMPERS SHALL BE MADE OF DOUBLE 1272 AAC "NARCISSUS" CONDUCTORS.
6. 69 kV TRANSFORMER JUMPERS SHALL BE MADE OF DOUBLE 1272 AAC "NARCISSUS" CONDUCTORS.
7. BUS COUPLING LOCATIONS SHALL BE DETERMINED BY CONTRACTOR AS NEEDED BASED UPON BUS LENGTHS USED. LOCATE AS NEEDED PER THE SPECIFICATIONS. CONTRACTOR SHALL ACQUIRE 40' LONG BUS PIPE AND LIMIT USE OF COUPLERS ON LONG SPANS. DO NOT USE COUPLERS OR EXCESS SHORTER BUS PIECES TO CREATE A LONGER PIECE LESS THAN 40' IN LENGTH.



LEGEND:

- F FIXED (WELDED)
- E EXPANSION
- S SLIP
- FLOOD LIGHT
- YARD RECEPTACLE BOX
- SAFETY BOLLARD
- CABLE TRENCH DRIVE SECTION (HS20 RATED)
- CABLE TRENCH PEDESTRIAN SECTION
- CHAINLINK FENCE
- OPERATOR PLATFORM

REGISTERED PROFESSIONAL ENGINEER — REG. NO. 10443 — PAUL D. KONECHNE — SOUTH DAKOTA

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly Registered Professional Engineer under the laws of the State of South Dakota.

By _____ Paul D. Konechne, P.E.

Registration Number 10443 Date: 01-18-19

P:\04233\15\DWG\WRC-C-101.DWG

DGR ENGINEERING
ROCK RAPIDS, IOWA
(712) 472-2531

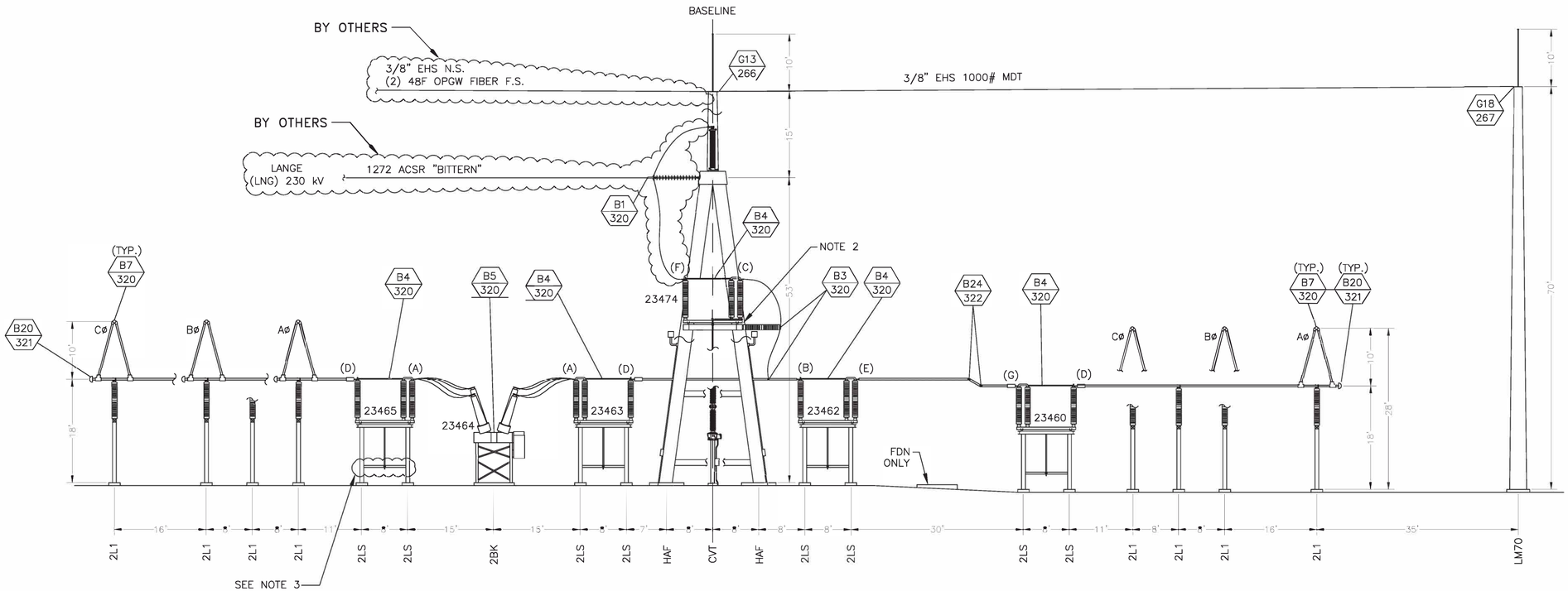
DATE	DRAWN BY	NO.	APPROVED BY	REVISION DESCRIPTION
01-19	KLV	0	PJK	FOR CONSTRUCTION

BLACK HILLS ENERGY

WEST RAPID CITY SUBSTATION

GENERAL ARRANGEMENT

DRAWN BY KLV DATE 08-18
APPROVED BY PJK DATE 08-18
DWG NO. WRC-C-101
REVISION 0



SECTION A–A

NOTES:

1. BUS COUPLING LOCATIONS SHALL BE DETERMINED BY CONTRACTOR AS NEEDED BASED UPON BUS LENGTHS PROCURED.
2. VERIFY 6'–4" RECOMMENDED PHASE TO GROUND CLEARANCE IS MAINTAINED BETWEEN SWITCH OPERATOR AND HIGH VOLTAGE CONDUCTOR ON Aø.
3. INSTALL SWITCH OPERATOR SUPPORT ON LOWEST MOUNTING PROVISION TO ACCOUNT FOR TALLER PIERS AT THIS LOCATION.

LEGEND

B27 / 320 — DETAIL # / DWG #

1L1 — STRUCTURE #

(A) — SUB–DETAIL ASSIGNMENT

0' 10' 20'
SCALE IN FEET

REGISTERED PROFESSIONAL ENGINEER — REG. NO. 10443 — PAUL D. KONECHNE — SOUTH DAKOTA

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By _____
Paul D. Konechne, P.E.

Registration Number 10443 Date: 01-18-19

DATE	DRAWN BY	NO.	APPROVED BY	REVISION DESCRIPTION
01-19	KLV	0	PJK	FOR CONSTRUCTION

BLACK HILLS ENERGY

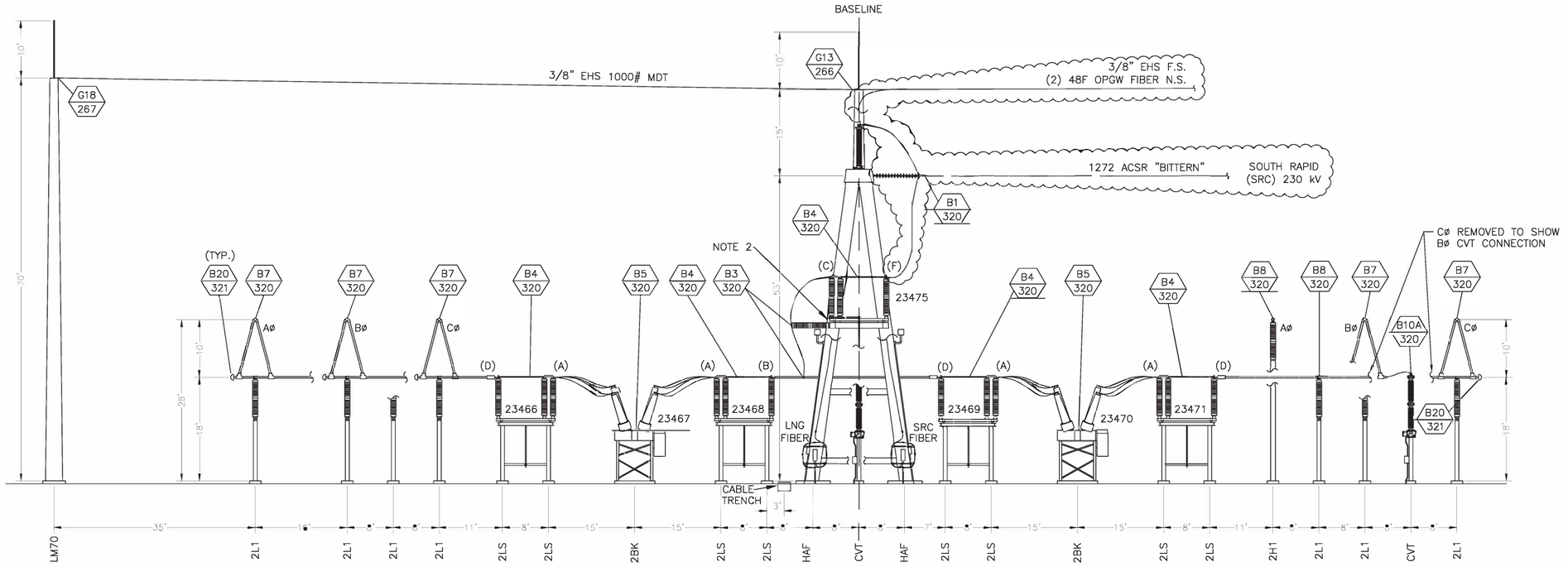
WEST RAPID CITY SUBSTATION

SECTION A

DRAWN BY KLV DATE 09-18
APPROVED BY PJK DATE 09-18
DWG NO. WRC-C-301
REVISION 0

DGR ENGINEERING
ROCK RAPIDS, IOWA
(712) 472-2531

P:\04233115\DWG\WRC-C-301.DWG



SECTION B–B

NOTES:

1. BUS COUPLING LOCATIONS SHALL BE DETERMINED BY CONTRACTOR AS NEEDED BASED UPON BUS LENGTHS PROCURED.
2. VERIFY 6'–4" RECOMMENDED PHASE TO GROUND CLEARANCE IS MAINTAINED BETWEEN SWITCH OPERATOR AND HIGH VOLTAGE CONDUCTOR ON C∅.

LEGEND

- B27 / 320 — DETAIL # / DWG #
- 1L1 — STRUCTURE #
- (A) — SUB–DETAIL ASSIGNMENT

0' 10' 20'
SCALE IN FEET

REGISTERED PROFESSIONAL ENGINEER
REG. NO. 10443
PAUL D. KONECHNE
SOUTH DAKOTA

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By _____
Paul D. Konechne, P.E.

Registration Number 10443 Date: 01-18-19

DATE	DRAWN BY	NO.	APPROVED BY	REVISION DESCRIPTION
01-19	KLV	0	PJK	FOR CONSTRUCTION

BLACK HILLS ENERGY

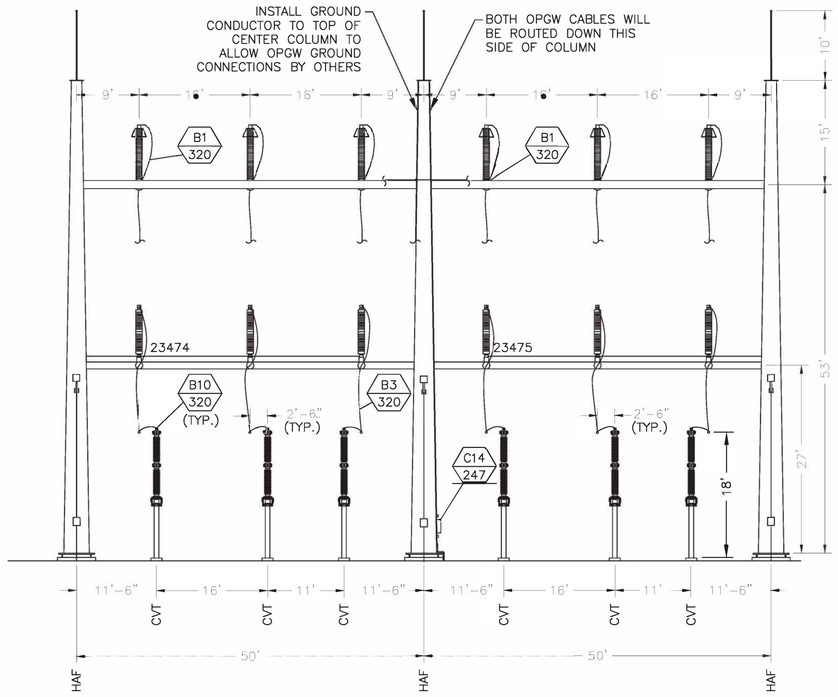
WEST RAPID CITY SUBSTATION

SECTION B

DRAWN BY KLV DATE 09-18
APPROVED BY PJK DATE 09-18
DWG NO. WRC-C-302
REVISION NO. 0

DGR ENGINEERING
ROCK RAPIDS, IOWA
(712) 472-2531

P:\04233\15\DWG\WRC-C-302.DWG



SECTION C–C



SECTION D–D

NOTES:

1. BUS COUPLING LOCATIONS SHALL BE DETERMINED BY CONTRACTOR AS NEEDED BASED UPON BUS LENGTHS PROCURED.

LEGEND

B27 / 320 — DETAIL # / DWG #

1L1 — STRUCTURE #

(A) — SUB–DETAIL ASSIGNMENT

0' 10' 20'
SCALE IN FEET

REGISTERED PROFESSIONAL ENGINEER — REG. NO. 10443 PAUL D. KONECHNE — SOUTH DAKOTA

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly Registered Professional Engineer under the laws of the State of South Dakota.

By _____
Paul D. Konechne, P.E.

Registration Number 10443 Date: 01-18-19

DATE	DRAWN BY	NO.	APPROVED BY	REVISION DESCRIPTION
01-19	KLV	0	PDK	FOR CONSTRUCTION

BLACK HILLS ENERGY

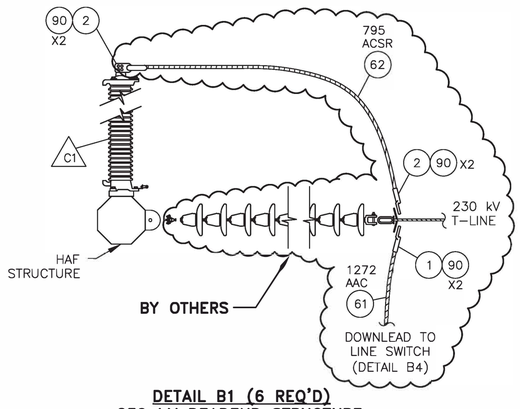
WEST RAPID CITY SUBSTATION

SECTIONS C AND D

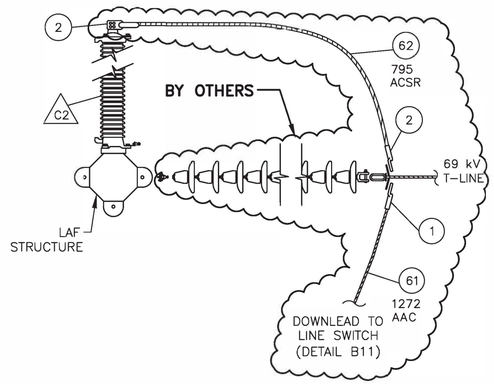
DRAWN BY KLV DATE 09-18
APPROVED BY PDK DATE 09-18
DWG NO. WRC-C-303 REVISION 0

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ROCK RAPIDS, IOWA
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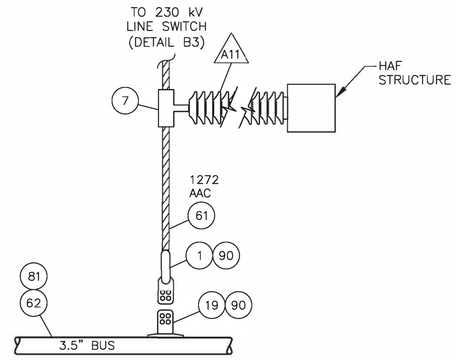
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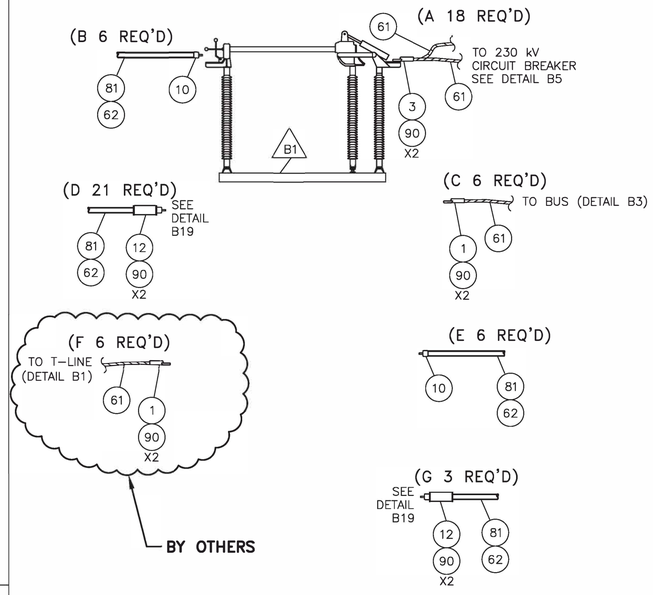
DETAIL B1 (6 REQ'D)
230 kV DEADEND STRUCTURE
T–LINE ATTACHMENT DETAIL



DETAIL B2 (12 REQ'D)
69 kV DEADEND STRUCTURE
T–LINE ATTACHMENT DETAIL



DETAIL B3 (6 REQ'D)
BUS CONNECTION DETAIL
230 kV DOWNLEAD CONNECTIONS



DETAIL B4
230 kV DISCONNECT SWITCH
CONNECTION DETAIL

DETAIL B5 (9 REQ'D)
230 kV PCB CONNECTION DETAIL

DETAIL B6 (3 REQ'D)
230/69 kV TRANSFORMER HIGHSIDE
CONNECTION DETAIL

DETAIL B7 (12 REQ'D)
230 kV BUS BI–LEVEL
SUPPORT ASSEMBLY DETAIL

DETAIL B10A (1 REQ'D)
230 kV BUS CVT
CONNECTION DETAIL

DETAIL B8 (14 REQ'D)
230 kV BUS SUPPORT
ASSEMBLY DETAIL

DETAIL B9 (3 REQ'D)
230/69 kV TRANSFORMER LOWSIDE
CONNECTION DETAIL

DETAIL B10 (6 REQ'D)
230 kV LINE CVT
CONNECTION DETAIL

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By _____
Paul D. Konechne, P.E.

Registration Number 10443 Date: 01-18-19

REGISTERED PROFESSIONAL ENGINEER — REG NO 10443 PAUL D KONECHNE — SOUTH DAKOTA

P:\04233\15\DWG\WRC-C-320.DWG

DGR ENGINEERING
ROCK RAPIDS, IOWA
(712) 472-2531

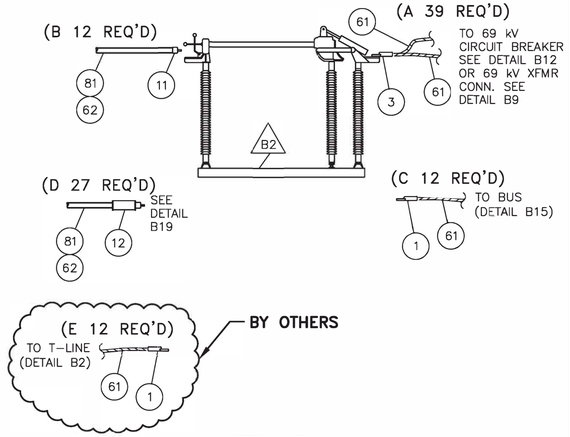
DATE	DRAWN BY	NO.	APPROVED BY	REVISION DESCRIPTION
01-19	KLV	0	PJK	FOR CONSTRUCTION

BLACK HILLS ENERGY

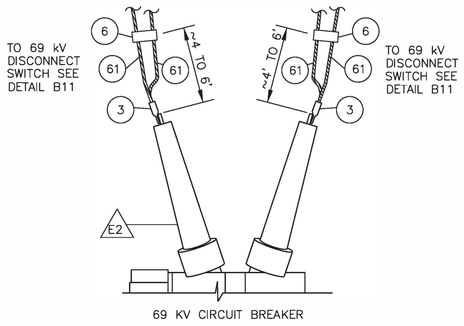
WEST RAPID CITY SUBSTATION

BUS CONNECTION DETAILS

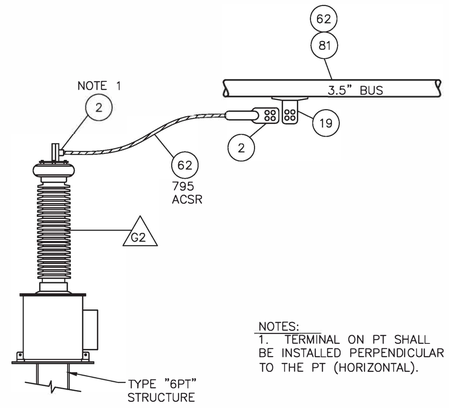
DRAWN BY KLV DATE 10-18
APPROVED BY PJK DATE 10-18
DWG NO. WRC-C-320 REVISION 0



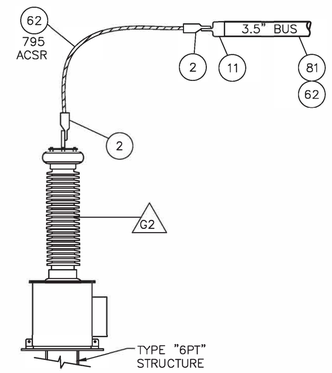
DETAIL B11
69 kV DISCONNECT SWITCH CONNECTION DETAIL



DETAIL B12 (18 REQ'D)
69 kV PCB CONNECTION DETAIL



DETAIL B13 (12 REQ'D)
69 kV LINE PT'S CONNECTION DETAIL



DETAIL B14 (1 REQ'D)
69 kV BUS PT CONNECTION DETAIL

DETAIL B15 (12 REQ'D)
BUS CONNECTION DETAIL
69 kV DOWNLEAD CONNECTIONS

DETAIL B16 (1 REQ'D)
69 kV POWER PT CONNECTION DETAIL

DETAIL B17 (12 REQ'D)
69 kV BUS BI-LEVEL SUPPORT ASSEMBLY DETAIL

DETAIL B18 (AS REQ'D)
BUS COUPLER JOINT

DETAIL B19
EXPANSION BUS TERMINAL DETAIL

DETAIL B20 (39 REQ'D)
END CAP DETAIL

DETAIL B21 (AS REQ'D)
69 kV 4-HOLE NEMA PAD CONNECTIONS

DETAIL B22 (AS REQ'D)
230 kV 4-HOLE NEMA PAD CONNECTIONS

P:\04233\15\DWG\WRC-C-321.DWG

DGR ENGINEERING
ROCK RAPIDS, IOWA
(712) 472-2531

REGISTERED PROFESSIONAL ENGINEER — REG. NO. 10443 PAUL D. KONECHNE — SOUTH DAKOTA

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly Registered Professional Engineer under the laws of the State of South Dakota.

By _____
Paul D. Konechne, P.E.

Registration Number 10443 Date: 01-18-19

DATE	DRAWN BY	NO.	APPROVED BY	REVISION DESCRIPTION
01-19	KLV	0	PDK	FOR CONSTRUCTION

BLACK HILLS ENERGY

WEST RAPID CITY SUBSTATION

BUS CONNECTION DETAILS

DRAWN BY KLV DATE 10-18
APPROVED BY PDK DATE 10-18
DWG NO. WRC-C-321
REVISION NO. 0

Item No.	OFM	Catalog Number	Description	Manufacturer	"Total Required"
1	X	WCF-136-D	CONNECTOR, TERMINAL, WELDED, 1272 AAC TO 4" NEMA 4HP	ANDERSON	75
1A	X	WCF-136-D-Y45	CONNECTOR, TERMINAL, WELDED, 1272 AAC TO 4" NEMA 4HP, 45°	ANDERSON	3
1B	X	WCF-136-D-Y90	CONNECTOR, TERMINAL, WELDED, 1272 AAC TO 4" NEMA 4HP, 90°	ANDERSON	3
2	X	WCF-106-D	CONNECTOR, TERMINAL, WELDED, 795 ACSR TO 4" NEMA 4HP	ANDERSON	77
2A	X	WCF-106-D-Y90	CONNECTOR, TERMINAL, WELDED, 795 ACSR TO 4" NEMA 4HP, 90°	ANDERSON	1
3	X	W2CF-136-D	CONNECTOR, TERMINAL, WELDED, (2) 1272 AAC TO 4" NEMA 4HP	ANDERSON	114
3A	X	W2CF-136-D-Y90	CONNECTOR, TERMINAL, WELDED, (2) 1272 AAC TO 4" NEMA 4HP, 90°	ANDERSON	3
4	X	ORT-2114-D	CONNECTOR, TEE, COMPRESSION, 1272 AAC MAIN TO 4" NEMA 4HP	ANDERSON	3
4A	X	ATCF-15401	CONNECTOR, TEE, BOLTED, 1272 AAC MAIN TO 4" NEMA 4HP	ANDERSON	3
5	X	110-121-CSTD-4-90	CONNECTOR, SPACER, BOLTED, (2) 1272 AAC, 4" SPACING TO 4" NEMA 4HP, 90°	TRAVIS (PDU)	3
6	X	APCS-15-4	CONNECTOR, SPACER, BOLTED, (2) 1272 AAC, 4" SPACING	ANDERSON	69
7	X	HVCS-12995	BUS SUPPORT, BOLTED, EHV, 1272 AAC TO 5" BOLT CIRCLE	ANDERSON	6
8	X	ACS-163	BUS SUPPORT, BOLTED, 1272 AAC TO 3" BOLT CIRCLE	ANDERSON	12
9	X	WTH-34-5	BUS SUPPORT, WELDED/SLIP, 3-1/2" IPS TO 5" BOLT CIRCLE	ANDERSON	38
10	X	WSTFE-34-D-CF-EHV	CONNECTOR, TERMINAL, WELDED, EHV, 3-1/2" IPS TO 4" NEMA 4HP, CENTER FORMED, WITH BOLT SHIELD	ANDERSON	16
11	X	WSTF-34-D-CF	CONNECTOR, TERMINAL, WELDED, 3-1/2" IPS TO 4" NEMA 4HP, CENTER FORMED	ANDERSON	17
12	X	WFTFV-34D	CONNECTOR, TERMINAL, WELDED, EXPANSION, 3-1/2" IPS TO 4" NEMA 4HP, 90°	ANDERSON	51
13	X	WTT-15-3424	FITTING, WELDED TEE, 15 DEGREE, 3-1/2" IPS MAIN TO 2-1/2" IPS TAP	ANDERSON	24
14	X	WTT-15-3434	FITTING, WELDED TEE, 15 DEGREE, 3-1/2" IPS MAIN TO 3-1/2" IPS TAP	ANDERSON	24
15	X	WTT2-15-3424	FITTING, WELDED VEE, 15 DEGREE, 3-1/2" IPS MAIN TO 2-1 /2" IPS VEE	ANDERSON	12
16	X	WTT2-15-3434	FITTING, WELDED VEE, 15 DEGREE, 3-1/2" IPS MAIN TO 3-1 /2" IPS VEE	ANDERSON	12
17	X	WCI-3434	FITTING, COUPLER, WELDED, INTERNAL, 3-1/2" IPS TO 3-1/2" IPS	ANDERSON	13
18	X	WLI45-3434	FITTING, COUPLER, WELDED, 45°, INTERNAL, 3-1/2" IPS TO 3-1/2" IPS	ANDERSON	6
19	X	WTTFR-30-60-D	FITTING, TEE, WELDED, 3"-6" IPS RUN TO 4" NEMA 4HP, INLINE PAD	ANDERSON	36
20	X	WEB34	FITTING, CORONA BELL, WELDED, INTERNAL FIT, 3-1/2" IPS	ANDERSON	39
41	X	E/INS-150-G	WILDLIFE PROTECTOR, SPLIT TUBING, GRAY, FOR 1272 AAC, 20 KV PHASE-GND	MIDSUN GROUP	10'
42	X	E/FTP-250G	WILDLIFE PROTECTOR, FUSING TAPE, GRAY, 2.5" WIDE, FOR EXPOSED CONNECTORS & W/ITEM 41 & 43	MIDSUN GROUP	AS REQ'D
43	X	E/BSC-350	WILDLIFE PROTECTOR, COVER FOR XFMR ARRESTERS	MIDSUN GROUP	3
44	X	E/BC-DBL-LEAD	WILDLIFE PROTECTOR, BUSHING COVER FOR TRANSFORMER	MIDSUN GROUP	3
61	X	NARCISSUS	CONDUCTOR, 1272 MCM AAC, 61 STRANDING	ALCOA	2500'
62	X	TERN	CONDUCTOR, 795 MCM ACSR 45/7 STRANDING, FOR HIGH VOLTAGE CONNECTIONS	ALCOA	500'
62	X	TERN	CONDUCTOR, 795 MCM ACSR 45/7 STRANDING, FOR BUS DAMPENING	ALCOA	2000'
80		2.5" - 6063-T6	CONDUCTOR, BUS, 2-1/2" IPS, SCHEDULE 40 ALUMINUM, 40' LENGTHS	ALCOA	200'
81		3.5" - 6063-T6	CONDUCTOR, BUS, 3-1/2" IPS, SCHEDULE 40 ALUMINUM, 40' LENGTHS	ALCOA	2520'
90	X	EVHS-D	HARDWARE SHIELDS, EHV, 4" NEMA 4HP (BOLT SHIELDS)	ANDERSON	230
91		HBS-XXX	STAINLESS STEEL BOLTS, 1/2" FOR ALUMINUM BUS CONNECTIONS, CONTRACTOR TO DETERMINE LENGTH	ANDERSON	AS REQ'D
92		BW500	STAINLESS STEEL BELLEVILLE WASHER, 1/2", 1.06" O.D.	ANDERSON	AS REQ'D
93		HNB500	SILICON BRONZE NUT, HIGH STRENGTH, 1/2"	ANDERSON	AS REQ'D
94		HFS5001	STAINLESS STEEL WASHER, 1/2", 1.13" O.D.	ANDERSON	AS REQ'D
96		PENETROX A	ELECTRICAL FILLER COMPOUND, NON-PETROLEUM BASED	BURNDY	AS REQ'D
200		4/0 COPPER	CONDUCTOR, 4/0 STRANDED SOFT DRAWN COPPER		14,000'
201		633400	GROUND ROD, 3/4" DIAMETER, 10' LONG, COPPER CLAD	ERICO	106
202		CR-34	GROUND ROD COUPLING, FOR CONNECTING MULTIPLE GROUND RODS OR DRIVE STUDS	ERICO	70
203		DS34	GROUND ROD DRIVING STUD	ERICO	20
205		GYR182Q	MOLD, GROUNDING CONNECTOR, EXOTHERMIC, 4/0 CABLE-3/4" GROUND ROD (USE 150 WELD)	ERICO	4
206		XBQ2Q2Q	MOLD, GROUNDING CONNECTOR, EXOTHERMIC, 4/0 CABLE - 4/0 CABLE CROSS (USE 250 WELD)	ERICO	25
207		TAC2Q2Q	MOLD, GROUNDING CONNECTOR, EXOTHERMIC, 4/0 CABLE - 4/0 CABLE TEE (USE 150 WELD)	ERICO	40
208		SSC2Q	MOLD, GROUNDING CONNECTOR, EXOTHERMIC, 4/0 CABLE - 4/0 CABLE SPLICE (USE 90 WELD)	ERICO	3
210		90	WELD METAL, 90 CARTRIDGE SIZE, FOR USE WITH ITEM 208	ERICO	40
211		150	WELD METAL, 150 CARTRIDGE SIZE, FOR USE WITH ITEMS 205 & 207	ERICO	400
212		250	WELD METAL, 250 CARTRIDGE SIZE, FOR USE WITH ITEM 206	ERICO	350
221		GC-141A-02	CONNECTOR, BRONZE, BOLTED, 1-4/0 COPPER TO FLAT SURFACE	ANDERSON	650
222		GC-143A-02	CONNECTOR, BRONZE, BOLTED, 2-4/0 COPPER TO FLAT SURFACE	ANDERSON	200
223		K3	CONNECTOR, BRONZE, BOLTED, 2 PARALLEL 4/0 COPPER	ANDERSON	150
224		K1	CONNECTOR, BRONZE, BOLTED, 2 PARALLEL #4 COPPER	ANDERSON	10
225		SWL-025-B	CONNECTOR, BRONZE, BOLTED, #4-4/0 COPPER TO NEMA 2HP	ANDERSON	80
226		C-4	CONNECTOR, BOLTED, 1-#4 SOLID COPPER TO TYPE A4 BARBED WIRE/FENCE FABRIC	ANDERSON	200
227		GC-111-5B	CONNECTOR, BOLTED, 1-#4 SOLID COPPER TO 1-5/8" FENCE TOP RAIL/GATE FRAME	ANDERSON	60
228		GC-110-82C	CONNECTOR, BOLTED, 2-4/0 STRANDED COPPER TO 2-1/2" FENCE LINE POST	ANDERSON	20
229		GC-110-102C	CONNECTOR, BOLTED, 2-4/0 STRANDED COPPER TO 3" FENCE CORNER POST	ANDERSON	4
230		GC-110-142C	CONNECTOR, BOLTED, 2-4/0 STRANDED COPPER TO 4" GATE POST	ANDERSON	4
231		GC-109-06	CONNECTOR, BOLTED, FLEXIBLE COPPER BRAID TO 2" GATE FRAME	ANDERSON	8
233		GB-100-3B	FLEXIBLE COPPER BRAID 24" LONG WITH TIN PLATED FERRULES EACH END	ANDERSON	8
240		#4 SD SOLID CU	CONDUCTOR, #4 SOLID SOFTDRAWN COPPER		500'
241		#6 SD SOLID CU	CONDUCTOR, #6 SOLID SOFTDRAWN COPPER		150'
242		3/8" EHS	CONDUCTOR, 7 WIRE, 3/8" EXTRA HIGH STRENGTH STEEL		500'
250		SWDE46N	DEADEND, BOLTED, STATIC WIRE, 3/8" EHS STEEL, QUADRANT STRAIN CLAMP	ANDERSON	8
251		YCS-04-90	Y-CLEVIS EYE, FOR STATIC WIRE DEADEND, 90°	ANDERSON	8

Item No.	OFM	Catalog Number	Description	Manufacturer	"Total Required"
271	X	804-LL8-400PE	FIBER OPTIC CABLE, MULTIMODE DUPLEX		400'
272	X	12048R101	FIBER OPTIC CABLE, MULTI-FIBER	SUPERIOR ESSEX	1460'
273	X	DF4X1C-XXXX	CONDUIT, INNERDUCT, 1" ORANGE CORROGATED W/TAPE	CARLON	1500'
280	X		CONTROL CABLE, (3) CONDUCTOR #12, 3/C-#12 SH		350'
281	X		CONTROL CABLE, (2) CONDUCTOR #10, 2/C-#10 SH		3600'
282	X		CONTROL CABLE, SHIELDED, (4) CONDUCTOR #10, 4/C-#10 SH		500'
283	X		CONTROL CABLE, SHIELDED, (9) CONDUCTOR #10, 9/C-#10 SH		5500'
284	X		CONTROL CABLE, SHIELDED, (12) CONDUCTOR #10, 12/C-#10 SH		5600'
285	X		CONTROL CABLE, (2) CONDUCTOR #6, 2/C-#6 SH		1500'
286	X		CONTROL CABLE, (3) CONDUCTOR #6, 3/C-#6 SH		2100'
287	X		POWER CABLE, (1) CONDUCTOR 500 MCM, 1/C-500		1000'
291			TERMINAL CONNECTORS, CONTROL CABLE, VARIOUS SIZES		1850
292			TERMINAL CONNECTORS, CONTROL CABLE, SHIELD		130
293			TERMINAL CONNECTORS, POWER CABLE, 500 MCM		18
294			CABLE MARKERS		1 LOT
300			CONDUIT, BELOW-GRADE, VARIOUS SIZES, SCHEDULE 40 PVC AND ASSOCIATED FITTINGS AND PULL WIRE		1 LOT
301			CONDUIT, STATION POWER RISERS, 90° ELBOW, 3-1/2" RIGID GALVANIZED STEEL, 40" MIN RADIUS		4
310			CONDUIT, ABOVE-GRADE, VARIOUS SIZES, RIGID GALVANIZED STEEL AND ASSOCIATED FITTINGS		1 LOT
311			CONDUIT, ABOVE-GRADE, VARIOUS SIZES, LIQUID-TIGHT FLEXIBLE AND ASSOCIATED FITTINGS		1 LOT
330			ANTI-CORROSION TAPE, FOR RIGID GALVANIZED STEEL INSTALLED BELOW GRADE		1 LOT
380	X		CABLE TRENCH ASSEMBLY	TRENWA	1 LOT
381	X		CABLE TRENCH GROUND CLAMPS	TRENWA	90
382			DRAIN TILE, 4" PERFORATED, HDPE, WITH COUPLINGS & ACCESSORIES AS NEEDED		630'
383			OUTLET, DRAIN TILE, 4", PREFABRICATED CMP, FLARED END, WITH RODENT GUARD		2
384			FENCE POST, MARKER FOR DRAIN TILE OUTLET		2
390			CONDUIT MARKER		9
400	X	FXL-56L-190-5K-W-U-Y-GR	FLOOD LIGHT, LED, 120-277 VAC, 187 WATT (400W MH EQUIVALENT)	HUBBELL	16
401	X	4024CM53	FLOOD LIGHT SLIP-FITTER, STEEL FOR 2" PIPE, 2 3/8" O.D. YOKE MOUNT	HUBBELL	16
402	X	6387	FLOOD LIGHT WALL BRACKET, 2" SLIP FITTER, GRAY	HOLOPHANE	16
500		FENCE	CHAIN-LINK FENCE SYSTEM		1184'
501		GATES	GATE, CHAIN-LINK DOUBLE GATE, 24' TOTAL WIDTH, WITH ONE PERSONNEL GATE		2

NOTES:
1. SEE PROJECT SPECIFICATIONS AND DETAIL DRAWINGS FOR FURTHER MATERIAL DETAILS AS NEEDED.
2. SUPPLIER SHALL BE RESPONSIBLE FOR PROVIDING OFM QUANTITIES AS REQUIRED TO COMPLETE THE PROJECT.
3. QUANTITIES OF CONTRACTOR-FURNISHED MATERIALS SHALL BE VERIFIED BY CONTRACTOR.
4. OWNER SHALL BE NOTIFIED OF ANY QUANTITIES THAT MAY BE SHOWN INCORRECTLY ON THIS DRAWING.

