MIDTOWN GREENWAY COALITION INFORMATION REQUEST

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Xcel Energy

Docket No.: OAH 15-2500-20599-2
PUC No. E-002/TL-09-38

Response To: Midtown Greenway Coalition

Information Request No. 30
Response Supplement

Date Received: December 4, 2009

Question:

A. Please explain with respect to Table 8 on page 69 of the Application, pertaining to magnetic fields for the proposed 115 kV transmission line;

a) the distinction between 3,000 kcmil and 1250 kcmil conductors for underground construction and what field conditions (Application, p. 68) would determine which conductor type would be used for an underground route for the Hiawatha line;

b) how the "distance to the proposed centerline: from the overhead and underground alternative along the Midtown Greenway was calculated, specifying for each distance referenced in the Table, (i) the route alignment and location with respect to the trench or shoulder of the Midtown Greenway for which the measurement was provided; (ii) the degree to which the measurement was horizontal or vertical, and (iii) the portion of the distance calculated to be through ground and the portion through air.

c) how many feet from the proposed power line centerline would trail users be for each of the following routes (i) Route A overhead route, (ii) Route A – underground route design, (iii) Route A any alternative route alignment under consideration by Applicant, as described in Applicant's answer to IR 28, Part B. If the distance varies based on which route alignment is selected, please describe the distances under all Route A alignments under consideration by Applicants;

d) to what magnetic flux density (milligauss) level would trail users to be exposed under either 3,000 kcmil or 1250 kcmil conductors for each overhead and underground Route A alternative alignment under consideration by Applicants, as described in Part A(c) above.

e) to what calculated electric field (kV/M) would trail users be exposed for each overhead and underground Route A alternative under consideration by Applicants, as described in Part A(c) above.

B. Please explain the following with respect to Revised Table 1 in Applicant's Supplemental Response to Midtown Greenway Coalition IR No. 3,

a) how the distances to residences from the proposed centerline for the Route A (Underground) alternative were calculated, specifying (i) the route alignment and location with respect to the trench or shoulder of the Greenway for which the measurement was provided; (ii) the degree to which the measurement was horizontal or vertical; (iii) the portion of each distance calculated to be through ground or through air;

b) whether Applicants have considered modifications of the Route A (Underground) alignment to account for information received from the City of Minneapolis or Hennepin County as referenced in the Supplemental Response to IR3, and if so, describe in detail and provide maps and cross-sections to scale disclosing any alternative route alignment(s) considered;

c) how the location of any proposed alignment, including depth of burial in the Greenway trench or south shoulder as well as horizontal distance from residences to the centerline, would affect (i) the number of residences within each distance to the centerline specified in Table 1, and (ii) the milligauss of magnetic fields to which such residents would be exposed.

d) for any such Route A (Underground) alternative route alignment(s) considered by Applicants (referred to in Part B(b) above) please provide information on Residences Near Transmission Line Routes comparable to the information in Revised Table 1, specifying (i) the degree to which the measurement was horizontal or vertical; (ii) the portion of each distance calculated to be through ground and through air.

e) for any such Route A (Underground) alternative route alignment(s) considered by Applicants (referred to in Part B(b) above) please provide information comparable to the provided in Table 8 on page 69 of the Application.

<u>Response:</u>

A.

a) The difference between 3000 and 1250 kcmil conductor is the cross-sectional area of the conductor and thus its capacity. The differences are noted in Attachment 1, which shows the data for a typical underground cable comparable to the type that would be used in this Project. The primary field condition that would dictate the conductor choice would be the physical space available for the duct bank, which dictates cable spacing. Another factor would be minimizing magnetic fields. The conductor size, spacing, and orientation would be selected to produce the lowest possible values of magnetic fields.

b) (i) (ii) (iii) The electric and magnetic fields are calculated using EPRI's software program, ENVIRO. All magnetic fields are calculated using two-dimensional analysis. The attached diagram (Attachment 2) shows the how the calculations are measured 1 meter above ground and the variables used in the program and the horizontal distance from the center of the pole on either direction of the ROW.

c) (i) (ii) (iii) It is uncertain what the specific distance would be between potential "trail users" and the proposed facilities. However, the distance between the proposed alignment and the paved surface of the Midtown Greenway at various locations is shown in the table below, Table 1. The points of measurement for these distances are shown in Attachment 3.

d) The magnetic field calculations for the overhead and underground alignments, taken from the center of the proposed facilities at every 5 to 20 feet from the center of the line to 300 feet on each direction of the ROW are provided in Table 3. It is uncertain what the specific distance would be between potential "trail users" and the proposed facilities and therefore magnetic fields cannot be determined with precision. However, the map provided in response to part A(c) (Attachment 3) can be used to visualize the levels at various distances.

e) The electric field calculations for overhead route at the center of the proposed facilities and every 5 to 20 feet from the center of the line to 300 feet on each direction of the ROW is provided in Table 4. It is uncertain what the specific distance would be between potential "trail users" and the proposed facilities and therefore electric field levels cannot be determined with precision. However, the map provided in response to part A(c) can be used to identified levels at various distances.

