Public Service Commission of Wisconsin RECEIVED: 04/01/11, 12:55:43 PM

CapX2020 Hampton – Rochester – La Crosse 345 kV Transmission Project Docket 5-CE-136 Completeness Response: Item 01-76

Date of PSCW Request: February 1, 2011 Date of Response: March 2011

Item 01-76 / Appendix U / AFR Section 2.7.1.4.1

Amperage reported on EMF tables for proposed structures report only one current value for each doublecircuit configuration. Include amperage for both circuits on each table (e.g. Tables 11 and 11c, the amperage reported for these two tables is identical but the magnetic fields suggest that at least one circuit has a much different amperage value).

Response:

The EMF tables included in Appendix U have been revised to include amperage for both circuits. This revised Appendix U replaces the original Appendix U.

THIS PAGE INTENTIONALLY LEFT BLANK.



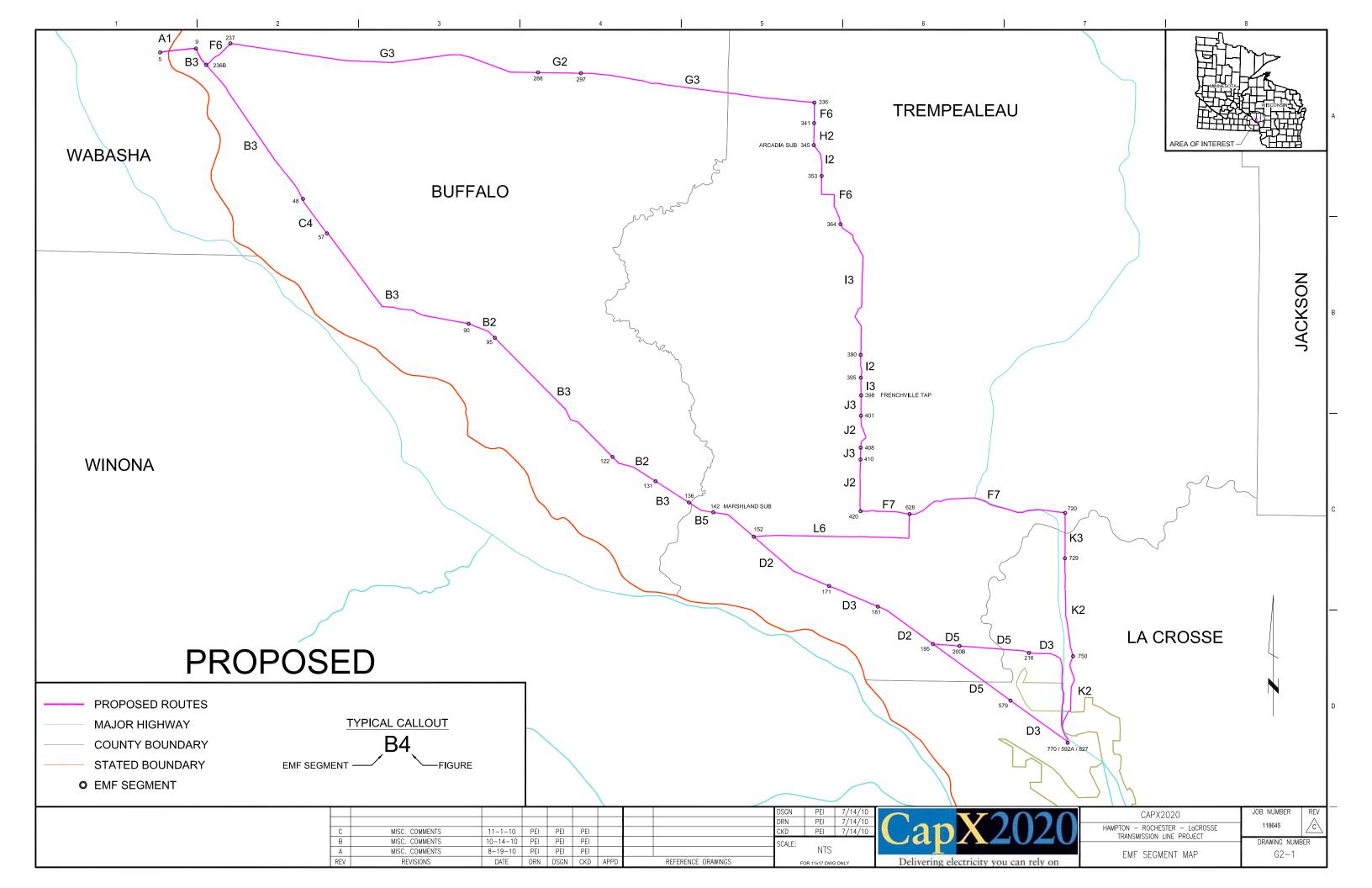
REVISED March 2011

Appendix U: Electric and Magnetic Fields (EMF) Information





THIS PAGE INTENTIONALLY LEFT BLANK.



