

**Nueces Electric Cooperative, Inc. (NEC)
2019 Distribution Loss Factor Calculation Summary**

The following summary contains the methods used to develop the adjusting factors for use in calculating Nueces Electric Cooperative, Inc (NEC) loss adjustments to be applied to load profiles as per ERCOT protocols. These factors apply to 2019 intervals.

ERCOT protocols include the following equation for the factor to be applied to each 15 minute interval of day ahead profiled load.

$$SILFi = F1 * (SIELi / AAL) + F2 + F3 / (SIELi / AAL)$$

Where,

- SILFi = Settlement Interval Distribution Loss Factor
- SIELi = Settlement Interval ERCOR Load
- AAL = Annual Interval Average ERCOT System Load
- F1, F2, & F3 = Coefficients derived from regression analysis of the TDSP loss study results.

and where,

$$AAL = \text{Annual ERCOT Total System MWH} / \text{Total annual intervals} \\ = 10,708 \text{ (to be used for 2019 loss calculations)}$$

Comparing NEC and ERCOT Demand Profiles

ERCOT Values for 2019

- ERCOT Annual MWH = 375,191,874
- ERCOT AAL (15-min intervals) MWH = 10,708
- ERCOT Peak MW = 73,308
- Peak Date = 7/19/2018 17:00

NEC Values

- NEC 2018 Peak (MW) = 72.53
- NEC AAL (15-min intervals) MWH = 10.59

NEC had an overall peak of 144.5 MW; however 71.97 MW of demand was metered on primary side of substation transformer. The peak to be used for the Distribution Loss Calculation will be 72.53.

	<u>15 mins</u>	<u>1 hour</u>
NEC Peak (MW)	18.13	72.53
NEC AAL (MWH)	10.59	42.37
ERCOT Peak (MW)	18,327	73,308
ERCOT AAL (MWH)	10,708	42,832

The ratio of NEC Peak to AAL is proportionate to ERCOT's with the ratio of both being 1.71. So for this analysis we can assume NEC and ERCOT demand correlate.

Methodology for Losses

NEC wire loads have been compensated for all substation transformer losses. Distribution primary conductor losses, distribution transformer losses and secondary conductor losses were calculated based on load levels using the following equation:

$$\begin{aligned} \text{Losses} &= AX^2 + B \\ A &= \text{Constant} \\ B &= \text{Constant (No - Load Losses)} \\ X &= \text{Input to System (MW)} \end{aligned}$$

The equation was solved for the A constant for each potential loss level in the distribution system. With the A constant for each level, losses can be determined based on the input to the system.

Primary Conductor

NEC uses Milsoft Engineering Analysis – Windmil modeling software to find primary conductor losses on every substation distribution feeder. kW demands are entered into each substation at a specific time to find line losses at that time with given load. The time used was 7/19/2018 17:00, ERCOT's 2018 time of Peak demand. Line losses were calculated to be 2.921MW.

Distribution Transformers

NEC's GIS model contained 16,771 transformers with most of them being single phase transformers. Averages and typical losses of transformers were used to find total losses of 1.207 MW.

Secondary Conductor

An average load per customer was calculated for single phase and three phase services. An assumed service length and resistance of service was determined to find secondary line loss.

NEC Customer Coding

NEC customers are divided into two groups, 'A' & 'B'. A group customers are primary metered at medium voltage with respect to distribution transformer. B group customers are secondary metered with respect to distribution transformers. F1, F2, & F3 were selected to match the curve of losses calculated based on system data.

Group A Coefficients:	F1 = 0.0234	F2 = 0.000141	F3 = 0.00012
Group B Coefficients:	F1 = 0.0256	F2 = 0.000120	F3 = 0.02500

Distribution Loss Factor Results

Group A Customers - Primary		Group B Customers - Secondary	
DLF at AAL	DLF at Peak	DLF at AAL	DLF at Peak
2.37%	4.03%	5.07%	5.85%