REGISTERED PROFESSIONAL ENGINEER — REG. NO. 10443 — PAUL D. KONECHNE — SOUTH DAKOTA

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly Registered Professional Engineer under the laws of the State of South Dakota.

By _____
Paul D. Konechne, P.E.

Registration Number 10443 Date: 01-18-19

DATE	DRAWN BY	NO.	APPROVED BY	REVISION DESCRIPTION
01-19	KLV	0	PJK	FOR CONSTRUCTION

BLACK HILLS ENERGY

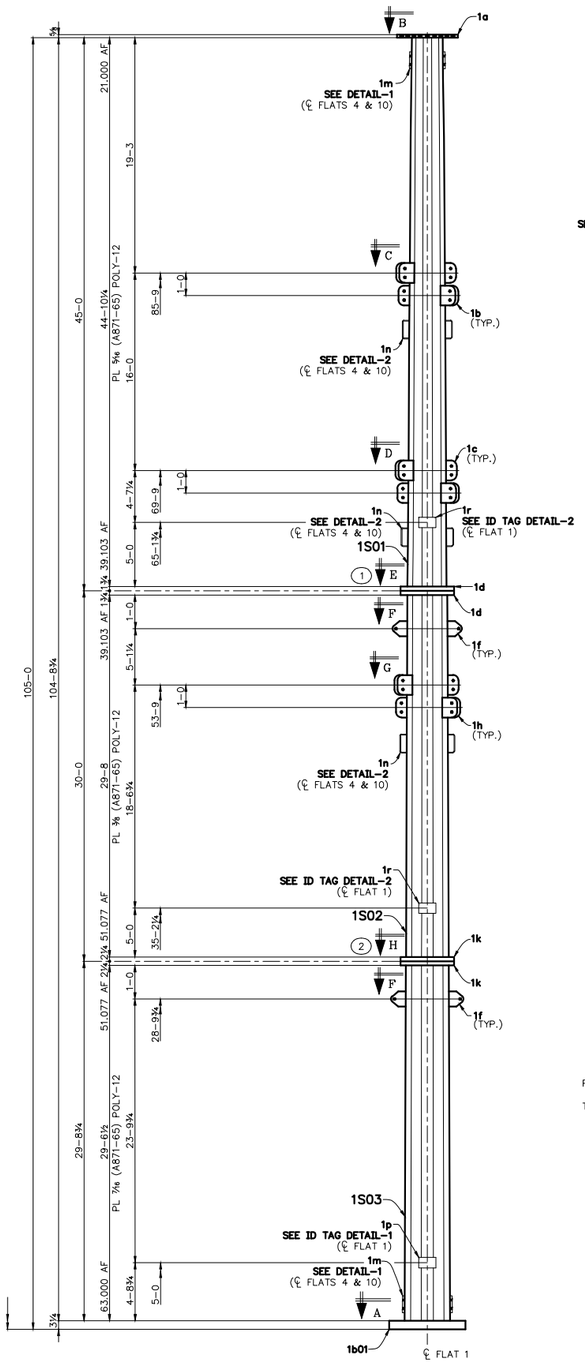
WEST RAPID CITY SUBSTATION

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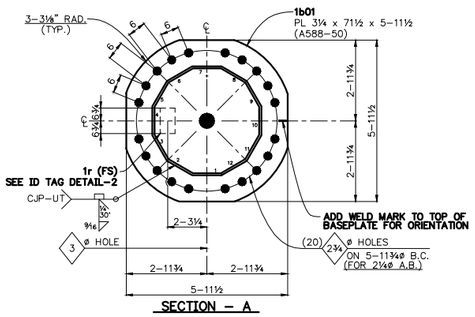
DRAWN BY KLV DATE 01-19 | APPROVED BY PJK DATE 01-19 | DWG NO. WRC-C-380 | REVISION 0

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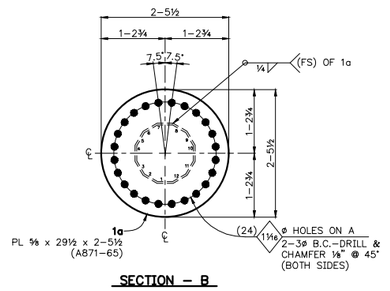
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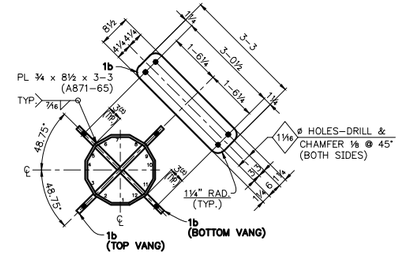
230KV TRANSMISSION POLE



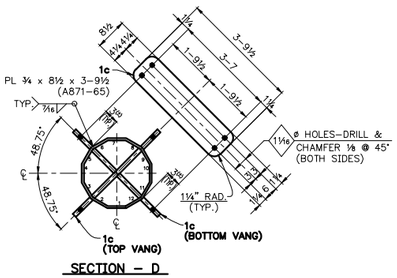
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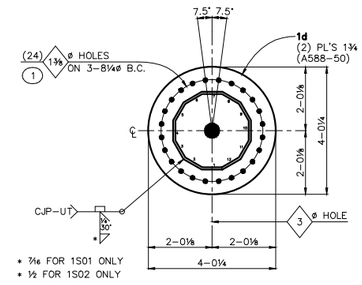
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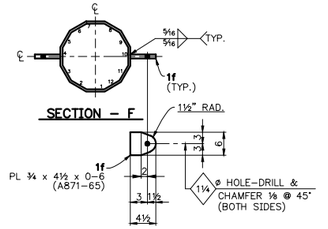
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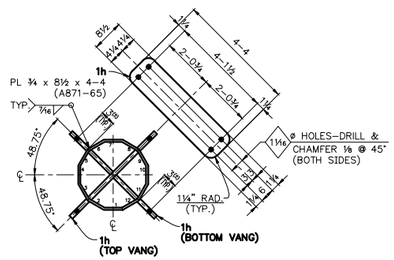
SECTION – D



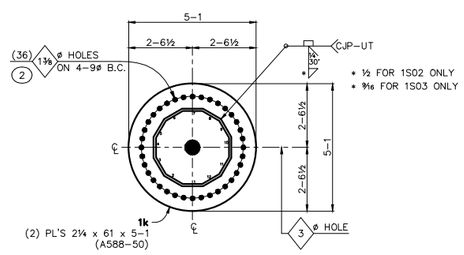
SECTION – E



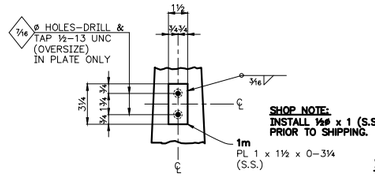
SECTION – F



SECTION – G



SECTION – H



SHOP NOTE:
INSTALL 1½ø x 1 (S.S.) BOLT
PRIOR TO SHIPPING.

DETAIL – 1

GROUNDING SCHEDULE
DIM'S TO CENTER OF GROUND PLATE
SEE DETAIL-1

POLE – 1S01	POLE – 1S03
℄ OF FLATS 4 & 10	℄ OF FLATS 4 & 10
43-10¼	0-8¾

ALL DIMENSIONS FROM BOTTOM OF SHAFT

MATERIAL REQ'D. FOR ASSEMBLY

MARK	QTY.	DESCRIPTION	BLACK WT.
1S01	ONE	POLY-12 POLE	6,159
1S02	ONE	POLY-12 POLE	9,154
1S03	ONE	POLY-12 POLE	15,083
		TOTAL BLACK WT.	30,396#

HARDWARE REQD. FOR ASSEMBLY

	MARK	QTY.	DESCRIPTION
PT	1	24	1¼ø x 5½ (A325 TYPE-3) BOLTS W/ ONE-1¼ø H. FLATWASHER (F436 TYPE-3) EACH ONE-1¼ø PIN-TYPE LOCKNUT (A563-DH TYPE-3) EACH
PT	2	36	1¼ø x 6½ (A325 TYPE-3) BOLTS W/ ONE-1¼ø H. FLATWASHER (F436 TYPE-3) EACH ONE-1¼ø PIN-TYPE LOCKNUT (A563-DH TYPE-3) EACH
	3	ONE	SEE ANCHOR BOLT CAGE DETAIL ON SHEET E02.

MATERIAL BILLED FOR ONE MAKE (2) TIMES

GENERAL NOTES:

1. ALL WELDS SHALL BE IN ACCORDANCE WITH A.W.S. (D1.1.) UNLESS NOTED OTHERWISE.
   a.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL BE U.T. TESTED IN ACCORDANCE WITH AWS & ASNDT.
   b.) ALL MATERIAL WELDED WITH E80-SERIES, LOW HYDROGEN ELECTRODES.
   c.) ALL FILLET WELDS AT JOINT TERMINATIONS OR ABRUPT CHANGES IN WELD DIRECTION SHALL HAVE END RETURNS TO WRAP CORNERS AS GEOMETRY PERMITS. IF JOINT GEOMETRY DOES NOT PERMIT A FULL SIZE RETURN, A SEAL WELD SHALL BE PROVIDED WHERE ACCESSIBLE.
   d.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL USE 3/16" X 1 1/4", (A36) STEEL BACKING (GALVANIZED POLES); (A588-50) (NON-GALVANIZED), MINIMUM. BACKING BARS SHALL BE SPLICED ON SHAFT FLATS ONLY, WITH A C.J.P. GROOVE WELD. BACKING BARS SHALL BE SEAL WELDED ALL AROUND, WHEN ACCESSIBLE.
   e.) LONGITUDINAL SEAM WELDS SHALL ACHIEVE A MINIMUM OF 80% PENETRATION. LONGITUDINAL SEAM WELDS SHALL ACHIEVE 100% PENETRATION WITHIN A MINIMUM OF 6" FROM THE ENDS OF THE SHAFT.
2. FIELD BOLT SHIPPING QUANTITIES WILL INCLUDE A MAXIMUM 5% OVERAGE FOR BOLTS 1"ø OR LESS. FIELD BOLTS OVER 1"ø WILL BE EXACT COUNT UNLESS NOTED OTHERWISE.
3. POLE TAPER = 0.403604 IN/FT.
4. ALL HARDWARE NOTED WITH "PT" SHALL BE PRE-TENSIONED PER THE TURN-OF-NUT METHOD. ALL OTHER HARDWARE SHALL BE SNUG-TIGHT. SPARE SHIPPING QUANTITIES WILL INCLUDE THREE EXTRA ASSEMBLIES OF EACH BOLT TYPE DESIGNATED AS "PT" FOR FIELD VERIFICATION OF PRE-TENSIONING METHOD.
5. **POLE SHALL BE SWEEP BLASTED DULLED AFTER FABRICATION.**

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL,
DO NOT GALVANIZE.

(STR. 1A & 1B) 19-9462PE01

NOTICE TO ERECTOR
BACKCHARGES FOR CORRECTIVE WORK OR REPLACED MATERIALS WILL NOT BE ACCEPTED UNLESS EXPRESSLY AUTHORIZED BY DIS-TRAN BEFORE ANY SUCH COST ARE INCURRED.

REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19
2					
3					
4					
5					
6					
7					
8					

DIS-TRAN Steel, LLC
P.O. BOX 5109•ALEXANDRIA, LA, 71307-5709
PHONE 318-448-0274•FAX 318-445-4454

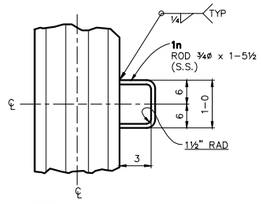
WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

230KV TRANSMISSION POLE / ITEM – 1

ERECTION ELEVATION, SECTIONS & DETAILS

SCALE	DATE	JOB NUMBER	DRAWING NUMBER	REV. NO.
N.T.S.	07/12/19	19-9462P	E01	1

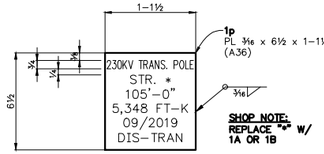
DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ



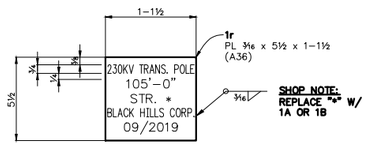
DETAIL – 2

GROUND LOOP SCHEDULE DIM'S TO CENTER OF GROUND LOOP SEE DETAIL–2	
POLE – 1S01	POLE – 1S02
℄ OF FLATS 4 & 10	℄ OF FLATS 4 & 10
7–4¼	21–3¾
23–4¼	

ALL DIMENSIONS FROM BOTTOM OF SHAFT



ID TAG DETAIL – 1



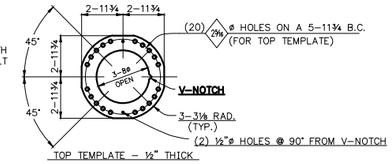
ID TAG DETAIL – 2

SPACE ANCHOR BOLTS 6" APART IN ALL FOUR QUADRANTS. START WITH THE FIRST ANCHOR BOLT ON THE 45° LINE AS SHOWN BELOW.

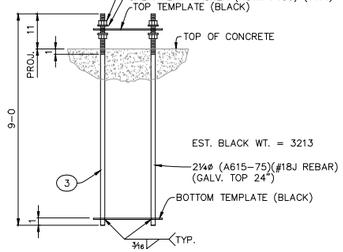


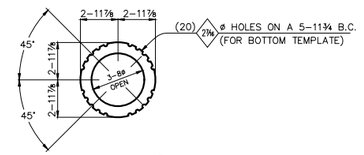
THEN LOCATE THE OTHER ANCHOR BOLTS 6" APART AS SHOWN BELOW.





TOP TEMPLATE – ½" THICK





BOTTOM TEMPLATE – ⅜" THICK

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL,
DO NOT GALVANIZE.

(STR. 1A & 1B) 19–9462PE02

NOTICE TO ERECTOR
BACKCHARGES FOR CORRECTIVE WORK OR REPLACED MATERIALS WILL NOT BE ACCEPTED UNLESS EXPRESSLY AUTHORIZED BY DIS–TRAN BEFORE ANY SUCH COST ARE INCURRED.

REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE	REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
4						8					
3						7					
2						6					
1						5					

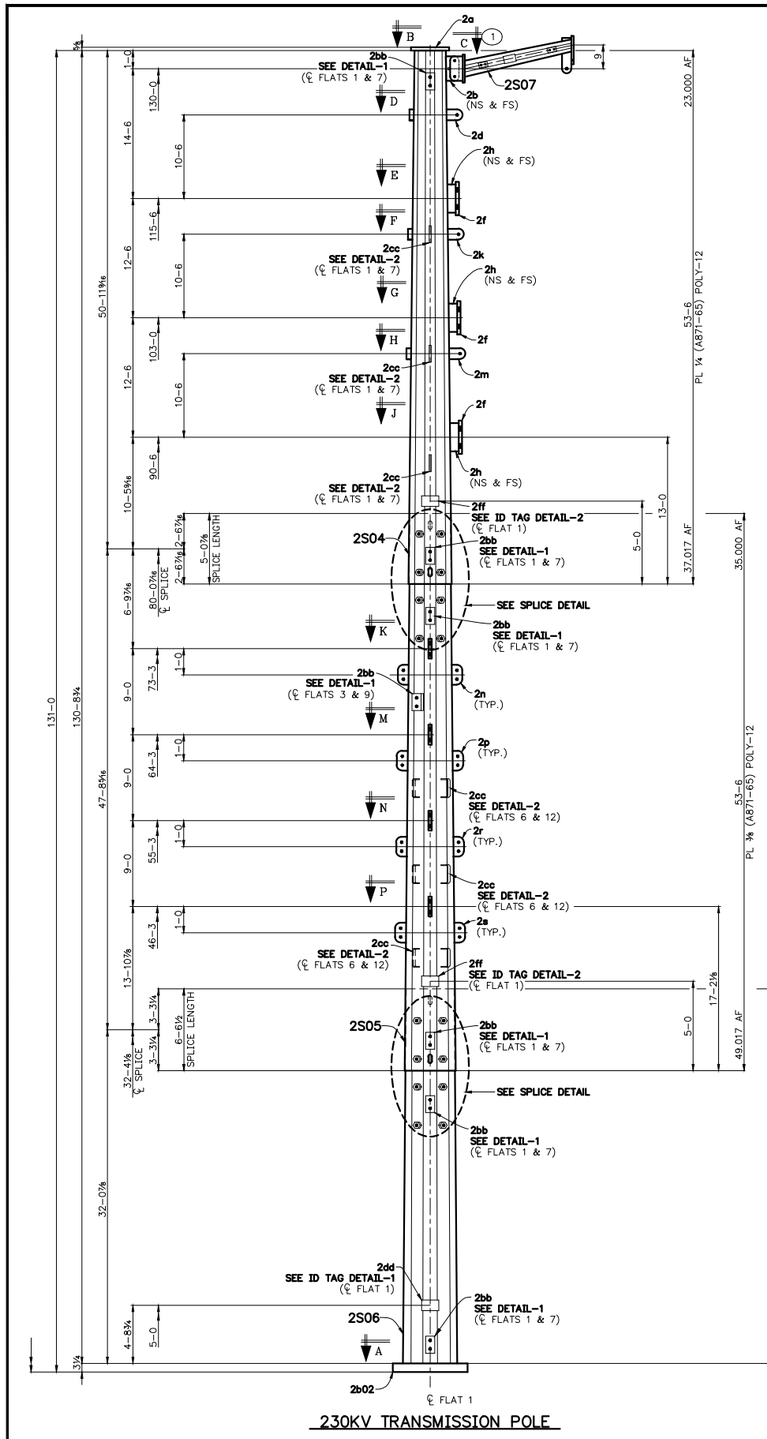
DIS-TRAN Steel, LLC
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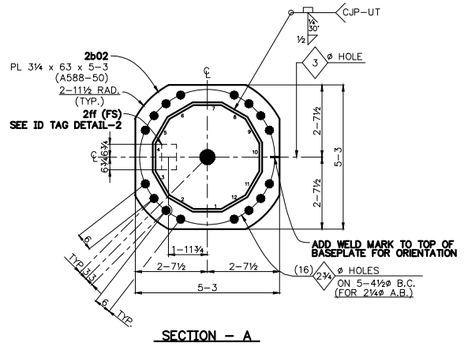
WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

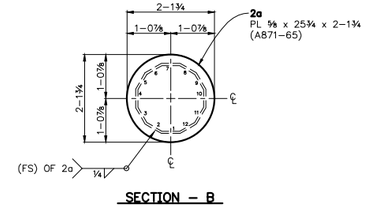
230KV TRANSMISSION POLE / ITEM – 1
SECTIONS & DETAILS (CONTINUED)

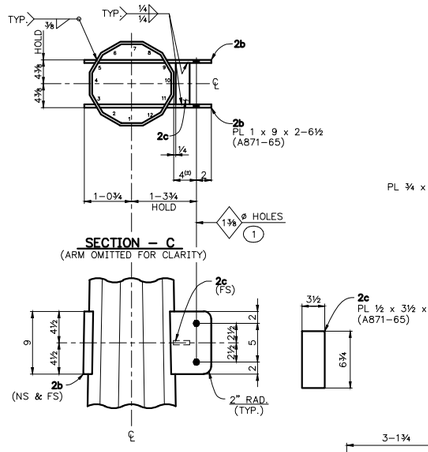
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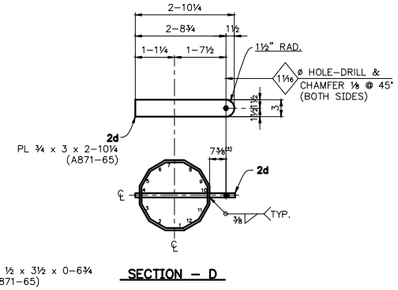
DRAWN BY	CHK'D. BY	APP'D. BY
DLW		

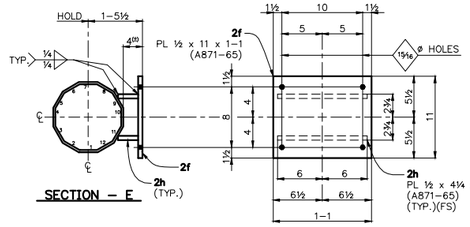


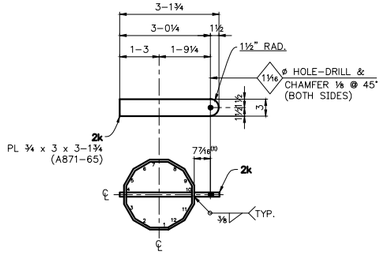


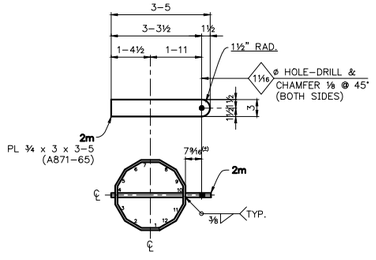


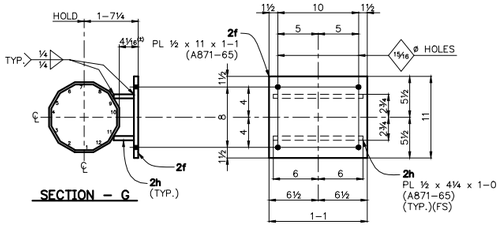


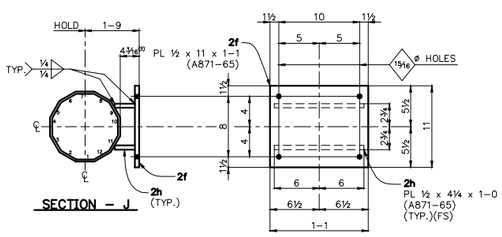












MATERIAL REQ'D. FOR ASSEMBLY			
MARK	QTY.	DESCRIPTION	BLACK WT.
2S04	ONE	POLY-12 POLE	4,796
2S05	ONE	POLY-12 POLE	9,835
2S06	ONE	POLY-12 POLE	10,986
2S07	ONE	POLY-8 POLE	167
		TOTAL BLACK WT.	25,784#

HARDWARE REQD. FOR ASSEMBLY		
MARK	QTY.	DESCRIPTION
(1)	4	1⅛ø x 4 (A325 TYPE-3) BOLTS W/ ONE-1⅛ø H. FLATWASHER (F436 TYPE-3) EACH ONE-1⅛ø H. HEX NUT LOCKNUT (A563-DH TYPE-3) EACH
(2)	ONE	SEE ANCHOR BOLT CAGE DETAIL ON SHEET E04.

MATERIAL BILLED FOR ONE MAKE (ONE) TIME

GENERAL NOTES:

1. ALL WELDS SHALL BE IN ACCORDANCE WITH A.W.S. (D1.1.) UNLESS NOTED OTHERWISE.
   a.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL BE U.T. TESTED IN ACCORDANCE WITH AWS & ASNDT.
   b.) ALL MATERIAL WELDED WITH E80-SERIES, LOW HYDROGEN ELECTRODES.
   c.) ALL FILLET WELDS AT JOINT TERMINATIONS OR ABRUPT CHANGES IN WELD DIRECTION SHALL HAVE END RETURNS TO WRAP CORNERS AS GEOMETRY PERMITS. IF JOINT GEOMETRY DOES NOT PERMIT A FULL SIZE RETURN, A SEAL WELD SHALL BE PROVIDED WHERE ACCESSIBLE.
   d.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL USE 3/16" X 1 1/4", (A36) STEEL BACKING (GALVANIZED POLES); (A588-50) (NON-GALVANIZED), MINIMUM. BACKING BARS SHALL BE SPLICED ON SHAFT FLATS ONLY, WITH A C.J.P. GROOVE WELD. BACKING BARS SHALL BE SEAL WELDED ALL AROUND, WHEN ACCESSIBLE.
   e.) LONGITUDINAL SEAM WELDS SHALL ACHIEVE A MINIMUM OF 80% PENETRATION. LONGITUDINAL SEAM WELDS SHALL ACHIEVE 100% PENETRATION WITHIN A MINIMUM OF 6" FROM THE ENDS OF THE SHAFT AND THE FULL LENGTH OF THE FEMALE SECTION IN THE SLIP JOINT.
2. LONGITUDINAL SEAM WELDS IN FEMALE SECTION OF THE SLIP JOINT SHALL BE FULL PENETRATION WELDS.
3. FOR PROPER SHAFT ALIGNMENT FOR ASSEMBLY, A 6" HORIZONTAL WELD BEAD AND A MARK NUMBER ARE POSITIONED ON EACH SHAFT AT EACH SPLICE. THE 6" HORIZONTAL WELD BEADS ARE ON MATCHING CORNERS. THE MARK NUMBER IS ON AN ADJACENT FLAT. THE HORIZONTAL WELD BEAD CORNERS SHALL BE ALIGNED TOP TO BOTTOM OF THE POLE. MATCH NUMBERS SHALL BE MATCHED FOR EACH SPLICE.
4. FIELD ASSEMBLY HOLES (1⅛ø) WITH 1"ø H. HEX NUTS ARE LOCATED ON OPPOSING SECTION FLATS ABOVE AND BELOW SPLICES FOR JACKING SHAFTS TOGETHER.
5. THE LOWER WELD ORIENTATION MARK AT EACH SPLICE LOCATION SHALL BE TELESCOPED IN THE FIELD TO WITHIN 24" OF THE UPPER WELD ORIENTATION MARK. AFTER TELESCOPED, THE SECTIONS SHOULD SHOW NO FURTHER MOVEMENT AND THERE SHOULD BE ADEQUATE METAL-TO-METAL CONTACT ON ALL FLATS.
6. TWO SLOTS (1½ø x 2½") WILL BE PROVIDED AT THE SLIP FITTED END OF EACH SHAFT.
7. POLE TAPER = 0.262000 IN/FT
8. FIELD BOLT SHIPPING QUANTITIES WILL INCLUDE A MAXIMUM 5% OVERAGE FOR BOLTS 1"ø OR LESS. FIELD BOLTS OVER 1"ø WILL BE EXACT COUNT UNLESS NOTED OTHERWISE.
9. ALL HARDWARE NOTED WITH "PT" SHALL BE PRE-TENSIONED PER THE TURN-OF-NUT METHOD. ALL OTHER HARDWARE SHALL BE SNUG-TIGHT. SPARE SHIPPING QUANTITIES WILL INCLUDE THREE EXTRA ASSEMBLIES OF EACH BOLT TYPE DESIGNATED AS "PT" FOR FIELD VERIFICATION OF PRE-TENSIONING METHOD.
10. **POLE SHALL BE SWEEP BLASTED DULLED AFTER FABRICATION.**

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL, DO NOT GALVANIZE.