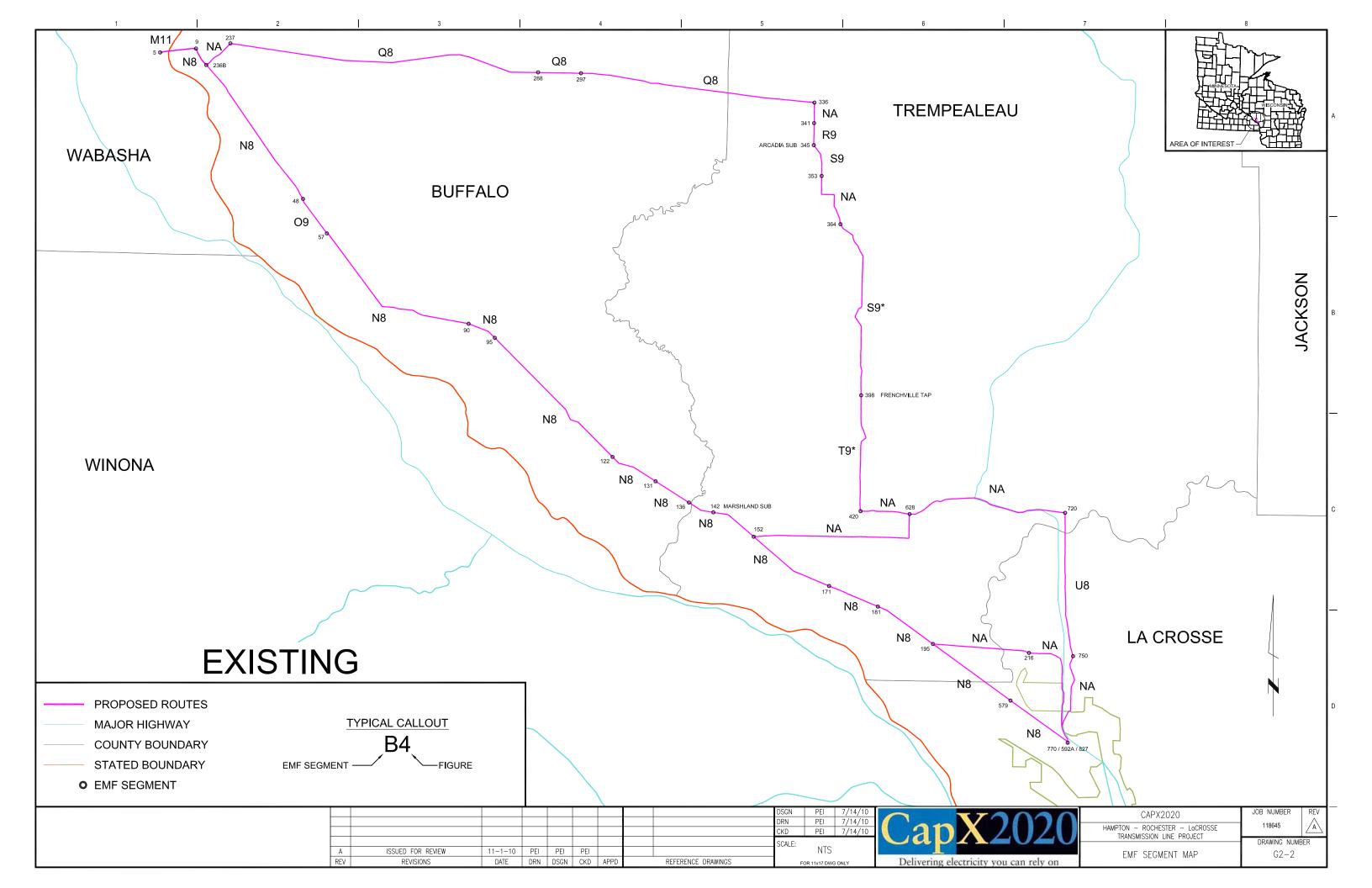


							Table 1 - Calculated Electric Field	de Table
								Calculated Electric Field Data ³
							Transmission Line Segments: Al Facility Description: ⁴ Proposed Tangent 7	Friple Circuit ⁵
							Facility Description: ⁴ Proposed Tangent Triple Circuit 345kV/161kV/69kV Mississippi River Crossing	·
							Distance from Centerline (frot)	
							Centerline 0	
							25 1.76 50 4.48 100 4.37	
							150 1.82 200 0.44	
							300 0.08 Assumptions:	
							Typical Midspan Sag = 35 to 50 feet Amperage = 304.6 A	
							⁴ Describe facility - Structure type, config ⁵ Figure 1	s showing the height of conductors from the ground at the structure. auration, location
	2'-6"			:	2'-6"		115401	
3/8", 7 STR, 0.360" DIA	EHS	3/8", 7 STR, EHS	3/8", 7 STR, EHS 0.360" DIA.	-	OPGW, DNO-6648 0.669" DIA.			
0.360" DIA	·	0.360" DIA.	0.360" DIA.			Ì		
<u> </u>					5,-7"			
A			/ $A / $					
	<u>12'-6" 12'-6" 25'-0" 15'-0"</u>	15'-0" 25'-0"	25'-0" 15'-0"	15'-0" 25'-0" 12'-6"	12'-6"			
	101 111			345-kV				
	161-kV 795 kcmil 26/7	69-k 795 kcmil	26/7	345-kV 2-CONDUCTOR BUNDLE 954 kcmil 54/7				
	DRAKE ACSŚ	DRAKE /	ACSS	954 kcmil 54/7 CARDINAL ACSS				
						Ê		
						140'-0" (TYPICAL HEIGHT)		
					PAN)	140°-0"		
					34'-0" [TYPICAL MIDSPAN]	HAT)		
					34 PICAL			
					E			
		(-) 0	(+)					
		LOOKING TOWARDS N	IORTH La CROSSE					
		FIGUF	RE 1					
PROPOSED								
SEGMENT: A								
OLOWILINI. A								
				I			7/44/40	
IS DRAWING WAS PREPARED BY POWER GINEERS, INC. FOR A SPECIFIC PROJECT, KING INTO CONSIDERATION THE SPECIFIC						DSGN PEI DRN PEI	7/14/10 7/14/10	pX202(
d unique requirements of the project. USE of this drawing or any information Ntained in this drawing for any purpose	REVISE	ED March 2011				CKD PEI	7/14/10 Ca	UNLUL
PROHIBITED UNLESS WRITTEN PERMISSION OM BOTH POWER AND POWER'S CLIENT IS					DDAWINCC			
ANTED.				REFERENCE	UNAWINGS	FOR 11x17 DW	g ONLY Deliver	ing electricity you can rely on

1

1

1

3

4

5

1

6

7

Table 8 - Calculated Magnetic Fields Table

Calculated Magnetic Field Data³

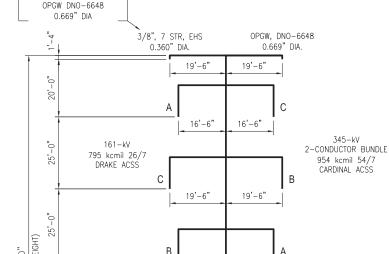
Transmission Line Segments: A1 Facility Description:⁴ Proposed Tangent Triple Circuit⁵ Triple Circuit 345kV/161kV/98kV

Distance from Magnetic Centerline (feet) Field (mG)		(2015) Normal Peak		(2025) ² No	ormal Load	(2025) Normal Peak		
		Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)	
Centerline	26.59	Centerline	33.23	Centerline	30.57	Centerline	38.15	
25	18.27	25	22.84	25	21.52	25	26.95	
50	33.99	50	42.49	50	39.91	50	49.96	
100	45.78	100	57.22	100	53.33	100	66.68	
150	12.35	150	15.44	150	14.34	150	17.92	
200	4.31	200	5.39	200	4.99	200	6.24	
300	1.37	300	1.71	300	1.58	300	1.97	

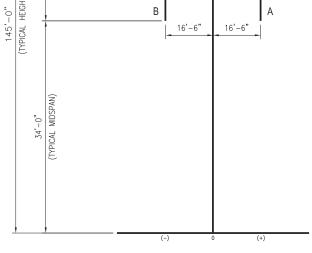
Assumptions: Typical Midspan Sag = 35 to 50 feet Amperage = 304.6A (345kV), 652.7A (161kV), 58.6A (69kV) for 2015 and 354.8A (345kV), 760.3A (161kV), 62.8A (69kV) for 2022 345 kV Circuit Phase Angles: A phase = 0 Deg, B phase = 240 Deg, C phase = 120 Deg 161 and 69 kV Circuit Phase Angles: A phase = 240 Deg, B Phase = 120 Deg, C phase = 0 Deg ¹Expected in-service date of new facility ²Calculated MF based on expected loads 10 years in the future after in-service date ³Provide a measured diagram of structures showing the height of conductors from the ground at the structure. ⁴Describe facility. Structure type, configuration, location ³Finure 1

5	CAPX2020	JOB NUMBER	REV
	EMF FIGURES	118645	B
J	GENERAL DRAWING	DRAWING NUMB	
235	345/345/161-kV TANGENT TRIPLE CIRCUIT	S5-1	

1	2		\$ 4	5	6	



FOR SEGMENTS B & C ONLY



LOOKING TOWARDS NORTH La CROSSE



PROPOSED

SEGMENTS: B,D,G,K - OPERATES 345/161kV SEGMENTS: H,I,J - OPERATES 345/69kV

THIS DRAWING WAS PREPARED BY POWER
ENGINEERS, INC. FOR A SPECIFIC PROJECT,
TAKING INTO CONSIDERATION THE SPECIFIC
AND UNIQUE REQUIREMENTS OF THE PROJECT.
REUSE OF THIS DRAWING OR ANY INFORMATION
CONTAINED IN THIS DRAWING FOR ANY PURPO
IS PROHIBITED UNLESS WRITTEN PERMISSION
FROM BOTH POWER AND POWER'S CLIENT IS
CRANTED

REVISED March 201

345-kV

	DSGN	PEI	7/14/10	TTADA
	DRN	PEI	7/14/10	
	CKD	PEI	7/14/10	
	SCALE:			Capitede
		NTS		
REFERENCE DRAWINGS	F	OR 11×17 DWG	ONLY	Delivering electricity you can rely on

		Calculated Electric Field Data ³
Transmission Li	ne Segments: B2,	D2, G2, K2
acility Descrip		ingle Pole, I String Tangent ⁵
Applies to all pr	oposed 345/1611	VI String type segments
Distance from Centerline (feet)	Electric Field (kV/m)	
Centerline	2.95	
25	4.63	
25		
25 50	1.74	
	1.74 0.14	
50		
50 100	0.14	

Table 2a - Calculated Electric Fields Table

Calculated Electric Field Data ³
Transmission Line Segments: H2, I2, J2
Facility Description: 4 Proposed Single Pole, 1 String Tangent 5
Double Circuit 345kV/161kV Operated at 345kV/69kV
Applies to all proposed segments energized as 345/69 kV with I string insulators

Distance from

Centerline (feet)	Electric Field (kV/m)
Centerline	3.39
25	4.72
50	1.73
100	0.16
150	0.15
200	0.11
300	0.06

Assumptions: Typical Midspan Sag = 35 to 50 feet

Amperage = 304.6 A

Figure 2

ovide a measured diagram of structures showing the height of conductors from the ground at the structure

Describe facility - Structure type, configuration, location

⁵Figure 2

Distance from

Centerline (feet)

Centerline

25

50

200

Assumptions: Typical Midspan Sag = 35 to 50 feet Amperage = 304.6A (345kV), 111.2A (161kV) for 2015 and 354.8A (345kV), 114.8A (161kV) for 2025 345 kV Circuit Phase Angle: A phase = 0 Deg, B phase = 240 Deg, C phase = 120 Deg 161 kV Circuit Phase Angle: A phase = 240 Deg, B Phase = 120 Deg, C phase = 0 Deg

Expected in-service date of new facility

Table 9 - Calculated Magnetic Fields Table

Facility Description: 4 Proposed Single Pole, I String Tangent

(2015) Normal Peak

Centerline 48.54

25 31.97 50 14.92

Magnetic

Field (mG)

4.7

2.25

Assumptions: Typical Midspan Sag = 35 to 50 feet Amperage = 304.6A (345kV), 351.4A (161kV) for 2015 and 354.8A (345kV), 412.4A (161kV) for 2025

Provide a measured diagram of structures showing the height of conductors from the ground at the structure.