B.

a) (i) (ii) All house distances for Route A, underground construction, were measured horizontally from the proposed alignment for the facilities to the nearest portion of each home. With respect to part iii, Xcel Energy is unclear what information is being requested. Should the request be appropriately clarified, Xcel Energy will provide additional information.

b) Xcel Energy has evaluated a second underground alignment along Route A generally located north of the paved surface. An aerial map showing this alignment is attached as Attachment 4.

c)

(i) There are approximately 379 residential units within 100' of the alternative alignment for Route A underground. Please see Table 2 for information regarding residential units and how the numbers were calculated.

(ii) Various distances from the centerline of the proposed facilities are shown in Table 1. The points of measurement are shown in Attachment 3. Tables 3 and 4 show the magnetic and electric fields, respectively, residents may be exposed to in their homes at varying distances from the center line of an underground or overhead facility along Route A.

d) (i) (ii) Attachment 2 shows how exposure levels are measured.

e) See Table 3 for magnetic fields of all proposed underground facilities (Routes A and D would be the same). Properly installed and shielded underground cable as intended in this design has no measurable electric field.

Response Supplement:

A(c) By email dated February 5, 2010, Midtown Greenway Coalition ("MGC") clarified that information regarding the distance from the "nearest usable surface, rather than from the centerline" for Route A3 (the alignment within the trench) was requested. The distance between the proposed alignment and the edge of the paved surface of the Midtown Greenway at various locations is shown in the table below, Table 5. The points of measurement for these distances are shown in Attachment 5 and listed on Attachment 6.

B(c) Also by email dated February 5, 2010, MGC clarified that information regarding residences within certain interval distances of the proposed alignment on Route A3 was requested. Specifically, MGC requested data for the following intervals: 0-25 feet, 25-50 feet, 50-100 feet, 100-200 feet, and 200-500 feet. The distance information is provided in Table 5. Tables 3 and 4 show the magnetic and electric fields, respectively, residents may be exposed to in their homes at varying distances from the center line of an underground or overhead facility along Route A.

Response By:	Mythili Chaganti, P.E/ Ben Gallay
Title:	Substation Specialty Engineer/ Transmission Specialty Engineer
Department:	Substation/Transmission Engineering & Design/ Transmission Engineering
Date:	January 5, 2010
Response Supplement By:	Mythili Chaganti, P.E/ Ben Gallay/B(c)
Title:	Substation Specialty Engineer/ Transmission Specialty Engineer
Department:	Substation/Transmission Engineering & Design/ Transmission Engineering
Date:	February 12, 2010
Response Supplement By:	RaeLynn Asah
Title:	Permitting Analyst
Department:	Siting and Land Rights
Date:	February 12, 2010

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MGC IR 30 - Table 1			
Measuring Point[1]	Distance from Propose Line Location to Center of Midtown Greenway Trail (feet)		
	Route A - Overhead	Route A – Underground	Route A – Underground (bottom of trench option)
1	47	19	19
2	69	81	81
3	297	299	298
4	296	295	295
5	24	23	11
6	8	9	10
7	14	17	14
8	71	97	9
9	65	89	13
10	68	89	13
11	60	87	14
12	56	79	14
13	80	101	3
14	78	96	3
15	23	23	11
16	21	21	14
17	20	19	14
18	20	20	20
19	23	NA[2]	NA[2]

[1] Measuring points correspond to the proposed Route A – Overhead structure locations numbered beginning at the proposed Hiawatha Substation location and traveling east to west.

[2] Not applicable. Underground routes would end at the east side of the Midtown substation.

MGC IR 30 - Table 2 - Xcel Energy - Hiawatha Project Residences Near Transmission Line Routes		
Transmission Line Route	**Type of Structure**	**0-100 Feet[1]**
Route A (Bottom of Greenway Trench)	Single Family Multi-Family	7 9
	Total Estimated Dwelling Units[1]	379

[1] Estimates are based on Hennepin County parcel data, Xcel Energy customer records, and additional data searches. See 'Methods' below for further detail.