(STR. 2A) 19-9462PE03

NOTICE TO ERECTOR
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REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19

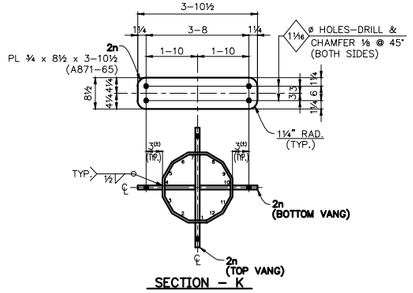
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WEST RAPID CITY 230KV PROJECT
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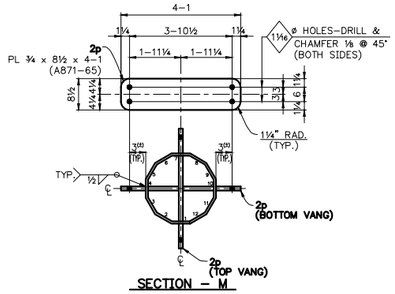
230KV TRANSMISSION POLE / ITEM - 3
ERECTION ELEVATION, SECTIONS & DETAILS

SCALE	DATE	JOB NUMBER	DRAWING NUMBER	REV. NO.
N.T.S.	07/12/19	19-9462P	E03	1

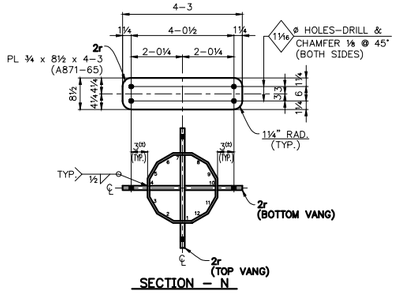
DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ



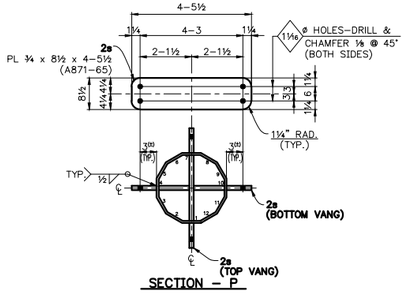
SECTION – K



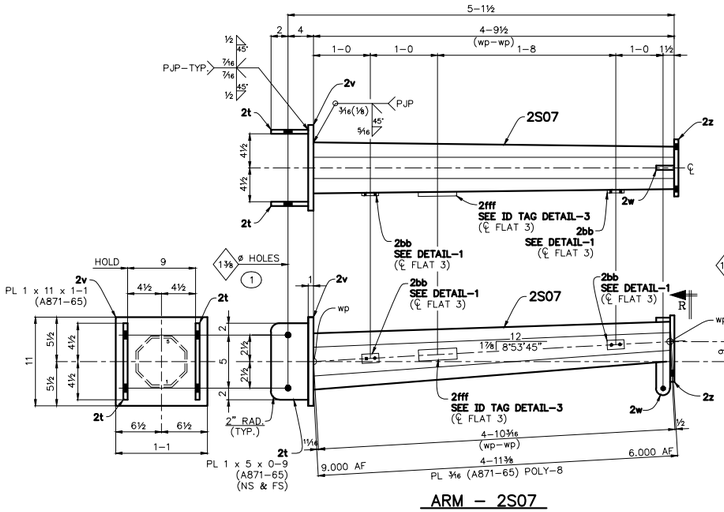
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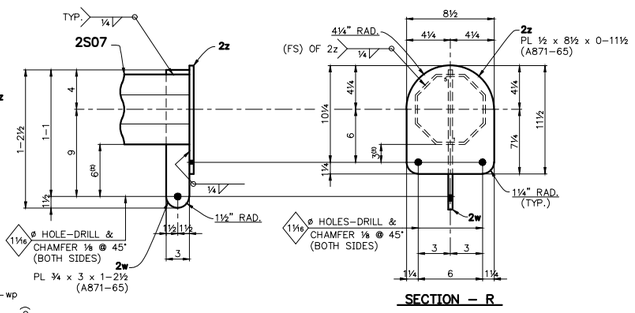
SECTION – N



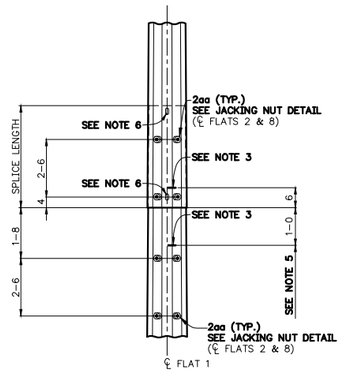
SECTION – P



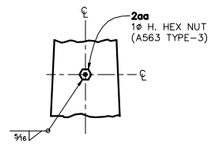
ARM – 2S07



SECTION – R

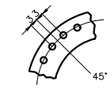


SPLICE DETAIL
(DETAIL–1 OMITTED FOR CLARITY)

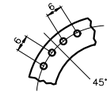


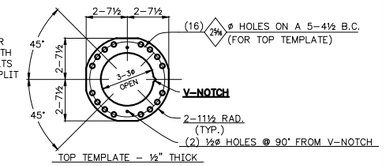
JACKING NUT DETAIL

SPACE ANCHOR BOLTS 6" APART IN ALL FOUR QUADRANTS. START WITH THE FIRST TWO A–BOLTS IN EACH QUADRANT SPLIT ON THE 45° LINES AS SHOWN BELOW.

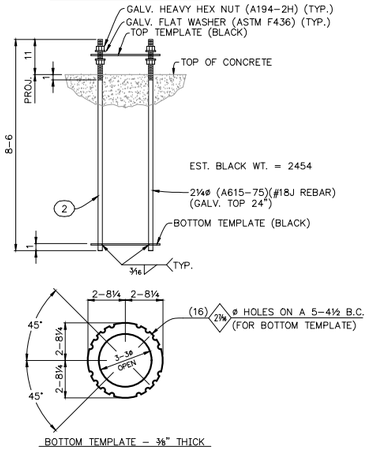


THEN LOCATE THE OTHER ANCHOR BOLTS 6" APART AS SHOWN BELOW.

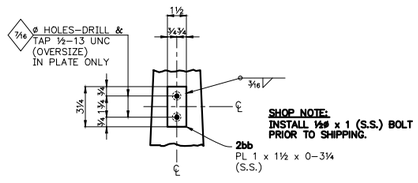




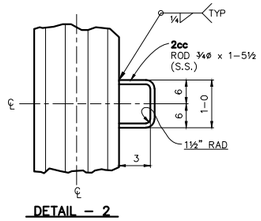
TOP TEMPLATE – ½" THICK



BOTTOM TEMPLATE – ⅜" THICK



DETAIL – 1



DETAIL – 2

GROUNDING SCHEDULE
DIM'S TO CENTER OF GROUND PLATE
SEE DETAIL–1

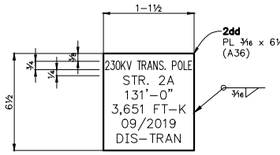
POLE – 2S04	POLE – 2S05		POLE – 2S06
℄ OF FLATS 1 & 7	℄ OF FLATS 1 & 7	℄ OF FLATS 3 & 9	℄ OF FLATS 1 & 7
0–11	0–11	42–5	0–8¾
51–6	47–6		27–10½

ALL DIMENSIONS FROM BOTTOM OF SHAFT

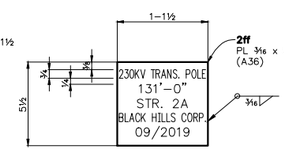
GROUND LOOP SCHEDULE
DIM'S TO CENTER OF GROUND LOOP
SEE DETAIL–2

POLE – 2S04	POLE – 2S05
℄ OF FLATS 1 & 7	℄ OF FLATS 6 & 12
11–0	14–11
23–6	23–11
36–0	32–11

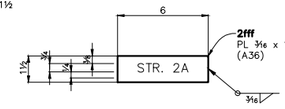
ALL DIMENSIONS FROM BOTTOM OF SHAFT



ID TAG DETAIL – 1



ID TAG DETAIL – 2



ID TAG DETAIL – 3

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL, DO NOT GALVANIZE.

(STR. 2A) 19–9462PE04

NOTICE TO ERECTOR
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REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19
2					
3					
4					
5					
6					
7					
8					

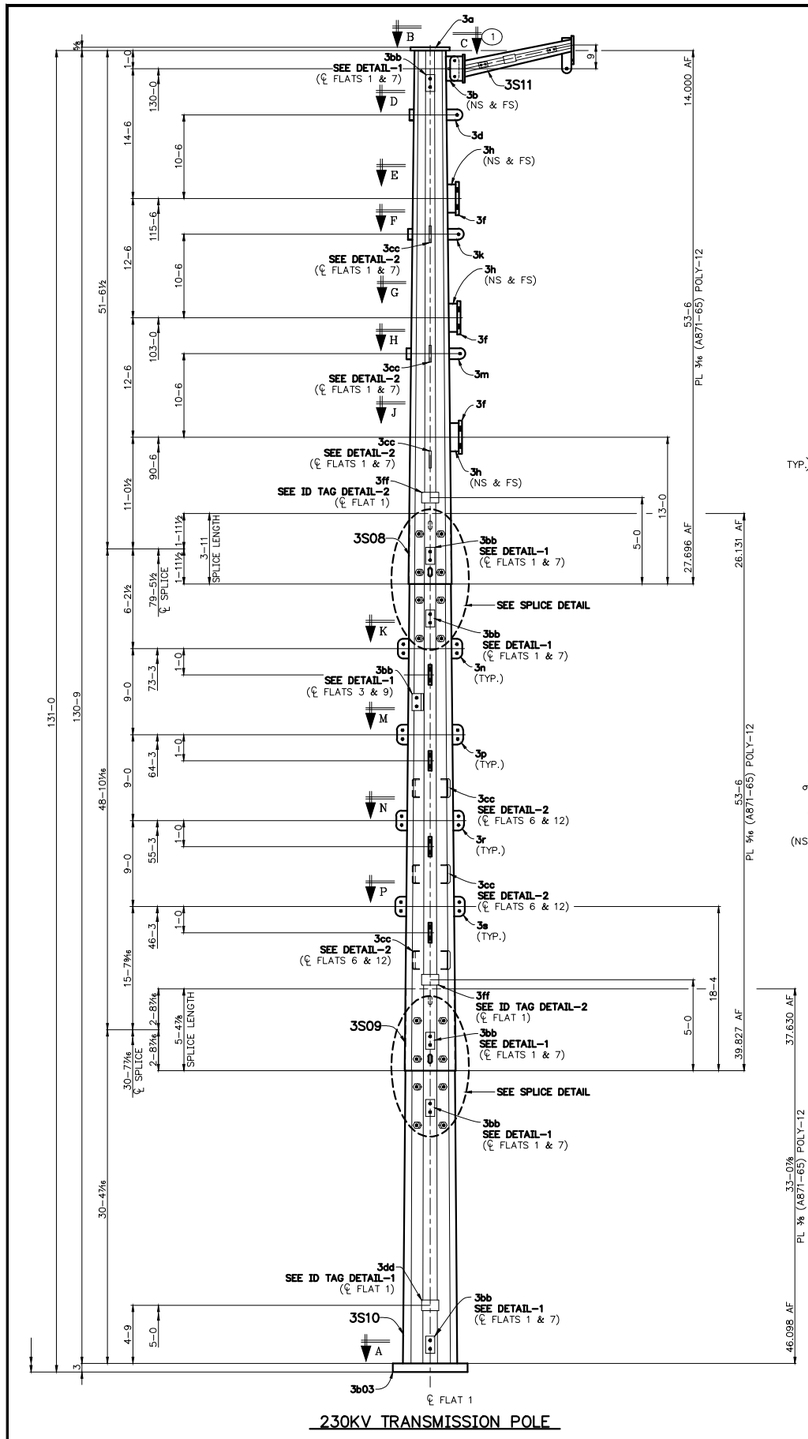
DIS-TRAN Steel, LLC
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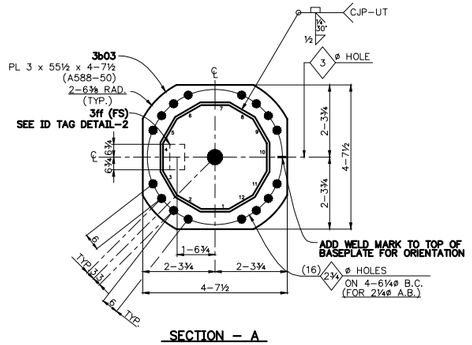
230KV TRANSMISSION POLE / ITEM – 3
SECTIONS & DETAILS (CONTINUED)

SCALE	DATE	JOB NUMBER	DRAWING NUMBER	REV. NO.
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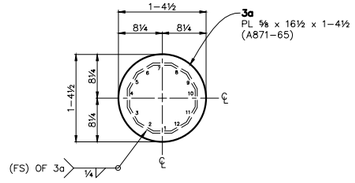
DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ



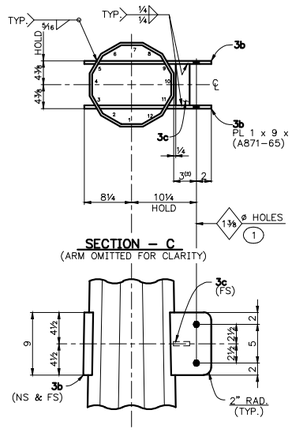
230KV TRANSMISSION POLE



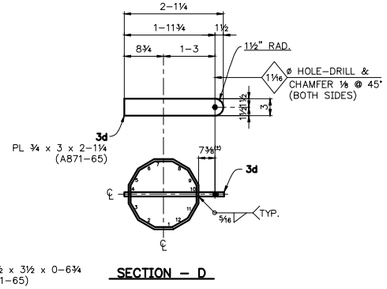
SECTION – A



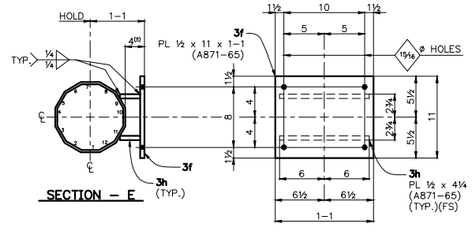
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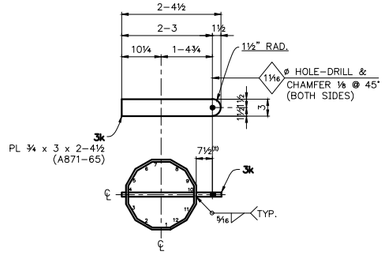
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(ARM OMITTED FOR CLARITY)



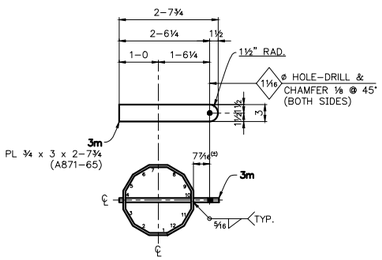
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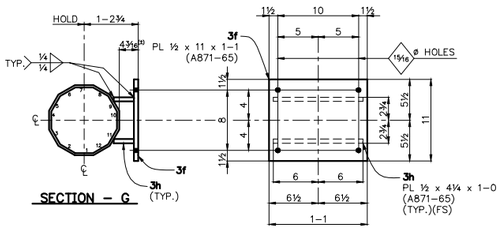
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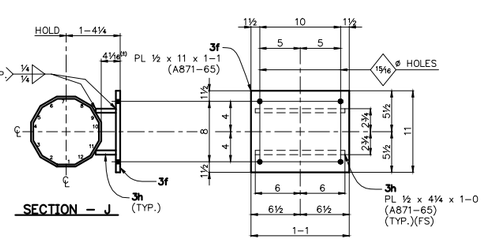
SECTION – F



SECTION – H



SECTION – G



SECTION – J

MATERIAL REQ'D. FOR ASSEMBLY			
MARK	QTY.	DESCRIPTION	BLACK WT.
3S08	ONE	POLY-12 POLE	2,582
3S09	ONE	POLY-12 POLE	6,558
3S10	ONE	POLY-12 POLE	8,240
3S11	ONE	POLY-8 POLE	167
		TOTAL BLACK WT.	17,547#

HARDWARE REQD. FOR ASSEMBLY		
MARK	QTY.	DESCRIPTION
(1)	4	1¼ø x 4 (A325 TYPE-3) BOLTS W/ ONE-1¼ø H. FLATWASHER (F436 TYPE-3) EACH ONE-1¼ø H. HEX NUT LOCKNUT (A563-DH TYPE-3) EACH
(2)	ONE	SEE ANCHOR BOLT CAGE DETAIL ON SHEET E06.

MATERIAL BILLED FOR ONE MAKE (ONE) TIME

GENERAL NOTES:

1. ALL WELDS SHALL BE IN ACCORDANCE WITH A.W.S. (D1.1.) UNLESS NOTED OTHERWISE.
   a.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL BE U.T. TESTED IN ACCORDANCE WITH AWS & ASNDT.
   b.) ALL MATERIAL WELDED WITH E80-SERIES, LOW HYDROGEN ELECTRODES.
   c.) ALL FILLET WELDS AT JOINT TERMINATIONS OR ABRUPT CHANGES IN WELD DIRECTION SHALL HAVE END RETURNS TO WRAP CORNERS AS GEOMETRY PERMITS. IF JOINT GEOMETRY DOES NOT PERMIT A FULL SIZE RETURN, A SEAL WELD SHALL BE PROVIDED WHERE ACCESSIBLE.
   d.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL USE 3/16" X 1 1/4", (A36) STEEL BACKING (GALVANIZED POLES); (A588-50) (NON-GALVANIZED), MINIMUM. BACKING BARS SHALL BE SPLICED ON SHAFT FLATS ONLY, WITH A C.J.P. GROOVE WELD. BACKING BARS SHALL BE SEAL WELDED ALL AROUND, WHEN ACCESSIBLE.
   e.) LONGITUDINAL SEAM WELDS SHALL ACHIEVE A MINIMUM OF 80% PENETRATION. LONGITUDINAL SEAM WELDS SHALL ACHIEVE 100% PENETRATION WITHIN A MINIMUM OF 6" FROM THE ENDS OF THE SHAFT AND THE FULL LENGTH OF THE FEMALE SECTION IN THE SLIP JOINT.
2. LONGITUDINAL SEAM WELDS IN FEMALE SECTION OF THE SLIP JOINT SHALL BE FULL PENETRATION WELDS.
3. FOR PROPER SHAFT ALIGNMENT FOR ASSEMBLY, A 6" HORIZONTAL WELD BEAD AND A MARK NUMBER ARE POSITIONED ON EACH SHAFT AT EACH SPLICE. THE 6" HORIZONTAL WELD BEADS ARE ON MATCHING CORNERS. THE MARK NUMBER IS ON AN ADJACENT FLAT. THE HORIZONTAL WELD BEAD CORNERS SHALL BE ALIGNED TOP TO BOTTOM OF THE POLE. MATCH NUMBERS SHALL BE MATCHED FOR EACH SPLICE.
4. FIELD ASSEMBLY HOLES (1⅛ø) WITH 1"ø H. HEX NUTS ARE LOCATED ON OPPOSING SECTION FLATS ABOVE AND BELOW SPLICES FOR JACKING SHAFTS TOGETHER.
5. THE LOWER WELD ORIENTATION MARK AT EACH SPLICE LOCATION SHALL BE TELESCOPED IN THE FIELD TO WITHIN 24" OF THE UPPER WELD ORIENTATION MARK. AFTER TELESCOPED, THE SECTIONS SHOULD SHOW NO FURTHER MOVEMENT AND THERE SHOULD BE ADEQUATE METAL-TO-METAL CONTACT ON ALL FLATS.
6. TWO SLOTS (1½ø x 2½") WILL BE PROVIDED AT THE SLIP FITTED END OF EACH SHAFT.
7. POLE TAPER = 0.256000 IN/FT
8. FIELD BOLT SHIPPING QUANTITIES WILL INCLUDE A MAXIMUM 5% OVERAGE FOR BOLTS 1"ø OR LESS. FIELD BOLTS OVER 1"ø WILL BE EXACT COUNT UNLESS NOTED OTHERWISE.
9. ALL HARDWARE NOTED WITH "PT" SHALL BE PRE-TENSIONED PER THE TURN-OF-NUT METHOD. ALL OTHER HARDWARE SHALL BE SNUG-TIGHT. SPARE SHIPPING QUANTITIES WILL INCLUDE THREE EXTRA ASSEMBLIES OF EACH BOLT TYPE DESIGNATED AS "PT" FOR FIELD VERIFICATION OF PRE-TENSIONING METHOD.
10. **POLE SHALL BE SWEEP BLASTED DULLED AFTER FABRICATION.**

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL, DO NOT GALVANIZE.

(STR. 2B) 19-9462PE05

NOTICE TO ERECTOR
BACKCHARGES FOR CORRECTIVE WORK OR REPLACED MATERIALS WILL NOT BE ACCEPTED UNLESS EXPRESSLY AUTHORIZED BY DIS-TRAN BEFORE ANY SUCH COST ARE INCURRED.

REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19

DIS-TRAN Steel, LLC
P.O. BOX 5109 • ALEXANDRIA, LA, 71307-5709
PHONE 318-448-0274 • FAX 318-445-4454

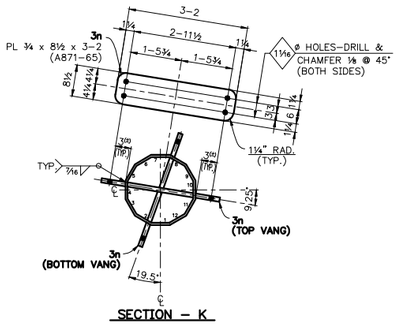
WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

230KV TRANSMISSION POLE / ITEM – 4

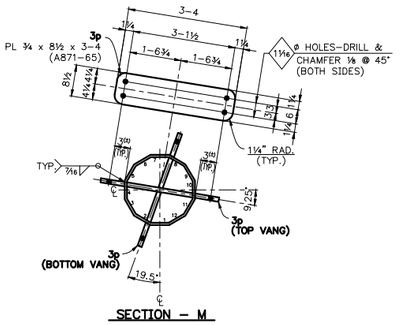
ERECTION ELEVATION, SECTIONS & DETAILS

SCALE	DATE	JOB NUMBER	DRAWING NUMBER	REV. NO.
N.T.S.	07/12/19	19-9462P	E05	1

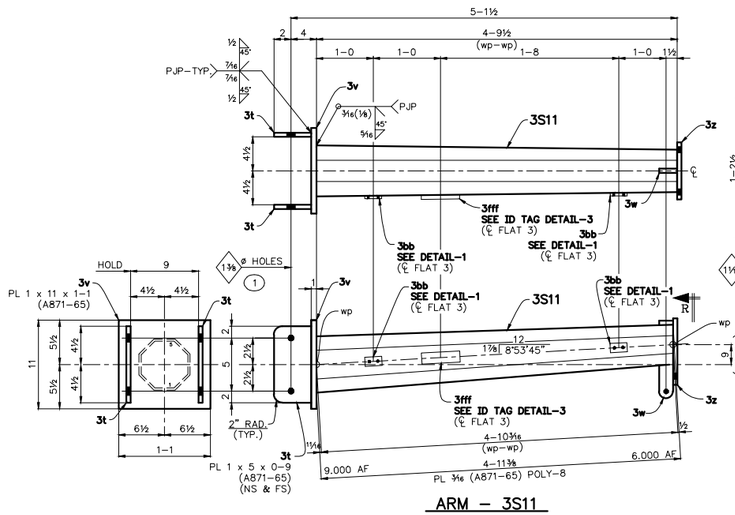
DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ



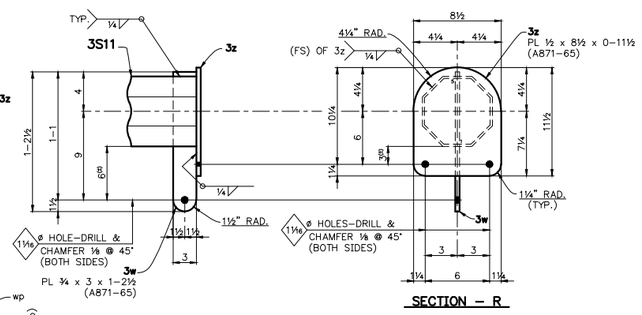
SECTION – K



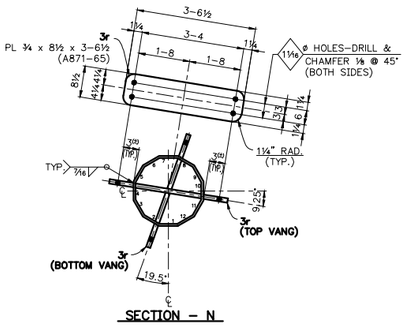
SECTION – M



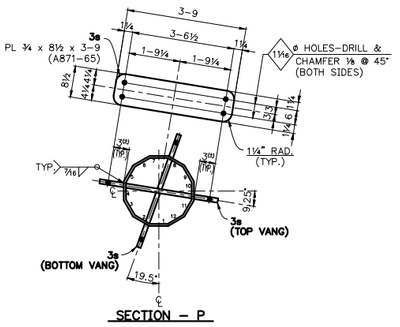
ARM – 3S11



SECTION – R

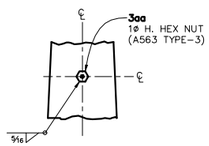


SECTION – N



SECTION – P

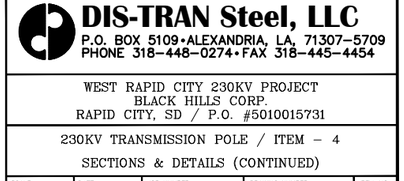
SPLICE DETAIL
(DETAIL-1 OMITTED FOR CLARITY)



JACKING NUT DETAIL

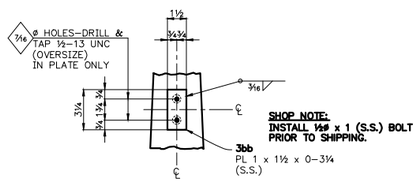
SPACE ANCHOR BOLTS 6" APART IN ALL FOUR QUADRANTS. START WITH THE FIRST TWO A-BOLTS IN EACH QUADRANT SPLIT ON THE 45° LINES AS SHOWN BELOW.

THEN LOCATE THE OTHER ANCHOR BOLTS 6" APART AS SHOWN BELOW.

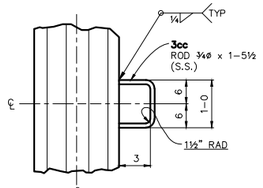


TOP TEMPLATE – ½" THICK

BOTTOM TEMPLATE – ⅜" THICK



DETAIL – 1



DETAIL – 2

GROUNDING SCHEDULE
DIM'S TO CENTER OF GROUND PLATE
SEE DETAIL–1

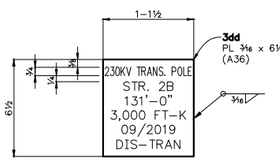
POLE – 3S08	POLE – 3S09		POLE – 3S10
℄ OF FLATS 1 & 7	℄ OF FLATS 1 & 7	℄ OF FLATS 3 & 9	℄ OF FLATS 1 & 7
0–11	0–11	43–7	0–9
51–6	48–8		26–9

ALL DIMENSIONS FROM BOTTOM OF SHAFT

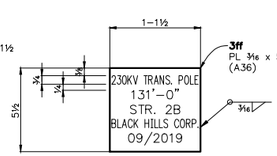
GROUND LOOP SCHEDULE
DIM'S TO CENTER OF GROUND LOOP
SEE DETAIL–2

POLE – 3S08	POLE – 3S09
℄ OF FLATS 1 & 7	℄ OF FLATS 6 & 12
11–0	16–1
23–6	25–1
36–0	34–1

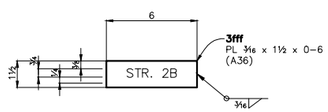
ALL DIMENSIONS FROM BOTTOM OF SHAFT



ID TAG DETAIL – 1



ID TAG DETAIL – 2



ID TAG DETAIL – 3

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL, DO NOT GALVANIZE.

(STR. 2B) 19–9462PE06

DIS-TRAN Steel, LLC
P.O. BOX 5109 • ALEXANDRIA, LA, 71307–5709
PHONE 318–448–0274 • FAX 318–445–4454

WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

230KV TRANSMISSION POLE / ITEM – 4
SECTIONS & DETAILS (CONTINUED)

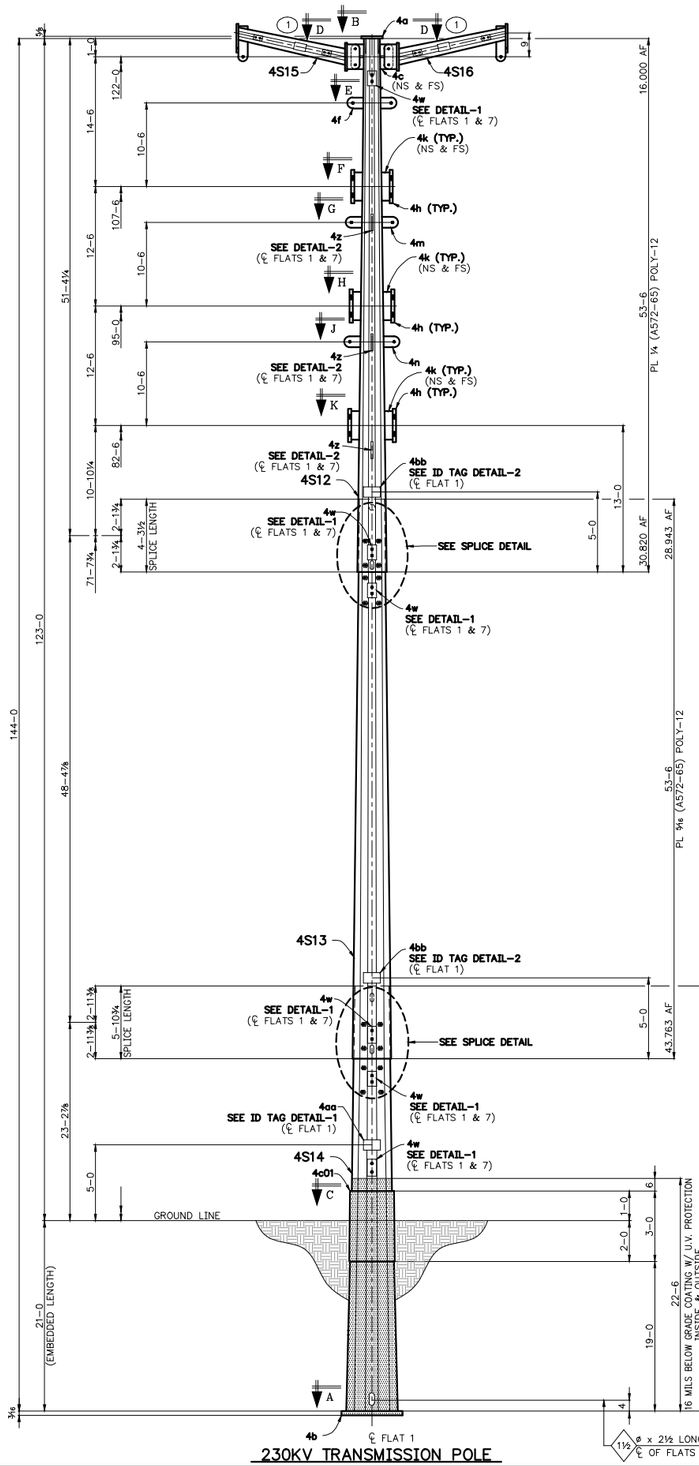
SCALE	DATE	JOB NUMBER	DRAWING NUMBER	REV. NO.
N.T.S.	07/12/19	19–9462P	E06	1

DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ

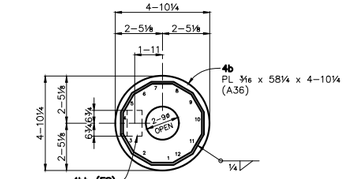
NOTICE TO ERECTOR
BACKCHARGES FOR CORRECTIVE WORK OR REPLACED MATERIALS WILL NOT BE ACCEPTED UNLESS EXPRESSLY AUTHORIZED BY DIS–TRAN BEFORE ANY SUCH COST ARE INCURRED.

REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
4					
3					
2					
1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19

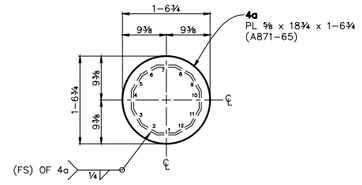
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8					
7					
6					
5					



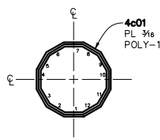
230KV TRANSMISSION POLE



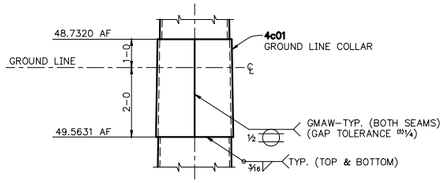
SECTION – A

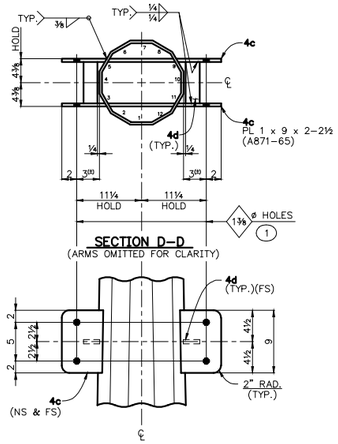


SECTION – B

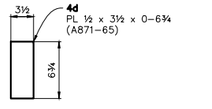


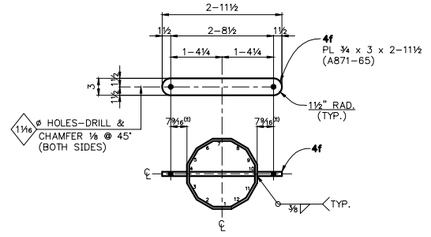
SECTION – C



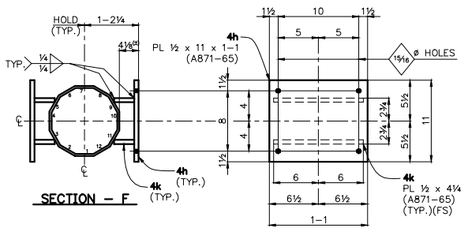


SECTION D–D
(ARMS OMITTED FOR CLARITY)

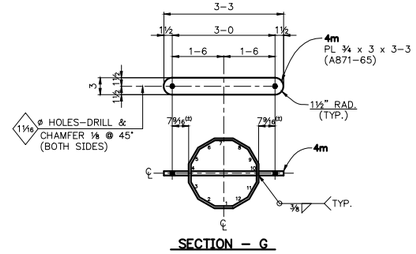




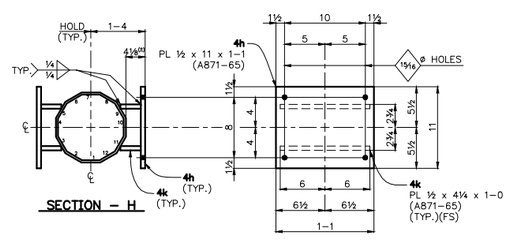
SECTION – E



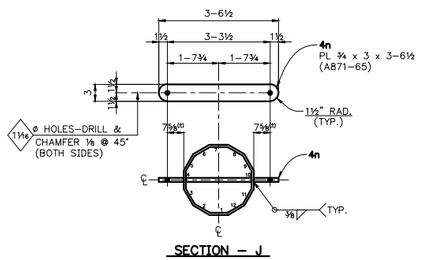
SECTION – F



SECTION – G



SECTION – H



SECTION – J

MATERIAL REQ'D. FOR ASSEMBLY			
MARK	QTY.	DESCRIPTION	BLACK WT.
4S12	ONE	POLY-12 POLE	3,869
4S13	ONE	POLY-12 POLE	6,575
4S14	ONE	POLY-12 POLE	9,654
4S15	ONE	POLY-8 POLE	170
4S16	ONE	POLY-8 POLE	170
		TOTAL BLACK WT.	20,438#

HARDWARE REQD. FOR ASSEMBLY		
MARK	QTY.	DESCRIPTION
(1)	8	1¼ø x 4 (A325 TYPE-3) BOLTS W/ ONE-1¼ø H. FLATWASHER (F436 TYPE-3) EACH ONE-1¼ø H. HEX NUT LOCKNUT (A563-DH TYPE-3) EACH

MATERIAL BILLED FOR ONE MAKE (2) TIMES

GENERAL NOTES:

1. ALL WELDS SHALL BE IN ACCORDANCE WITH A.W.S. (D1.1.) UNLESS NOTED OTHERWISE.
   a.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL BE U.T. TESTED IN ACCORDANCE WITH AWS & ASNDT.
   b.) ALL MATERIAL WELDED WITH E80-SERIES, LOW HYDROGEN ELECTRODES.
   c.) ALL FILLET WELDS AT JOINT TERMINATIONS OR ABRUPT CHANGES IN WELD DIRECTION SHALL HAVE END RETURNS TO WRAP CORNERS AS GEOMETRY PERMITS. IF JOINT GEOMETRY DOES NOT PERMIT A FULL SIZE RETURN, A SEAL WELD SHALL BE PROVIDED WHERE ACCESSIBLE.
   d.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL USE 3/16" X 1 1/4", (A36) STEEL BACKING (GALVANIZED POLES); (A588-50) (NON-GALVANIZED), MINIMUM. BACKING BARS SHALL BE SPLICED ON SHAFT FLATS ONLY, WITH A C.J.P. GROOVE WELD. BACKING BARS SHALL BE SEAL WELDED ALL AROUND, WHEN ACCESSIBLE.
   e.) LONGITUDINAL SEAM WELDS SHALL ACHIEVE A MINIMUM OF 80% PENETRATION. LONGITUDINAL SEAM WELDS SHALL ACHIEVE 100% PENETRATION WITHIN A MINIMUM OF 6" FROM THE ENDS OF THE SHAFT AND THE FULL LENGTH OF THE FEMALE SECTION IN THE SLIP JOINT.
2. LONGITUDINAL SEAM WELDS IN FEMALE SECTION OF THE SLIP JOINT SHALL BE FULL PENETRATION WELDS.
3. FOR PROPER SHAFT ALIGNMENT FOR ASSEMBLY, A 6" HORIZONTAL WELD BEAD AND A MARK NUMBER ARE POSITIONED ON EACH SHAFT AT EACH SPLICE. THE 6" HORIZONTAL WELD BEADS ARE ON MATCHING CORNERS. THE MARK NUMBER IS ON AN ADJACENT FLAT. THE HORIZONTAL WELD BEAD CORNERS SHALL BE ALIGNED TOP TO BOTTOM OF THE POLE. MATCH NUMBERS SHALL BE MATCHED FOR EACH SPLICE.
4. FIELD ASSEMBLY HOLES (1⅛ø) WITH 1"ø H. HEX NUTS ARE LOCATED ON OPPOSING SECTION FLATS ABOVE AND BELOW SPLICES FOR JACKING SHAFTS TOGETHER.
5. THE LOWER WELD ORIENTATION MARK AT EACH SPLICE LOCATION SHALL BE TELESCOPED IN THE FIELD TO WITHIN 24" OF THE UPPER WELD ORIENTATION MARK. AFTER TELESCOPED, THE SECTIONS SHOULD SHOW NO FURTHER MOVEMENT AND THERE SHOULD BE ADEQUATE METAL-TO-METAL CONTACT ON ALL FLATS.
6. TWO SLOTS (1½ø x 2½") WILL BE PROVIDED AT THE SLIP FITTED END OF EACH SHAFT.
7. POLE TAPER = 0.277000 IN/FT
8. FIELD BOLT SHIPPING QUANTITIES WILL INCLUDE A MAXIMUM 5% OVERAGE FOR BOLTS 1"ø OR LESS. FIELD BOLTS OVER 1"ø WILL BE EXACT COUNT UNLESS NOTED OTHERWISE.
9. ALL HARDWARE NOTED WITH "PT" SHALL BE PRE-TENSIONED PER THE TURN-OF-NUT METHOD. ALL OTHER HARDWARE SHALL BE SNUG-TIGHT. SPARE SHIPPING QUANTITIES WILL INCLUDE THREE EXTRA ASSEMBLIES OF EACH BOLT TYPE DESIGNATED AS "PT" FOR FIELD VERIFICATION OF PRE-TENSIONING METHOD.
10. **POLE SHALL BE SWEEP BLASTED DULLED AFTER FABRICATION.**

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL, DO NOT GALVANIZE.

(STR. 3 & 5) 19-9462PE07

DIS-TRAN Steel, LLC
P.O. BOX 5109 • ALEXANDRIA, LA, 71307-5709
PHONE 318-448-0274 • FAX 318-445-4454

WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

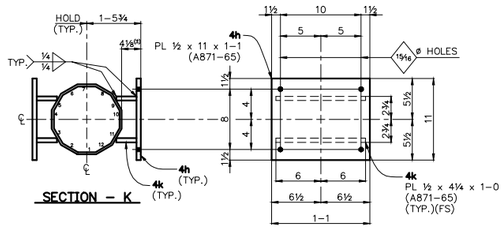
230KV TRANSMISSION POLE / ITEM – 5
ERECTION ELEVATION, SECTIONS & DETAILS

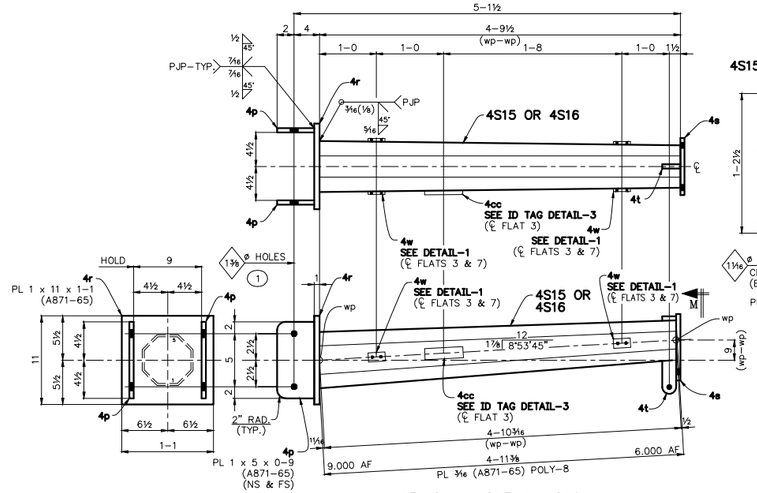
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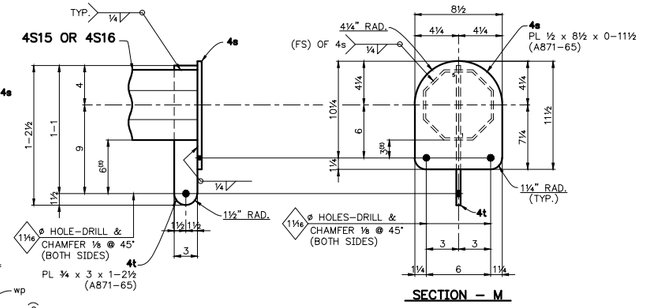
NOTICE TO ERECTOR
BACKCHARGES FOR CORRECTIVE WORK OR REPLACED MATERIALS WILL NOT BE ACCEPTED UNLESS EXPRESSLY AUTHORIZED BY DIS-TRAN BEFORE ANY SUCH COST ARE INCURRED.

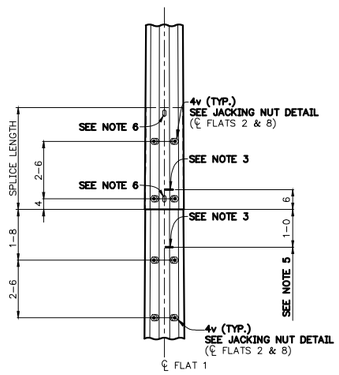
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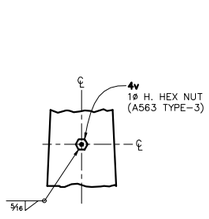
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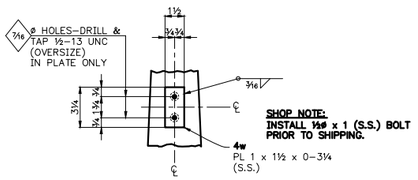






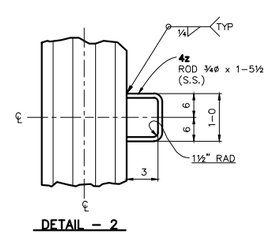






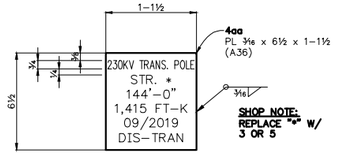
GROUNDING SCHEDULE DIM'S TO CENTER OF GROUND PLATE SEE DETAIL–1		
POLE – 4S12	POLE – 4S13	POLE – 4S14
℄ OF FLATS 1 & 7	℄ OF FLATS 1 & 7	℄ OF FLATS 1 & 7
0–11	0–11	24–0
51–6	48–3½	40–4½

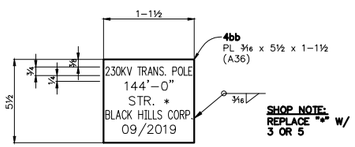
ALL DIMENSIONS FROM BOTTOM OF SHAFT

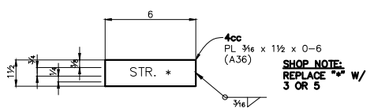


GROUND LOOP SCHEDULE DIM'S TO CENTER OF GROUND LOOP SEE DETAIL–2
POLE – 4S12
℄ OF FLATS 1 & 7
11–0
23–6
36–0

ALL DIMENSIONS FROM BOTTOM OF SHAFT







SHOP NOTE:
ALL MATERIAL WEATHERING STEEL, DO NOT GALVANIZE.

(STR. 3 & 5)

19–9462PE08

DIS-TRAN Steel, LLC
P.O. BOX 5109•ALEXANDRIA, LA, 71307–5709
PHONE 318–448–0274•FAX 318–445–4454

WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

230KV TRANSMISSION POLE / ITEM – 5

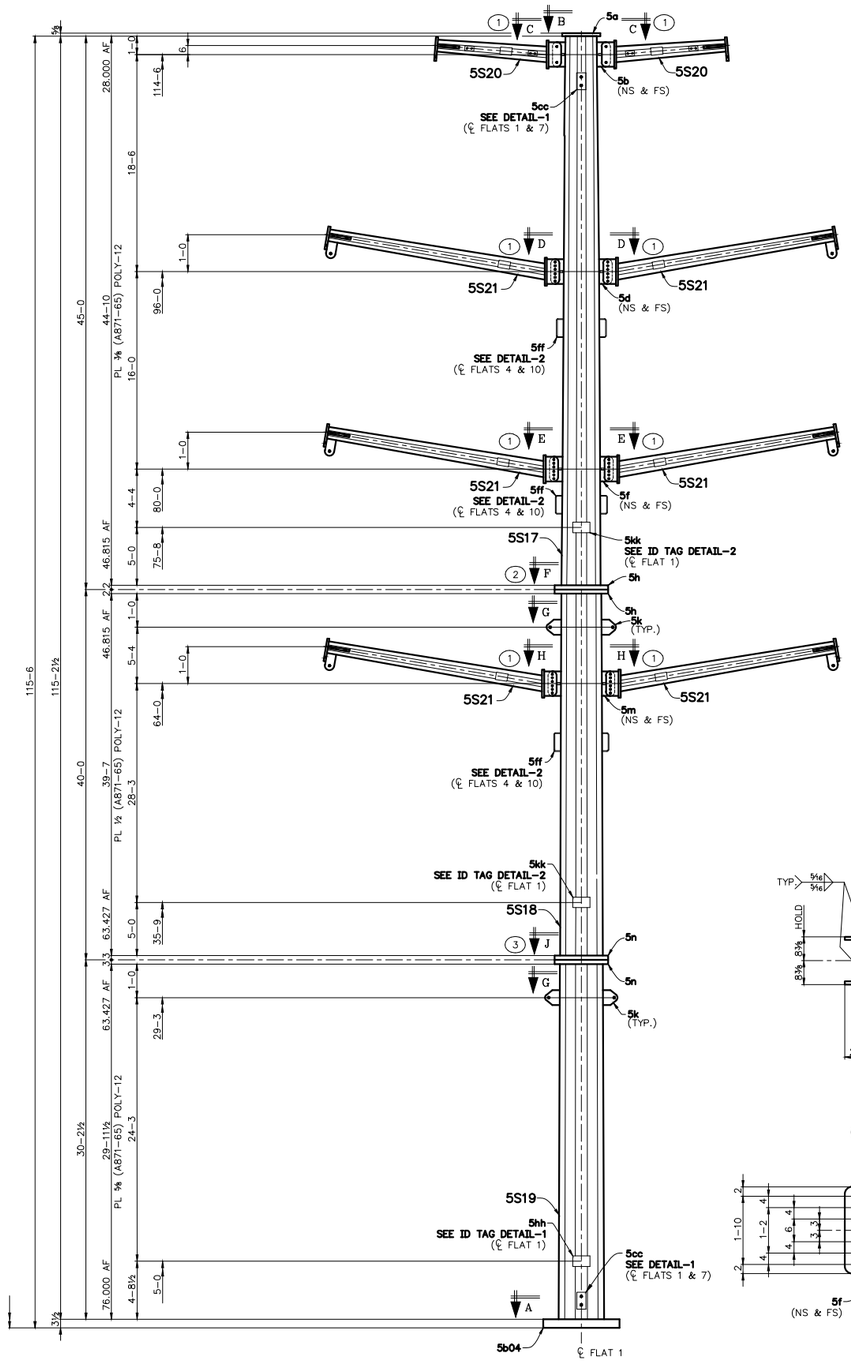
SECTIONS & DETAILS (CONTINUED)

SCALE	DATE	JOB NUMBER	DRAWING NUMBER	REV. NO.
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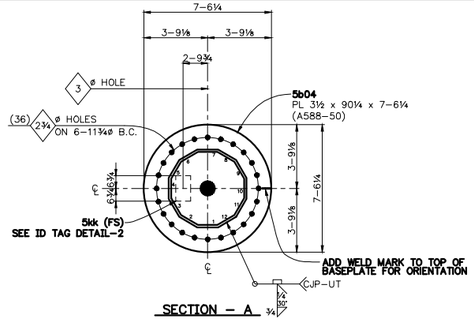
DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ

NOTICE TO ERECTOR
BACKCHARGES FOR CORRECTIVE WORK OR REPLACED MATERIALS WILL NOT BE ACCEPTED UNLESS EXPRESSLY AUTHORIZED BY DIS–TRAN BEFORE ANY SUCH COST ARE INCURRED.

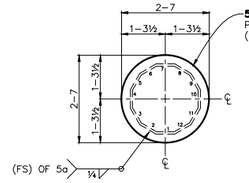
REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
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8					



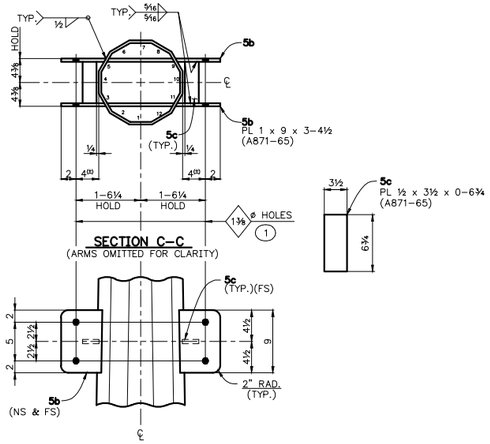
230KV TRANSMISSION POLE

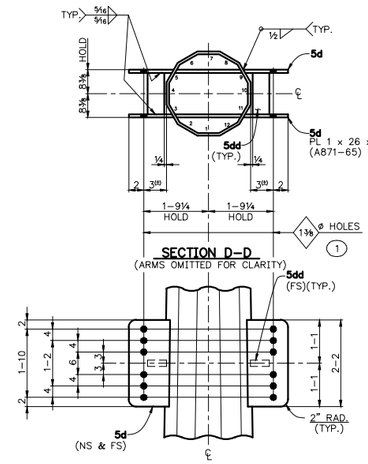


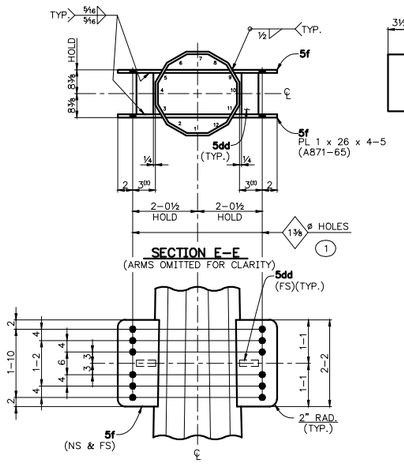
SECTION – A

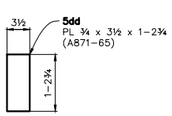


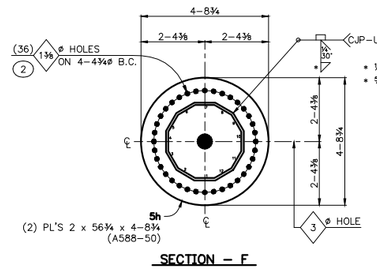
SECTION – B



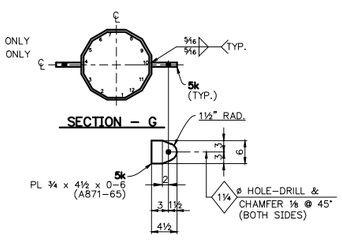








* ½ FOR 5S17 ONLY
* ⅝ FOR 5S18 ONLY



MATERIAL REQ'D. FOR ASSEMBLY			
MARK	QTY.	DESCRIPTION	BLACK WT.
5S17	ONE	POLY-12 POLE	10,507
5S18	ONE	POLY-12 POLE	19,335
5S19	ONE	POLY-12 POLE	27,016
5S20	2	POLY-8 POLE (UNIT WT. = 219)	438
5S21	6	POLY-8 POLE (UNIT WT. = 817)	4,902
		TOTAL BLACK WT.	62,198#

HARDWARE REQD. FOR ASSEMBLY			
	MARK	QTY.	DESCRIPTION
	(1)	80	1¼ø x 4 (A325 TYPE-3) BOLTS W/ ONE-1¼ø H. FLATWASHER (F436 TYPE-3) EACH ONE-1¼ø H. HEX NUT LOCKNUT (A563-DH TYPE-3) EACH
PT	(2)	36	1¼ø x 6 (A325 TYPE-3) BOLTS W/ ONE-1¼ø H. FLATWASHER (F436 TYPE-3) EACH ONE-1¼ø PIN-TYPE LOCKNUT (A563-DH TYPE-3) EACH
PT	(3)	48	1½ø x 8¼ (A325 TYPE-3) BOLTS W/ ONE-1½ø H. FLATWASHER (F436 TYPE-3) EACH ONE-1½ø PIN-TYPE LOCKNUT (A563-DH TYPE-3) EACH
	(4)	ONE	SEE ANCHOR BOLT CAGE DETAIL ON SHEET E11.

MATERIAL BILLED FOR ONE MAKE (ONE) TIME

GENERAL NOTES:

1. ALL WELDS SHALL BE IN ACCORDANCE WITH A.W.S. (D1.1) UNLESS NOTED OTHERWISE.
   a.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL BE U.T. TESTED IN ACCORDANCE WITH AWS & ASNDT.
   b.) ALL MATERIAL WELDED WITH E80-SERIES, LOW HYDROGEN ELECTRODES.
   c.) ALL FILLET WELDS AT JOINT TERMINATIONS OR ABRUPT CHANGES IN WELD DIRECTION SHALL HAVE END RETURNS TO WRAP CORNERS AS GEOMETRY PERMITS. IF JOINT GEOMETRY DOES NOT PERMIT A FULL SIZE RETURN, A SEAL WELD SHALL BE PROVIDED WHERE ACCESSIBLE.
   d.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL USE 3/16" x 1 1/4", (A36) STEEL BACKING (GALVANIZED POLES); (A588-50) (NON-GALVANIZED), MINIMUM. BACKING BARS SHALL BE SPLICED ON SHAFT FLATS ONLY, WITH A C.J.P. GROOVE WELD. BACKING BARS SHALL BE SEAL WELDED ALL AROUND, WHEN ACCESSIBLE.
   e.) LONGITUDINAL SEAM WELDS SHALL ACHIEVE A MINIMUM OF 80% PENETRATION. LONGITUDINAL SEAM WELDS SHALL ACHIEVE 100% PENETRATION WITHIN A MINIMUM OF 6" FROM THE ENDS OF THE SHAFT.
2. FIELD BOLT SHIPPING QUANTITIES WILL INCLUDE A MAXIMUM 5% OVERAGE FOR BOLTS 1"ø OR LESS. FIELD BOLTS OVER 1"ø WILL BE EXACT COUNT UNLESS NOTED OTHERWISE.
3. POLE TAPER = 0.419672 IN/FT.
4. ALL HARDWARE NOTED WITH "PT" SHALL BE PRE-TENSIONED PER THE TURN-OF-NUT METHOD. ALL OTHER HARDWARE SHALL BE SNUG-TIGHT. SPARE SHIPPING QUANTITIES WILL INCLUDE THREE EXTRA ASSEMBLIES OF EACH BOLT TYPE DESIGNATED AS "PT" FOR FIELD VERIFICATION OF PRE-TENSIONING METHOD.
5. **POLE SHALL BE SWEEP BLASTED DULLED AFTER FABRICATION.**

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL, DO NOT GALVANIZE.

(STR. 4) 19-9462PE09

DIS-TRAN Steel, LLC
P.O. BOX 5109•ALEXANDRIA, LA, 71307-5709
PHONE 318-448-0274•FAX 318-445-4454

WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

230KV TRANSMISSION POLE / ITEM – 6

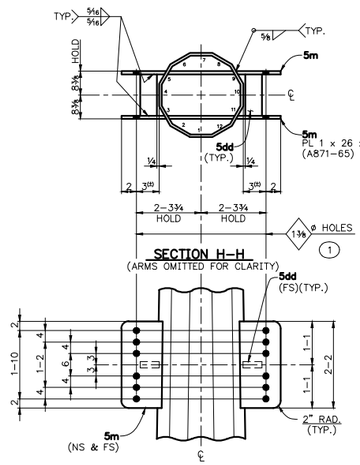
ERECTION ELEVATION, SECTIONS & DETAILS

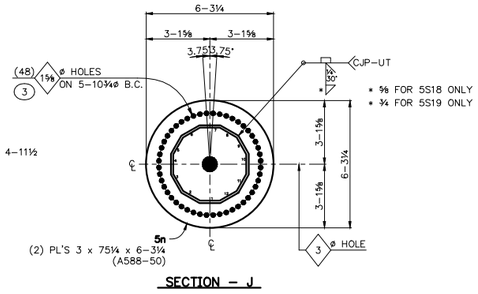
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N.T.S.	07/12/19	19-9462P	E09	1
DRAWN BY: DLW	CHK'D. BY: KLN	APP'D. BY: KEJ		

NOTICE TO ERECTOR
BACKCHARGES FOR CORRECTIVE WORK OR REPLACED MATERIALS WILL NOT BE ACCEPTED UNLESS EXPRESSLY AUTHORIZED BY DIS-TRAN BEFORE ANY SUCH COST ARE INCURRED.

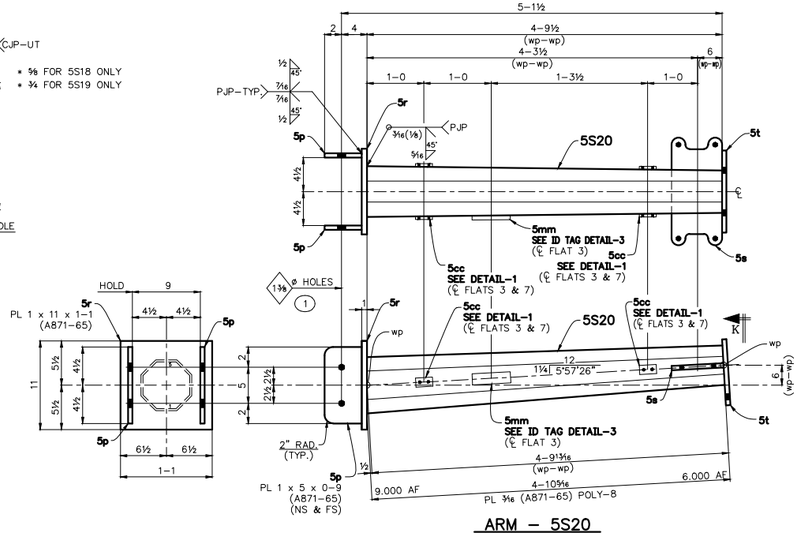
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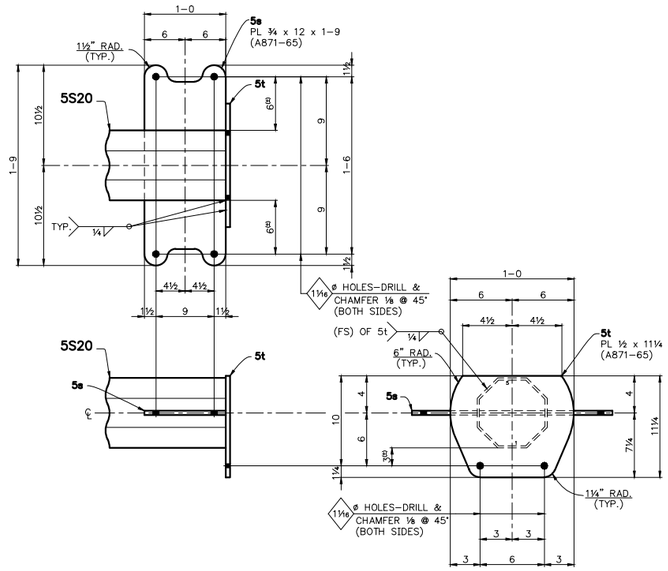




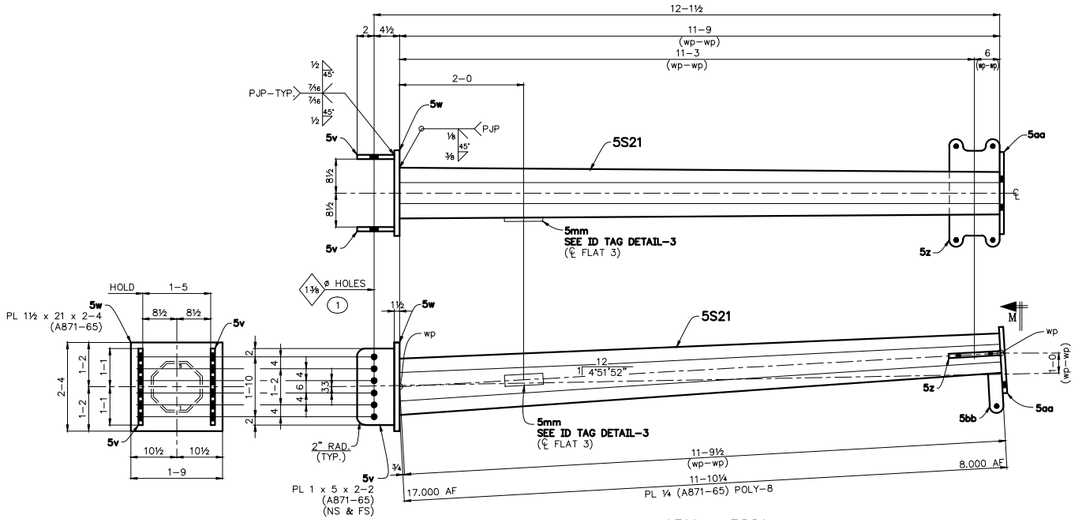
SECTION – J



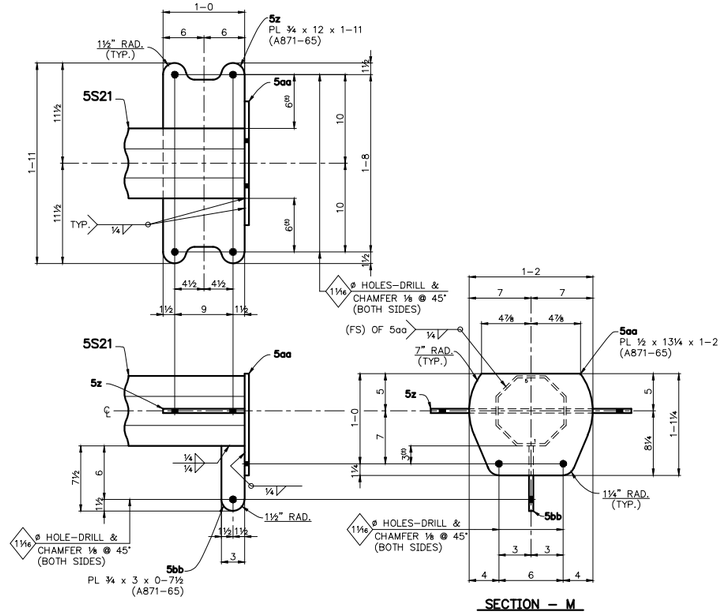
ARM – 5S20



SECTION – K



ARM – 5S21



SECTION – M

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL, DO NOT GALVANIZE.

(STR. 4)

19-9462PE10

NOTICE TO ERECTOR
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REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19

DIS-TRAN Steel, LLC
P.O. BOX 5109 • ALEXANDRIA, LA, 71307-5709
PHONE 318-448-0274 • FAX 318-445-4454

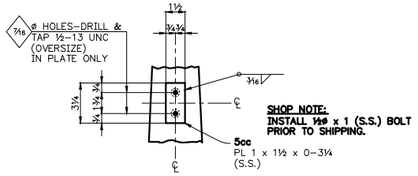
WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

230KV TRANSMISSION POLE / ITEM – 6

SECTIONS & DETAILS (CONTINUED)

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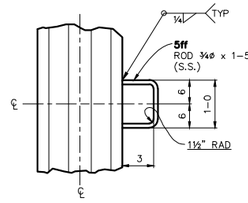
DRAWN BY	CK'D. BY	APP'D. BY
DLW	KLN	KEJ



DETAIL – 1

GROUNDING SCHEDULE DIM'S TO CENTER OF GROUND PLATE SEE DETAIL–1	
POLE – 5S17	POLE – 5S19
℄ OF FLATS 1 & 7	℄ OF FLATS 1 & 7
42–10	0–8½

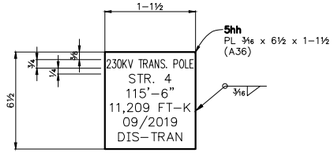
ALL DIMENSIONS FROM BOTTOM OF SHAFT



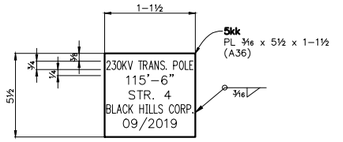
DETAIL – 2

GROUND LOOP SCHEDULE DIM'S TO CENTER OF GROUND LOOP SEE DETAIL–2	
POLE – 5S17	POLE – 5S18
℄ OF FLATS 4 & 10	℄ OF FLATS 4 & 10
6–10	30–9
22–10	

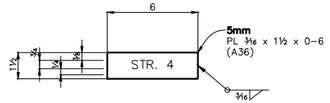
ALL DIMENSIONS FROM BOTTOM OF SHAFT



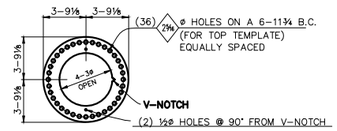
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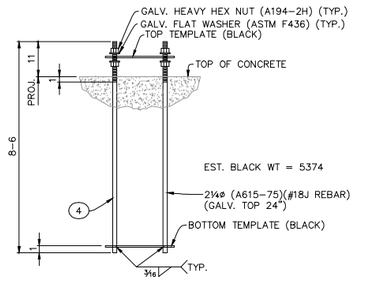
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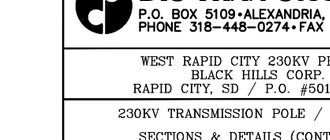


ID TAG DETAIL – 3



TOP TEMPLATE – ½" THICK





BOTTOM TEMPLATE – ⅜" THICK

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REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
4					
3					
2					
1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19

REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
8					
7					
6					
5					

SHOP NOTE:
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(STR. 4) 19–9462PE11

DIS-TRAN Steel, LLC
P.O. BOX 5109•ALEXANDRIA, LA, 71307–5709
PHONE 318–448–0274•FAX 318–445–4454

WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

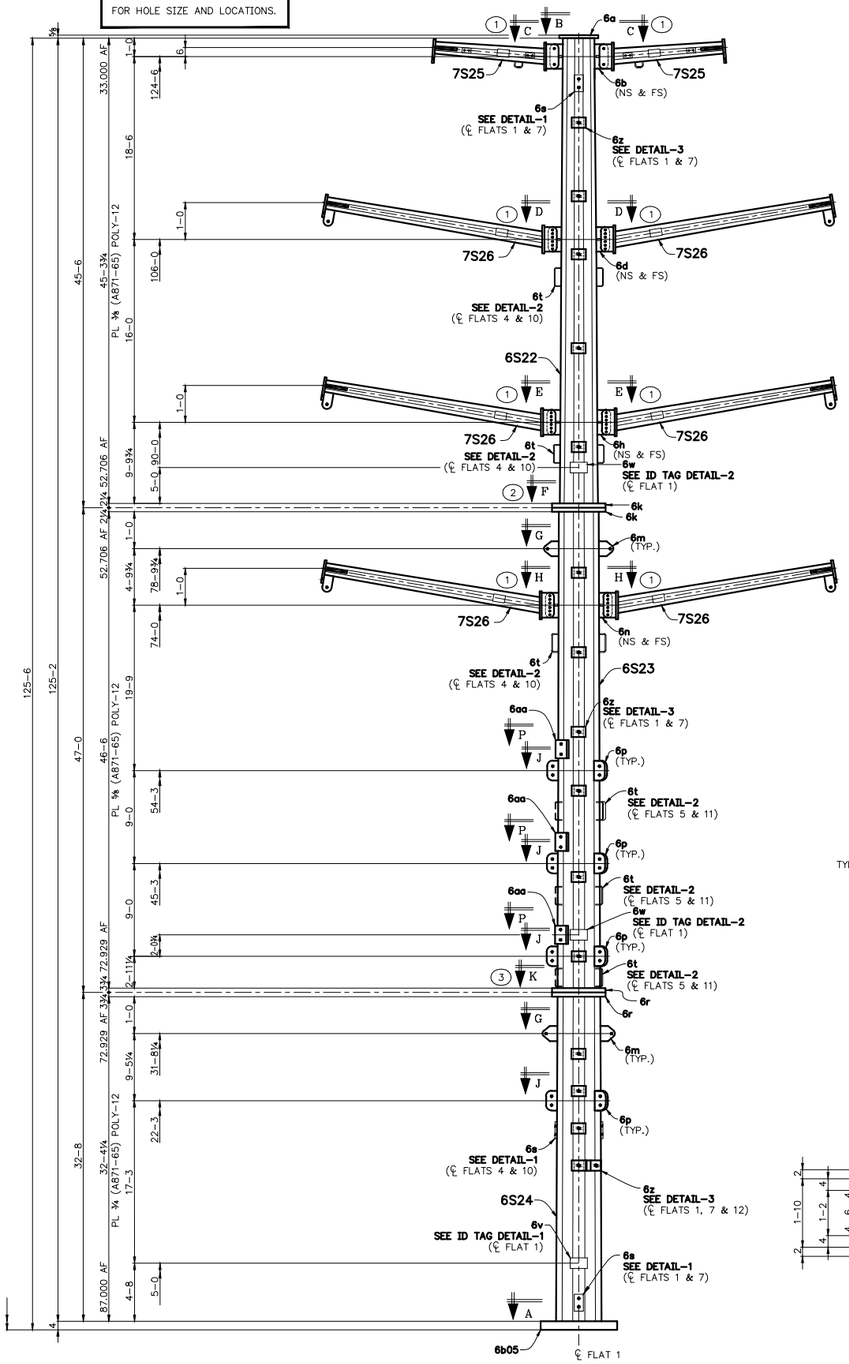
230KV TRANSMISSION POLE / ITEM – 6

SECTIONS & DETAILS (CONTINUED)

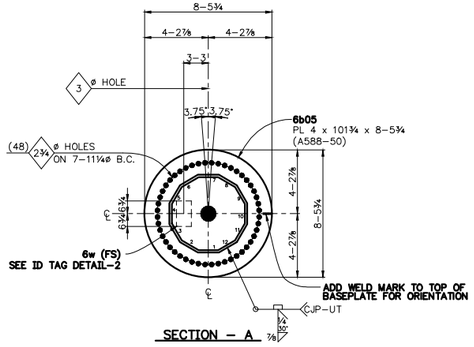
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N.T.S.	07/12/19	19–9462P	E11	1

DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ

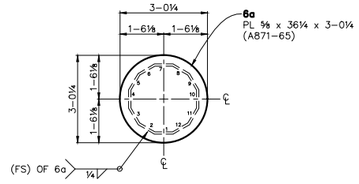
SHOP NOTE:
SEE HOLE DETAIL & SCHEDULE FOR HOLE SIZE AND LOCATIONS.