(2015) Normal Peak

Magnetic

Field (mG)

32.2

19.38 6.87

Distance from

Centerline (feet)

25

50

100 150

Centerline 32.71

200 1.76

Calculated Magnetic Field Data

istance from Centerline

(feet)

100

150

345 kV Circuit Phase Angle: A phase = 0 Deg, B phase = 240 Deg, C phase = 120 Deg 161 kV Circuit Phase Angle: A phase = 240 Deg, B Phase = 120 Deg, C phase = 0 Deg

Calculated MF based on expected loads 10 years in the future after in-service date

Circuit 1: Capx North Rochester -- Briggs Road 345 kV

Magnetio

Field (mG)

38.84

25.58 11.93

1.06

Expected in-service date of new facility

mission Line Segments: D2

(2015)¹ Normal Load

Double Circuit 345kV/161kV

Describe facility - Structure type, configuration, location

Facility Description: 4 Proposed Single Pole, I String Tangent

Circuit 1: Capx North Rochester -- Briggs Road 345 kV

Magnetic

Field (mG)

26.17

25.76

15.51 5.5 2.54

1.41

Table 10 - Calculated Magnetic Fields Table

3.76

1.8

Transmission Line Segments: B2

Double Circuit 345kV/161kV

(2015)¹ Normal Load

Distance from Centerline

(feet)

Centerline

25

100

150

5Figure 2

Calculated Magnetic Field Data3

Circuit 2: Dairyland Alma -- Marshland 161 kV

Magneti

Field (mG

45.45

2.1

Circuit 2: Dairyland Marshland -- La Crosser tap 161 kV

Magnetic Field (mG)

30.13

30.21

18.36

6.56 3.04

200 1.69

(2025) Normal Peak

Magneti

Field (mG

37.62

22.99

8.21

2.12

Magneti Field (mG) 38.35 37.38 22.39 7.91

Distance from

Centerline (feet)

Centerline

50

200

(2025)² Normal Load

Distance from

Centerline (feet)

Centerline

25

50

29.83 13.88

(2025)² Normal Load

tance from

Centerline

(feet)

Centerline

25 50

100

150

(2025) Normal Peak

Magneti

Field (mG

56.81

5.47

2.62

ance fro

Centerline

(feet)

Centerline

100

150

²Calculated MF based on expected loads 10 years in the future after in-service date ³Provide a measured diagram of structures showing the height of conductors from the ground at the structure. Describe facility - Structure type, configuration, location

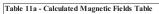
Table 11 - Calculated Magnetic Fields Table

			Calculated Mag	netic Field Data ³		
Transmission Li	ne Segments: K	2				
Facility Descript Double Circuit 3		Single Pole, I Str	ing Tangent ⁵			
Circuit 1: Capx	North Rochester	r Briggs Road 3	45 kV	Circuit 2: Xcel	Energy Tremval	Mayfair 161
Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)	Distance fro Centerline (feet)
Centerline	29.16	Centerline	36.46	Centerline	30.67	Centerline
25	24.93	25	31.16	25	29.9	25
50	13.92	50	17.39	50	17.91	50
100	4.69	100	5.86	100	6.33	100
150	2.12	150	2.65	150	2.92	150
200	1.16	200	1.46	200	1.62	200
300	0.49	300	0.61	300	0.68	300

Typical Midspan Sag = 35 to 50 feet Amperage = 304.6A (345kV), 190.1A (161kV) for 2015 and 354.8A (345kV), 136.3A (161kV) for 2025 345 and 161 kV Circuit Phase Angles: A phase = 0 Deg, B phase = 240 Deg, C phase = 120 Deg 1 Expected in-service date of new facility

Calculated MF based on expected loads 10 years in the future after in-service date rovide a measured diagram of structures showing the height of conductors from the ground at the structure

⁴Describe facility - Structure type, configuration, location





Transmission Line Segments: H2, I2 Facility Description: 4 Proposed Single Pole, I String Tangent Double Circuit 345kV/161kV; Operated at 345kV/69kV

Circuit 1: Capx N	North Rochest	er Briggs Road	345 kV	Circuit 2: North Creek Arcadia 69 kV or Arcadia Frenchville Tap 69 kV					
(2015) ¹ Normal Load (2015)			ormal Peak (2025) ² N		rmal Load	(2025) Normal Peak			
Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)		
Centerline	25.69	Centerline	32.11	Centerline	30.24	Centerline	37.8		
25	26.07	25	32.58	25	30.14	25	37.68		
50	15.94	50	19.92	50	18.26	50	22.83		
100	5.72	100	7.15	100	6.51	100	8.13		
150	2.65	150	3.32	150	3.01	150	3.76		
200	1.48	200	1.85	200	1.67	200	2.09		
300	0.63	300	0.79	300	0.71	300	0.89		

Typical Midspan Sag = 35 to 50 feet

Amperage = 304.6A (345kV), 92A (69kV) for 2015 and 354.8A (345kV), 120.49A (69kV) for 2025 345 kV Circuit Phase Angle: A phase = 0 Deg, B phase = 240 Deg, C phase = 120 Deg

69 kV Circuit Phase Angle: A phase = 240 Deg, B Phase = 120 Deg, C phase = 0 Deg

1 Expected in-service date of new facility

²Calculated MF based on expected loads 10 years in the future after in-service date

Provide a measured diagram of structures showing the height of conductors from the ground at the structure.

Describe facility - Structure type, configuration, location

⁵Figure 2

⁶ Because of the very small load at Arcadia substation, current flows at each side of the substation are very similar in valu Therefore, calculations for H and I were made using the higher of the two values (Segment H).

Table 11b - Calculated Magnetic Fields Table

		С	alculated Mag	netic Field Data ³			
Transmission Li	ne Segments:	J2					
Facility Descript	tion: Propose	d Single Pole, IS	tring Tangent	5			
Double Circuit 3	45kV/161kV; C	perated at 345kV	//69kV				
Circuit 1: Capx ?	North Rochest	er Briggs Road	345 kV	Circuit	2: Frenchville	Tap Galesville (59 kV
(2015) ¹ No	rmal Load	(2015) Not	rmal Peak	(2025) ² No	rmal Load	(2025) Nor	mal Peak
Distance from Centerline (feet)	Magnetic Field (mG)						
Centerline	29.69	Centerline	37.1	Centerline	34.59	Centerline	43.24
25	24.88	25	31.09	25	28.97	25	36.21
50	13.73	50	17.15	50	15.98	50	19.97
100	4.59	100	5.74	100	5.34	100	6.68
150	207	150	2.59	150	2.41	150	3.02
200	1.14	200	1.42	200	1.32	200	1.66
300	0.48	300	0.6	300	0.56	300	0.7

sumption

Typical Mikspan Sag = 35 to 50 feet Amperage = 304.6A (345kV), 200.82A (69kV) for 2015 and 354.8A (345kV), 234.29A (69kV) for 2025 345 kV Circuit Phase Angle: A phase = 0 Deg, B phase = 240 Deg, C phase = 120 Deg

9 kV Circuit Phase Angle: A phase = 240 Deg, B Phase = 120 Deg, C phase = 0 Deg

1 Expected in-service date of new facility

²Calculated MF based on expected loads 10 years in the future after in-service date

Provide a measured diagram of structures showing the height of conductors from the ground at the structure.

Describe facility - Structure type, configuration, location ⁵Figure 2

Table	11.	Calculated	Magnetie	Eable	Table
1 able	11c -	Calculated	Magnetic	Fleids	I adie

Transmission Li	ne Segments: G	2					
Facility Descrip Double Circuit 3		Single Pole, I Stri	ing Tangent ⁵				
Circuit 1: Capx	North Rochester	Briggs Road 3	45 kV	(Circuit 2: Alma -	- Tremval 161 kV	,
(2015) ¹ No	rmal Load	(2015) No	rmal Peak	(2025) ² No	ormal Load	(2025) No	rmal Peak
Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG
Centerline	80.03	Centerline	100.03	Centerline	98.29	Centerline	122.87
25	42.5	25	53.13	25	52.18	25	65.23
50	19.36	50	24.2	50	24.17	50	30.21
100	8.34	100	10.42	100	10.52	100	13.15
150	4.81	150	6.02	150	6.07	150	7.58
200	3.09	200	3.87	200	3.89	200	4.87
					1.96	300	2.45

Typical Midspan Sag = 35 to 50 feet

perage = 304.6A (345kV), 861.84A (161kV) for 2015 and 354.8A (345kV), 1062.66A (161kV) for 2025

345 kV Circuit Phase Angle: A phase = 240 Deg, B Phase = 240 Deg, C phase = 0 Deg 161 kV Circuit Phase Angle: A phase = 240 Deg, B Phase = 120 Deg, C phase = 0 Deg

Expected in-service date of new facility

Calculated MF based on expected loads 10 years in the future after in-service date Provide a measured diagram of structures showing the height of conductors from the ground at the structure

Describe facility - Structure type, configuration, location



THIS DRAWING WAS PREPARED BY POWER
ENGINEERS, INC. FOR A SPECIFIC PROJECT,
TAKING INTO CONSIDERATION THE SPECIFIC
AND UNIQUE REQUIREMENTS OF THE PROJECT.
REUSE OF THIS DRAWING OR ANY INFORMATION
CONTAINED IN THIS DRAWING FOR ANY PURPO!
IS PROHIBITED UNLESS WRITTEN PERMISSION
FROM BOTH POWER AND POWER'S CLIENT IS
GRANTED.

