

**Volume V RD-1**  
**Docket No. E015/GR-16-664**  
**Page 1 of 1**

**Minnesota Power --- MPUC Docket No. E015/GR-16-664**  
**Voltage Discount Cost Support**  
**Test Year Ended 12/31/2017**

	Secondary (1)	Primary (2)	Dist. Bulk Delivery (3)	Transmission (4)	
Revenue Requirements: Demand & Customer 1/					
A	General Service	5,347,868	9,562,935	2,177,242	6,812,671
B	Large Light & Power	1,858,913	9,991,304	3,155,578	15,015,478
C	Municipal Pumping	221,066	478,220	127,998	198,447
D	Revenue Requirements Sum.	7,427,847	20,032,459	5,460,818	22,026,596
Billing Units (MWh) 2/					
E	General Service	651,396	668,751	669,292	669,292
F	Large Light & Power	609,636	964,948	1,100,320	1,494,916
G	Municipal Pumping	17,074	17,074	17,074	17,074
H	Total Billing Demands	1,278,106	1,650,773	1,786,686	2,181,282
Billing Units (kW) 3/					
I	General Service	2,307,309	2,368,782	2,370,698	2,370,698
J	Large Light & Power	1,322,733	2,093,656	2,387,374	3,243,533
K	Municipal Pumping	140,084	140,084	140,084	140,084
L	Total Billing Demands	3,770,125	4,602,522	4,898,156	5,754,315
M	Revenue Req. (\$/MWh) (Line D / Line H)	5.81	12.14	3.06	10.10
N	Revenue Req. (\$/kW) (Line D / Line L)	1.97	4.35	1.11	3.83
O	Avoided Cost for Customers at Primary Voltage or Higher (\$/kW)	1.97	equivalent to = \$5.81/MWh or .00581 \$/kWh		
P	Additional Avoided Cost for Customers at Transmission Voltage or Higher (\$/MWh)	15.19	equivalent to .01519 \$/kWh or \$5.46/kW		
Q			<b>Proposed Primary Discount</b>	<b>\$2.00/kW</b>	
R			<b>Proposed Transmission Discount</b>	<b>\$0.00350/kWh</b>	

NOTES:

1/ Revenue Requirements per Cost of Service Study for the classes identified (page 35-1)

2/ Billing Units (MWh) per BD - Allocation Energy - 2017.xlsx

3/ Transmission level set equal to Sum NCP from 2017TY\_D01-D15.xlsx (multiplied by 12). Lower voltage demands determined based on the energy ratio by class at the corresponding voltage level.

The company's standard rates for General Service (GS), Large Light & Power (LLP) and Municipal Pumping (MP) classes are designed based on costs for service at secondary voltage. Since service at higher voltage generally requires fewer facilities and experiences less line and transformer losses, a discount is applicable.

To determine an appropriate discount, the demand and customer-related revenue requirement of the Distribution, Distribution Bulk Delivery and Transmission systems utilized by the GS, LLP and MP classes were segregated by voltage level (secondary, primary, distribution bulk delivery) as shown in spreadsheet above.

Row M shows that on average these three customer classes are charged \$31.10/MWh for Transmission and Distribution (equal to 11.27/kW, shown in Row N).

Row O shows that the avoided secondary distribution costs for customers taking service at Primary Voltage or higher is \$1.97/kW.

Row P shows that the additional avoided costs for customers taking service at Transmission voltage (and already receiving the discount for the avoided secondary distribution costs) is \$15.19/MWh = \$5.46/kW.

Row Q shows the proposed primary discount which is rounded up from \$1.97 to \$2.00 and slightly higher than the current \$1.75/kW

Row R shows the proposed transmission discount which is based on the current rate .00284 increased by approximately 25%, to avoid making a large change to the discount.