Methods: A total residential structure count was estimated for each buffered zone using aerial photography and information contained in Hennepin County parcel data, which was subsequently divided into single family and multi-family residential structures. Where the Hennepin County parcel data specified the number of dwelling units within a multi-family residential structure, that data was used to estimate total dwelling units. Where Hennepin County parcel data did not specify the number of dwelling units within a particular multi-family residential structure, Xcel Energy customer records were reviewed to determine the number of separate customers at the address corresponding to the structure, which was then used to estimate the number of dwelling units within the structure. If available, dwelling unit counts were verified based upon information on building websites (e.g., Midtown Exchange Apartments). If Xcel Energy customer data and/or building websites did not provide information regarding the number of dwelling units at a particular multi-family structure, an online mapping tool was used to view the structure and estimate the number of dwelling units within the structure.

Residential structures--and associated dwelling unit counts associated with each structure--located within multiple buffers were included in the counts for each buffer in which a portion of the building was located.

MGC IR 30 - Table 3 - Calculated Magnetic Flux Density (milligauss) for Proposed 115 kV Transmission Line Designs
(1 Meter or 3.28 feet above ground)

Route	Structure Type	System Condition	Current (Amps)	Distance to Proposed Centerline																																					
				-300'	-280'	-260'	-240'	-220'	-200'	-180'	-160'	-140'	-120'	-100'	-80'	-60'	-40'	-25'	-20'	-15'	-10'	-5'	0'	5'	10'	15'	20'	25'	40'	60'	80'	100'	120'	140'	160'	180'	200'	220'	240'	260'	280'	300'
A	Davit Arm 115kV/115kV Steel Pole Double Circuit	Peak	230	0.07	0.09	0.11	0.13	0.17	0.22	0.29	0.41	0.6	0.91	1.49	2.66	5.32	12.05	23.03	27.8	32.32	35.82	37.84	38.44	37.74	35.63	32.08	27.53	22.77	11.85	5.2	2.59	1.44	0.88	0.57	0.39	0.28	0.21	0.16	0.13	0.11	0.09	0.07
		Average	138	0.04	0.05	0.06	0.08	0.1	0.13	0.18	0.25	0.36	0.55	0.9	1.6	3.19	7.23	13.82	16.68	19.39	21.49	22.7	23.06	22.64	21.38	19.25	16.52	13.66	7.11	3.12	1.55	0.87	0.53	0.34	0.24	0.17	0.13	0.1	0.08	0.06	0.05	0.04
A & D (3000 kcmil)	Transmission Duct Bank 115kV / 115kV Under ground Double Circuit	Peak	230	0	0	0	0	0	0	0	0	0	0	0.01	0.01	0.03	0.11	0.37	0.69	1.45	3.66	10.63	19.67	10.61	3.65	1.45	0.68	0.37	0.11	0.03	0.01	0.01	0	0	0	0	0	0	0	0	0	0
		Average	138	0	0	0	0	0	0	0	0	0	0	0	0.01	0.02	0.06	0.22	0.41	0.87	2.2	6.38	11.8	6.37	2.19	0.87	0.41	0.22	0.06	0.02	0.01	0	0	0	0	0	0	0	0	0	0	0
A & D (1250 Kcmil)	Transmission Duct Bank 115kV / 115kV Under ground Double Circuit	Peak	230	0	0	0	0	0	0	0	0	0	0	0.01	0.01	0.03	0.11	0.42	0.79	1.69	4.14	8.56	6.54	8.56	4.15	1.69	0.79	0.42	0.11	0.03	0.01	0.01	0	0	0	0	0	0	0	0	0	0
		Average	138	0	0	0	0	0	0	0	0	0	0	0	0.01	0.02	0.06	0.25	0.47	1.02	2.49	5.13	3.92	5.13	2.49	1.02	0.47	0.25	0.06	0.02	0.01	0	0	0	0	0	0	0	0	0	0	0

MGC IR 30 - Table 4 - Calculated Electric Fields (kV/m) for Proposed 115 kV Transmission Line Designs
(1 Meter or 3.28 feet above ground)

Routes	Structure Type	Nominal Voltage (kV)	Distance to Proposed Centerline																																						
			-300'	-280'	-260'	-240'	-220'	-200'	-180'	-160'	-140'	-120'	-100'	-80'	-60'	-40'	-25'	-20'	-15'	-10'	-5'	0'	5'	10'	15'	20'	25'	40'	60'	80'	100'	120'	140'	160'	180'	200'	220'	240'	260'	280'	300'
A	Davit Arm 115kV/115kV Steel Pole Double Circuit	121	0.003	0.004	0.004	0.005	0.006	0.008	0.01	0.012	0.016	0.02	0.024	0.02	0.049	0.355	0.99	1.22	1.31	1.17	0.85	0.56	0.85	1.17	1.31	1.22	0.99	0.355	0.049	0.02	0.024	0.02	0.016	0.012	0.01	0.008	0.006	0.005	0.004	0.004	0.003