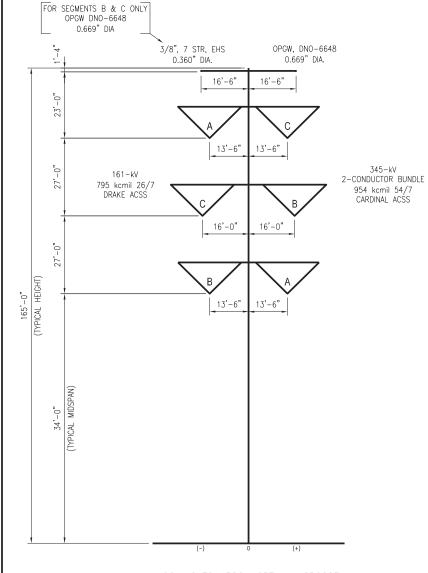
	DSGN	PEI	7/14/10	
	DRN	PEI	7/14/10	
	CKD	PEI	7/14/10	
	SCALE:			Capiteve
	1	NTS		
REFERENCE DRAWINGS	F	OR 11×17 DWG	ONLY	Delivering electricity you can rely or

SEGMENTS: B,D,G,K - OPERATES 345/161kV SEGMENTS: I,J - OPERATES 345/69kV

PROPOSED







Amperage = 304 Provide a meas		tructures showing the height of conductors from the ground at the structure.
		e, configuration, location
⁵ Figure 3	ty - Structure type	e, configuration, location
Figure 5		
Table 3a - Ca	lculated Elect	tric Fields Table
		Calculated Electric Field Data ³
Transmission Li	ne Segments: I3,	J3
Facility Descrip	tion: ⁴ Proposed S	ingle Pole, V String Tangent5
		perated at 345kV/69kV
Applies to all pr	oposed segments	energized as 345/69 kV with I string insulators
Distance from		
Centerline	Electric Field	
(feet)	(kV/m)	
Centerline	3.93	
25	4.4.5	
50	1.52	
100	0.15	
150	0.15	
200	0.11	
300	0.06	
Assumptions:		
	Sag = 35 to 50 f	eet
Amperage = 304		
		tructures showing the height of conductors from the ground at the structure.
*Describe facilit	ty - Structure type	e, configuration, location

Calculated Electric Field Data

Table 3 - Calculated Electric Fields Table

smission Line Segments: B3, D3, G3, K3

0.02

Double Circuit 345kV/161kV

Distance from Centerline (feet) Electric Field (kV/m)

Centerline 3.68 25 4.35

Applies to all proposed 34

Facility Description: 4 Proposed Single Pole, V String Tangent⁵

61 kV segme

			Calculated Mag	netic Field Data ³		
Transmission Li	ne Segments: B.	3				
Facility Descrip	tion:4 Proposed	Single Pole, V St	ring Tangent5			
Double Circuit		-				
Circuit 1: Capx	North Rochester	r Briggs Road 3	45 kV	Circuit 2: Alma	Marshland 16	1 kV
(2015) ¹ No	rmal Load	(2015) No	rmal Peak	(2025) ² No	rmal Load	(2025) N
Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)
Centerline	36.81	Centerline	46	Centerline	43.05	Centerline
25	25.31	25	31.64	25	29.52	25
50	14.4	50	17.99	50	16.78	50
100	5.97	100	7.46	100	6.96	100
150	3.09	150	3.86	150	3.61	150
200	1.85	200	2.31	200	2.16	200
300	0.86	300	1.07	300	1	300

345 kV Circuit Phase Angle: A phase = 0 Deg, B phase = 240 Deg, C phase = 120 Deg 161 kV Circuit Phase Angle: A phase = 240 Deg, B Phase = 120 Deg, C phase = 0 Deg Expected in-service date of new facility

Calculated MF based on expected loads 10 years in the future after in-service date Provide a measured diagram of structures showing the height of conductors from the ground at the structure

4Describe facility - Structure type, configuration, location

⁵Figure 3

Table 13 - Calculated Magnetic Fields Table

			Calculated Mag	netic Field Data3			
Transmission Li	ne Segments: D	3					
Facility Descrip	tion:4 Proposed 1	Single Pole, V St	ring Tangent5				
Double Circuit 3	45kV/161kV						
Circuit 1: Capx	North Rochester	Briggs Road 3	45 kV	Circuit 2: Marsl	hland La Cross	e tap 161 kV	
(2015) ¹ No	rmal Load	(2015) No	rmal Peak	(2025) ² No	ormal Load	(2025) No	rmal Peak
Distance from Centerline (feet)	Magnetic Field (mG)						
Centerline	26.8	Centerline	33.5	Centerline	31.03	Centerline	38.79
25	25.64	25	32.05	25	30.1	25	37.63
50	15.82	50	19.77	50	18.63	50	23.29
100	6.13	100	7.66	100	7.21	100	9.02
150	2.99	150	3.74	150	3.52	150	4.4
200	1.72	200	2.15	200	2.02	200	2.53
300	0.76	300	0.95	300	0.89	300	1.12

⁵Figure 3

Assumptions: Typical Midspan Sag = 35 to 50 feet Amperage = 304.6A (345kV), 111.2A (161kV) for 2015 and 354.8A (345kV), 114.8A (161kV) for 2025

Fungerage - 304 AG (394 K), 1112A (101 K) for 2013 and 354 AG (394 K), 1143AG (394 K) (Criticuit Phase Angle: A phase = 0 Deg, B phase = 240 Deg, C phase = 120 Deg 161 kV Circuit Phase Angle: A phase = 240 Deg, B Phase = 120 Deg, C phase = 0 Deg Expected in-service date of new facility

Calculated MF based on expected loads 10 years in the future after in-service date Provide a measured diagram of structures showing the height of conductors from the ground at the structure. escribe facility - Structure type, configuration, location

Table 14 - Calculated Magnetic Fields Table

			Calculated Mag	netic Field Data3			
Transmission Li	ne Segments: K3						
Facility Descrip Double Circuit 3		Single Pole, I Str	ing Tangent ⁵				
Circuit 1: Capx	North Rochester	Briggs Road 3	45 kV	Circuit 2: Trem	val Mayfair 16	1 kV	
(2015) ¹ No	rmal Load	(2015) No	rmal Peak	(2025) ² No	rmal Load	(2025) No	r
Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	
Centerline	28.75	Centerline	35.94	Centerline	31.31	Centerline	Ē
25	24.77	25	30.96	25	29.76	25	
50	14.9	50	18.62	50	18.33	50	
100	5.84	100	7.3	100	7.11	100	
150	2.89	150	3.61	150	3.47	150	
200	1.67	200	2.09	200	2	200	
300	0.75	300	0.93	300	0.88	300	

Assumptions Assumptions. Typical Midspan Sag = 35 to 50 feet Amperage = 304.6A (345kV), 190.1A (161kV) for 2015 and 354.8A (345kV), 136.3A (161kV) for 2025 345 and 161 kV Circuit Phase Angles: A phase = 0 Deg, B phase = 240 Deg, C phase = 120 Deg expected in-service date of new facility Calculated MF based on expected loads 10 years in the future after in-service date Provide a measured diagram of structures showing the height of conductors from the ground at the structure.