Loss Calculations

The equation from page 2 re-arranged to solve for A:

$$A = \frac{\text{Losses} - B}{X^2}$$

Primary Conductor

Total Losses = 2.92 MW

No Load Losses = 0 MW

Input = 72.53 MW

$$A = \frac{2.92 - 0}{72.53^2}$$

$$A = 5.553E-4$$

$$B = 0$$

Distribution Transformer

Total Losses = 1.21MW

No Load Losses = 1.084 MW

Input = 69.61 MW

$$A = \frac{1.21 - 1.084}{69.61^2}$$

$$A = 2.550E-5$$

$$B = 1.084$$

Secondary Conductor

Total Losses = 0.082 MW

No Load Losses = 0 MW

Input = 68.40 MW

$$A = \frac{0.082 - 0}{68.40^2}$$

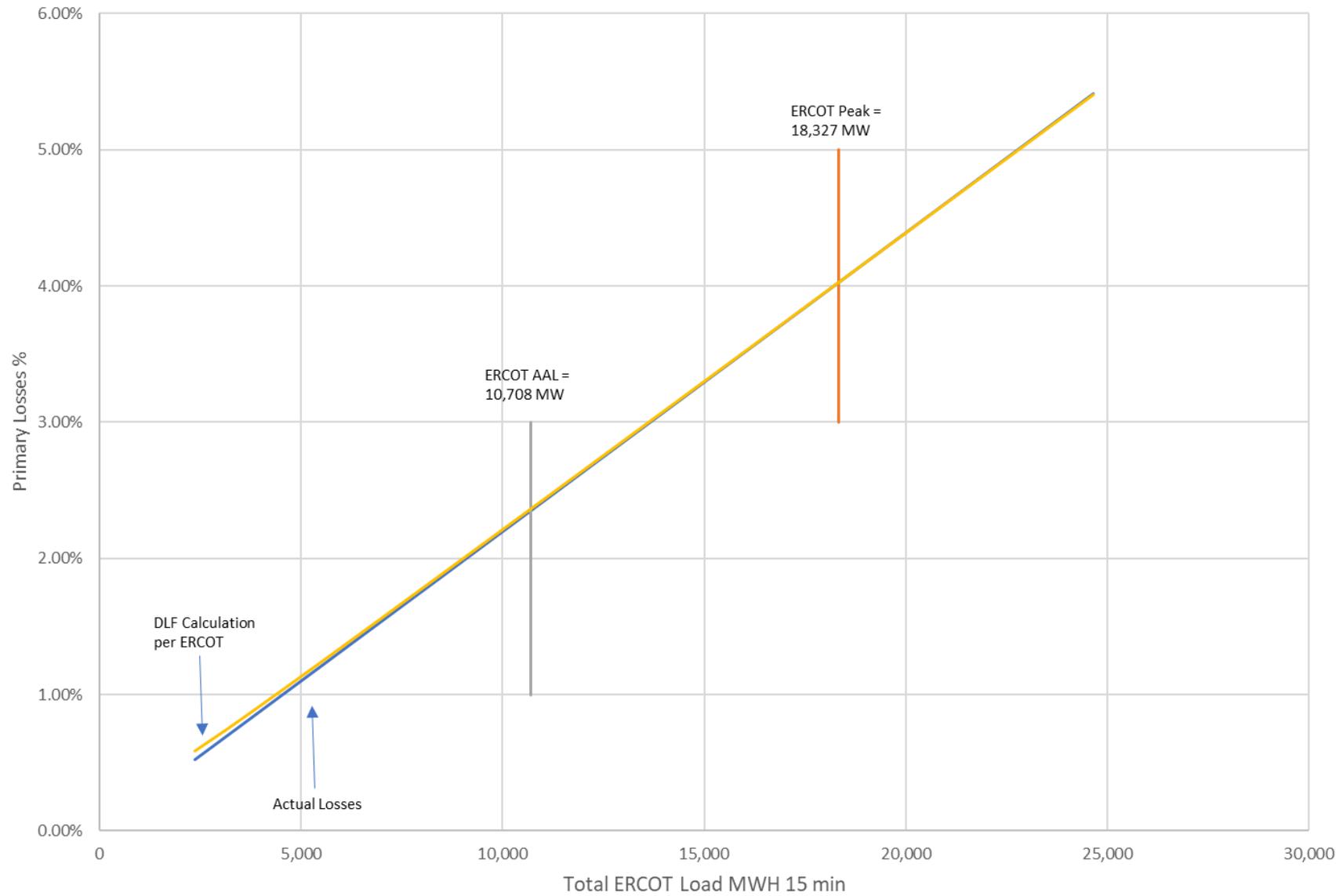
$$A = 1.665E-5$$

$$B = 0$$

NEC Distribution Load Factor Table

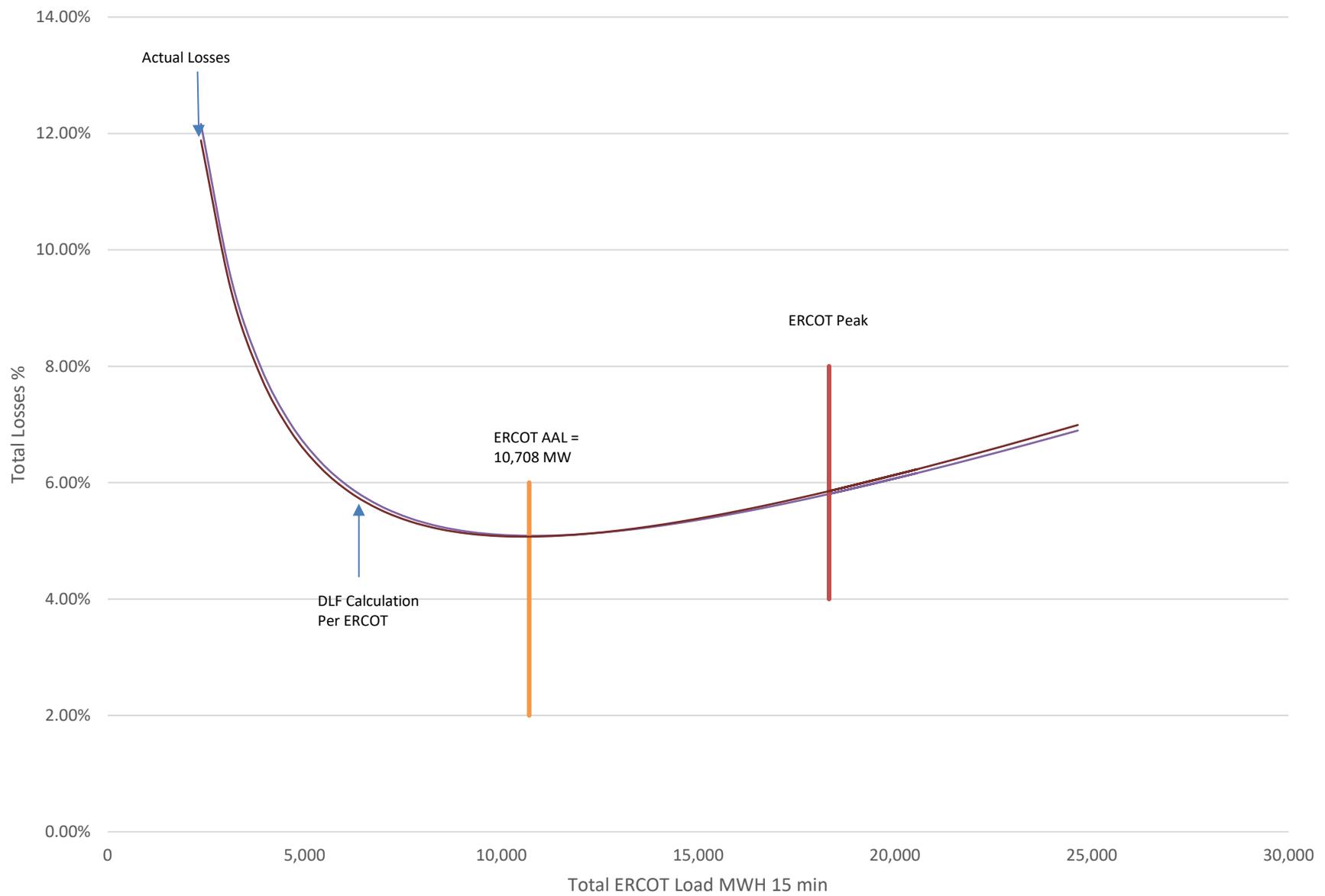
ERCOT Load (1 hr)	ERCOT Interval Load SIEL (15 min)	NEC Load	NEC Interval Load	Primary Conductor Losses	Primary Losses %	Input to Dist Trfs	Dist Trf Losses	Input to Secondary	Secondary Conductor Losses	Total Losses	Total Losses	DLF Secondary	DLF Primary
MW	MW	MW	MW	MW	%	MW	MW	MW	MW	MW	MW		
9,475	2,369	9.37	2.34	0.05	0.52%	9.32	1.09	8.24	0.01	1.14	12.16%	11.88%	0.59%
12,507	3,127	12.37	3.09	0.09	0.69%	12.29	1.09	11.20	0.01	1.18	9.53%	9.32%	0.74%
15,540	3,885	15.37	3.84	0.13	0.85%	15.24	1.09	14.15	0.01	1.23	7.99%	7.83%	0.90%
18,572	4,643	18.37	4.59	0.19	1.02%	18.19	1.09	17.09	0.01	1.29	7.01%	6.89%	1.06%
21,605	5,401	21.37	5.34	0.25	1.19%	21.12	1.10	20.02	0.01	1.36	6.36%	6.26%	1.22%
24,637	6,159	24.37	6.09	0.33	1.35%	24.04	1.10	22.94	0.01	1.44	5.91%	5.83%	1.38%
27,670	6,917	27.37	6.84	0.42	1.52%	26.96	1.10	25.85	0.02	1.53	5.60%	5.54%	1.54%