TABLE 5

Xcel Energy - Hiawatha Project Residences Near Transmission Line Routes						
Transmission Line Route	Type of Structure	0-25 Feet[1]	25-50 Feet[1]	0-100 Feet[1]	100-200 Feet[1]	200-500 Feet[1]
Route A-3	Single Family	0	3	7	41	171
	Multi-Family	0	1	9	42	159
	Total Estimated Dwelling Units[2]	0	7	379	640	1,083

[1] Structures and associated dwelling unit counts located within more than one buffer are included in each buffer in which a portion of the structure is located. As such, values from each buffer cannot be summed to estimate an aggregate structure or dwelling unit count for multiple buffers.

[2] Estimates are based on Hennepin County parcel data, Xcel Energy customer records, and additional data searches. See 'Methods' below for further detail.

Methods: A total residential structure count was estimated for each buffered zone using aerial photography and information contained in Hennepin County parcel data, which was subsequently divided into single family and multi-family residential structures. Where the Hennepin County parcel data specified the number of dwelling units within a multi-family residential structure, that data was used to estimate total dwelling units. Where Hennepin County parcel data did not specify the number of dwelling units within a particular multi-family residential structure, Xcel Energy customer records were reviewed to determine the number of separate customers at the address corresponding to the structure, which was then used to estimate the number of dwelling units within the structure. If available, dwelling unit counts were verified based upon information on building websites (e.g., Midtown Exchange Apartments). If Xcel Energy customer data and/or building websites did not provide information regarding the number of dwelling units at a particular multi-family structure, an online mapping tool was used to view the structure and estimate the number of dwelling units within the structure.

Residential structures--and associated dwelling unit counts associated with each structure--located within multiple buffers were included in the counts for each buffer in which a portion of the building was located.