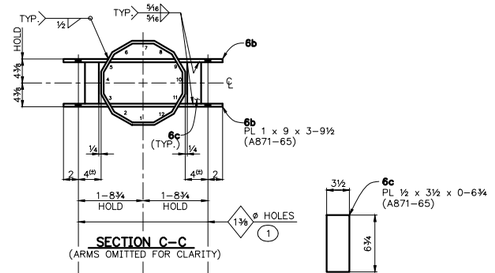
230KV TRANSMISSION POLE



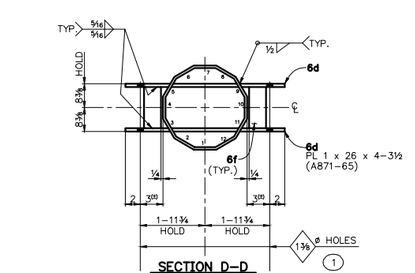
SECTION – A



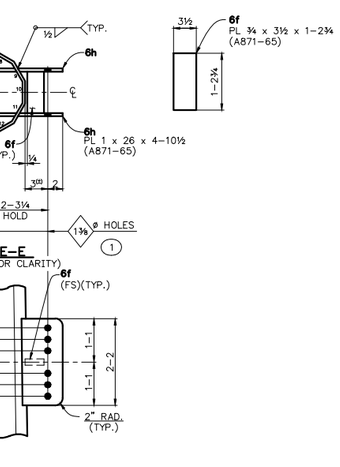
SECTION – B



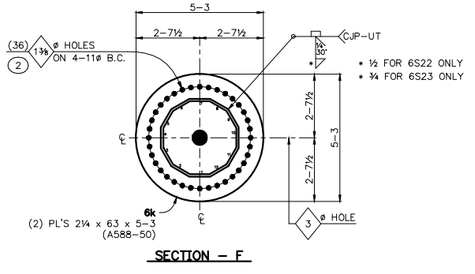
SECTION C-C
(ARMS OMITTED FOR CLARITY)



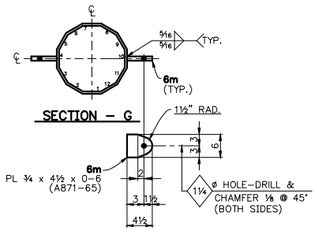
SECTION D-D
(ARMS OMITTED FOR CLARITY)



SECTION E-E
(ARMS OMITTED FOR CLARITY)



SECTION – F



SECTION – G

MATERIAL REQ'D. FOR ASSEMBLY

MARK	QTY.	DESCRIPTION	BLACK WT.
6S22	ONE	POLY-12 POLE	12,577
6S23	ONE	POLY-12 POLE	31,537
6S24	ONE	POLY-12 POLE	40,844
7S25	2	POLY-8 POLE (UNIT WT. = 230)	460
7S26	6	POLY-8 POLE (UNIT WT. = 872)	5,232
		TOTAL BLACK WT.	90,650#

HARDWARE REQD. FOR ASSEMBLY

	MARK	QTY.	DESCRIPTION
	(1)	80	1¼ø x 4 (A325 TYPE-3) BOLTS W/ ONE-1¼ø H. FLATWASHER (F436 TYPE-3) EACH ONE-1¼ø H. HEX NUT LOCKNUT (A563-DH TYPE-3) EACH
PT	(2)	36	1¼ø x 6½ (A325 TYPE-3) BOLTS W/ ONE-1¼ø H. FLATWASHER (F436 TYPE-3) EACH ONE-1¼ø PIN-TYPE LOCKNUT (A563-DH TYPE-3) EACH
	(3)	36	2ø x 1-4 (A193-B7) STUD (ALL THREAD) W/ 2-2ø SPLIT LOCKWASHERS EACH 2-2ø H. FLATWASHERS (F436) EACH 2-2ø H. HEX NUTS (A194-2H) EACH
	(4)	ONE	SEE ANCHOR BOLT CAGE DETAIL ON SHEET E14.

MATERIAL BILLED FOR ONE MAKE (ONE) TIME

GENERAL NOTES:

1. ALL WELDS SHALL BE IN ACCORDANCE WITH A.W.S. (D1.1.) UNLESS NOTED OTHERWISE.
   a.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL BE U.T. TESTED IN ACCORDANCE WITH AWS & ASNDT.
   b.) ALL MATERIAL WELDED WITH E80-SERIES, LOW HYDROGEN ELECTRODES.
   c.) ALL FILLET WELDS AT JOINT TERMINATIONS OR ABRUPT CHANGES IN WELD DIRECTION SHALL HAVE END RETURNS TO WRAP CORNERS AS GEOMETRY PERMITS. IF JOINT GEOMETRY DOES NOT PERMIT A FULL SIZE RETURN, A SEAL WELD SHALL BE PROVIDED WHERE ACCESSIBLE.
   d.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL USE 3/16" X 1 1/4", (A36) STEEL BACKING (GALVANIZED POLES); (A588-50) (NON-GALVANIZED), MINIMUM. BACKING BARS SHALL BE SPLICED ON SHAFT FLATS ONLY, WITH A C.J.P. GROOVE WELD. BACKING BARS SHALL BE SEAL WELDED ALL AROUND, WHEN ACCESSIBLE.
   e.) LONGITUDINAL SEAM WELDS SHALL ACHIEVE A MINIMUM OF 80% PENETRATION. LONGITUDINAL SEAM WELDS SHALL ACHIEVE 100% PENETRATION WITHIN A MINIMUM OF 6" FROM THE ENDS OF THE SHAFT.
2. FIELD BOLT SHIPPING QUANTITIES WILL INCLUDE A MAXIMUM 5% OVERAGE FOR BOLTS 1"ø OR LESS. FIELD BOLTS OVER 1"ø WILL BE EXACT COUNT UNLESS NOTED OTHERWISE.
3. POLE TAPER = 0.434899 IN/FT.
4. ALL HARDWARE NOTED WITH "PT" SHALL BE PRE-TENSIONED PER THE TURN-OF-NUT METHOD. ALL OTHER HARDWARE SHALL BE SNUG-TIGHT. SPARE SHIPPING QUANTITIES WILL INCLUDE THREE EXTRA ASSEMBLIES OF EACH BOLT TYPE DESIGNATED AS "PT" FOR FIELD VERIFICATION OF PRE-TENSIONING METHOD.
5. **POLE SHALL BE SWEEP BLASTED DULLED AFTER FABRICATION.**

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL, DO NOT GALVANIZE.

(STR. 6) 19-9462PE12

DIS-TRAN Steel, LLC
P.O. BOX 5109•ALEXANDRIA, LA, 71307-5709
PHONE 318-448-0274•FAX 318-445-4454

WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

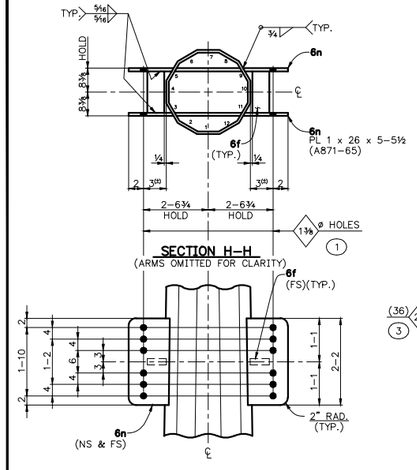
230KV TRANSMISSION POLE / ITEM – 8
ERECTION ELEVATION, SECTIONS & DETAILS

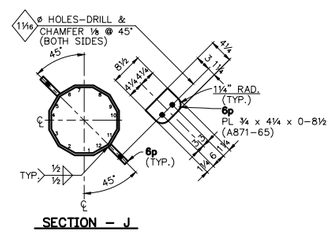
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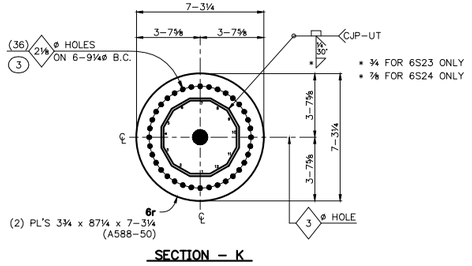
DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ

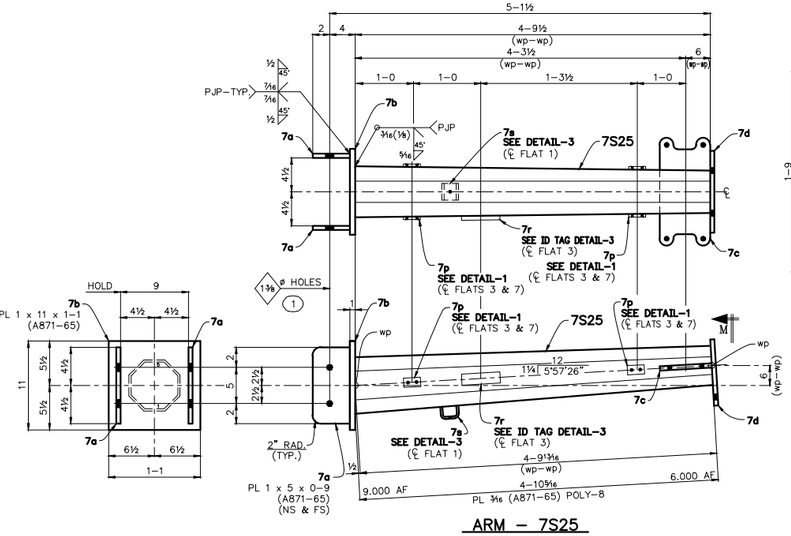
NOTICE TO ERECTOR
BACKCHARGES FOR CORRECTIVE WORK OR REPLACED MATERIALS WILL NOT BE ACCEPTED UNLESS EXPRESSLY AUTHORIZED BY DIS-TRAN BEFORE ANY SUCH COST ARE INCURRED.

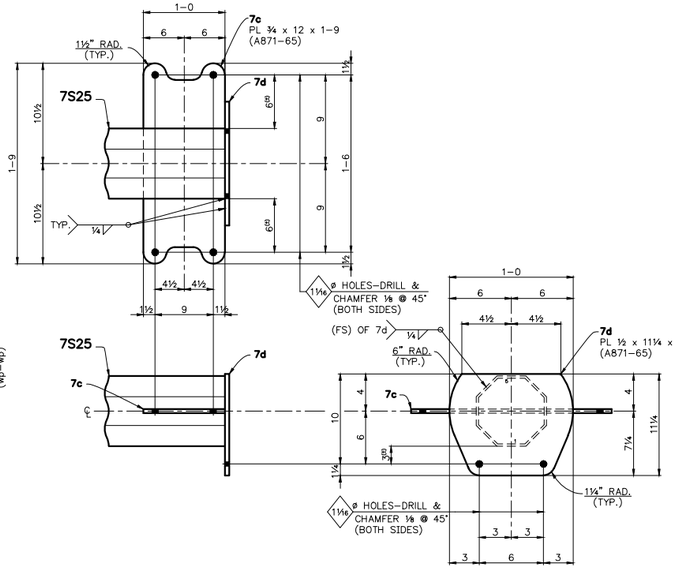
REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19
2					
3					
4					
5					
6					
7					
8					











SHOP NOTE:
ALL MATERIAL WEATHERING STEEL, DO NOT GALVANIZE.

(STR. 6) 19–9462PE13

DIS-TRAN Steel, LLC
P.O. BOX 5109•ALEXANDRIA, LA, 71307–5709
PHONE 318–448–0274•FAX 318–445–4454

WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

230KV TRANSMISSION POLE / ITEM – 8

SECTIONS & DETAILS (CONTINUED)

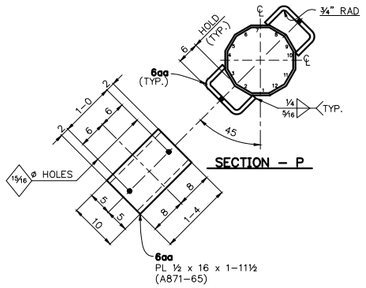
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DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ

NOTICE TO ERECTOR
BACKCHARGES FOR CORRECTIVE WORK OR REPLACED MATERIALS WILL NOT BE ACCEPTED UNLESS EXPRESSLY AUTHORIZED BY DIS-TRAN BEFORE ANY SUCH COST ARE INCURRED.

REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
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2					
1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19

REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
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7					
6					
5					

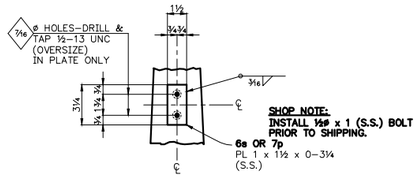


SECTION – P

BRACKET SCHEDULE
DIM'S TO CENTER OF BRACKET
SEE SECTION–P

POLE – 6S23
4–2¼
13–2¼
22–2¼

ALL DIMENSIONS FROM BOTTOM OF SHAFT



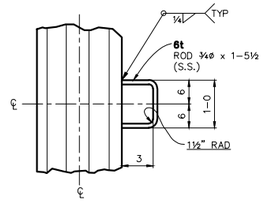
SHOP NOTE:
INSTALL ½ø x 1 (S.S.) BOLT PRIOR TO SHIPPING.

DETAIL – 1

GROUNDING SCHEDULE
DIM'S TO CENTER OF GROUND PLATE
SEE DETAIL–1

POLE – 6S22	POLE – 6S24	
¢ OF FLATS 1 & 7	¢ OF FLATS 1 & 7	¢ OF FLATS 4 & 10
43–3¾	0–8	19–2

ALL DIMENSIONS FROM BOTTOM OF SHAFT

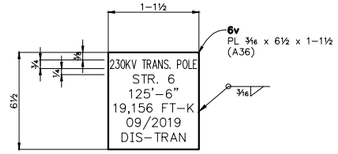


DETAIL – 2

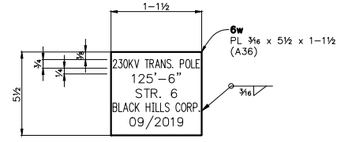
GROUND LOOP SCHEDULE
DIM'S TO CENTER OF GROUND LOOP
SEE DETAIL–2

POLE – 6S22	POLE – 6S23		POLE – 6S24
¢ OF FLATS 4 & 10	¢ OF FLATS 4 & 10	¢ OF FLATS 5 & 11	¢ OF FLATS 1 & 7
7–3¾	38–2¼	0–11½	19–2
23–3¾		9–11¼	
		18–11¼	

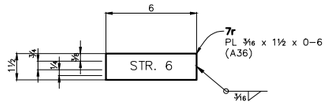
ALL DIMENSIONS FROM BOTTOM OF SHAFT



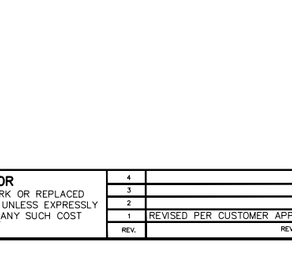
ID TAG DETAIL – 1



ID TAG DETAIL – 2



ID TAG DETAIL – 3

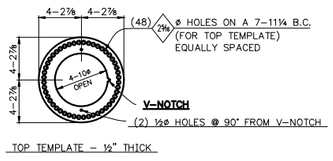


DETAIL – 3

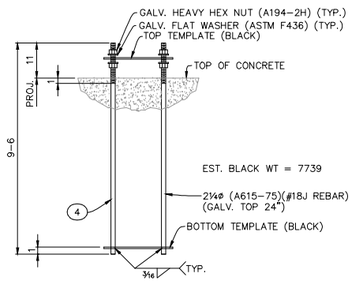
OPGW SCHEDULE
DIM'S TO CENTER OF OPGW
SEE DETAIL–3

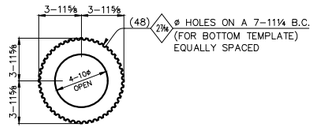
POLE – 6S22	POLE – 6S23	POLE – 6S24		POLE – 7S25
¢ OF FLATS 1 & 7	¢ OF FLATS 1 & 7	¢ OF FLATS 1 & 7	¢ OF FLAT 12	¢ OF FLAT 1
3–0	3–0	15–2	15–2	2–6
10–0	11–0	19–8	19–8	
17–0	19–0	24–2		
24–0	27–0	29–4¼		
31–0	35–0			
38–0	43–0			

ALL DIMENSIONS FROM BOTTOM OF SHAFT



TOP TEMPLATE – ½" THICK





BOTTOM TEMPLATE – ⅜" THICK

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL,
DO NOT GALVANIZE.

(STR. 6) 19–9462PE14

DIS-TRAN Steel, LLC
P.O. BOX 5109•ALEXANDRIA, LA, 71307–5709
PHONE 318–448–0274•FAX 318–445–4454

WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

230KV TRANSMISSION POLE / ITEM – 8
SECTIONS & DETAILS (CONTINUED)

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N.T.S.	07/12/19	19–9462P	E14	1

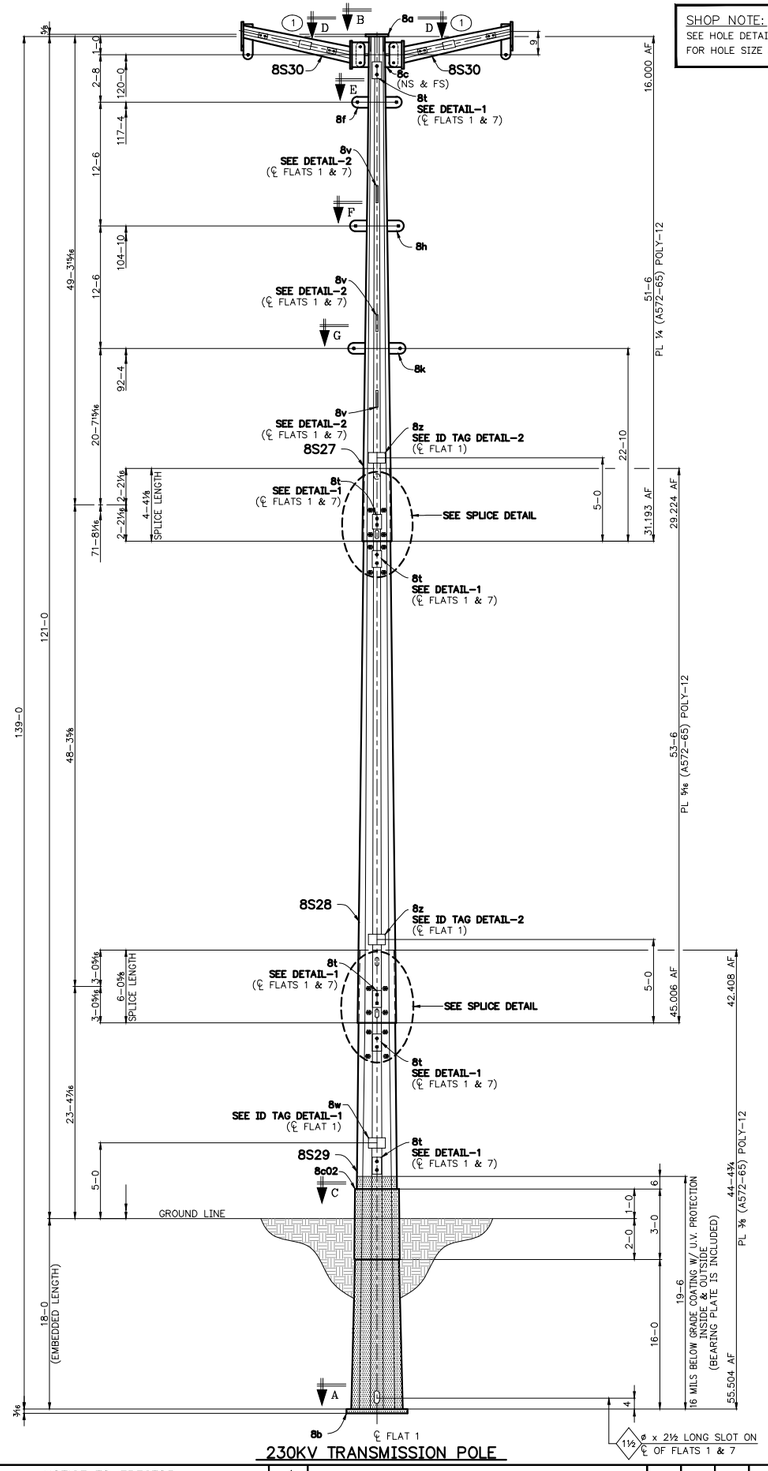
DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ

NOTICE TO ERECTOR
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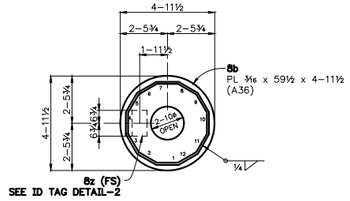
REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
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3					
2					
1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19

REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
8					
7					
6					
5					

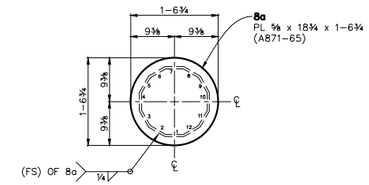
SHOP NOTE:
SEE HOLE DETAIL & SCHEDULE FOR HOLE SIZE AND LOCATIONS.



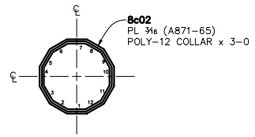
230KV TRANSMISSION POLE



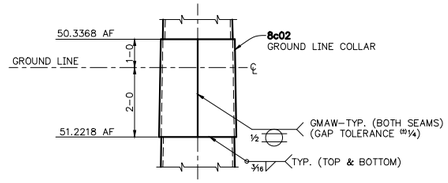
SECTION – A

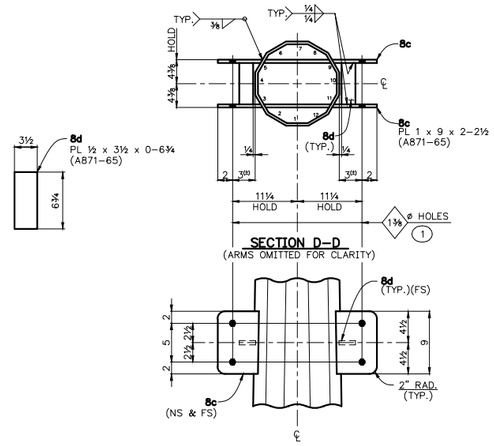


SECTION – B

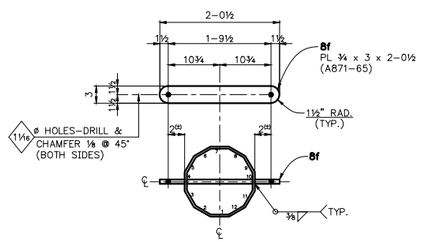


SECTION – C

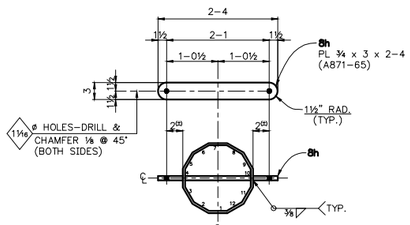




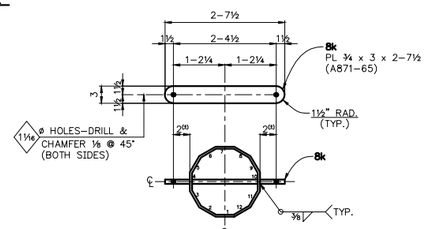
SECTION D-D



SECTION – F



SECTION – F



SECTION – G

MATERIAL REQ'D. FOR ASSEMBLY			
MARK	QTY.	DESCRIPTION	BLACK WT.
8S27	ONE	POLY-12 POLE	3,539
8S28	ONE	POLY-12 POLE	6,714
8S29	ONE	POLY-12 POLE	9,330
8S30	2	POLY-8 POLE (UNIT WT. = 170)	340
		TOTAL BLACK WT.	19,923#

HARDWARE REQD. FOR ASSEMBLY		
MARK	QTY.	DESCRIPTION
(1)	8	1¼ø x 4 (A325 TYPE-3) BOLTS W/ ONE-1¼ø H. FLATWASHER (F436 TYPE-3) EACH ONE-1¼ø H. HEX NUT LOCKNUT (A563-DH TYPE-3) EACH

MATERIAL BILLED FOR ONE MAKE (ONE) TIME

GENERAL NOTES:

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   a.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL BE U.T. TESTED IN ACCORDANCE WITH AWS & ASNDT.
   b.) ALL MATERIAL WELDED WITH E80-SERIES, LOW HYDROGEN ELECTRODES.
   c.) ALL FILLET WELDS AT JOINT TERMINATIONS OR ABRUPT CHANGES IN WELD DIRECTION SHALL HAVE END RETURNS TO WRAP CORNERS AS GEOMETRY PERMITS. IF JOINT GEOMETRY DOES NOT PERMIT A FULL SIZE RETURN, A SEAL WELD SHALL BE PROVIDED WHERE ACCESSIBLE.
   d.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL USE 3/16" X 1 1/4", (A36) STEEL BACKING (GALVANIZED POLES); (A588-50) (NON-GALVANIZED), MINIMUM. BACKING BARS SHALL BE SPLICED ON SHAFT FLATS ONLY, WITH A C.J.P. GROOVE WELD. BACKING BARS SHALL BE SEAL WELDED ALL AROUND, WHEN ACCESSIBLE.
   e.) LONGITUDINAL SEAM WELDS SHALL ACHIEVE A MINIMUM OF 80% PENETRATION. LONGITUDINAL SEAM WELDS SHALL ACHIEVE 100% PENETRATION WITHIN A MINIMUM OF 6" FROM THE ENDS OF THE SHAFT AND THE FULL LENGTH OF THE FEMALE SECTION IN THE SLIP JOINT.
2. LONGITUDINAL SEAM WELDS IN FEMALE SECTION OF THE SLIP JOINT SHALL BE FULL PENETRATION WELDS.
3. FOR PROPER SHAFT ALIGNMENT FOR ASSEMBLY, A 6" HORIZONTAL WELD BEAD AND A MARK NUMBER ARE POSITIONED ON EACH SHAFT AT EACH SPLICE. THE 6" HORIZONTAL WELD BEADS ARE ON MATCHING CORNERS. THE MARK NUMBER IS ON AN ADJACENT FLAT. THE HORIZONTAL WELD BEAD CORNERS SHALL BE ALIGNED TOP TO BOTTOM OF THE POLE. MATCH NUMBERS SHALL BE MATCHED FOR EACH SPLICE.
4. FIELD ASSEMBLY HOLES (1⅛ø) WITH 1"ø H. HEX NUTS ARE LOCATED ON OPPOSING SECTION FLATS ABOVE AND BELOW SPLICES FOR JACKING SHAFTS TOGETHER.
5. THE LOWER WELD ORIENTATION MARK AT EACH SPLICE LOCATION SHALL BE TELESCOPED IN THE FIELD TO WITHIN 24" OF THE UPPER WELD ORIENTATION MARK. AFTER TELESCOPED, THE SECTIONS SHOULD SHOW NO FURTHER MOVEMENT AND THERE SHOULD BE ADEQUATE METAL-TO-METAL CONTACT ON ALL FLATS.
6. TWO SLOTS (1⅛ø x 2½") WILL BE PROVIDED AT THE SLIP FITTED END OF EACH SHAFT.
7. POLE TAPER = 0.295000 IN/FT
8. FIELD BOLT SHIPPING QUANTITIES WILL INCLUDE A MAXIMUM 5% OVERAGE FOR BOLTS 1"ø OR LESS. FIELD BOLTS OVER 1"ø WILL BE EXACT COUNT UNLESS NOTED OTHERWISE.
9. ALL HARDWARE NOTED WITH "PT" SHALL BE PRE-TENSIONED PER THE TURN-OF-NUT METHOD. ALL OTHER HARDWARE SHALL BE SNUG-TIGHT. SPARE SHIPPING QUANTITIES WILL INCLUDE THREE EXTRA ASSEMBLIES OF EACH BOLT TYPE DESIGNATED AS "PT" FOR FIELD VERIFICATION OF PRE-TENSIONING METHOD.
10. **POLE SHALL BE SWEEP BLASTED DULLED AFTER FABRICATION.**

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL, DO NOT GALVANIZE.

(STR. 7) 19-9462PE15

NOTICE TO ERECTOR
BACKCHARGES FOR CORRECTIVE WORK OR REPLACED MATERIALS WILL NOT BE ACCEPTED UNLESS EXPRESSLY AUTHORIZED BY DIS-TRAN BEFORE ANY SUCH COST ARE INCURRED.

REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
4					
3					
2					
1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19

REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
8					
7					
6					
5					

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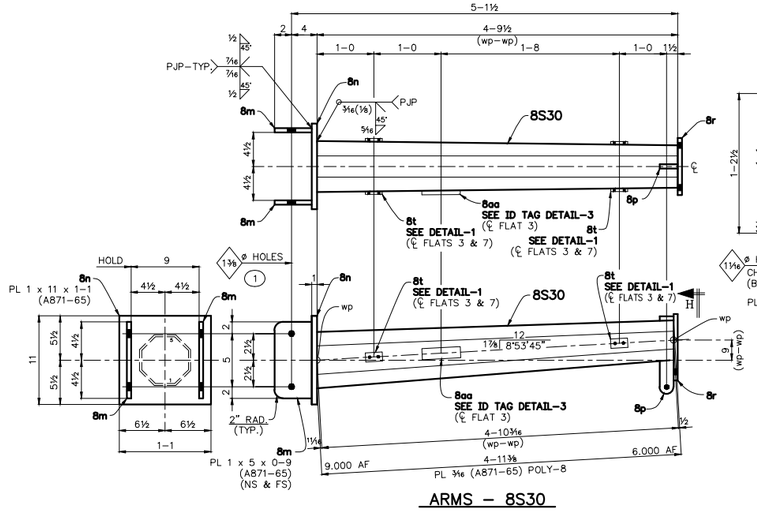
WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

230KV TRANSMISSION POLE / ITEM – 9

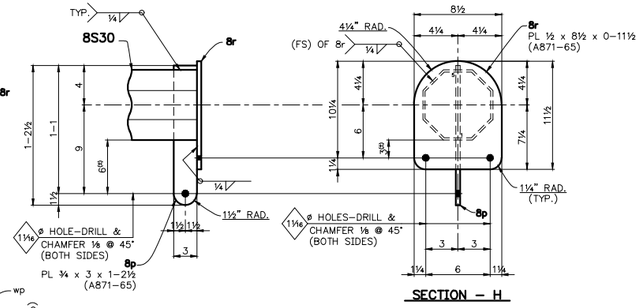
ERECTION ELEVATION, SECTIONS & DETAILS

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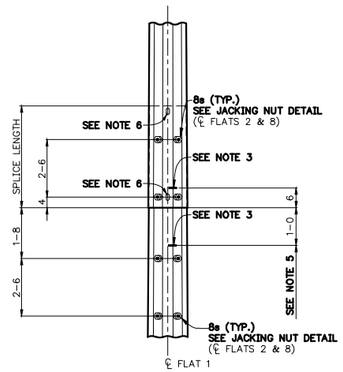
DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ



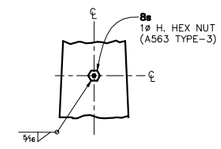
ARMS – 8S30



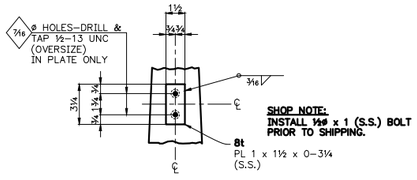
SECTION – H



SPLICE DETAIL
(DETAIL–1 OMITTED FOR CLARITY)



JACKING NUT DETAIL

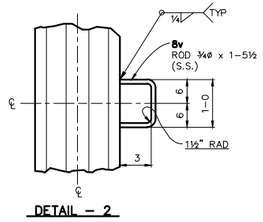


SHOP NOTE:
INSTALL ½ø x 1 (S.S.) BOLT PRIOR TO SHIPPING.

DETAIL – 1

GROUNDING SCHEDULE DIM'S TO CENTER OF GROUND PLATE SEE DETAIL–1		
POLE – 8S27	POLE – 8S28	POLE – 8S29
℄ OF FLATS 1 & 7	℄ OF FLATS 1 & 7	℄ OF FLATS 1 & 7
0–11	0–11	21–0
49–6	48–3	37–5¼

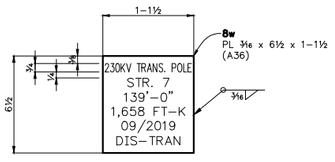
ALL DIMENSIONS FROM BOTTOM OF SHAFT



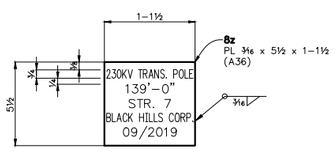
DETAIL – 2

GROUND LOOP SCHEDULE DIM'S TO CENTER OF GROUND LOOP SEE DETAIL–2
POLE – 8S27
℄ OF FLATS 1 & 7
11–6
24–0
36–6

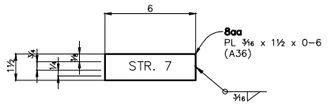
ALL DIMENSIONS FROM BOTTOM OF SHAFT



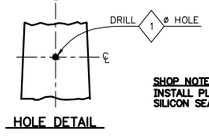
ID TAG DETAIL – 1



ID TAG DETAIL – 2



ID TAG DETAIL – 3



SHOP NOTE:
INSTALL PLASTIC PLUGS W/ SILICON SEALANT PRIOR TO SHIPPING.

HOLE DETAIL

HOLE SCHEDULE DIM'S TO CENTER OF HOLES SEE HOLE DETAIL	
POLE – 8S27	POLE – 8S28
℄ OF FLATS 4 & 10	℄ OF FLATS 4 & 10
12–6	29–7⅞
13–6	30–7⅞
25–0	37–7⅞
26–0	38–7⅞
37–6	45–7⅞
38–6	46–7⅞

ALL DIMENSIONS FROM BOTTOM OF SHAFT

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL, DO NOT GALVANIZE.

(STR. 7) 19–9462PE16

DIS-TRAN Steel, LLC
P.O. BOX 5109•ALEXANDRIA, LA, 71307–5709
PHONE 318–448–0274•FAX 318–445–4454

WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

230KV TRANSMISSION POLE / ITEM – 9

SECTIONS & DETAILS (CONTINUED)

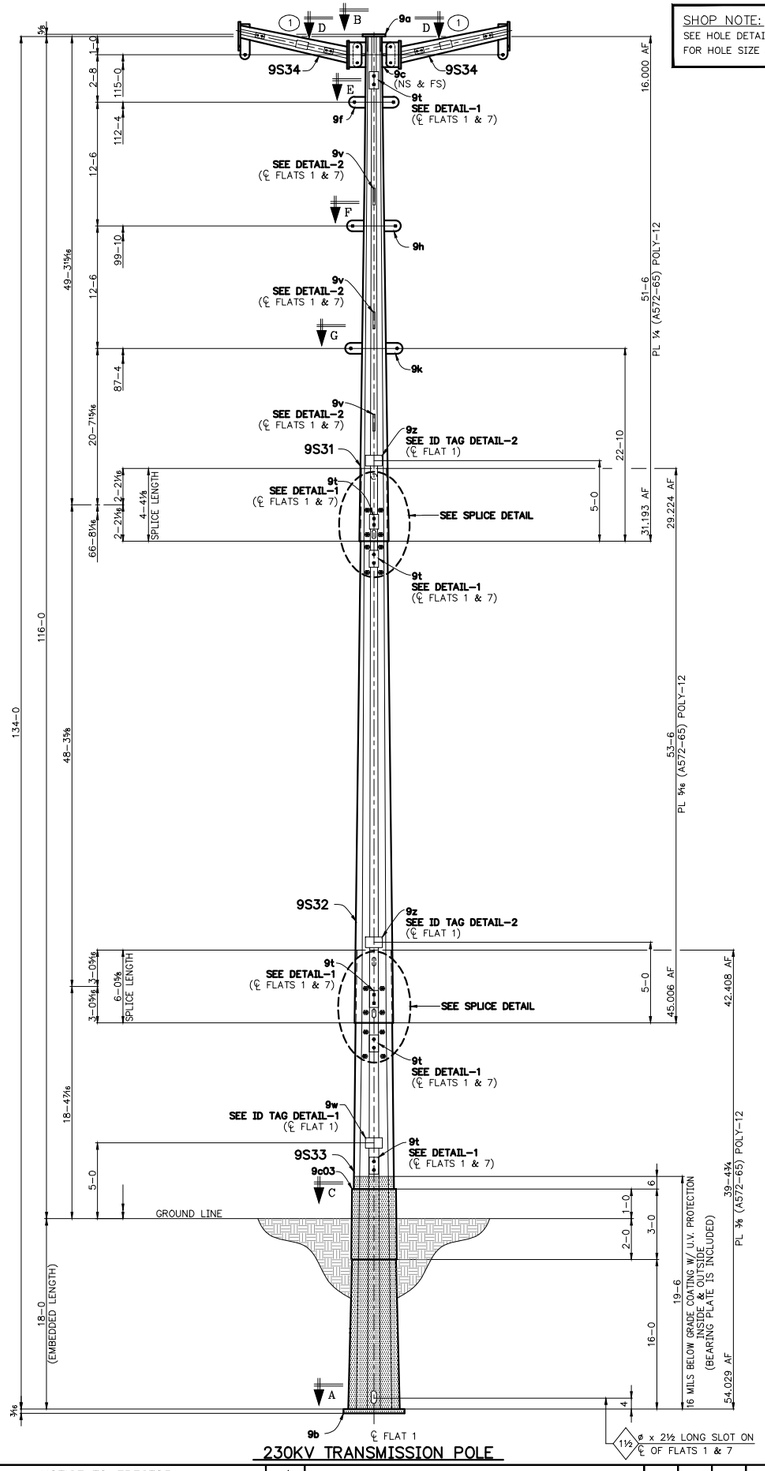
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N.T.S.	07/12/19	19–9462P	E16	1
DRAWN BY: DLW	CHK'D. BY: KLN	APP'D. BY: KEJ		

NOTICE TO ERECTOR
BACKCHARGES FOR CORRECTIVE WORK OR REPLACED MATERIALS WILL NOT BE ACCEPTED UNLESS EXPRESSLY AUTHORIZED BY DIS–TRAN BEFORE ANY SUCH COST ARE INCURRED.

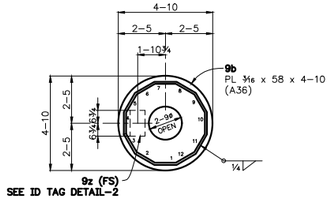
REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
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2					
1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19

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7					
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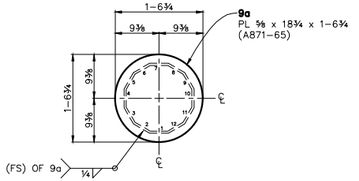
SHOP NOTE:
SEE HOLE DETAIL & SCHEDULE FOR HOLE SIZE AND LOCATIONS.



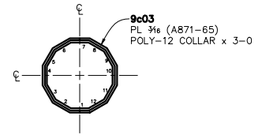
230KV TRANSMISSION POLE



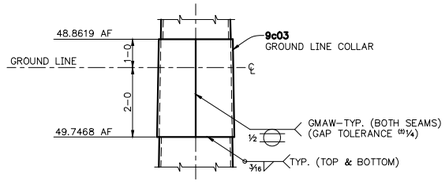
SECTION – A

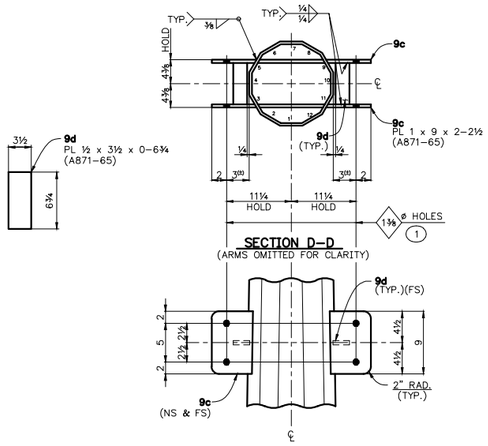


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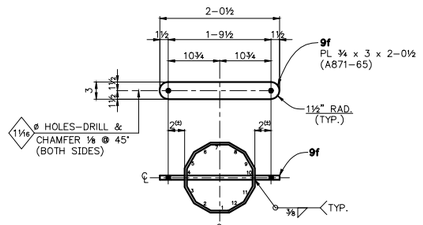


SECTION – C

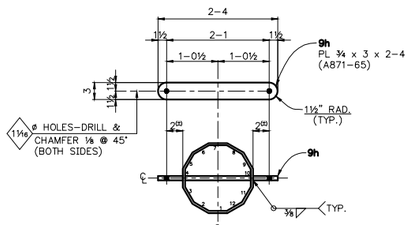




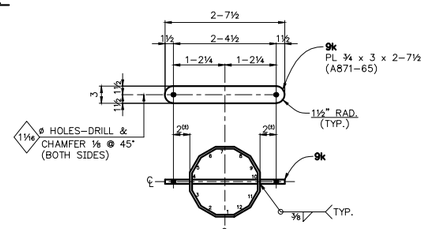
SECTION D-D



SECTION – F



SECTION – F



SECTION – G

MATERIAL REQ'D. FOR ASSEMBLY			
MARK	QTY.	DESCRIPTION	BLACK WT.
9S31	ONE	POLY-12 POLE	3,539
9S32	ONE	POLY-12 POLE	6,714
9S33	ONE	POLY-12 POLE	8,200
9S34	2	POLY-8 POLE (UNIT WT. = 170)	340
		TOTAL BLACK WT.	18,793#

HARDWARE REQD. FOR ASSEMBLY		
MARK	QTY.	DESCRIPTION
(1)	8	1¼ø x 4 (A325 TYPE-3) BOLTS W/ ONE-1¼ø H. FLATWASHER (F436 TYPE-3) EACH ONE-1¼ø H. HEX NUT LOCKNUT (A563-DH TYPE-3) EACH

MATERIAL BILLED FOR ONE MAKE (3) TIMES

GENERAL NOTES:

1. ALL WELDS SHALL BE IN ACCORDANCE WITH A.W.S. (D1.1.) UNLESS NOTED OTHERWISE.
   a.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL BE U.T. TESTED IN ACCORDANCE WITH AWS & ASNDT.
   b.) ALL MATERIAL WELDED WITH E80-SERIES, LOW HYDROGEN ELECTRODES.
   c.) ALL FILLET WELDS AT JOINT TERMINATIONS OR ABRUPT CHANGES IN WELD DIRECTION SHALL HAVE END RETURNS TO WRAP CORNERS AS GEOMETRY PERMITS. IF JOINT GEOMETRY DOES NOT PERMIT A FULL SIZE RETURN, A SEAL WELD SHALL BE PROVIDED WHERE ACCESSIBLE.
   d.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL USE 3/16" X 1 1/4", (A36) STEEL BACKING (GALVANIZED POLES); (A588-50) (NON-GALVANIZED), MINIMUM. BACKING BARS SHALL BE SPLICED ON SHAFT FLATS ONLY, WITH A C.J.P. GROOVE WELD. BACKING BARS SHALL BE SEAL WELDED ALL AROUND, WHEN ACCESSIBLE.
   e.) LONGITUDINAL SEAM WELDS SHALL ACHIEVE A MINIMUM OF 80% PENETRATION. LONGITUDINAL SEAM WELDS SHALL ACHIEVE 100% PENETRATION WITHIN A MINIMUM OF 6" FROM THE ENDS OF THE SHAFT AND THE FULL LENGTH OF THE FEMALE SECTION IN THE SLIP JOINT.
2. LONGITUDINAL SEAM WELDS IN FEMALE SECTION OF THE SLIP JOINT SHALL BE FULL PENETRATION WELDS.
3. FOR PROPER SHAFT ALIGNMENT FOR ASSEMBLY, A 6" HORIZONTAL WELD BEAD AND A MARK NUMBER ARE POSITIONED ON EACH SHAFT AT EACH SPLICE. THE 6" HORIZONTAL WELD BEADS ARE ON MATCHING CORNERS. THE MARK NUMBER IS ON AN ADJACENT FLAT. THE HORIZONTAL WELD BEAD CORNERS SHALL BE ALIGNED TOP TO BOTTOM OF THE POLE. MATCH NUMBERS SHALL BE MATCHED FOR EACH SPLICE.
4. FIELD ASSEMBLY HOLES (1⅛ø) WITH 1"ø H. HEX NUTS ARE LOCATED ON OPPOSING SECTION FLATS ABOVE AND BELOW SPLICES FOR JACKING SHAFTS TOGETHER.
5. THE LOWER WELD ORIENTATION MARK AT EACH SPLICE LOCATION SHALL BE TELESCOPED IN THE FIELD TO WITHIN 24" OF THE UPPER WELD ORIENTATION MARK. AFTER TELESCOPED, THE SECTIONS SHOULD SHOW NO FURTHER MOVEMENT AND THERE SHOULD BE ADEQUATE METAL-TO-METAL CONTACT ON ALL FLATS.
6. TWO SLOTS (1½ø x 2½") WILL BE PROVIDED AT THE SLIP FITTED END OF EACH SHAFT.
7. POLE TAPER = 0.295000 IN/FT
8. FIELD BOLT SHIPPING QUANTITIES WILL INCLUDE A MAXIMUM 5% OVERAGE FOR BOLTS 1"ø OR LESS. FIELD BOLTS OVER 1"ø WILL BE EXACT COUNT UNLESS NOTED OTHERWISE.
9. ALL HARDWARE NOTED WITH "PT" SHALL BE PRE-TENSIONED PER THE TURN-OF-NUT METHOD. ALL OTHER HARDWARE SHALL BE SNUG-TIGHT. SPARE SHIPPING QUANTITIES WILL INCLUDE THREE EXTRA ASSEMBLIES OF EACH BOLT TYPE DESIGNATED AS "PT" FOR FIELD VERIFICATION OF PRE-TENSIONING METHOD.
10. **POLE SHALL BE SWEEP BLASTED DULLED AFTER FABRICATION.**

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL, DO NOT GALVANIZE.

(STR. 8, 9 & 10) 19-9462PE17

NOTICE TO ERECTOR
BACKCHARGES FOR CORRECTIVE WORK OR REPLACED MATERIALS WILL NOT BE ACCEPTED UNLESS EXPRESSLY AUTHORIZED BY DIS-TRAN BEFORE ANY SUCH COST ARE INCURRED.

REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
4					
3					
2					
1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19

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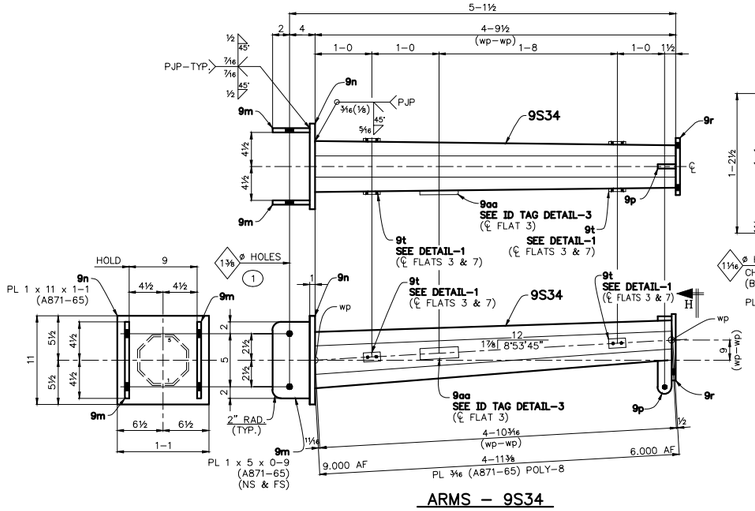
WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

230KV TRANSMISSION POLE / ITEM – 10

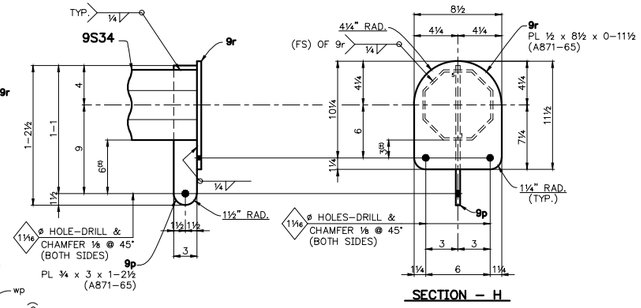
ERECTION ELEVATION, SECTIONS & DETAILS

SCALE	DATE	JOB NUMBER	DRAWING NUMBER	REV. NO.
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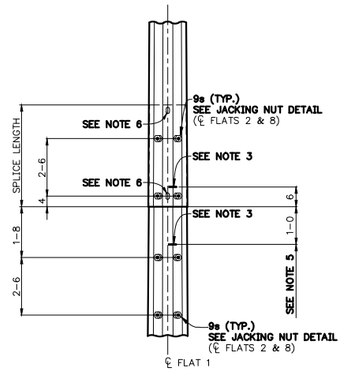
DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ



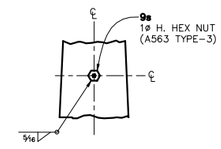
ARMS – 9S34



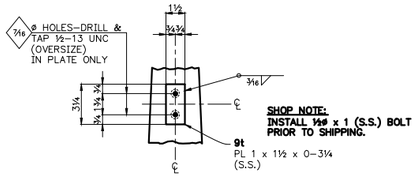
SECTION – H



SPLICE DETAIL
(DETAIL–1 OMITTED FOR CLARITY)



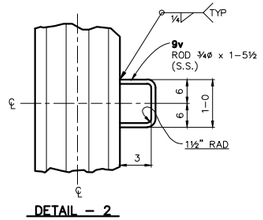
JACKING NUT DETAIL



DETAIL – 1

GROUNDING SCHEDULE DIM'S TO CENTER OF GROUND PLATE SEE DETAIL–1		
POLE – 9S31	POLE – 9S32	POLE – 9S33
℄ OF FLATS 1 & 7	℄ OF FLATS 1 & 7	℄ OF FLATS 1 & 7
0–11	0–11	21–0
49–6	48–3	32–5¼

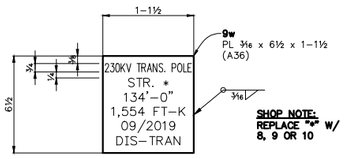
ALL DIMENSIONS FROM BOTTOM OF SHAFT



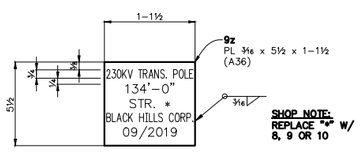
DETAIL – 2

GROUND LOOP SCHEDULE DIM'S TO CENTER OF GROUND LOOP SEE DETAIL–2
POLE – 9S31
℄ OF FLATS 1 & 7
11–6
24–0
36–6

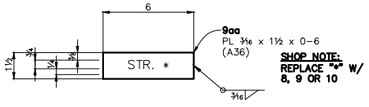
ALL DIMENSIONS FROM BOTTOM OF SHAFT



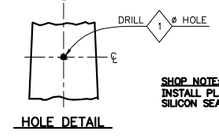
ID TAG DETAIL – 1



ID TAG DETAIL – 2



ID TAG DETAIL – 3



HOLE DETAIL

HOLE SCHEDULE DIM'S TO CENTER OF HOLES SEE HOLE DETAIL	
POLE – 9S31	POLE – 9S32
℄ OF FLATS 4 & 10	℄ OF FLATS 4 & 10
12–6	29–7⅞
13–6	30–7⅞
25–0	37–7⅞
26–0	38–7⅞
37–6	45–7⅞
38–6	46–7⅞

ALL DIMENSIONS FROM BOTTOM OF SHAFT

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL, DO NOT GALVANIZE.

(STR. 8, 9 & 10)

19–9462PE18

NOTICE TO ERECTOR
BACKCHARGES FOR CORRECTIVE WORK OR REPLACED MATERIALS WILL NOT BE ACCEPTED UNLESS EXPRESSLY AUTHORIZED BY DIS–TRAN BEFORE ANY SUCH COST ARE INCURRED.

REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19
2					
3					
4					
5					
6					
7					
8					

DIS-TRAN Steel, LLC
P.O. BOX 5109•ALEXANDRIA, LA, 71307–5709
PHONE 318–448–0274•FAX 318–445–4454

WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

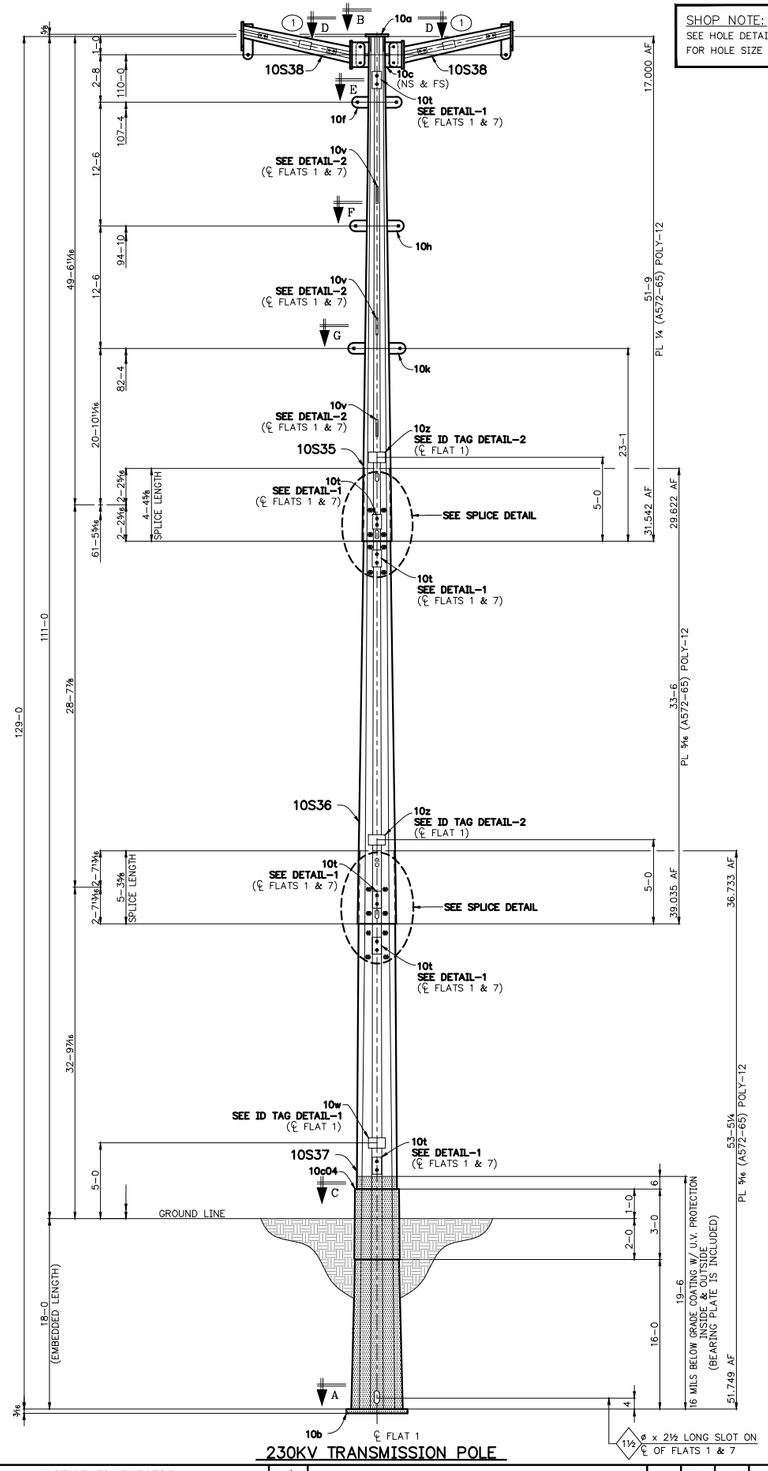
230KV TRANSMISSION POLE / ITEM – 10

SECTIONS & DETAILS (CONTINUED)

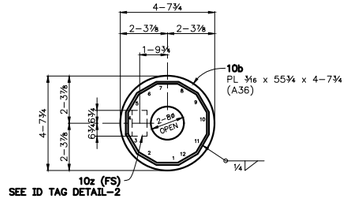
SCALE	DATE	JOB NUMBER	DRAWING NUMBER	REV. NO.
N.T.S.	07/12/19	19–9462P	E18	1

DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ

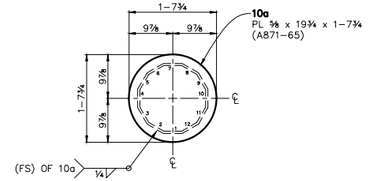
SHOP NOTE:
SEE HOLE DETAIL & SCHEDULE FOR HOLE SIZE AND LOCATIONS.



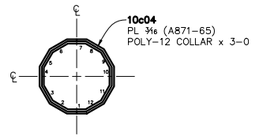
230KV TRANSMISSION POLE



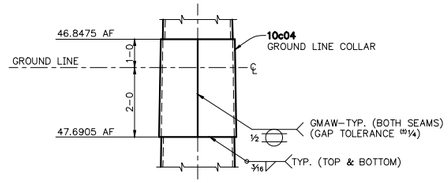
SECTION – A

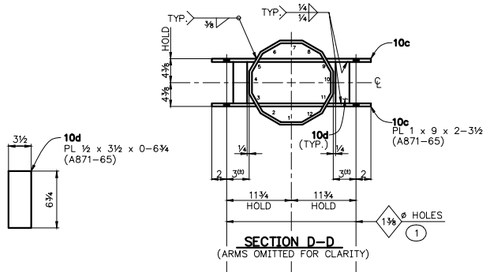


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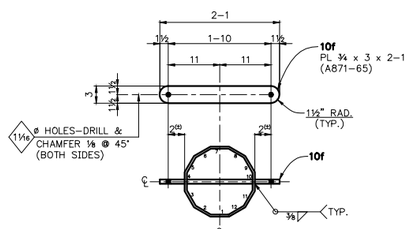


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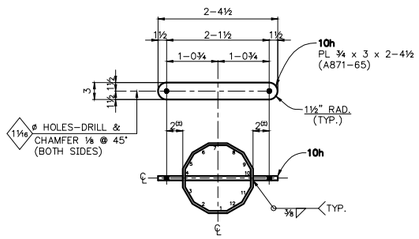




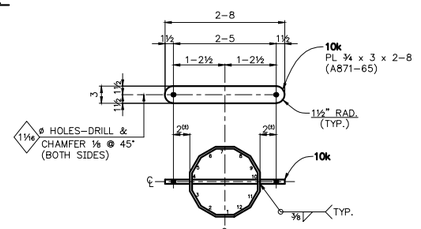
SECTION D-D



SECTION – E



SECTION – F



SECTION – G

MATERIAL REQ'D. FOR ASSEMBLY			
MARK	QTY.	DESCRIPTION	BLACK WT.
10S35	ONE	POLY-12 POLE	3,663
10S36	ONE	POLY-12 POLE	3,888
10S37	ONE	POLY-12 POLE	8,468
10S38	2	POLY-8 POLE (UNIT WT. = 170)	340
		TOTAL BLACK WT.	16,359#

HARDWARE REQD. FOR ASSEMBLY		
MARK	QTY.	DESCRIPTION
(1)	8	1¼ø x 4 (A325 TYPE-3) BOLTS W/ ONE-1¼ø H. FLATWASHER (F436 TYPE-3) EACH ONE-1¼ø H. HEX NUT LOCKNUT (A563-DH TYPE-3) EACH

MATERIAL BILLED FOR ONE MAKE (3) TIMES

GENERAL NOTES:

1. ALL WELDS SHALL BE IN ACCORDANCE WITH A.W.S. (D1.1.) UNLESS NOTED OTHERWISE.
   a.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL BE U.T. TESTED IN ACCORDANCE WITH AWS & ASNDT.
   b.) ALL MATERIAL WELDED WITH E80-SERIES, LOW HYDROGEN ELECTRODES.
   c.) ALL FILLET WELDS AT JOINT TERMINATIONS OR ABRUPT CHANGES IN WELD DIRECTION SHALL HAVE END RETURNS TO WRAP CORNERS AS GEOMETRY PERMITS. IF JOINT GEOMETRY DOES NOT PERMIT A FULL SIZE RETURN, A SEAL WELD SHALL BE PROVIDED WHERE ACCESSIBLE.
   d.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL USE 3/16" X 1 1/4", (A36) STEEL BACKING (GALVANIZED POLES); (A588-50) (NON-GALVANIZED), MINIMUM. BACKING BARS SHALL BE SPLICED ON SHAFT FLATS ONLY, WITH A C.J.P. GROOVE WELD. BACKING BARS SHALL BE SEAL WELDED ALL AROUND, WHEN ACCESSIBLE.
   e.) LONGITUDINAL SEAM WELDS SHALL ACHIEVE A MINIMUM OF 80% PENETRATION. LONGITUDINAL SEAM WELDS SHALL ACHIEVE 100% PENETRATION WITHIN A MINIMUM OF 6" FROM THE ENDS OF THE SHAFT AND THE FULL LENGTH OF THE FEMALE SECTION IN THE SLIP JOINT.
2. LONGITUDINAL SEAM WELDS IN FEMALE SECTION OF THE SLIP JOINT SHALL BE FULL PENETRATION WELDS.
3. FOR PROPER SHAFT ALIGNMENT FOR ASSEMBLY, A 6" HORIZONTAL WELD BEAD AND A MARK NUMBER ARE POSITIONED ON EACH SHAFT AT EACH SPLICE. THE 6" HORIZONTAL WELD BEADS ARE ON MATCHING CORNERS. THE MARK NUMBER IS ON AN ADJACENT FLAT. THE HORIZONTAL WELD BEAD CORNERS SHALL BE ALIGNED TOP TO BOTTOM OF THE POLE. MATCH NUMBERS SHALL BE MATCHED FOR EACH SPLICE.
4. FIELD ASSEMBLY HOLES (1⅛ø) WITH 1"ø H. HEX NUTS ARE LOCATED ON OPPOSING SECTION FLATS ABOVE AND BELOW SPLICES FOR JACKING SHAFTS TOGETHER.
5. THE LOWER WELD ORIENTATION MARK AT EACH SPLICE LOCATION SHALL BE TELESCOPED IN THE FIELD TO WITHIN 24" OF THE UPPER WELD ORIENTATION MARK. AFTER TELESCOPED, THE SECTIONS SHOULD SHOW NO FURTHER MOVEMENT AND THERE SHOULD BE ADEQUATE METAL-TO-METAL CONTACT ON ALL FLATS.
6. TWO SLOTS (1½ø x 2½") WILL BE PROVIDED AT THE SLIP FITTED END OF EACH SHAFT.
7. POLE TAPER = 0.281000 IN/FT
8. FIELD BOLT SHIPPING QUANTITIES WILL INCLUDE A MAXIMUM 5% OVERAGE FOR BOLTS 1"ø OR LESS. FIELD BOLTS OVER 1"ø WILL BE EXACT COUNT UNLESS NOTED OTHERWISE.
9. ALL HARDWARE NOTED WITH "PT" SHALL BE PRE-TENSIONED PER THE TURN-OF-NUT METHOD. ALL OTHER HARDWARE SHALL BE SNUG-TIGHT. SPARE SHIPPING QUANTITIES WILL INCLUDE THREE EXTRA ASSEMBLIES OF EACH BOLT TYPE DESIGNATED AS "PT" FOR FIELD VERIFICATION OF PRE-TENSIONING METHOD.
10. **POLE SHALL BE SWEEP BLASTED DULLED AFTER FABRICATION.**

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL, DO NOT GALVANIZE.