30,702	7,676	30.37	7.59	0.51	1.69%	29.86	1.11	28.75	0.02	1.64	5.39%	5.33%	1.71%
33,735	8,434	33.37	8.34	0.62	1.85%	32.75	1.11	31.64	0.02	1.75	5.25%	5.20%	1.87%
36,767	9,192	36.37	9.09	0.73	2.02%	35.64	1.12	34.52	0.02	1.87	5.15%	5.12%	2.04%
39,800	9,950	39.37	9.84	0.86	2.19%	38.51	1.12	37.39	0.03	2.01	5.10%	5.08%	2.20%
42,832	10,708	42.37	10.59	1.00	2.35%	41.38	1.13	40.25	0.03	2.16	5.09%	5.07%	2.37%
45,864	11,466	45.37	11.34	1.14	2.52%	44.23	1.13	43.10	0.03	2.31	5.10%	5.09%	2.53%
48,897	12,224	48.37	12.09	1.30	2.69%	47.07	1.14	45.93	0.04	2.48	5.12%	5.12%	2.70%
51,929	12,982	51.37	12.84	1.47	2.85%	49.91	1.15	48.76	0.04	2.66	5.17%	5.18%	2.86%
54,962	13,740	54.37	13.59	1.64	3.02%	52.73	1.15	51.58	0.05	2.84	5.23%	5.25%	3.03%
57,994	14,499	57.37	14.34	1.83	3.19%	55.55	1.16	54.38	0.05	3.04	5.31%	5.32%	3.19%
61,027	15,257	60.37	15.09	2.02	3.35%	58.35	1.17	57.18	0.06	3.25	5.39%	5.41%	3.36%
64,059	16,015	63.37	15.84	2.23	3.52%	61.14	1.18	59.96	0.06	3.47	5.48%	5.51%	3.52%
67,092	16,773	66.37	16.59	2.45	3.69%	63.93	1.19	62.74	0.07	3.70	5.58%	5.62%	3.69%
70,124	17,531	69.37	17.34	2.67	3.85%	66.70	1.20	65.50	0.08	3.95	5.69%	5.73%	3.85%
73,157	18,289	72.37	18.09	2.91	4.02%	69.46	1.21	68.26	0.08	4.20	5.80%	5.85%	4.02%
76,189	19,047	75.37	18.84	3.15	4.19%	72.22	1.22	71.00	0.09	4.46	5.92%	5.97%	4.18%
79,222	19,805	78.37	19.59	3.41	4.35%	74.96	1.23	73.74	0.09	4.73	6.04%	6.10%	4.35%
82,254	20,564	81.37	20.34	3.68	4.52%	77.70	1.24	76.46	0.10	5.02	6.16%	6.23%	4.51%