RD-2.2

Minnesota Power - Docket No. E015/GR-16-664  
Compliance Filing per Docket No. E-015/M-12-1359  
2015 Embedded Line Extension Cost Calculation

FERC Account	Item	Gross Plant	Depreciation Reserve	CIAC	Net Plant Net of CIAC	Allocator	Residential	General Service	Light & Power	Large Power	Municipal Pumping	Lighting
364	Poles, Towers and Fixtures	\$102,128,828 [a]	\$55,384,000 [h]	\$3,790,222 [o]	\$42,954,606	DDISTPOL	\$ 15,054,375	\$ 9,477,842	\$ 12,120,933	\$ 413,330	\$ 557,628	\$ 454,630
365	Overhead Conductors	\$90,102,573 [b]	\$51,265,146 [i]	\$2,590,273 [p]	\$36,247,154	CDISTPOL	14,452,501	2,581,705	55,878	129	29,484	92,314
369-1	Services	\$6,541,976 [f]	\$4,509,346 [j]	\$289,001 [q]	\$1,743,629							
	Net Overhead Lines				\$80,945,390							
	Allocated to:											
	Primary				\$38,078,739	DDISTPOL	\$ 15,054,375	\$ 9,477,842	\$ 12,120,933	\$ 413,330	\$ 557,628	\$ 454,630
	Demand Customer				\$17,212,010	CDISTPOL	14,452,501	2,581,705	55,878	129	29,484	92,314
	Secondary Demand Customer				\$13,299,305	DDISTSOL	9,709,667	2,856,662	470,291	-	129,074	133,612
	Services				\$10,611,707	CDISTSOL	9,075,649	1,434,578	7,599	-	11,521	82,361
	Demand Customer				\$181,533	DDISTSOT	124,515	44,190	8,282	-	1,951	2,594
	Services				\$430,307	CDISTSOT	368,019	58,172	308	-	467	3,340
366	Underground Conduit	\$10,526,764 [c]	\$3,763,805 [k]	\$399,995 [r]	\$ 6,362,963							
367	Underground Conductors	\$91,322,078 [d]	\$31,384,356 [l]	\$7,294,775 [s]	\$2,642,946							
369-2	Services	\$11,782,586 [g]	\$6,030,855 [m]	\$356,440 [t]	\$5,395,291							
	Net Underground Lines				\$ 64,401,201							
	Allocated to:											
	Primary				\$38,592,233	DDISTPUL	\$ 15,257,385	\$ 9,605,651	\$ 12,284,385	\$ 418,904	\$ 565,148	\$ 460,761
	Demand Customer				\$14,259,360	CDISTPUL	11,973,233	2,138,824	46,292	107	24,426	76,478
	Secondary Demand Customer				\$5,332,715	DDISTSUL	2,737,277	1,112,532	1,376,932	-	101,029	4,945
	Services				\$821,601	CDISTSUL	666,372	145,600	6,489	-	2,355	785
	Demand Customer				\$1,288,767	DDISTSUS	662,137	269,117	333,075	-	24,438	-
	Services				\$2,213,317	CDISTSUT	1,795,145	392,233	17,481	-	6,344	2,115
373	Street Lighting	\$ 3,341,476 [e]	\$ 2,378,364 [n]	\$ 95,476 [u]	\$ 867,636	DIRECT						867,636

[SEE NEXT PAGE FOR TOTALS]

RD-2.3

[SEE PREVIOUS PAGE FOR DETAILS]

FERC Account	Item	Gross Plant	Depreciation Reserve	CIAC	Net Plant Net of CIAC	Allocator	Residential	General Service	Large Light & Power	Large Power	Municipal Pumping	Lighting	Total Res, GS, LLP & Muni Pump Average Embedded Cost
	<b>Rate Class Totals (\$)</b>				<b>\$142,321,593</b>		<b>81,876,274</b>	<b>30,117,106</b>	<b>26,727,943</b>	<b>832,470</b>	<b>1,453,865</b>	<b>2,181,571</b>	<b>All Phase</b>
	Distribution System						78,926,458	29,353,393	26,368,798	832,470	1,420,664	2,173,522	136,069,314
	Services						2,949,816	763,712	359,145	-	33,201	8,049	57,142,856
	Total Plant Net of CIAC				143,189,229		111,265	19,700	443	11	225	5,039	4,105,874
	Number of Customers				136,672								20,368
	<b>Average Embedded Cost (\$/customer)</b>						<b>\$ 736</b>	<b>1,529</b>	<b>60,334</b>	<b>6,462</b>	<b>6,462</b>	<b>1,065</b>	<b>2,862</b>
	Distribution System						709	1,490	59,523	6,314			
	Services						27	39	811	-	148	2	