Southwire®

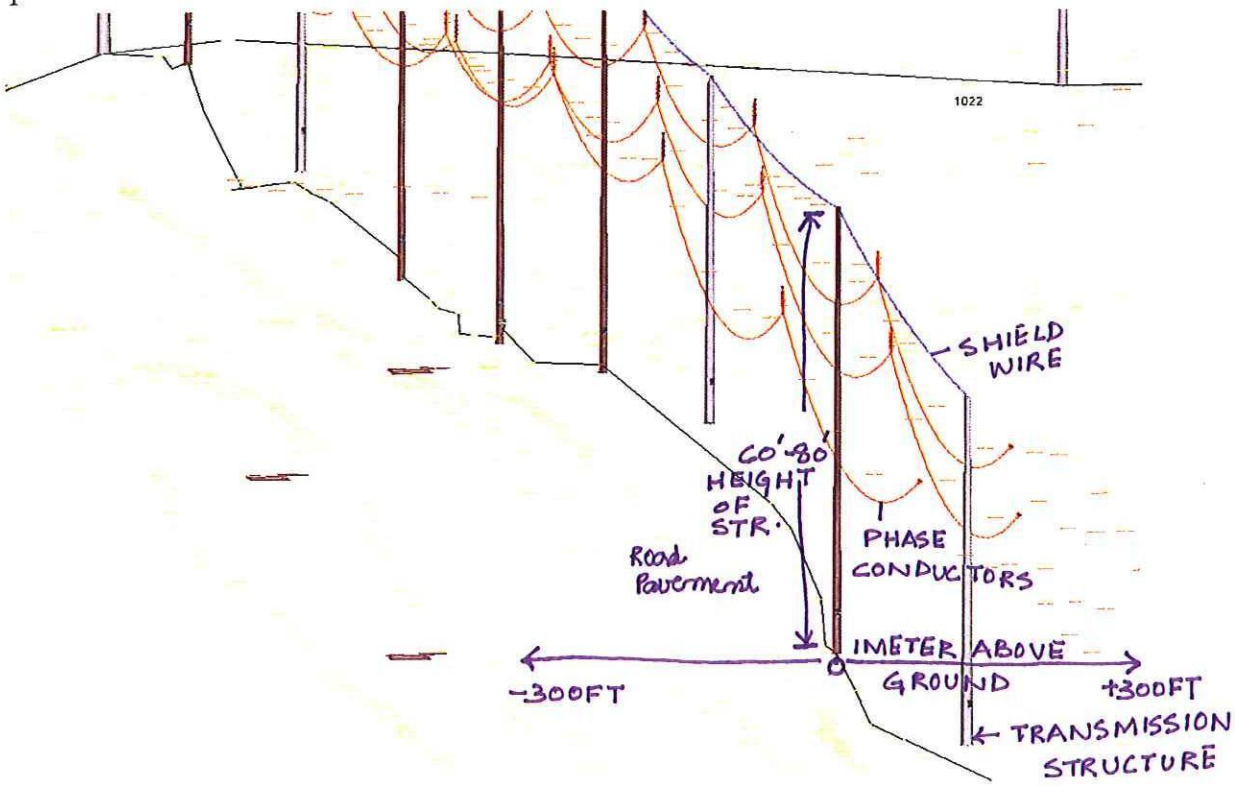
High Voltage Solutions®

115 kV XLPE - Copper Conductor
Traditional Wall 800 mil XLPE Copper Corrugated Sheath

Conductor Size in kcmil		750	1000	1250	1500	1750	2000	2500	3000
Dimensional	Nominal								
Conductor Diameter	in	0.97	1.12	1.25	1.37	1.48	1.59	1.77	2.00
	(mm)	(24.7)	(28.5)	(31.8)	(34.8)	(37.6)	(40.4)	(45)	(50.8)
Diameter over Insulation	in	2.64	2.79	2.92	3.04	3.17	3.28	3.46	3.69
	(mm)	(67.1)	(70.8)	(74.2)	(77.3)	(80.6)	(83.2)	(87.9)	(93.7)
Diameter over Sheath	in	3.17	3.33	3.48	3.61	3.75	3.87	4.07	4.32
	(mm)	(80.5)	(84.6)	(88.3)	(91.7)	(95.3)	(98.2)	(103.4)	(109.7)
Overall Jacket Diameter	in	3.48	3.64	3.79	3.92	4.06	4.18	4.38	4.63
	(mm)	(88.4)	(92.5)	(96.3)	(99.6)	(103.2)	(106.2)	(111.3)	(117.6)
Total Weight	lbs/ft	6.2	7.3	8.3	9.2	10.2	11.2	13.1	15.2
Min. Bending Radius (install/perm.)	in	70/52	73/4	76/57	78/59	81/61	84/63	88/66	93/69
Maximum Pulling Tension	lbs	6,000	8,000	10,000	12,000	14,000	16,000	20,000	24,000
Typical Shipping Reel Size									
Flange x Traverse	in	138x95	138x95	138x95	138x95	138x95	138x95	158x95	158x95
Shipping Reel Capacity*	ft	3,000	3,000	2,650	2,700	2,550	2,425	2,250	2,150
Electrical									
Electrical Stress @ U_o									
Conductor Shield	kV/mm	5.4	5.2	5.0	4.9	4.7	4.7	4.5	4.4
Insulation Shield	kV/mm	2.1	2.2	2.3	2.3	2.4	2.4	2.4	2.5
Short Circuit for 0.5s**									
Conductor	kA	76.9	102.5	128.1	153.8	179.4	205	256.3	307.5
Sheath	kA	39.7	41.7	43.6	45.2	47	48.4	51	54.1
Conductor Resistance									
DC @ 20° C	Ω/kft	0.014	0.011	0.008	0.007	0.006	0.005	0.004	0.004
DC @ 90° C	Ω/kft	0.018	0.014	0.011	0.009	0.008	0.007	0.005	0.005
Capacitance	pF/ft	41.8	45.7	49.1	52.2	55.5	58.1	62.8	68.5
Charging Current	Amps/kft	1.04	1.14	1.22	1.30	1.38	1.49	1.58	1.72
Ampacity @ 90o C	per circuit								
Typical Single Ductbank***	Amps	740	860	960	1040	1110	1170	1270	1350
Power Rating	MVA	148	172	192	208	222	234	253	269
Typical Double Ductbank***	Amps	630	730	810	870	930	980	1060	1120
Power Rating	MVA	126	146	162	174	186	196	212	224

*Increased shipping reel capacity can be accomodated on request.
**Declared values for 30 mils copper sheath. Thicker sheath can accommodate more current.
***4ft top of duct, 1°C-m/W native, 0.8°C-m/W ductbank backfill, 25°C Ambient, 75% lf, 9" spacing, single-point or cross bonded.

1


1022
SHIELD WIRE
60'-80' HEIGHT OF STR.
Road Pavement
PHASE CONDUCTORS
1METER ABOVE GROUND
-300FT
+300FT
TRANSMISSION STRUCTURE

2