85,286	21,322	84.37	21.09	3.94	4.68%	80.54	1.25	79.21	0.10	5.31	6.28%	6.35%	4.67%
88,318	22,080	87.37	21.84	4.20	4.84%	83.38	1.26	81.96	0.11	5.60	6.40%	6.47%	4.83%
91,350	22,838	90.37	22.59	4.46	5.00%	86.22	1.27	84.71	0.11	5.89	6.52%	6.59%	5.00%
94,382	23,596	93.37	23.34	4.72	5.16%	89.06	1.28	87.46	0.12	6.18	6.64%	6.71%	5.16%
97,414	24,354	96.37	24.09	4.98	5.32%	91.90	1.29	90.21	0.12	6.47	6.76%	6.83%	5.32%
100,446	25,112	99.37	24.84	5.24	5.48%	94.74	1.30	92.96	0.13	6.76	6.88%	6.95%	5.48%
103,478	25,870	102.37	25.59	5.50	5.64%	97.58	1.31	95.71	0.13	7.05	7.00%	7.07%	5.64%
106,510	26,628	105.37	26.34	5.76	5.80%	100.42	1.32	98.46	0.14	7.34	7.12%	7.19%	5.80%
109,542	27,386	108.37	27.09	6.02	5.96%	103.26	1.33	101.21	0.14	7.63	7.24%	7.31%	5.96%
112,574	28,144	111.37	27.84	6.28	6.12%	106.10	1.34	103.96	0.15	7.92	7.36%	7.43%	6.12%
115,606	28,902	114.37	28.59	6.54	6.28%	108.94	1.35	106.71	0.15	8.21	7.48%	7.55%	6.28%
118,638	29,660	117.37	29.34	6.80	6.44%	111.78	1.36	109.46	0.16	8.50	7.60%	7.67%	6.44%
121,670	30,418	120.37	30.09	7.06	6.60%	114.62	1.37	112.21	0.16	8.79	7.72%	7.79%	6.60%
124,702	31,176	123.37	30.84	7.32	6.76%	117.46	1.38	114.96	0.17	9.08	7.84%	7.91%	6.76%
127,734	31,934	126.37	31.59	7.58	6.92%	120.30	1.39	117.71	0.17	9.37	7.96%	8.03%	6.92%
130,766	32,692	129.37	32.34	7.84	7.08%	123.14	1.40	120.46	0.18	9.66	8.08%	8.15%	7.08%
133,798	33,450	132.37	33.09	8.10	7.24%	125.98	1.41	123.21	0.18	9.95	8.20%	8.27%	7.24%
136,830	34,208	135.37	33.84	8.36	7.40%	128.82	1.42	125.96	0.19	10.24	8.32%	8.39%	7.40%