(STR. 11, 12 & 13) 19-9462PE19

NOTICE TO ERECTOR
BACKCHARGES FOR CORRECTIVE WORK OR REPLACED MATERIALS WILL NOT BE ACCEPTED UNLESS EXPRESSLY AUTHORIZED BY DIS-TRAN BEFORE ANY SUCH COST ARE INCURRED.

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P.O. BOX 5109 • ALEXANDRIA, LA, 71307-5709
PHONE 318-448-0274 • FAX 318-445-4454

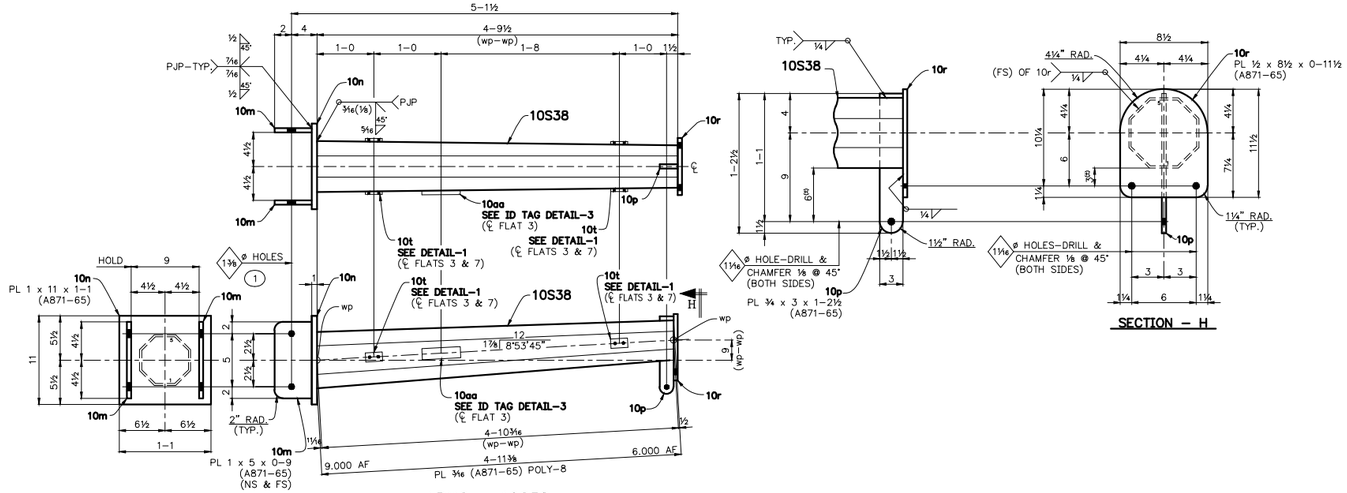
WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

230KV TRANSMISSION POLE / ITEM – 13

ERECTION ELEVATION, SECTIONS & DETAILS

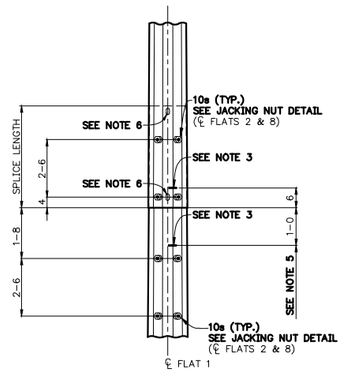
SCALE	DATE	JOB NUMBER	DRAWING NUMBER	REV. NO.
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DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ

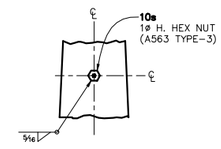


ARMS – 10S38

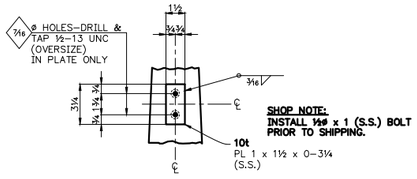
SECTION – H



SPLICE DETAIL
(DETAIL–1 OMITTED FOR CLARITY)



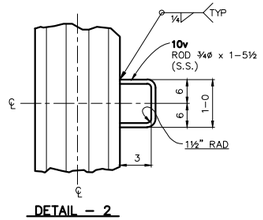
JACKING NUT DETAIL



DETAIL – 1

GROUNDING SCHEDULE DIM'S TO CENTER OF GROUND PLATE SEE DETAIL–1		
POLE – 10S35	POLE – 10S36	POLE – 10S37
℄ OF FLATS 1 & 7	℄ OF FLATS 1 & 7	℄ OF FLATS 1 & 7
0–11	0–11	21–0
49–9	28–2½	47–2¾

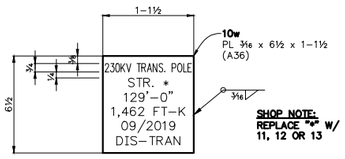
ALL DIMENSIONS FROM BOTTOM OF SHAFT



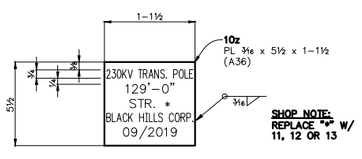
DETAIL – 2

GROUND LOOP SCHEDULE DIM'S TO CENTER OF GROUND LOOP SEE DETAIL–2
POLE – 10S35
℄ OF FLATS 1 & 7
11–9
24–3
36–9

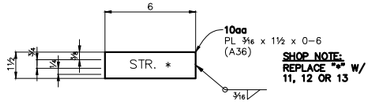
ALL DIMENSIONS FROM BOTTOM OF SHAFT



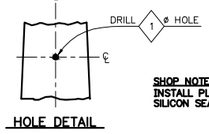
ID TAG DETAIL – 1



ID TAG DETAIL – 2



ID TAG DETAIL – 3



HOLE DETAIL

HOLE SCHEDULE DIM'S TO CENTER OF HOLES SEE HOLE DETAIL	
POLE – 10S35	POLE – 10S36
℄ OF FLATS 4 & 10	℄ OF FLATS 4 & 10
12–9	9–10⅜
13–9	10–10⅜
25–3	17–10⅜
26–3	18–10⅜
37–9	25–10⅜
38–9	26–10⅜

ALL DIMENSIONS FROM BOTTOM OF SHAFT

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL,
DO NOT GALVANIZE.

(STR. 11, 12 & 13) 19–9462PE20

NOTICE TO ERECTOR
BACKCHARGES FOR CORRECTIVE WORK OR REPLACED MATERIALS WILL NOT BE ACCEPTED UNLESS EXPRESSLY AUTHORIZED BY DIS–TRAN BEFORE ANY SUCH COST ARE INCURRED.

REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19
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4					
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7					
8					

DIS-TRAN Steel, LLC
P.O. BOX 5109•ALEXANDRIA, LA, 71307–5709
PHONE 318–448–0274•FAX 318–445–4454

WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

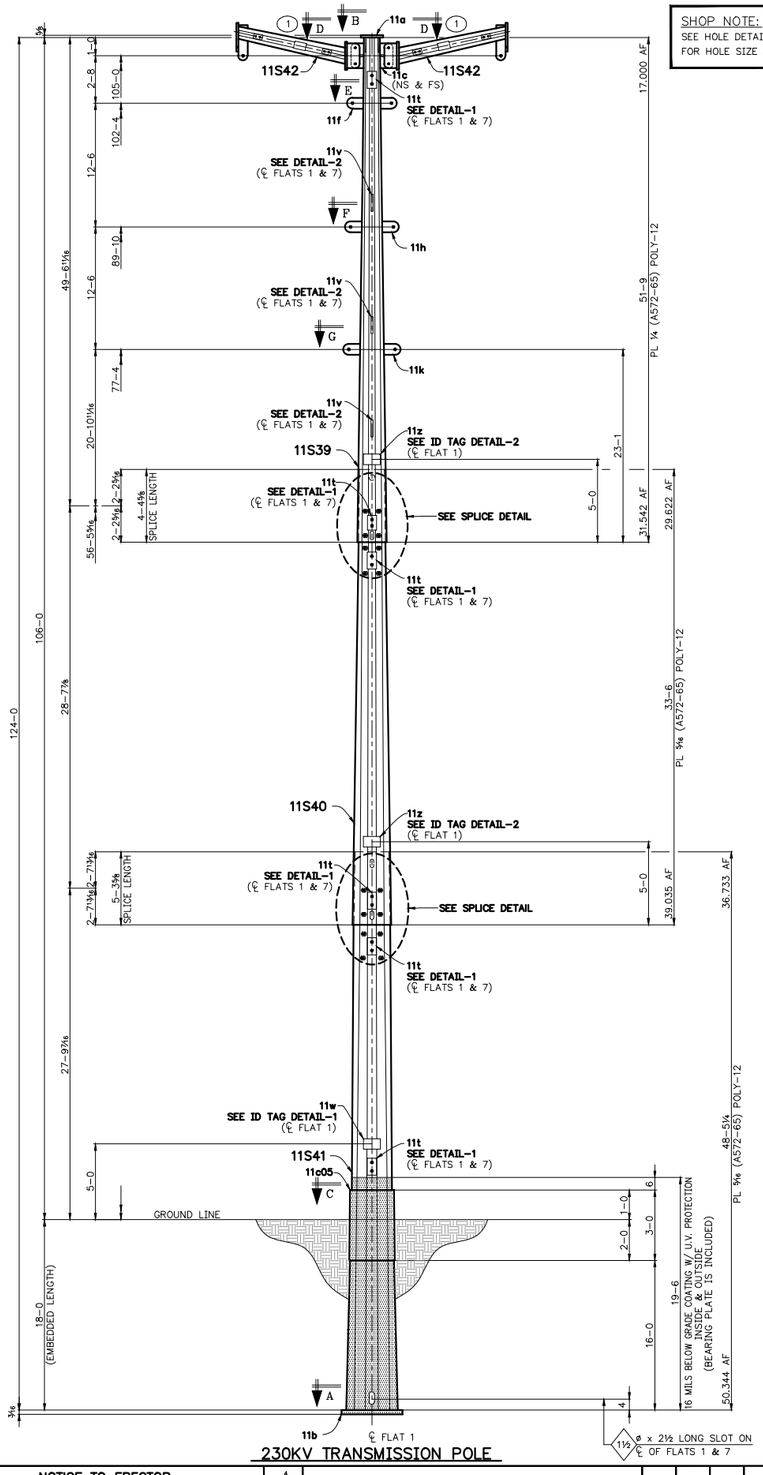
230KV TRANSMISSION POLE / ITEM – 13

SECTIONS & DETAILS (CONTINUED)

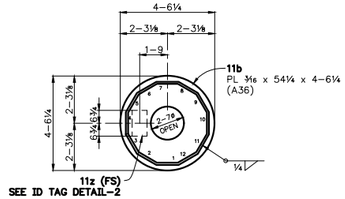
SCALE	DATE	JOB NUMBER	DRAWING NUMBER	REV. NO.
N.T.S.	07/12/19	19–9462P	E20	1

DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ

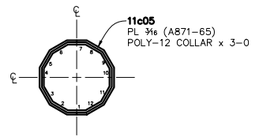
SHOP NOTE:
SEE HOLE DETAIL & SCHEDULE FOR HOLE SIZE AND LOCATIONS.



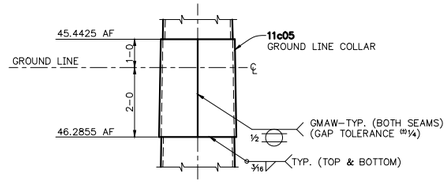
230KV TRANSMISSION POLE

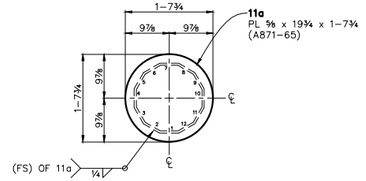


SECTION – A

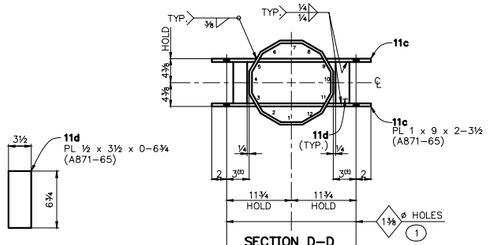


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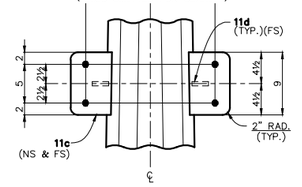


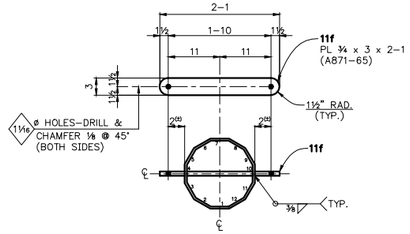


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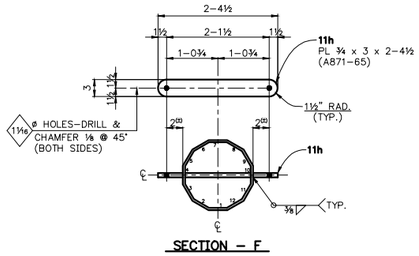


SECTION D-D

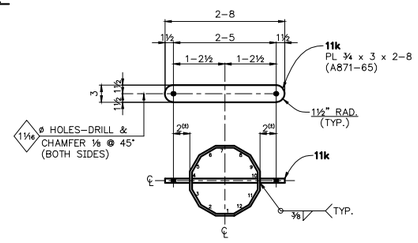




SECTION – E



SECTION – F



SECTION – G

MATERIAL REQ'D. FOR ASSEMBLY			
MARK	QTY.	DESCRIPTION	BLACK WT.
11S39	ONE	POLY-12 POLE	3,663
11S40	ONE	POLY-12 POLE	3,888
11S41	ONE	POLY-12 POLE	7,587
11S42	2	POLY-8 POLE (UNIT WT. = 170)	340
		TOTAL BLACK WT.	15,478#

HARDWARE REQD. FOR ASSEMBLY		
MARK	QTY.	DESCRIPTION
(1)	8	1¼ø x 4 (A325 TYPE-3) BOLTS W/ ONE-1¼ø H. FLATWASHER (F436 TYPE-3) EACH ONE-1¼ø H. HEX NUT LOCKNUT (A563-DH TYPE-3) EACH

MATERIAL BILLED FOR ONE MAKE (ONE) TIME

GENERAL NOTES:

1. ALL WELDS SHALL BE IN ACCORDANCE WITH A.W.S. (D1.1.) UNLESS NOTED OTHERWISE.
   a.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL BE U.T. TESTED IN ACCORDANCE WITH AWS & ASNDT.
   b.) ALL MATERIAL WELDED WITH E80-SERIES, LOW HYDROGEN ELECTRODES.
   c.) ALL FILLET WELDS AT JOINT TERMINATIONS OR ABRUPT CHANGES IN WELD DIRECTION SHALL HAVE END RETURNS TO WRAP CORNERS AS GEOMETRY PERMITS. IF JOINT GEOMETRY DOES NOT PERMIT A FULL SIZE RETURN, A SEAL WELD SHALL BE PROVIDED WHERE ACCESSIBLE.
   d.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL USE 3/16" X 1 1/4", (A36) STEEL BACKING (GALVANIZED POLES); (A588-50) (NON-GALVANIZED), MINIMUM. BACKING BARS SHALL BE SPLICED ON SHAFT FLATS ONLY, WITH A C.J.P. GROOVE WELD. BACKING BARS SHALL BE SEAL WELDED ALL AROUND, WHEN ACCESSIBLE.
   e.) LONGITUDINAL SEAM WELDS SHALL ACHIEVE A MINIMUM OF 80% PENETRATION. LONGITUDINAL SEAM WELDS SHALL ACHIEVE 100% PENETRATION WITHIN A MINIMUM OF 6" FROM THE ENDS OF THE SHAFT AND THE FULL LENGTH OF THE FEMALE SECTION IN THE SLIP JOINT.
2. LONGITUDINAL SEAM WELDS IN FEMALE SECTION OF THE SLIP JOINT SHALL BE FULL PENETRATION WELDS.
3. FOR PROPER SHAFT ALIGNMENT FOR ASSEMBLY, A 6" HORIZONTAL WELD BEAD AND A MARK NUMBER ARE POSITIONED ON EACH SHAFT AT EACH SPLICE. THE 6" HORIZONTAL WELD BEADS ARE ON MATCHING CORNERS. THE MARK NUMBER IS ON AN ADJACENT FLAT. THE HORIZONTAL WELD BEAD CORNERS SHALL BE ALIGNED TOP TO BOTTOM OF THE POLE. MATCH NUMBERS SHALL BE MATCHED FOR EACH SPLICE.
4. FIELD ASSEMBLY HOLES (1⅛ø) WITH 1"ø H. HEX NUTS ARE LOCATED ON OPPOSING SECTION FLATS ABOVE AND BELOW SPLICES FOR JACKING SHAFTS TOGETHER.
5. THE LOWER WELD ORIENTATION MARK AT EACH SPLICE LOCATION SHALL BE TELESCOPED IN THE FIELD TO WITHIN 24" OF THE UPPER WELD ORIENTATION MARK. AFTER TELESCOPED, THE SECTIONS SHOULD SHOW NO FURTHER MOVEMENT AND THERE SHOULD BE ADEQUATE METAL-TO-METAL CONTACT ON ALL FLATS.
6. TWO SLOTS (1½ø x 2½") WILL BE PROVIDED AT THE SLIP FITTED END OF EACH SHAFT.
7. POLE TAPER = 0.281000 IN/FT
8. FIELD BOLT SHIPPING QUANTITIES WILL INCLUDE A MAXIMUM 5% OVERAGE FOR BOLTS 1"ø OR LESS. FIELD BOLTS OVER 1"ø WILL BE EXACT COUNT UNLESS NOTED OTHERWISE.
9. ALL HARDWARE NOTED WITH "PT" SHALL BE PRE-TENSIONED PER THE TURN-OF-NUT METHOD. ALL OTHER HARDWARE SHALL BE SNUG-TIGHT. SPARE SHIPPING QUANTITIES WILL INCLUDE THREE EXTRA ASSEMBLIES OF EACH BOLT TYPE DESIGNATED AS "PT" FOR FIELD VERIFICATION OF PRE-TENSIONING METHOD.
10. **POLE SHALL BE SWEEP BLASTED DULLED AFTER FABRICATION.**

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL, DO NOT GALVANIZE.

(STR. 14)

19-9462PE21

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WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

230KV TRANSMISSION POLE / ITEM – 16

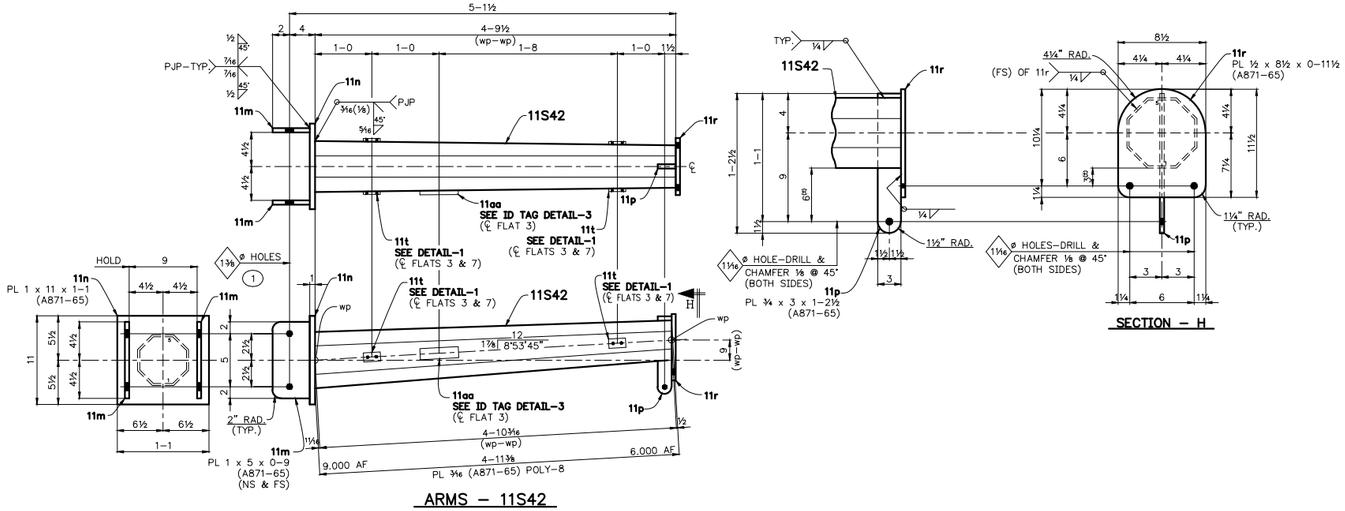
ERECTION ELEVATION, SECTIONS & DETAILS

SCALE	DATE	JOB NUMBER	DRAWING NUMBER	REV. NO.
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DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ

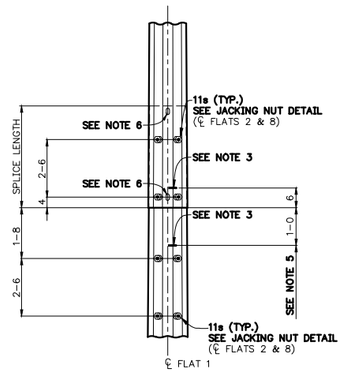
NOTICE TO ERECTOR
BACKCHARGES FOR CORRECTIVE WORK OR REPLACED MATERIALS WILL NOT BE ACCEPTED UNLESS EXPRESSLY AUTHORIZED BY DIS-TRAN BEFORE ANY SUCH COST ARE INCURRED.

REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19

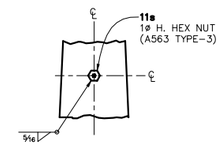


ARMS – 11S42

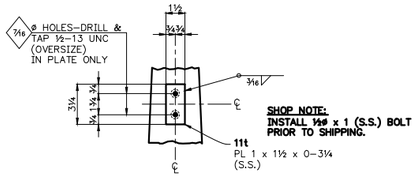
SECTION – H



SPLICE DETAIL
(DETAIL–1 OMITTED FOR CLARITY)



JACKING NUT DETAIL

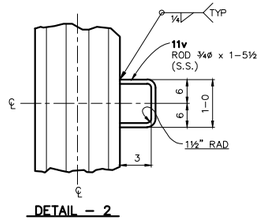


SHOP NOTE:
INSTALL ½ø x 1 (S.S.) BOLT PRIOR TO SHIPPING.

DETAIL – 1

GROUNDING SCHEDULE DIM'S TO CENTER OF GROUND PLATE SEE DETAIL–1		
POLE – 11S39	POLE – 11S40	POLE – 11S41
℄ OF FLATS 1 & 7	℄ OF FLATS 1 & 7	℄ OF FLATS 1 & 7
0–11	0–11	21–0
49–9	28–2½	42–2¾

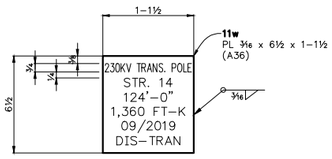
ALL DIMENSIONS FROM BOTTOM OF SHAFT



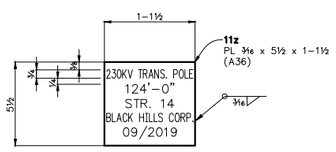
DETAIL – 2

GROUND LOOP SCHEDULE DIM'S TO CENTER OF GROUND LOOP SEE DETAIL–2
POLE – 11S39
℄ OF FLATS 1 & 7
11–9
24–3
36–9

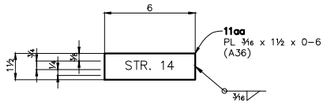
ALL DIMENSIONS FROM BOTTOM OF SHAFT



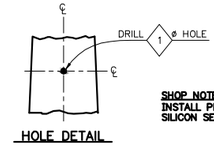
ID TAG DETAIL – 1



ID TAG DETAIL – 2



ID TAG DETAIL – 3



SHOP NOTE:
INSTALL PLASTIC PLUGS W/ SILICON SEALANT PRIOR TO SHIPPING.

HOLE DETAIL

HOLE SCHEDULE DIM'S TO CENTER OF HOLES SEE HOLE DETAIL	
POLE – 11S39	POLE – 11S40
℄ OF FLATS 4 & 10	℄ OF FLATS 4 & 10
12–9	9–10⅜
13–9	10–10⅜
25–3	17–10⅜
26–3	18–10⅜
37–9	25–10⅜
38–9	26–10⅜

ALL DIMENSIONS FROM BOTTOM OF SHAFT

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL, DO NOT GALVANIZE.

(STR. 14) 19–9462PE22

DIS-TRAN Steel, LLC
P.O. BOX 5109•ALEXANDRIA, LA, 71307–5709
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WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

230KV TRANSMISSION POLE / ITEM – 16

SECTIONS & DETAILS (CONTINUED)

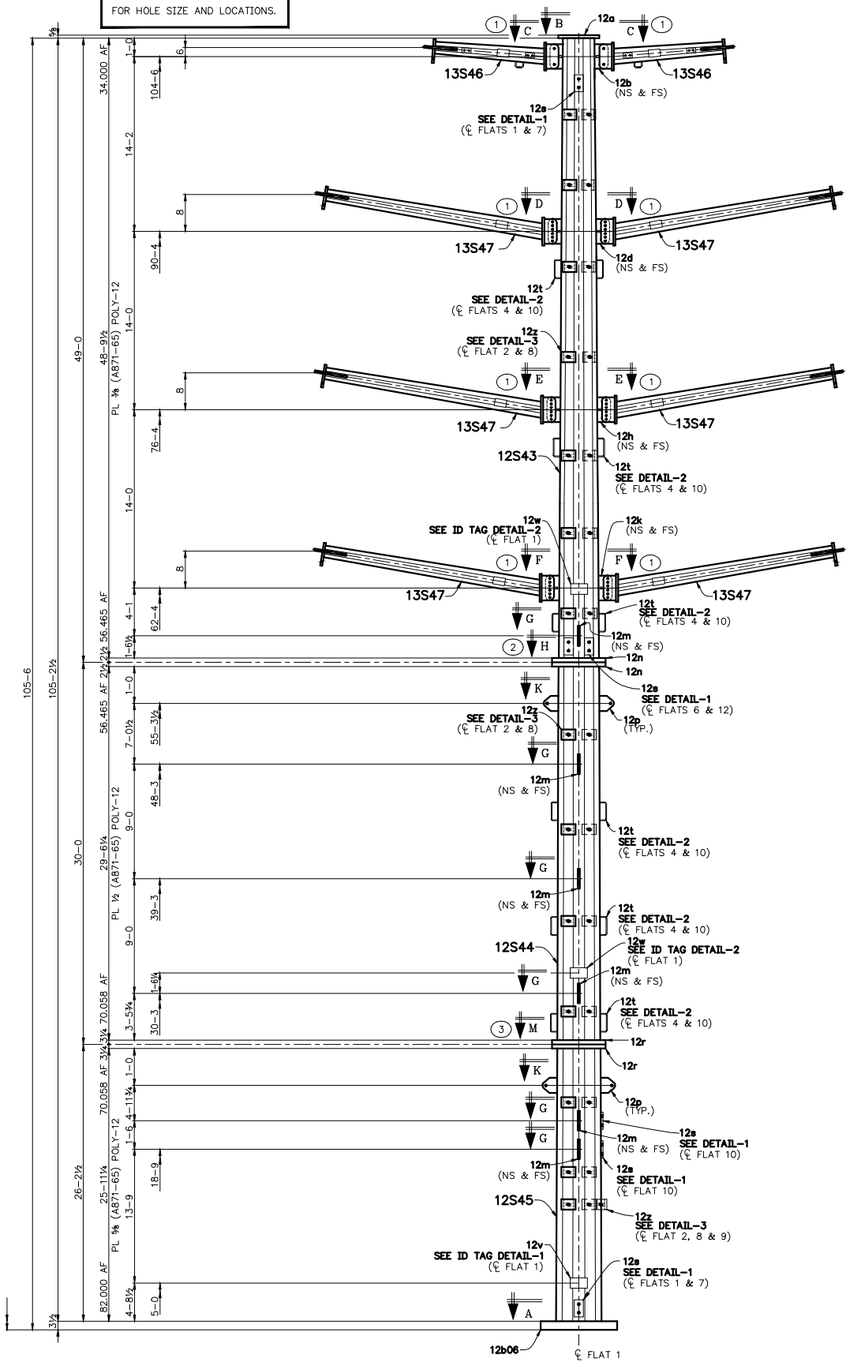
SCALE	DATE	JOB NUMBER	DRAWING NUMBER	REV. NO.
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DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ

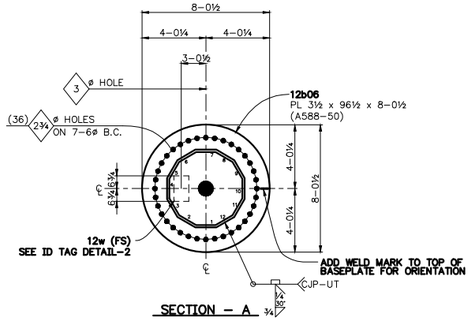
NOTICE TO ERECTOR
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REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19
2					
3					
4					
5					
6					
7					
8					

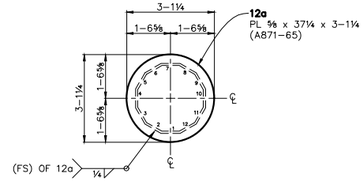
SHOP NOTE:
SEE HOLE DETAIL & SCHEDULE
FOR HOLE SIZE AND LOCATIONS.



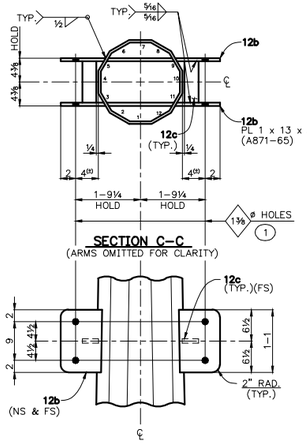
230KV TRANSMISSION POLE



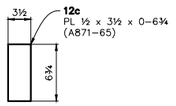
SECTION – A

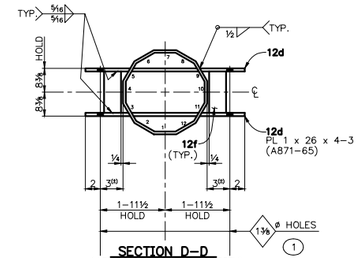


SECTION – B

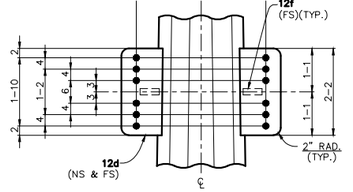


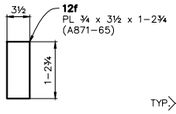
SECTION C–C
(ARMS OMITTED FOR CLARITY)

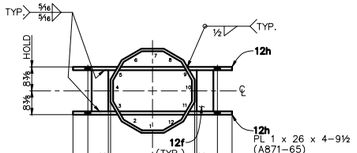




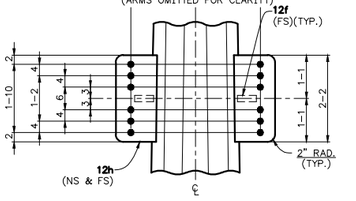
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(ARMS OMITTED FOR CLARITY)

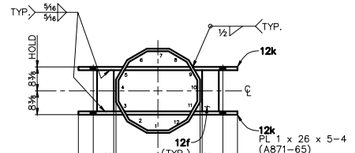




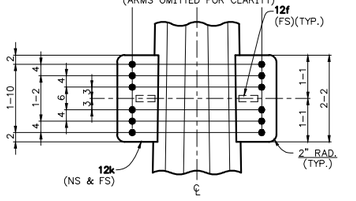


SECTION E–E
(ARMS OMITTED FOR CLARITY)





SECTION F–F
(ARMS OMITTED FOR CLARITY)



MATERIAL REQ'D. FOR ASSEMBLY			
MARK	QTY.	DESCRIPTION	BLACK WT.
12S43	ONE	POLY–12 POLE	15,447
12S44	ONE	POLY–12 POLE	19,610
12S45	ONE	POLY–12 POLE	28,841
13S46	2	POLY–8 POLE (UNIT WT. = 267)	534
13S47	6	POLY–8 POLE (UNIT WT. = 690)	4,140
		TOTAL BLACK WT.	68,572#

HARDWARE REQD. FOR ASSEMBLY			
	MARK	QTY.	DESCRIPTION
	(1)	80	1¼ø x 4 (A325 TYPE–3) BOLTS W/ ONE–1¼ø H. FLATWASHER (F436 TYPE–3) EACH ONE–1¼ø H. HEX NUT LOCKNUT (A563–DH TYPE–3) EACH
PT	(2)	36	1½ø x 7¼ (A325 TYPE–3) BOLTS W/ ONE–1½ø H. FLATWASHER (F436 TYPE–3) EACH ONE–1½ø PIN–TYPE LOCKNUT (A563–DH TYPE–3) EACH
PT	(3)	48	1½ø x 8¾ (A325 TYPE–3) BOLTS W/ ONE–1½ø H. FLATWASHER (F436 TYPE–3) EACH ONE–1½ø PIN–TYPE LOCKNUT (A563–DH TYPE–3) EACH
	(4)	ONE	SEE ANCHOR BOLT CAGE DETAIL ON SHEET E25.