Describe facility - Structure type, configuration, location

FIGURE 3

ormal Peak

Magnetic Field (mG)

53.82 36.9 20.97 8.7

4.51 2.7

Table 14a - Calculated Magnetic Fields Table

Calculated Magnetic Field Data

Transmission Line Segments: I3, J3 Facility Description: 4 Proposed Single Pole, V String Tangent

Double Circuit 345kV/161kV; operated at 345kV/69kV Circuit 2: North Creek -- Arcadia 69 kV or Arcadia -uit 1: Capx North Rochester -- Briggs Road 345 kV

Circuit I: Capx i	North Rochest	er Briggs Road	343 KV	Frenchville Tap 69 kV				
(2015) ¹ Normal Load		(2015) Nor	rmal Peak	(2025) ² No	rmal Load	(2025) Noi	mal Peak	
Distance from Centerline (feet)	Magnetic Field (mG)							
Centerline	29.14	Centerline	36.42	Centerline	33.94	Centerline	42.44	
25	24.71	25	30.88	25	28.77	25	35.97	
50	14.81	50	18.51	50	17.24	50	21.55	
100	5.82	100	7.28	100	6.78	100	8.47	
150	2.89	150	3.61	150	3.3.6	150	4.2	
200	1.67	200	2.09	200	1.95	200	2.44	
300	0.75	300	0.94	300	0.87	300	1.00	

sumptions

Typical Midspan Sag = 35 to 50 feet Amperage = 304.6A (345kV), 92A (69kV) for 2015 and 354.8A (345kV), 120.49A (69kV) for 2025

345 kV Circuit Phase Angle: A phase = 0 Deg, B phase = 240 Deg, C phase = 120 Deg 69 kV Circuit Phase Angle: A phase = 240 Deg, B Phase = 120 Deg, C phase = 0 Deg

1 Expected in-service date of new facility

²Calculated MF based on expected loads 10 years in the future after in-service date

³Provide a measured diagram of structures showing the height of conductors from the ground at the structure.

⁴Describe facility - Structure type, configuration, location ⁵Figure 3

Table 14b - Calculated Magnetic Fields Table

	Calculated Magnetic Field Data ³									
Transmission Li	ne Segments: G3									
Facility Descript Double Circuit 3		Single Pole, V St	ring Tangent ⁵							
		r Briggs Road 3	45 kV		Circuit 2: Alma	Tremval 161 kV	r			
(2015) ¹ No	rmal Load	(2015) No	rmal Peak	(2025) ² No	ormal Load	(2025) No	rmal Peak			
Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)			
Centerline	75.69	Centerline	94.61	Centerline	93.07	Centerline	116.34			
25	41.96	25	52.45	25	51.53	25	64.41			
50	23.26	50	29.08	50	28.66	50	35.83			
100	10.72	100	13.4	100	13.23	100	16.53			
150	5.94	150	7.43	150	7.33	150	9.17			
200	3.7	200	4.62	200	4.57	200	5.71			
300	1.8	300	2.24	300	2.22	300	2.77			

Assumptions: Typical Midspan Sag = 35 to 50 feet Amperage = 304.6A (345kV), 861.84A (161kV) for 2015 and 354.8A (345kV), 1062.66A (161kV) for 2025 345 kV Circuit Phase Angle: A phase = 0 Deg, B phase = 240 Deg, C phase = 120 Deg 161 kV Circuit Phase Angle: A phase = 240 Deg, B Phase = 120 Deg, C phase = 0 Deg

Expected in-service date of new facility

²Calculated MF based on expected loads 10 years in the future after in-service date

Provide a measured diagram of structures showing the height of conductors from the ground at the structure. ⁴Describe facility - Structure type, configuration, location

5Figure 3



ormal Peak Magnetic Field (mG)

riciu (iiio)
39.15
37.2
22.91
8.88
4.34
2.5
1.1

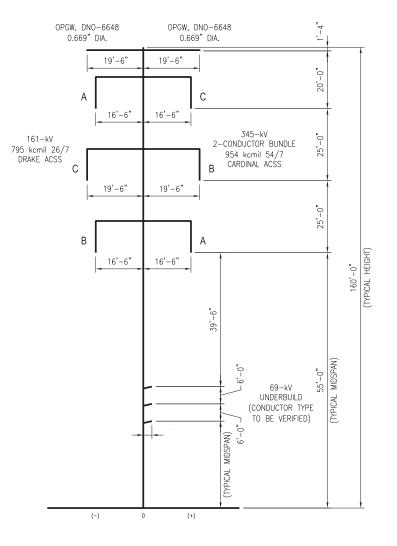
5	CAPX2020	JOB NUMBER	REV
		118645	
	EMF FIGURES GENERAL DRAWING	110040	
	GENERAL DRAWING	DRAWING NUME	BER
	345/161-kV V-STRING TANGENT	\$5-3	
on	STOPTOT KY V STRING PRIVELYT	50 0	

THIS DRAWING WAS PREPARED BY POWER
ENGINEERS, INC. FOR A SPECIFIC PROJECT,
TAKING INTO CONSIDERATION THE SPECIFIC
AND UNIQUE REQUIREMENTS OF THE PROJECT.
REUSE OF THIS DRAWING OR ANY INFORMATION
CONTAINED IN THIS DRAWING FOR ANY PURPOSE
IS PROHIBITED UNLESS WRITTEN PERMISSION
FROM BOTH POWER AND POWER'S CLIENT IS
GRANTED.

	DSGN	PEI	7/14/10	
	DRN	PEI	7/14/10	
	CKD	PEI	7/14/10	
	SCALE:			Capziz
	1	NTS		
REFERENCE DRAWINGS	, F	OR 11×17 DWG	ONLY	Delivering electricity yo

PROPOSED SEGMENT: C FIGURE 4

LOOKING TOWARDS NORTH La CROSSE



3

4

Table 4 - Cal	culated Electr	ic Fields Table
		Calculated Electric Field Data ³
Transmission Li	ine Segments: C4	
Facility Descrip	tion:4 Proposed S	ingle Pole, I String Tangent with underbuild5
		h 69kV underbuild
Applies to prope	osed 345/161/69	kV triple circuit south of Cochrane, WI
Distance from Centerline (feet)	Electric Field (kV/m)	
Centerline	1.35	
25	1.28	
50	0.95	
100	0.22	
150	0.02	
200	0.06	
300	0.04	

Describe facility - Structure type, configuration, location

⁵Figure 4

Table 15 - Calculated Magnetic Fields Table

Calculated Magnetic Field Data³

Transmission Line Segments: C4 Facility Description:⁴ Proposed Single Pole, I String Tangent with underbuild⁵ Double Circuit 345kV/161kV with 69kV underbuild

Circuit 1: Capx	ircuit 1: Capx North Rochester Briggs Road 345 kV Circuit 2: Alma Marshland 161 kV							
Circuit 3: Dairy	land's Xcel Coch	arane DPC Con	chrane 69 kV					
(2015) ¹ No	rmal Load	(2015) Normal Peak		(2025) ² Normal Load		(2025) Normal Peak		
Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)	
Centerline	14.48	Centerline	18.09	Centerline	16.56	Centerline	20.7	
25	10.23	25	12.79	25	11.88	25	14.85	
50	7.71	50	9.63	50	8.98	50	11.23	
100	4.36	100	5.45	100	5.08	100	6.35	
150	2.56	150	3.2	150	2.98	150	3.73	
200	1.62	200	2.03	200	1.89	200	2.36	
300	0.79	300	0.98	300	0.92	300	1.15	

umptior

Pasamiprons. Typical Midspan Sag = 35 to 50 feet Amperage = 304.6A (434kV), 351.4A (161kV), 58.6A (69kV) for 2015 and 354.8A (345kV), 412.4A (161kV), 62.8A (69kV) for 2 345 and 69 kV (Circuit Phase Angles: A phase = 0 Deg. B phase = 240 Deg. C phase = 120 Deg 161 kV Circuit Phase Angles: A phase = 240 Deg, B Phase = 120 Deg, C phase = 0 Deg

Expected in-service date of new facility 2Calculated MF based on expected loads 10 years in the future after in-service date

¹Provide a measured diagram of structures showing the height of conductors from the ground at the structure. ⁶Describe facility - Structure type, configuration, location

2020	CAPX2020	JOB NUMBER	
ZUZU	EMF FIGURES GENERAL DRAWING	118645 DRAWING NUME	
you can rely on	345/161-kV I-STRING TANGENT W/ 69-kV UB	S5-4	