139,862	34,966	138.37	34.59	8.62	7.56%	131.66	1.43	128.71	0.19	10.53	8.44%	8.51%	7.56%
142,894	35,724	141.37	35.34	8.88	7.72%	134.50	1.44	131.46	0.20	10.82	8.56%	8.63%	7.72%
145,926	36,482	144.37	36.09	9.14	7.88%	137.34	1.45	134.21	0.20	11.11	8.68%	8.75%	7.88%
148,958	37,240	147.37	36.84	9.40	8.04%	140.18	1.46	136.96	0.21	11.40	8.80%	8.87%	8.04%
151,990	38,000	150.37	37.59	9.66	8.20%	143.02	1.47	139.71	0.21	11.69	8.92%	8.99%	8.20%
155,022	38,758	153.37	38.34	9.92	8.36%	145.86	1.48	142.46	0.22	11.98	9.04%	9.11%	8.36%
158,054	39,516	156.37	39.09	10.18	8.52%	148.70	1.49	145.21	0.22	12.27	9.16%	9.23%	8.52%
161,086	40,274	159.37	39.84	10.44	8.68%	151.54	1.50	147.96	0.23	12.56	9.28%	9.35%	8.68%
164,118	41,032	162.37	40.59	10.70	8.84%	154.38	1.51	150.71	0.23	12.85	9.40%	9.47%	8.84%
167,150	41,790	165.37	41.34	10.96	9.00%	157.22	1.52	153.46	0.24	13.14	9.52%	9.59%	9.00%
170,182	42,548	168.37	42.09	11.22	9.16%	160.06	1.53	156.21	0.24	13.43	9.64%	9.71%	9.16%
173,214	43,306	171.37	42.84	11.48	9.32%	162.90	1.54	158.96	0.25	13.72	9.76%	9.83%	9.32%
176,246	44,064	174.37	43.59	11.74	9.48%	165.74	1.55	161.71	0.25	14.01	9.88%	9.95%	9.48%
179,278	44,822	177.37	44.34	12.00	9.64%	168.58	1.56	164.46	0.26	14.30	10.00%	10.07%	9.64%
182,310	45,580	180.37	45.09	12.26	9.80%	171.42	1.57	167.21	0.26	14.59	10.12%	10.19%	9.80%
185,342	46,338	183.37	45.84	12.52	9.96%	174.26	1.58	170.00	0.27	14.88	10.24%	10.31%	9.96%
188,374	47,096	186.37	46.59	12.78	10.12%	177.10	1.59	172.75	0.27	15.17	10.36%	10.43%	10.12%
191,406	47,854	189.37	47.34	13.04	10.28%	179.94	1.60	175.50	0.28	15.46	10.48%	10.55%	10.28%