General Service & Municipal Pumping	
Distribution System	30,774,058 (v)
Services	796,913 (w)
Number of Customers	19,925 (x)
<b>Average Embedded Cost (\$/cust)</b>	<b>1,584 (y)</b>

GS = General Service  
 LL&P = Large Light & Power  
 Muni Pump = Municipal Pumping

FERC Account \_\_\_\_\_ Item \_\_\_\_\_ Gross Plant \_\_\_\_\_ Depreciation Reserve \_\_\_\_\_ CIAC \_\_\_\_\_ Net Plant Net of CIAC \_\_\_\_\_ Allocator \_\_\_\_\_ Residential \_\_\_\_\_ General Service \_\_\_\_\_ Light & Power \_\_\_\_\_ Large Power \_\_\_\_\_ Municipal Pumping \_\_\_\_\_ Lighting \_\_\_\_\_ RD-2.4

Source:

	Gross Plant	Depreciation Reserve	CIAC	Net Plant Net of CIAC	Allocator	Residential	General Service	Light & Power	Large Power	Municipal Pumping	Lighting
	Gross Plant, Accumulated Depreciation and CIAC amounts are 2014 actual (Property Accounting) Allocation factors from 2009 Retail Rate Case, Docket No. E-015/GR-09-1151										
	Number of Customers are 2015 Actual from FERC Form 1 Yearly Summary Report										
(a)	2015 FERC Form 1, Page 207, L 64, Col g										
(b)	2015 FERC Form 1, Page 207, L 65, Col g										
(c)	2015 FERC Form 1, Page 207, L 66, Col g										
(d)	2015 FERC Form 1, Page 207, L 67, Col g										
(e)	2015 FERC Form 1, Page 207, L 73, Col g										
(f)	Net Value Report by Utility Account: (note for Property Acc: Filler Functional Class= Distribution Electric) Accum Cost, Account 3691										
(g)	Net Value Report by Utility Account: (note for Property Acc: Filler Functional Class= Distribution Electric) Accum Cost, Account 3692										
(h)	Net Value Report by Utility Account: (note for Property Acc: Filler Functional Class= Distribution Electric) Alloc Reserve, Account 3640										
(i)	Net Value Report by Utility Account: (note for Property Acc: Filler Functional Class= Distribution Electric) Alloc Reserve, Account 3650 & 3651										
(j)	Net Value Report by Utility Account: (note for Property Acc: Filler Functional Class= Distribution Electric) Alloc Reserve, Account 3691										
(k)	Net Value Report by Utility Account: (note for Property Acc: Filler Functional Class= Distribution Electric) Alloc Reserve, Account 3660										
(l)	Net Value Report by Utility Account: (note for Property Acc: Filler Functional Class= Distribution Electric) Alloc Reserve, Account 3670										
(m)	Net Value Report by Utility Account: (note for Property Acc: Filler Functional Class= Distribution Electric) Alloc Reserve, Account 3692										
(n)	Net Value Report by Utility Account: (note for Property Acc: Filler Functional Class= Distribution Electric) Alloc Reserve, Account 3730										
(o)	CIAC report from Property Accounting: (note for Property Accounting: PA WO# In Ser CIAC) Account 3640										
(p)	CIAC report from Property Accounting: (note for Property Accounting: PA WO# In Ser CIAC) Account 3650 & 3651										
(q)	CIAC report from Property Accounting: (note for Property Accounting: PA WO# In Ser CIAC) Account 3691										
(r)	CIAC report from Property Accounting: (note for Property Accounting: PA WO# In Ser CIAC) Account 3660										
(s)	CIAC report from Property Accounting: (note for Property Accounting: PA WO# In Ser CIAC) Account 3670										
(t)	CIAC report from Property Accounting: (note for Property Accounting: PA WO# In Ser CIAC) Account 3692										
(u)	CIAC report from Property Accounting: (note for Property Accounting: PA WO# In Ser CIAC) Account 3730										
(v)	Sum of General Service and Municipal Pumping Distribution System costs shown above										
(w)	Sum of General Service and Municipal Pumping Services costs shown above										
(x)	Sum of General Service and Municipal Pumping Number of Customers shown above										
(y)	Single Average Embedded Cost per customer for the General Service and Municipal Pumping Classes ((v)+(w))/(x)										