1		2	3	4	5	6
	· ·			· · ·		
						Table 5 - Calculated Electric Fields Table Calculated Electric Field Data ²
						Transmission Line Segments: B5, D5 Facility Description: ⁴ Proposed H Frame Tangent ⁵ Double Circuit 345kV/161kV
						Applies to all proposed 345/161 kV H-frame segments
						Distance from Centerline (feet) Electric Field (kV/m)
						Centerline 5.35 25 5.39
						50 4.96 100 2.17 150 0.42
						200 0.14 300 0.04
						Assumptions: Typical Midspan Sag = 35 to 50 feet
						Amperage = 304.6 A ¹ Provide a measured diagram of structures showing the height of conductors from the ground at the structure. ⁴ Describe facility - Structure type, configuration, location
						³ Figure 5
	OPGW, DNO-6648 . 6'-7".			6'-7" OPGW. DNO-6648		
	OPGW, DNO-6648 6'-7" 0.669" DIA.			6'-7" OPGW, DNO-6648		
l t						
				500"		
		СВ				
			СВ			
	7'-7"	9'-0" 10'-0" 9'-0"	14'-3" 18'-6"	14'-3" 13'-7"		
	161-kV			345-kV 2-CONDUCTOR BUNDLE		
75'-0" (TYPICAL HEIGHT)	795 kcmil 26/7 DRAKE ACSS			954 kcmil 54/7 CARDINAL ACSS		
75'-0" .CAL HEI				CARDINAL ACSS		
(TYP)	0" MIDSPAN)					
	CAL CAL					
	(TYPI)					
<u>+</u>	•	(-	-) 0 (+)			
		LOOKING	TOWARDS NORTH La CROSSE			
			FIGURE 5			
			HOOKE			
PROPOSED						
SEGMENTS: C,D						
THIS DRAWING WAS PREPARED BY POWER					DSGN PEI	7/14/10
ENGINEERS, INC. FOR A SPECIFIC PROJECT, TAKING INTO CONSIDERATION THE SPECIFIC AND UNIQUE REQUIREMENTS OF THE PROJECT.					DRN PEI	$\frac{7/14/10}{7/14/10}$ Cap X2020
REUSE OF THIS DRAWING OR ANY INFORMATION CONTAINED IN THIS DRAWING FOR ANY PURPOSE	R	EVISED March	2011		SCALE	
IS PROHIBITED UNLESS WRITTEN PERMISSION FROM BOTH POWER AND POWER'S CLIENT IS GRANTED.				REFERENCE DRAWINGS	FOR 11x17 DWG	
-	•			•		, jour see, ou

Table 16a - Calculated Magnetic Fields Table

Calculated Magnetic Field Data3

Transmission Line Segments: B5 Facility Description:⁴ Proposed H Frame Tangent⁵ Double Circuit 345kV/161kV

Circuit 1: Capx North Rochester Briggs Road 345 kV				Circuit 2: Alma Marshland 161 kV				
(2015) ¹ Normal Load (2015) Normal Peak		2	ormal Load	(2025) Normal Peak				
Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)	
Centerline	63.66	Centerline	79.56	Centerline	74.43	Centerline	93.05	
25	74.28	25	92.84	25	58.22	25	108.26	
50	68.76	50	85.94	50	80.11	50	100.15	
100	14.41	100	18.02	100	12.85	100	20.97	
150	4.19	150	5.23	150	2.17	150	6.09	
200	1.92	200	2.4	200	0.69	200	2.8	
300	0.71	300	0.89	300	0.16	300	1.04	

Assumptions: Typical Midspan Sag = 35 to 50 feet Amperage = 304.6, A (345kV), 351.4A (161kV) for 2015 and 354.8A (345kV), 412.4A (161kV) for 2025 345 kV Circuit Phase Angle: A phase = 0 Deg, B phase = 240 Deg, C phase = 120 Deg 161 kV Circuit Phase Angle: A phase = 240 Deg, B Phase = 120 Deg, C phase = 0 Deg ¹Expected in-service date of new facility ¹Expected in-service date of new facility

²Calculated MF based on expected loads 10 years in the future after in-service date

³Provide a measured diagram of structures showing the height of conductors from the ground at the structure. ⁴Describe facility - Structure type, configuration, location

⁵Figure 5

Table 16 - Calculated Magnetic Fields Table

	Calculated Magnetic Field Data ³							
Transmission Line Segments: D5								
		H Frame Tangent ⁵						
Double Circuit 3								
Circuit I: Capx	North Rochester	Briggs Road 3	45 kV	Circuit 2: Marsh	iland La Cross	e tap 161 kV		
(2015) ¹ No	rmal Load	(2015) No	rmal Peak	(2025) ² No	ormal Load	(2025) No	rmal Peak	
Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)	
Centerline	43.12	Centerline	53.91	Centerline	49.21	Centerline	61.52	
25	67.18	25	83.97	25	77.83	25	97.31	
50	65.81	50	82.26	50	76.47	50	95.6	
100	15.57	100	19.47	100	18.21	100	22.77	
150	4.78	150	5.97	150	5.6	150	7	
200	2.25	200	2.81	200	2.64	200	3.3	
300	0.84	300	1.05	300	0.99	300	1.24	

Assumptions: Typical Midspan Sag = 35 to 50 feet Amperage = 304.6A (345kV), 111.2A (161kV) for 2015 and 354.8A (345kV), 114.8A (161kV) for 2025 345 kV (Tircuit Phase Angle: A phase = 0 Deg. B phase = 240 Deg. C phase = 120 Deg 161 kV Circuit Phase Angle: A phase = 240 Deg. B Phase = 120 Deg. C phase = 0 Deg Expected in-service date of new facility Columbra 10 based on an end facility

Calculated MF based on expected loads 10 years in the future after in-service date Provide a measured diagram of structures showing the height of conductors from the ground at the structure.

⁴Describe facility - Structure type, configuration, location

5 Figure 5

5	CAPX2020	JOB NUMBER	REV	
()	EMF FIGURES GENERAL DRAWING	118645	B	
	GENERAL DRAWING	DRAWING NUME	BER	
on	345/161-kV H-FRAME TANGENT	S5-5		

С

1	2 3 4	5 6
		Table (Caladar DE and Table Table
		Table 6 - Calculated Electric Fields Table Calculated Electric Field Data ³
		Transmission Line Segments: F6, L6,
		Facility Description. ⁴ Proposed Single Pole, 1 String Delta Tangent ⁵ Single Circuit 345kV Applies to proposed 345 kV single circuit delta segments
		Distance from Centerline Electric Field (VVm)
		Centerline 2.46
		25 4.86 50 2.41 100 0.5
		150 0.2 200 0.1 300 0.04
		Assumptions:
		Typical Midspan Sag = 35 to 50 feet Amperage = 304.6 A "Provide a measured diagram of structures showing the height of conductors from the ground at the structure.
		¹ Describe facility - Structure type, configuration, location ³ Figure 6
	3/8", 7 STR, EHS OPGW, DNO-6648 54 0.360" DIA. 0.669" DIA. 1	
	A	
	345-kV 2-CONDUCTOR BUNDLE 19'-6"	
	954 kcmil 54/7 CARDINAL ACSS	
	АГ НЕ АГ НЕ	
)" IIDSPAI	
	34'-0" (TYPICAL_MIDSPAN)	
	(-) 0 (+)	
	LOOKING TOWARDS NORTH La CROSSE	
	FIGURE 6	
PROPOSED		
SEGMENT: F,L		
* SEE NOTE ON TABLE 20.		

THIS DRAWING WAS PREPARED BY POWER ENGINEERS, INC. FOR A SPECIFIC PROJECT, TAKING NTO CONSIDERATION THE SPECIFIC AND UNADUE REQUIRELISTICS OF THE PROJECT. REUSE OF THIS DRAWING OR ANY INFORMATION CONTAINED IN THIS DRAWING FOR ANY PURPOSE IS PROVINEED UNLESS WRITENE PREMISSION FROM BOTH POWER AND POWER'S CLIENT IS GRANTED. NTED.

RE\	VISED	March	2011

	DSGN	PEI	7/14/10	
	DRN	PEI	7/14/10	
	CKD	PEI	7/14/10	
	SCALE:			JULIEVE
	00,1221	NTS		
REFERENCE DRAWINGS	F	OR 11x17 DWG	ONLY	Delivering electricity you can rely on

7

Table 17 - Calculated Magnetic Fields Table

Calculated Magnetic Field Data³

Transmission Line Segments: F6, L6 Facility Description:⁴ Proposed Single Pole, 1 String Delta Tangent⁵ Single Circuit 345kV Circuit: Capts North Rochester -- Brigos Road 345 VV

Circuit: Capx N	orth Rochester -	 Briggs Road 34. 	3 K V				
(2015) ¹ No	rmal Load	(2015) Normal Peak		(2025) ² Normal Load		(2025) No	rmal Peak
Distance from Centerline (feet)	Magnetic Field (mG)						
Centerline	32.67	Centerline	40.83	Centerline	38.04	Centerline	47.56
25	30.94	25	38.67	25	36.03	25	45.05
50	18.24	50	22.79	50	21.24	50	26.55
100	6.33	100	7.91	100	7.37	100	9.21
150	3.03	150	3.78	150	3.53	150	4.41
200	1.76	200	2.2	200	2.05	200	2.56
300	0.86	300	1.02	300	0.95	300	1.19

Assumptions: Typical Midspan Sag = 35 to 50 feet Amperage = 304.6 A for 2015 and 354.8 A for 2025 345 kV Circuit Phase Angle: A phase = 0 Deg. B phase = 240 Deg. C phase = 120 Deg Expected in-service date of new facility Calculated MF based on expected loads 10 years in the future after in-service date Provide a measured diagram of structures showing the height of conductors from the ground at the structure. "Describe facility - Structure type, configuration, location "Finare 6