MATERIAL BILLED FOR ONE MAKE (ONE) TIME

GENERAL NOTES:

1. ALL WELDS SHALL BE IN ACCORDANCE WITH A.W.S. (D1.1.) UNLESS NOTED OTHERWISE.
   a.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL BE U.T. TESTED IN ACCORDANCE WITH AWS & ASNDT.
   b.) ALL MATERIAL WELDED WITH E80–SERIES, LOW HYDROGEN ELECTRODES.
   c.) ALL FILLET WELDS AT JOINT TERMINATIONS OR ABRUPT CHANGES IN WELD DIRECTION SHALL HAVE END RETURNS TO WRAP CORNERS AS GEOMETRY PERMITS. IF JOINT GEOMETRY DOES NOT PERMIT A FULL SIZE RETURN, A SEAL WELD SHALL BE PROVIDED WHERE ACCESSIBLE.
   d.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL USE 3/16" X 1 1/4", (A36) STEEL BACKING (GALVANIZED POLES); (A588–50) (NON–GALVANIZED), MINIMUM. BACKING BARS SHALL BE SPLICED ON SHAFT FLATS ONLY, WITH A C.J.P. GROOVE WELD. BACKING BARS SHALL BE SEAL WELDED ALL AROUND, WHEN ACCESSIBLE.
   e.) LONGITUDINAL SEAM WELDS SHALL ACHIEVE A MINIMUM OF 80% PENETRATION. LONGITUDINAL SEAM WELDS SHALL ACHIEVE 100% PENETRATION WITHIN A MINIMUM OF 6" FROM THE ENDS OF THE SHAFT.
2. FIELD BOLT SHIPPING QUANTITIES WILL INCLUDE A MAXIMUM 5% OVERAGE FOR BOLTS 1"ø OR LESS. FIELD BOLTS OVER 1"ø WILL BE EXACT COUNT UNLESS NOTED OTHERWISE.
3. POLE TAPER = 0.460432 IN/FT.
4. ALL HARDWARE NOTED WITH "PT" SHALL BE PRE–TENSIONED PER THE TURN–OF–NUT METHOD. ALL OTHER HARDWARE SHALL BE SNUG–TIGHT. SPARE SHIPPING QUANTITIES WILL INCLUDE THREE EXTRA ASSEMBLIES OF EACH BOLT TYPE DESIGNATED AS "PT" FOR FIELD VERIFICATION OF PRE–TENSIONING METHOD.
5. **POLE SHALL BE SWEEP BLASTED DULLED AFTER FABRICATION.**

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL,
DO NOT GALVANIZE.

(STR. 15) 19–9462PE23

NOTICE TO ERECTOR
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REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19

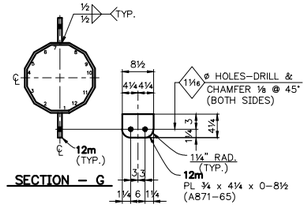
DIS-TRAN Steel, LLC
P.O. BOX 5109•ALEXANDRIA, LA, 71307–5709
PHONE 318–448–0274•FAX 318–445–4454

WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

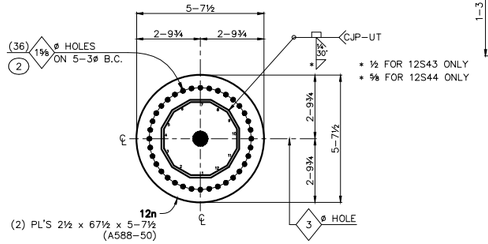
230KV TRANSMISSION POLE / ITEM – 17

ERECTION ELEVATION, SECTIONS & DETAILS

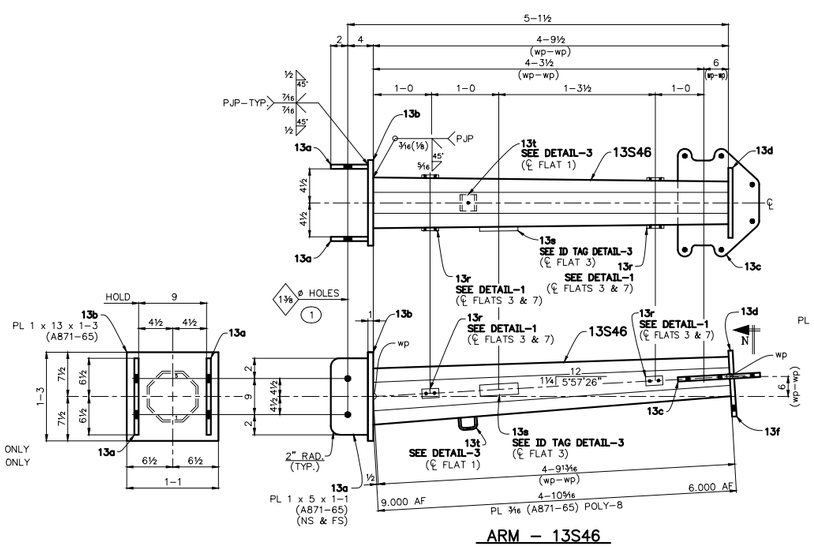
SCALE	DATE	JOB NUMBER	DRAWING NUMBER	REV. NO.
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DRAWN BY: DLW	CHK'D. BY: KLN	APP'D. BY: KEJ		



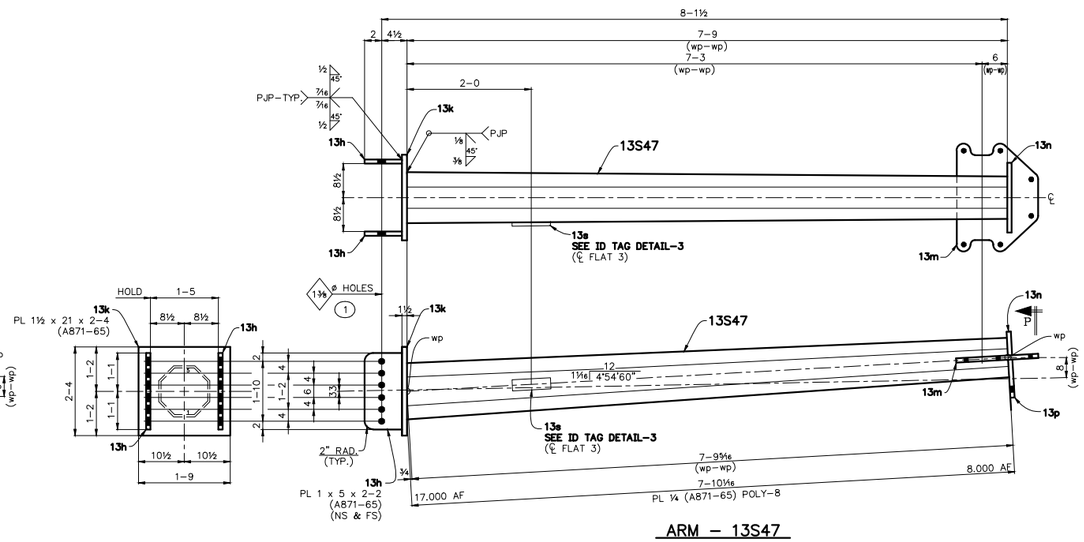
SECTION – G



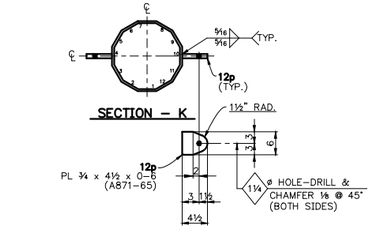
SECTION – H

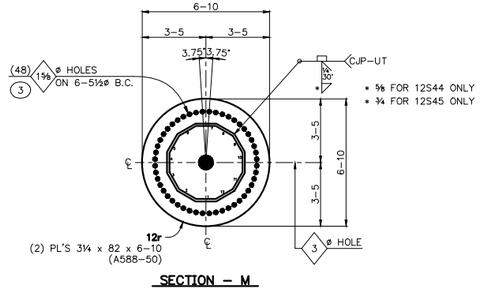


ARM – 13S46

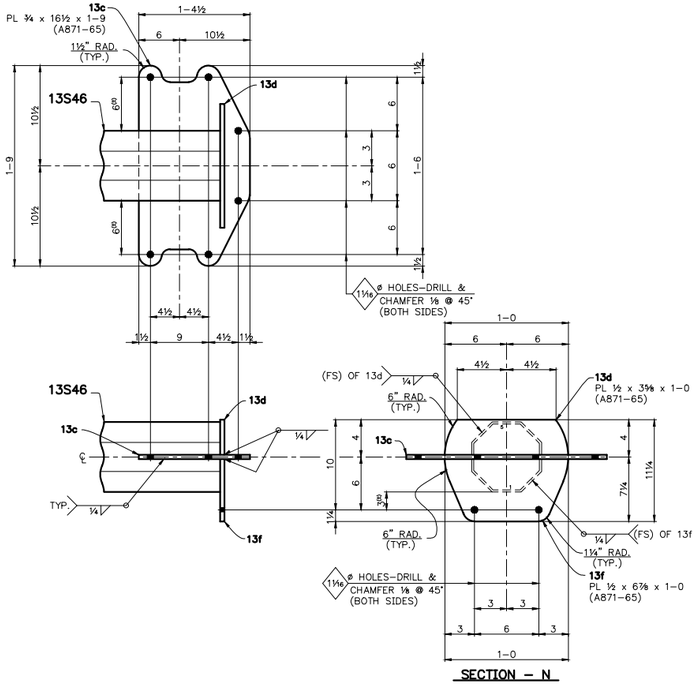


ARM – 13S47

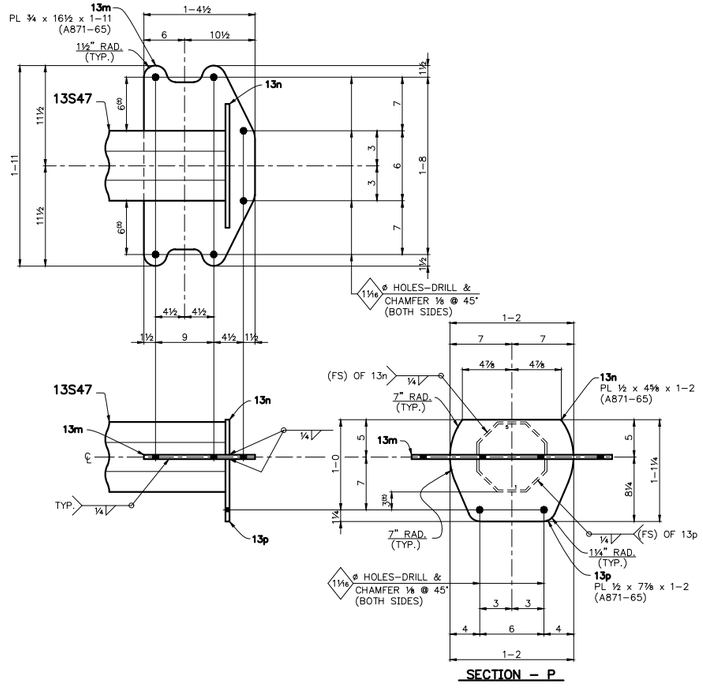




SECTION – M



SECTION – N



SECTION – P

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL, DO NOT GALVANIZE.

(STR. 15) 19–9462PE24

DIS-TRAN Steel, LLC
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WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

230KV TRANSMISSION POLE / ITEM – 17

SECTIONS & DETAILS (CONTINUED)

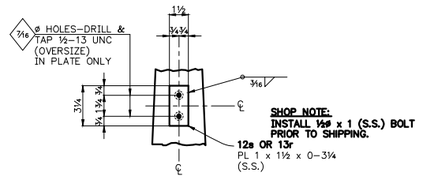
SCALE	DATE	JOB NUMBER	DRAWING NUMBER	REV. NO.
N.T.S.	07/12/19	19–9462P	E24	1

DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ

NOTICE TO ERECTOR
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REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
4					
3					
2					
1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19

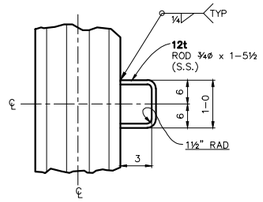
REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
8					
7					
6					
5					



DETAIL – 1

GROUNDING SCHEDULE DIM'S TO CENTER OF GROUND PLATE SEE DETAIL–1			
POLE – 12S43		POLE – 12S45	
℄ OF FLATS 1 & 7	℄ OF FLATS 6 & 12	℄ OF FLATS 1 & 7	℄ OF FLAT 10
46–9½	1–0	0–8½	18–5½
			19–11½

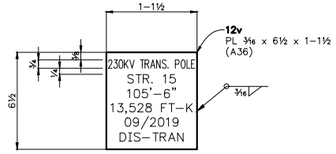
ALL DIMENSIONS FROM BOTTOM OF SHAFT



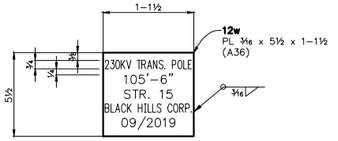
DETAIL – 2

GROUND LOOP SCHEDULE DIM'S TO CENTER OF GROUND LOOP SEE DETAIL–2	
POLE – 12S43	POLE – 12S44
℄ OF FLATS 4 & 10	℄ OF FLATS 4 & 10
3–9½	1–8¾
17–9½	10–8¾
31–9½	19–8¾

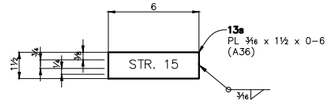
ALL DIMENSIONS FROM BOTTOM OF SHAFT



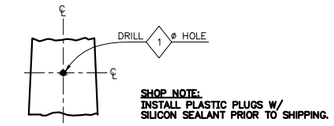
ID TAG DETAIL – 1



ID TAG DETAIL – 2



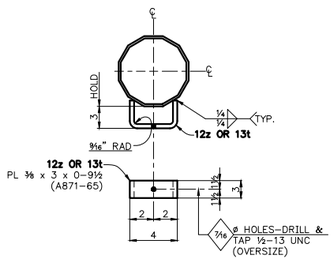
ID TAG DETAIL – 3



HOLE DETAIL

HOLE SCHEDULE DIM'S TO CENTER OF HOLES SEE HOLE DETAIL
POLE – 12S44
℄ OF FLATS 4 & 10
4–2¾
5–2¾
13–2¾
14–2¾
22–2¾
23–2¾

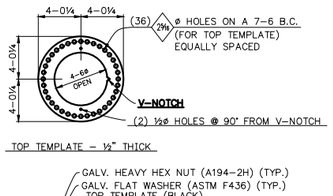
ALL DIMENSIONS FROM BOTTOM OF SHAFT



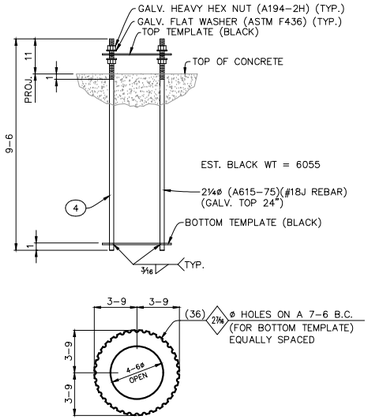
DETAIL – 3

OPGW SCHEDULE DIM'S TO CENTER OF OPGW SEE DETAIL–3				
POLE – 12S43	POLE – 12S44	POLE – 12S45		POLE – 13S46
℄ OF FLATS 2 & 8	℄ OF FLATS 2 & 8	℄ OF FLATS 2 & 8	℄ OF FLAT 9	℄ OF FLAT 1
3–0	3–0	14–0	14–0	2–6
10–0	10–6	17–0	17–0	
17–0	18–0	22–6		
24–0	25–6			
31–0				
38–0				
45–0				

ALL DIMENSIONS FROM BOTTOM OF SHAFT



TOP TEMPLATE – ½" THICK



BOTTOM TEMPLATE – ⅜" THICK

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL,
DO NOT GALVANIZE.

(STR. 15) 19–9462PE25

DIS-TRAN Steel, LLC
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WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

230KV TRANSMISSION POLE / ITEM – 17

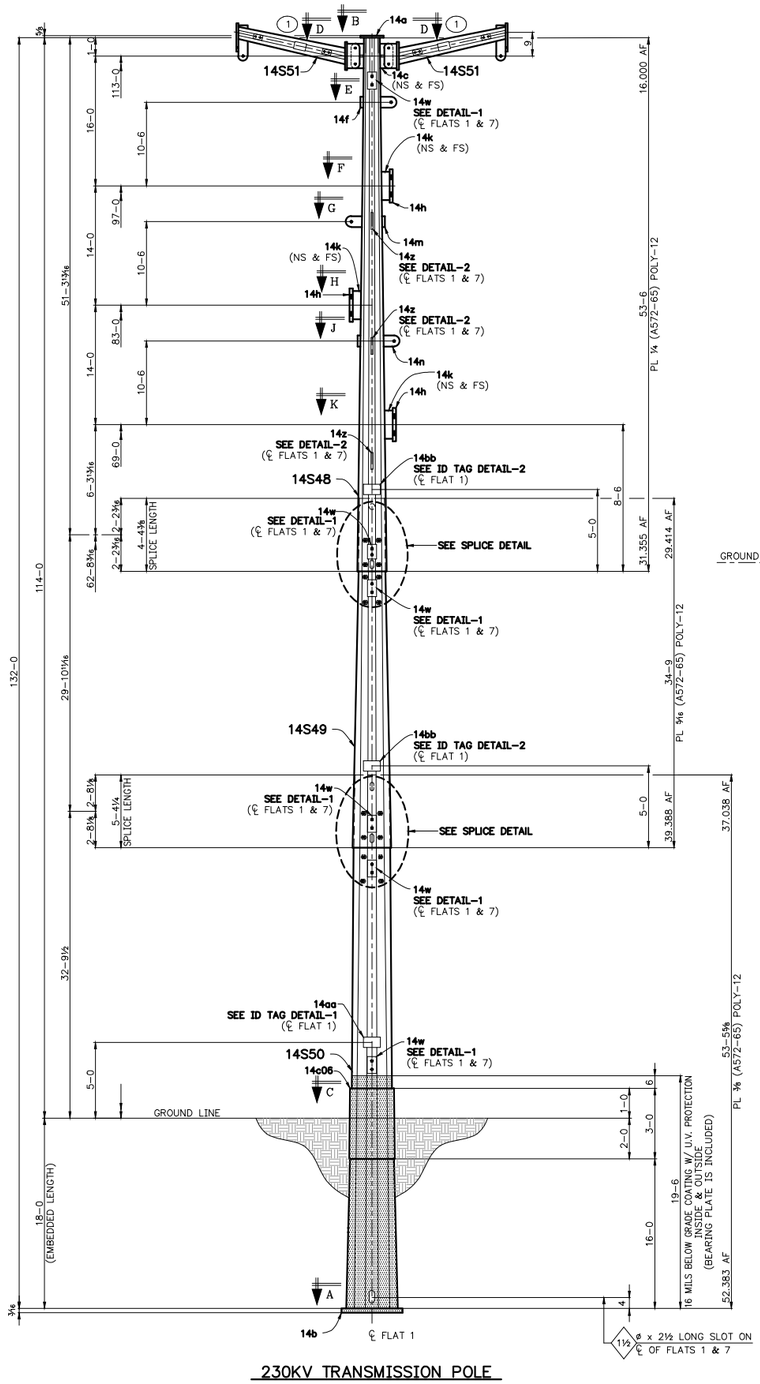
SECTIONS & DETAILS (CONTINUED)

SCALE	DATE	JOB NUMBER	DRAWING NUMBER	REV. NO.
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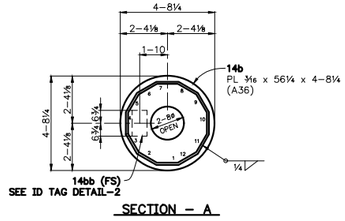
DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ

NOTICE TO ERECTOR
BACKCHARGES FOR CORRECTIVE WORK OR REPLACED MATERIALS WILL NOT BE ACCEPTED UNLESS EXPRESSLY AUTHORIZED BY DIS–TRAN BEFORE ANY SUCH COST ARE INCURRED.

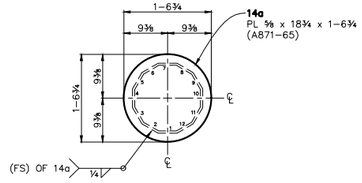
REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
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3					
4					
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7					
8					



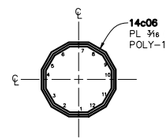
230KV TRANSMISSION POLE



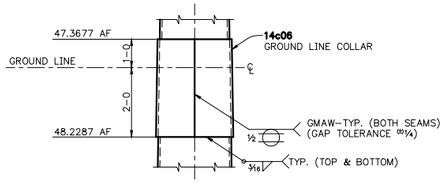
SECTION – A

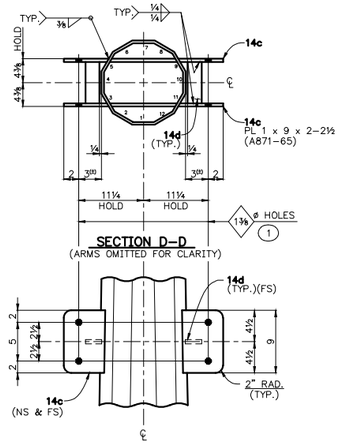


SECTION – B

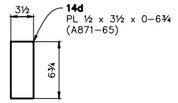


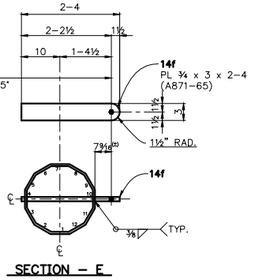
SECTION – C



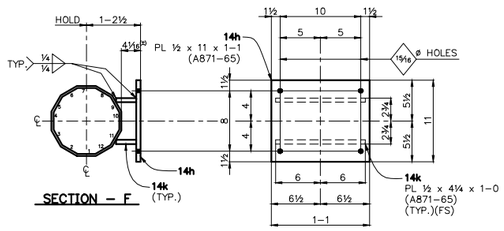


SECTION D–D
(ARMS OMITTED FOR CLARITY)

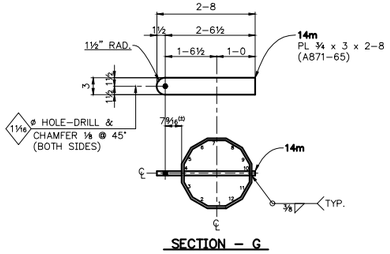




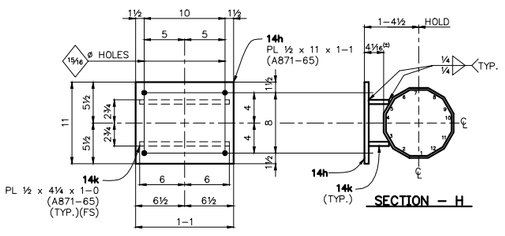
SECTION – E



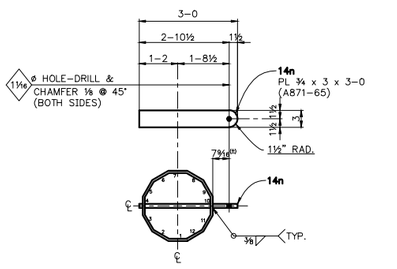
SECTION – F



SECTION – G



SECTION – H



SECTION – J

MATERIAL REQ'D. FOR ASSEMBLY

MARK	QTY.	DESCRIPTION	BLACK WT.
14S48	ONE	POLY-12 POLE	3,790
14S49	ONE	POLY-12 POLE	4,042
14S50	ONE	POLY-12 POLE	10,163
14S51	2	POLY-8 POLE (UNIT WT. = 171)	342
		TOTAL BLACK WT.	18,337#

HARDWARE REQD. FOR ASSEMBLY

MARK	QTY.	DESCRIPTION
(1)	8	1¼ø x 4 (A325 TYPE-3) BOLTS W/ ONE-1¼ø H. FLATWASHER (F436 TYPE-3) EACH ONE-1¼ø H. HEX NUT LOCKNUT (A563-DH TYPE-3) EACH

MATERIAL BILLED FOR ONE MAKE (ONE) TIME

GENERAL NOTES:

1. ALL WELDS SHALL BE IN ACCORDANCE WITH A.W.S. (D1.1.) UNLESS NOTED OTHERWISE.
   a.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL BE U.T. TESTED IN ACCORDANCE WITH AWS & ASNDT.
   b.) ALL MATERIAL WELDED WITH E80-SERIES, LOW HYDROGEN ELECTRODES.
   c.) ALL FILLET WELDS AT JOINT TERMINATIONS OR ABRUPT CHANGES IN WELD DIRECTION SHALL HAVE END RETURNS TO WRAP CORNERS AS GEOMETRY PERMITS. IF JOINT GEOMETRY DOES NOT PERMIT A FULL SIZE RETURN, A SEAL WELD SHALL BE PROVIDED WHERE ACCESSIBLE.
   d.) ALL CIRCUMFERENTIAL, C.J.P. WELDS SHALL USE 3/16" X 1 1/4", (A36) STEEL BACKING (GALVANIZED POLES); (A588-50) (NON-GALVANIZED), MINIMUM. BACKING BARS SHALL BE SPLICED ON SHAFT FLATS ONLY, WITH A C.J.P. GROOVE WELD. BACKING BARS SHALL BE SEAL WELDED ALL AROUND, WHEN ACCESSIBLE.
   e.) LONGITUDINAL SEAM WELDS SHALL ACHIEVE A MINIMUM OF 80% PENETRATION. LONGITUDINAL SEAM WELDS SHALL ACHIEVE 100% PENETRATION WITHIN A MINIMUM OF 6" FROM THE ENDS OF THE SHAFT AND THE FULL LENGTH OF THE FEMALE SECTION IN THE SLIP JOINT.
2. LONGITUDINAL SEAM WELDS IN FEMALE SECTION OF THE SLIP JOINT SHALL BE FULL PENETRATION WELDS.
3. FOR PROPER SHAFT ALIGNMENT FOR ASSEMBLY, A 6" HORIZONTAL WELD BEAD AND A MARK NUMBER ARE POSITIONED ON EACH SHAFT AT EACH SPLICE. THE 6" HORIZONTAL WELD BEADS ARE ON MATCHING CORNERS. THE MARK NUMBER IS ON AN ADJACENT FLAT. THE HORIZONTAL WELD BEAD CORNERS SHALL BE ALIGNED TOP TO BOTTOM OF THE POLE. MATCH NUMBERS SHALL BE MATCHED FOR EACH SPLICE.
4. FIELD ASSEMBLY HOLES (1⅛ø) WITH 1"ø H. HEX NUTS ARE LOCATED ON OPPOSING SECTION FLATS ABOVE AND BELOW SPLICES FOR JACKING SHAFTS TOGETHER.
5. THE LOWER WELD ORIENTATION MARK AT EACH SPLICE LOCATION SHALL BE TELESCOPED IN THE FIELD TO WITHIN 24" OF THE UPPER WELD ORIENTATION MARK. AFTER TELESCOPED, THE SECTIONS SHOULD SHOW NO FURTHER MOVEMENT AND THERE SHOULD BE ADEQUATE METAL-TO-METAL CONTACT ON ALL FLATS.
6. TWO SLOTS (1⅛ø x 2½") WILL BE PROVIDED AT THE SLIP FITTED END OF EACH SHAFT.
7. POLE TAPER = 0.287000 IN/FT
8. FIELD BOLT SHIPPING QUANTITIES WILL INCLUDE A MAXIMUM 5% OVERAGE FOR BOLTS 1"ø OR LESS. FIELD BOLTS OVER 1"ø WILL BE EXACT COUNT UNLESS NOTED OTHERWISE.
9. ALL HARDWARE NOTED WITH "PT" SHALL BE PRE-TENSIONED PER THE TURN-OF-NUT METHOD. ALL OTHER HARDWARE SHALL BE SNUG-TIGHT. SPARE SHIPPING QUANTITIES WILL INCLUDE THREE EXTRA ASSEMBLIES OF EACH BOLT TYPE DESIGNATED AS "PT" FOR FIELD VERIFICATION OF PRE-TENSIONING METHOD.
10. **POLE SHALL BE SWEEP BLASTED DULLED AFTER FABRICATION.**

SHOP NOTE:
ALL MATERIAL WEATHERING STEEL, DO NOT GALVANIZE.

(STR. L-SRC-20) 19-9462PE26

DIS-TRAN Steel, LLC
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WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

230KV TRANSMISSION POLE / ITEM – 18

ERECTION ELEVATION, SECTIONS & DETAILS

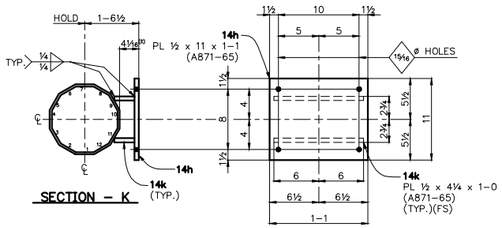
SCALE	DATE	JOB NUMBER	DRAWING NUMBER	REV. NO.
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DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ

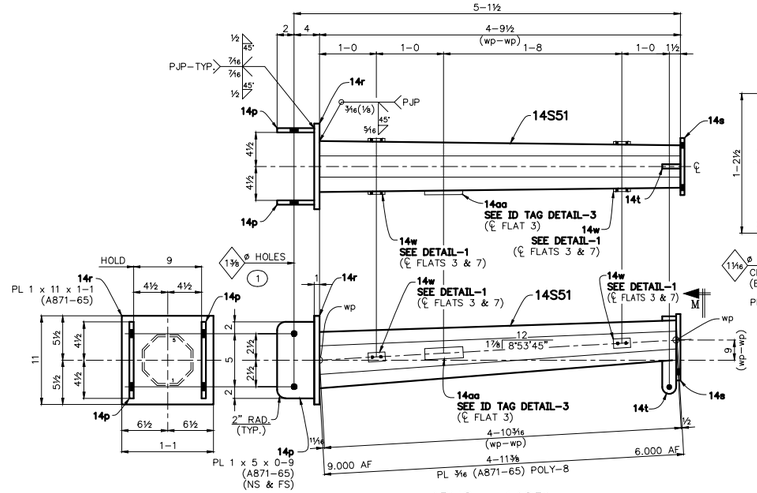
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REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
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3					
2					
1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19

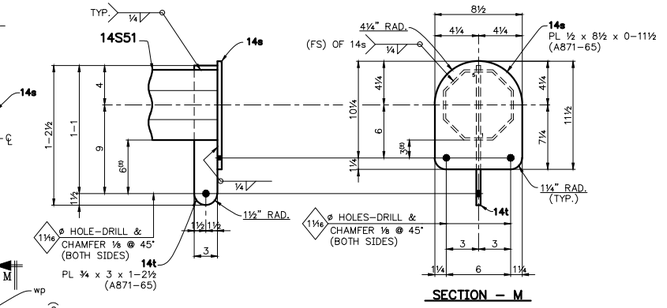
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5					



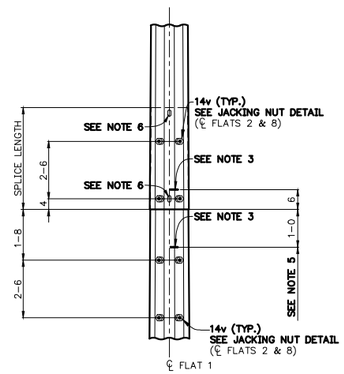
SECTION – K



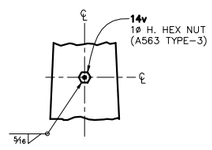
ARMS – 14S51



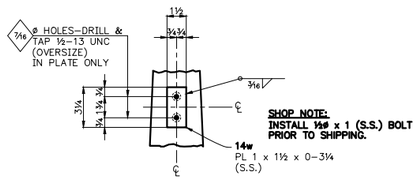
SECTION – M



SPLICE DETAIL
(DETAIL–1 OMITTED FOR CLARITY)



JACKING NUT DETAIL

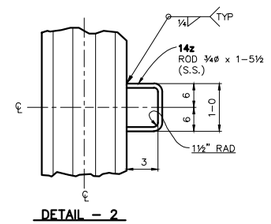


SHOP NOTE:
INSTALL ⅛ø x 1 (S.S.) BOLT PRIOR TO SHIPPING.

DETAIL – 1

GROUNDING SCHEDULE DIM'S TO CENTER OF GROUND PLATE SEE DETAIL–1		
POLE – 14S48	POLE – 14S49	POLE – 14S50
℄ OF FLATS 1 & 7	℄ OF FLATS 1 & 7	℄ OF FLATS 1 & 7
0–11	0–11	21–0
51–6	29–5¾	47–2½

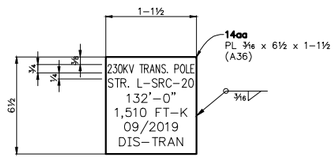
ALL DIMENSIONS FROM BOTTOM OF SHAFT



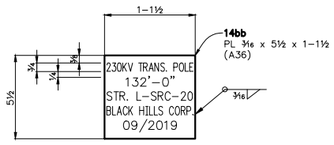
DETAIL – 2

GROUND LOOP SCHEDULE DIM'S TO CENTER OF GROUND LOOP SEE DETAIL–2
POLE – 14S48
℄ OF FLATS 1 & 7
6–6
20–6
34–6

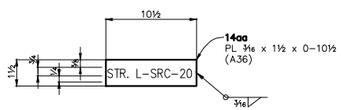
ALL DIMENSIONS FROM BOTTOM OF SHAFT



ID TAG DETAIL – 1



ID TAG DETAIL – 2



ID TAG DETAIL – 3

SHOP NOTE:
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WEST RAPID CITY 230KV PROJECT
BLACK HILLS CORP.
RAPID CITY, SD / P.O. #5010015731

230KV TRANSMISSION POLE / ITEM – 18

SECTIONS & DETAILS (CONTINUED)

SCALE	DATE	JOB NUMBER	DRAWING NUMBER	REV. NO.
N.T.S.	07/12/19	19–9462P	E27	1

DRAWN BY	CHK'D. BY	APP'D. BY
DLW	KLN	KEJ

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REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
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3					
2					
1	REVISED PER CUSTOMER APPROVAL DRAWINGS	DLW			08/27/19

REV.	REVISION DESCRIPTION	MADE BY	CK'D BY	APP'D BY	DATE
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