Minnesota Power - Docket No. E015/GR-16-664  
Compliance Filing per Docket No. E-015/M-12-1359  
2015 Embedded Line Extension Cost Calculation  
Customer Count 1/

RD-2.5

Rate Schedule		
Title	Number	Customers
Residential	20 & 22	107,908
Residential Seasonal Service	23	3,357
Sub Total		111,265
General Service	25	19,700
Sub Total		19,700
Large Light & Power	75	443
Sub Total		443
Large Power	74	11
Sub Total		11
Municipal Pumping	87	225
Sub Total		225
Outdoor Lighting	76	79
Area Lighting	77	4,443
Highway Lighting	80	81
Overhead Lighting	83	318
Ornamental Lighting	84	118
Sub Total		5,039
<b>Grand Total</b>		<b>136,683</b>

Reconciliation FERC Form 1 Total 145,033  
Source:

21	7,430
23	
24	320
26	536
27	57
26	7
	<u>8,350</u>
	145,033

2015 FERC Form 1, page 304-304.2, col d line 41  
1/ FERC Form 1 page 304 - 304.1

Minnesota Power - Docket No. E015/GR-16-664  
 Compliance Filing per Docket No. E-015/M-12-1359  
 2015 Embedded Line Extension Cost Calculation  
 Rate Class Allocation

RD-2.6

Line	ALLOC	Description	Total Company	Wholesale	Total Retail	Residential	General Service	Large Light & Power	Large Power	Municipal Pumping	Lighting
1	D01	Production Power Supply	100,000	16,305	83,695	11,110	6,904	15,217	49,999	201	264
2	D02	Transmission	100,000	18,014	81,986	10,884	6,763	14,906	48,978	197	258
3	D03	Sub-Transmission	640,530	148,903	491,627	184,260	116,093	168,259	10,625	6,825	5,565
4	D04	Distribution Substations	464,537		464,537	183,654	115,624	147,868	5,042	6,803	5,546
5	D05	Primary Overhead Lines	455,474		455,474	180,071	113,368	144,983	4,944	6,670	5,438
6	D06	Secondary Overhead Lines	489,423		489,423	357,322	105,127	17,307	-	4,750	4,917
7	D07	Primary Underground Lines	455,474		455,474	180,071	113,368	144,983	4,944	6,670	5,438
8	D08	Secondary Underground Lines	359,091		359,091	184,321	74,915	92,719	-	6,803	333
9	D14	Overhead Services	348,377		348,377	238,955	84,804	15,894	-	3,745	4,979
10	D15	Underground Services	358,758		358,758	184,321	74,915	92,719	-	6,803	-
11	E01	Power Supply Production Energy E8760	100,000	16,345	83,655	11,647	7,317	15,496	48,815	184	196
12	C01	Primary Overhead Lines	133,685		133,685	112,252	20,052	434	1	229	717
13	C02	Secondary Overhead Lines	86,583		86,583	74,050	11,705	62	-	94	672
14	C03	Primary Underground Lines	133,685		133,685	112,252	20,052	434	1	229	717
15	C04	Secondary Underground Lines	47,101		47,101	38,202	8,347	372	-	135	45
16	C10	Overhead Services	86,583		86,583	74,050	11,705	62	-	94	672
17	C11	Underground Services	47,101		47,101	38,202	8,347	372	-	135	45
18	C12	Customers Meters	#####	736,790	#####	#####	9,150,447	907,552	1,941,898	219,575	-
19	C14	Leased Property	2,034,121		2,034,121	-	-	-	-	-	2,034,121
20	C15	Customer Accounts	6,460,357	98,085	6,362,272	5,098,202	908,660	89,097	117,789	73,751	74,773
21	C16	Customer Sales	94,546		94,546	79,416	5,673	1,247	8,210	-	-