⁵Figure 6

5	CAPX2020	JOB NUMBER	REV
2()	EMF FIGURES	118645	B
	GENERAL DRAWING	DRAWING NUME	BER
1000	345-kV I-STRING DELTA TANGENT	S5-6	

С

D

R

А

1	2		3		4		6
	150'-0" 150'-0" 34'-0" (TYPICAL HEIGHT) 34'-0" 25'-0" (TYPICAL MIDSPAN) 25'-0"	OPGW, DNO-6648 0.669" DIA.	345-kV 2-CONDUCTOR BUNDLE 954 kcmi 54/7 CARDINAL ACSS				Fabe 7 - Calculated Electric Field Dag ² Tammission Lang Segments: F2 Tamity Operations ¹ Proposed Single Pole, 1 String Vertical Tangon ³ Tamity Data Segments: F2 Tamity Data Segments: F3 T
<u>PROPOSED</u> SEGMENT: F		LOOKING TOWARDS NORTH					

THIS DRAWING WAS PREPARED BY POWER ENGINEERS, INC. FOR A SPECIFIC PROJECT, TAKING INTO CONSIDERATION THE SPECIFIC AND UNADUE REQUIRELINGS OF THE PROJECT. REUSE OF THIS DRAWING OR ANY INFORMATION CONTARLED IN THIS DRAWING FOR ANY DURFOSE IS PROVINEED UNLESS WRITENE PREMISSION FROM BOTH POWER AND POWER'S CLIENT IS GRANTED. NTED.

REVISED March 2011

	DSGN	PEI	7/14/10	\sim -
	DRN	PEI	7/14/10	
	CKD	PEI	7/14/10	
	SCALE:			
		NTS		
REFERENCE DRAWINGS	F	OR 11x17 DWG	ONLY	Delivering electric

Table 18 - Calculated Magnetic Fields Table

Calculated Magnetic Field Data³

Transmission Line Segments: F7 Facility Description⁴ proposed Single Pole, 1 String Vertical Tangem⁵ Single Circuit 345kV Circuit: Capt North Rochester -- Briggs Road 345 kV

Circuit. Capx is	ofth Rochester -	 Briggs Roau 34. 	JKV			-	
(2015) ¹ No	(2015) ¹ Normal Load		rmal Peak	(2025) ² No	ormal Load	(2025) Normal Peak	
Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magneti c Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)
Centerline	24.93	Centerline	31.16	Centerline	29.04	Centerline	36.3
25	15.07	25	18.83	25	17.55	25	21.94
50	9.13	50	11.41	50	10.63	50	13.29
100	4.06	100	5.07	100	4.73	100	5.91
150	2.2	150	2.75	150	2.56	150	3.21
200	1.36	200	1.7	200	1.58	200	1.98
300	0.65	300	0.82	300	0.76	300	0.95

Assumptions: Typical Midspan Sag = 35 to 50 feet Amperage = 304.6 A for 2015 and 354.8 A for 2025 345 KV Greuir Phase Angle: A phase = 0 Deg, B phase = 240 Deg, C phase = 120 Deg ¹Expected in-service date of new facility

⁵Figure 7

X2020	CAPX2020 EMF FIGURES GENERAL DRAWING	JOB NUMBER 118645	REV B
ricity you can rely on	345-kV I-STRING VERTICAL TANGENT	- drawing nume S5–7	BER

С

D

А

В

		Calculated Electric Field Data Facility Description Single Crient 161VE Applets to all examing 161VE1 Dataset from Calculated Electric Field Construction Constreliant Construction
	LOOKING TOWARDS NORTH La CROSSE	
EXISTING SEGMENTS: N,P,Q,U THIS DRAWING WAS PREPARED BY POWER ENDINGERS, INC. FOR A SPECIFIC PROJECT, TAKING INTO CONSIDERATION THE SPECIFIC AND UNIQUE ROUREMENTS OF THE PROJECT. REUSE OF THIS DRAWING FOR ANY INFORMATION CONTAINED IN THIS ORAWING FOR ANY INFORMATION FOR BOTH POWER AND POWER'S CLIENT IS GRAVIED.	REVISED March 2011	DSGN PEI 9/27/10 DRN PEI 9/27/10 CKD PEI 9/27/10 SCALE: NTS FOR 11x17 DWG ONLY Delivering electricity you can rely of the second s

1

1

1

3

4

5

Table 19 - Calculated Electric Fields Table

6

Table 22 - Calculated Magnetic Fields Table

Calculated Magnetic Field Data³

 Transmission Line Segments: U8

 Facility Description.⁴ Existing H-Frame⁵

 Single Circuit 161kV

 Circuit: Dailyaland Marshland – La Crosse tap 161 kV and Xcel Energy's Tremval – Mayfair 161 kV

 Existing Normal Load
 Existing Normal Peak

LAISING TO	i initi Lottu	LAISTING TO	i initi i cuix
Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)
Centerline	14.46	Centerline	18.06
25	10.1	25	12.61
50	4.5	50	5.62
100	1.32	100	1.66
150	0.61	150	0.76
200	0.35	200	0.44
300	0.16	300	0.2

A ssumptions: Typical Midspan Sag = 26 to 30 feet Amperage = 89.6 A Amperage on these two lines were essentially the same, so the highest of the two values was used for magnetic field calculations. The calculation used Xcel Energy's phase angles of A = 0, B = 240 and C = 120. Using Dairyland's phase angles changes the values by only 0.1%.

³Provide a measured diagram of structures showing the height of conductors from the ground at the structure. ⁴Describe facility - Structure type, configuration, location

⁵Figure 8

Table 22a - Calculated Magnetic Fields Table

Transmission Li	ne Segments: N	8.08			
	tion:4 Existing H			-	
Single Circuit 1		-i rame			
		kV or Alma Tr			
Existing N	ormal Load	Existing No	ormal Peak		
Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)		
Centerline	68.74	Centerline	86.07		
25	48	25	60.11		
50	21.39	50	26.78		
100	6.3	100	7.89		
150	2.91	150	3.64		
200	1.67	200	2.09		
300	0.77	300	0.96		

Assumptions: Typical Midspan Sag = 26 to 30 feet Amperage = 427 A 161 kV Circuit Phase Angle: A phase = 240 Deg, B Phase = 120 Deg, C phase = 0 Deg ¹Provide a measured diagram of structures showing the height of conductors from the ground at the structure. ⁴Describe facility - Structure type, configuration, location ⁵crimes *q*

⁵Figure 8

⁶Flows on Alma - Marshland and Alma - Tremval are essentially identical

5	CAPX2020	JOB NUMBER	REV
	EMF FIGURES GENERAL DRAWING	118645	B
	GENERAL DIAMING	DRAWING NUME	BER
200	161-kV H-FRAME	S5-8	
311			

D

THIS DRAWING WAS PREPARED BY POWER
ENGINEERS, INC. FOR A SPECIFIC PROJECT,
TAKING INTO CONSIDERATION THE SPECIFIC
AND UNIQUE REQUIREMENTS OF THE PROJECT.
REUSE OF THIS DRAWING OR ANY INFORMATION
CONTAINED IN THIS DRAWING FOR ANY PURPOSE
IS PROHIBITED UNLESS WRITTEN PERMISSION
FROM BOTH POWER AND POWER'S CLIENT IS
GRANTED.

	DSGN	PEI	9/27/10	TTANA
	DRN	PEI	9/27/10	
	CKD	PEI	9/27/10	
	SCALE:			Capitelle
		NTS		
REFERENCE DRAWINGS	F	OR 11×17 DWG	ONLY	Delivering electricity you can rely

* SEE NOTE ON TABLE 20.

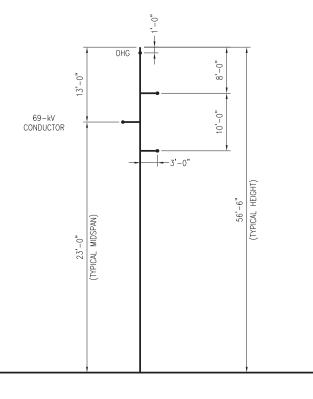
SEGMENTS: R,S,T,O

EXISTING

FIGURE 9

LOOKING TOWARDS NORTH La CROSSE

(-) 0 (+)



Fransmission Li		Calculated Electric Field Data3
	ne Segments: R9	, S9, T9 (majority of existing poles); ⁶ O9 (all poles)
Facility Descrip Single Circuit 6		ngle Pole, Horizontal Post ⁵
Applies to all ex	isting 69 kV	
Distance from Centerline (feet)	Electric Field (kV/m)	
Centerline	0.69	
25	0.28	
50	0.08	
	0.03	
100		
100	0.01	
	0.01 0.01	

⁵Figure 9

Table 23 - Calculated Magnetic Fields Table

Calculated Magnetic Field Data³ Transmission Line Segments: R9, S9 (majority of spans)⁶ Facility Description: ⁴Existing Single Pole, Horizontal Post⁵ Single Circuit 69kV ircuit: Dairyland North Creek -- Arcadia 69 kV and Dairyland Arcadia -- Frenchville tap 69 kV

Existing No	ormal Load	Existing Normal Peak		
Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)	
Centerline	13.05	Centerline	16.32	
25	6.59	25	8.23	
50	2.53	50	3.16	
100	0.71	100	0.89	
150	0.31	150	0.39	
200	0.17	200	0.22	
300	0.07	300	0.09	

Assumptions: Typical Midspan Sag = 23 to 25 feet Amperage = 138.9 A 69 kV Circuit Phase Angle: A phase = 240 Deg, B Phase = 120 Deg, C phase = 0 Deg

³Provide a measured diagram of structures showing the height of conductors from the ground at the structure.

⁴Describe facility - Structure type, configuration, location ⁵Figure 9

⁶Segments R, S, and T: The majority of the poles on these segments are horizontal post. Although a few wishbone and vertical configured structures exist they were modeled as horizontal post because 1) there are very few of them and 2) horizontal posts h

Because of the very small load at Arcadia substation, current flows at each side of the substation are very similar in value. Therefo calculations for H and I were made using the higher of the two values (Segment H).

Table 23a - Calculated Magnetic Fields Table

Calculated Magnetic Field Data³

Transmission Line Segments: T9 (majority of spans) Facility Description:⁴Existing Single Pole, Horizontal Post Single Circuit 69kV

Circuit: Dairyland Frenchville tap Galesville 69 kV						
Existing No	ormal Load	Existing No	ormal Peak			
Distance from Centerline (feet) Magnetic Field (mG)		Distance from Centerline (feet)	Magnetic Field (mG)			
Centerline	18.88	Centerline	23.59			
25	9.53	25	11.9			
50	3.66	50	4.57			
100	1.02	100	1.28			
150	0.45	150	0.57			
200	0.25	200	0.31			
300	0.11	300	0.13			

Assumptions: Typical Midspan Sag = 23 to 25 feet Ampergae = 200.8 A 69 kV Circuit Phase Angle: A phase = 240 Deg, B Phase = 120 Deg, C phase = 0 Deg ¹Provide a measured diagram of structures showing the height of conductors from the ground at the structure. ⁴Describe facility - Structure type, configuration, location

Table 23b - C	Table 23b - Calculated Magnetic Fields Table						
			Calculated Mag				
Transmission Lin	ne Segments: O9)					
Facility Descript	tion: ⁴ Existing Si	ngle Pole, Horiz	ontal Post ⁵				
Single Circuit 69							
Circuit: Xcel Co	ochrane Dairy	land Cochrane 69	kV				
Existing No	ormal Load	Existing No	ormal Peak				
Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)				
Centerline	3.77	Centerline	4.72				
25	1.9	25	2.38				
50	0.73	50	0.92				
100	0.2	100	0.26				
150	0.09	150	0.11				
200	0.05	200	0.06				
300	0.02	300	0.03				

Assumptions: Typical Mickpan Sag = 23 to 25 feet Amperage = 40.2 A 69 kV Circuit Phase Angle: A phase = 0 Deg, B phase = 240 Deg, C phase = 120 Deg

Provide a measured diagram of structures showing the height of conductors from the ground at the structure. Describe facility - Structure type, configuration, location

	CAPX2020	JOB NUMBER	REV	-
		110015		
	EMF FIGURES GENERAL DRAWING	118645	<u>∠</u> B∖	
	GENERAL BRANNING	DRAWING NUM	BER	
	69-kV MONO-POLF	S5-9		
on				1

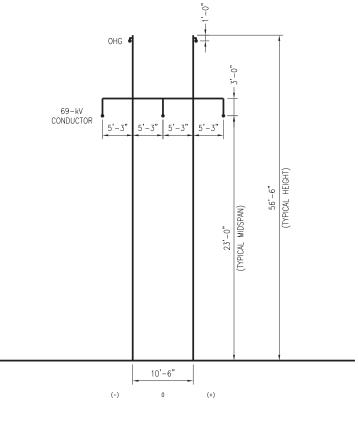
THIS DRAWING WAS PREPARED BY POWER			DSGN	PEI	9/27/10	
ENGINEERS, INC. FOR A SPECIFIC PROJECT, TAKING INTO CONSIDERATION THE SPECIFIC			DRN	PEI	9/27/10	
AND UNIQUE REQUIREMENTS OF THE PROJECT.	REVISED March 2011		CKD	PEI	9/27/10	
REUSE OF THIS DRAWING OR ANY INFORMATION CONTAINED IN THIS DRAWING FOR ANY PURPOSE	REVISED WAICH 2011		SCALE:			
IS PROHIBITED UNLESS WRITTEN PERMISSION FROM BOTH POWER AND POWER'S CLIENT IS				NTS		
GRANTED.		REFERENCE DRAWINGS		FOR 11x17 DW	G ONLY	

EXISTING SEGMENTS: R,S,T

1

FIGURE 10

LOOKING TOWARDS NORTH La CROSSE



3

4

		Calculated Electric Field Data3
Transmission Li	ne Segments: R1	0, S10, T10
Facility Descript Single Circuit 69		ngle Pole, H Frame (used on large angles and long spans) ⁵
Applies to all ex	isting 69 kV H-	
Distance from Centerline (feet)	Electric Field (kV/m)	
Centerline	0.3	
25	0.72	
50	0.22	
100	0.04	
150	0.01	
200	0.01	
300	0	

6

5

⁵Figure 10

7

R

С

D

Table 24 - Calculated Magnetic Fields Table

Calculated Magnetic Field Data³

Transmission Line Segments: S10 (certain long spans) Facility Description⁴ Existing Single Pole, H Frame⁵ Single Circuit 69kV Circuit Divider Alvert Contents

Circuit: Dairyla	nd North Creek -	Arcadia 69 kV a	and Dairyland Ar	cadia Frenchville tap 69
Existing No	ormal Load	Existing No.	ormal Peak	
Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)	
Centerline	27.79	Centerline	34.74	
25	13.56	25	16.96]
50	4.74	50	5.92	
100	1.28	100	1.6	
150	0.58	150	0.72	
200	0.32	200	0.41	
300	0.14	300	0.18	1

Assumptions: Typical Midspan Sag = 23 to 25 feet Amperage = 138,9 A 69 KV Circuit Phase Angle: A phase = 240 Deg, B Phase = 120 Deg, C phase = 0 Deg ¹Provide a measured diagram of structures showing the height of conductors from the ground at the structure. ¹Describe facility - Structure type, configuration, location

	CAPX2020	JOB NUMBER	REV
$an \mathbf{X} / U / U$	EMF FIGURES GENERAL DRAWING	118645	B
Suprieve		DRAWING NUME	BER
Delivering electricity you can rely on	69-kV H-FRAME	S5-10	

	1 2 4 4	<text></text>	<text></text>
<u>EXISITING</u> SEGMENT: M	LOOKING EAST FIGURE 11		
THIS DRAWING WAS PREPARED BY POWER ENGINEERS, INC. FOR A SPECIFIC PROJECT, TANIG INTO CONSIDERATION THE SPECIFIC AND UNIQUE REQUIREMENTS OF THE PROJECT. REUSE OF THIS DRAWING FOR ANY PURPOSE EVELS FOR THIS DRAWING FOR ANY PURPOSE IS PROHIBITED UNLESS WRITTEN PERMISSION RROM BOTH POWER AND POWER'S CLIENT IS GRANTED.	REVISED March 2011	DSGN PEI 9/27/10 DRN PEI 9/27/10 CKD PEI 9/27/10 SCALE: FOR 11x17 DWG ONLY DRN NC ONLY DRN PEI 9/27/10 DRN PEI 9/27/	CAPX2020JOB NUMBER 118645REV IEMF FIGURES GENERAL DRAWING118645IDRAWING NUMBER 161-kV TOWERDRAWING NUMBER S5-11

Existing No	ormal Load	Existing Normal Peak		
Distance from Centerline (feet)	Magnetic Field (mG)	Distance from Centerline (feet)	Magnetic Field (mG)	
Centerline	14.3	Centerline	17.88	
25	14.32	25	17.9	
50	9.05	50	11.31	
100	3.27	100	4.09	
150	1.56	150	1.95	
200	0.9	200	1.13	
300	0.41	300	0.51	