Source:

Schedule C1, 2017 MP Retail CCOSS General, pages 35 and 36 of 46

Minnesota Power - Docket No. E015/GR-16-664  
 Compliance Filing per Docket No. E-015/M-12-1359  
 2015 Embedded Line Extension Cost Calculation  
 Customer Count by Phase and Average Extension Costs by Type

RD-2.7

Customer Count by Phase		Average Cost of a Service Extension <sup>2/</sup>	
	Number of Customers		Ratio
Residential	111,227		99.97%
Single Phase	38		0.03%
Three Phase			
	111,265		100.00%
Municipal Customers			
Single Phase	78		34.67%
Three Phase	147		65.33%
	225		100.00%
General Service			
Single Phase	14,889		75.58%
Three Phase	4,811		24.42%
	19,700		100.00%

Residential Single Overhead	\$3,067	\$3,493
Residential Single Underground	\$3,919	
Commercial Single Overhead	\$4,083	\$4,192
Commercial Single Underground	\$4,300	
Commercial 3Phase Overhead	\$8,441	
Commercial 3Phase Underground	\$13,142	\$10,791

<sup>1/</sup> Customer count using the information in Minnesota Power Geographical Information System (GIS)  
<sup>2/</sup> Average costs of service extension calculated using Minnesota Power Compatible Unit Estimator (CUE).  
 This estimator was approved to calculate the annual per-foot charge for services under or equal to 1,000 feet  
 Commission Order dated January 31, 2014, Page 4, Order Point 4



RD-3.1

Line No.	Rate Class	kWh	Rate/kWh	Targeted Funds Amount	Number of Customers	Average Cost/Cust per Year	Average Cost/Cust per Month	Average Percent Month
1			<b>\$0.00085</b>					
2	Residential (excluding LIHEAP)	880,005,990		\$751,357	101,117	\$7.43	\$0.62	0.25%
3	All Residential	985,494,000		\$0				
4	LIHEAP 1/	105,488,010		\$0				
5	Residential Dual Fuel	101,014,000		\$86,247	7,520	\$11.47	\$0.96	0.39%
6	General Service	641,438,000		\$547,665	20,057	\$27.31	\$2.28	0.92%
7	General Service Dual Fuel	27,854,000		\$23,782	20,058	\$1.19	\$0.10	0.04%
8	Large Light & Power	1,494,916,000		\$1,276,372	449	\$2,842.70	\$236.89	96.24%
9	Municipal Pumping	17,074,000		\$14,578	229	\$63.66	\$5.30	2.16%
10	Total	3,162,301,990		\$2,700,000	149,430	2,954	246	100.00%

1/ kWh for Residential LIHEAP customers per EITE Docket No. E015/GR-16-564



**Lighting Costs**

**Outdoor and Area Lighting**

Service - 76, 77

Old Code	Lamp Code	Implied Increase			Per Lamp Increase			Charges if Per Lamp Increase			Revenue if Per Lamp Increase		
		Option 1	Option 2	Option 3	Option 1	Option 2	Option 3	Option 1	Option 2	Option 3	Option 1	Option 2	Option 3
<b>Mercury Vapor Lamps</b>													
	7,000 Lumens												
	175 K	0.26%	30.70%	0.00%	0.00%	0.00%	\$11.60	\$8.06		\$162,446.40	\$13,057.20		
	400 M/P	-42.37%	1.59%	0.00%	0.00%	0.00%	\$18.36	\$12.69		\$26,879.04	\$913.68		
	55,000	-102.65%	-44.83%	0.00%	0.00%	0.00%	\$34.38	\$24.57		\$412.56	\$589.68		
<b>Sodium Vapor Lamps</b>													
	8,500 Lumens												
	100 I	24.67%	53.34%	0.00%	0.00%	0.00%	\$10.19	\$5.86		\$298,852.32	\$3,234.72	\$70.32	
	150 X	17.19%	43.02%	0.00%	0.00%	0.00%	\$11.73	\$7.44		\$39,975.84	\$267.84		
	23,000	9.31%	37.24%	0.00%	0.00%	0.00%	\$16.65	\$9.89		\$172,827.00	\$2,492.28	\$0.00	
	45,000	-14.98%	20.90%	0.00%	0.00%	0.00%	\$22.22	\$13.23		\$167,183.28	\$2,063.88	\$0.00	
<b>Metal Halide Lamps</b>													
	17,000 Lumens												
	250 R	17.58%		0.00%	0.00%	0.00%	\$16.44			\$29,197.44			
	400 S	-1.19%		0.00%	0.00%	0.00%	\$20.12			\$56,014.08		\$0.00	
	88,000	-28.35%		0.00%	0.00%	0.00%	\$33.39			\$31,653.72		\$0.00	
<b>Light Emitting Diode</b>													
	4,674 Lumens												
	≤ 48 -						\$9.17			\$0.00			
<b>Street and Highway Lighting</b>													
Service - 80, 83, 84													
<b>Mercury Vapor Lamps</b>													
	7,000 Lumens												
	175 K	-20.15%	37.21%	0.00%	0.00%	0.00%	\$15.94	\$8.33		\$204,860.88	\$180,027.96	\$1,063.92	
	250 L			0.00%	0.00%	0.00%						\$977.28	
	20,000	-46.78%	2.08%	0.00%	0.00%	0.00%	\$21.33	\$14.23		\$7,422.84	\$12,294.72	\$4,293.12	
	55,000			0.00%	0.00%	0.00%						\$0.00	
<b>Sodium Vapor Lamps</b>													
	8,500 Lumens												
	100 I	14.54%	53.36%	0.00%	0.00%	0.00%	\$13.62	\$6.83		\$174,063.60	\$277,106.76	\$3,732.48	
	150 X	3.16%	42.54%	0.00%	0.00%	0.00%	\$15.73	\$8.59		\$237,271.32	\$135,344.04	\$10,295.88	
	14,000			0.00%	0.00%	0.00%						\$0.00	
	200 F	-34.90%	25.78%	0.00%	0.00%	0.00%	\$18.32	\$10.08		\$219.84	\$483.84	\$9,671.40	
	23,000	-12.32%	30.95%	0.00%	0.00%	0.00%	\$19.77	\$11.05		\$124,788.24	\$139,893.00	\$30,960.00	
	45,000	-30.44%	11.89%	0.00%	0.00%	0.00%	\$24.22	\$14.95		\$6,684.72	\$6,458.40	\$21,135.00	
<b>Metal Halide Lamps</b>													
	28,800 Lumens												
	400 S		10.87%	0.00%	0.00%	0.00%					\$314.64		
<b>Light Emitting Diode</b>													
	4,000 Lumens												
	≤ 54 W	35.60%		0.00%	0.00%	0.00%	\$12.74			\$47,851.44			
	8,800	28.35%		0.00%	0.00%	0.00%	\$16.60			\$31,075.20			
	≤ 118 Y						\$21.07			\$0.00			
	23,000												
	≤ 219 -												
<b>Option 4</b>													
	Customer Charge (Service Agreements)						\$2.00			\$6,768.00			
	Energy Charge (¢/KWh)						\$0.05774			\$361,544.40			
<b>Pole Costs</b>													
	Pole Charge						\$4.70			\$77,380.80			
<b>Total Annual Revenue</b>													
										\$3,122,115.00			

1/ LED48W Option 1 Charge = (LED54W Rate / LED54W Cost) \* LED48W Cost  
 = (\$12.74 / \$19.78) \* \$14.24  
 2/ LED219W Option 1 Charge = (LED118W Rate / LED118W Cost) \* LED219W Cost  
 = (\$16.60 / \$23.17) \* \$29.41