194,438	48,612	192.37	48.09	13.30	10.44%	182.78	1.61	178.25	0.28	15.75	10.60%	10.67%	10.44%
197,470	49,370	195.37	48.84	13.56	10.60%	185.62	1.62	181.00	0.29	16.04	10.72%	10.79%	10.60%
200,502	50,128	198.37	49.59	13.82	10.76%	188.46	1.63	183.75	0.29	16.33	10.84%	10.91%	10.76%
203,534	50,886	201.37	50.34	14.08	10.92%	191.30	1.64	186.50	0.30	16.62	10.96%	11.03%	10.92%
206,566	51,644	204.37	51.09	14.34	11.08%	194.14	1.65	189.25	0.30	16.91	11.08%	11.15%	11.08%
209,598	52,402	207.37	51.84	14.60	11.24%	196.98	1.66	192.00	0.31	17.20	11.20%	11.27%	11.24%
212,630	53,160	210.37	52.59	14.86	11.40%	199.82	1.67	194.75	0.31	17.49	11.32%	11.39%	11.40%
215,662	53,918	213.37	53.34	15.12	11.56%	202.66	1.68	197.50	0.32	17.78	11.44%	11.51%	11.56%
218,694	54,676	216.37	54.09	15.38	11.72%	205.50	1.69	200.25	0.32	18.07	11.56%	11.63%	11.72%
221,726	55,434	219.37	54.84	15.64	11.88%	208.34	1.70	203.00	0.33	18.36	11.68%	11.75%	11.88%
224,758	56,192	222.37	55.59	15.90	12.04%	211.18	1.71	205.75	0.33	18.65	11.80%	11.87%	12.04%
227,790	56,950	225.37	56.34	16.16	12.20%	214.02	1.72	208.50	0.34	18.94	11.92%	11.99%	12.20%
230,822	57,708	228.37	57.09	16.42	12.36%	216.86	1.73	211.25	0.34	19.23	12.04%	12.11%	12.36%
233,854	58,466	231.37	57.84	16.68	12.52%	219.70	1.74	214.00	0.35	19.52	12.16%	12.23%	12.52%
236,886	59,224	234.37	58.59	16.94	12.68%	222.54	1.75	216.75	0.35	19.81	12.28%	12.35%	12.68%
239,918	59,982	237.37	59.34	17.20	12.84%	225.38	1.76	219.50	0.36	20.10	12.40%	12.47%	12.84%
242,950	60,740	240.37	60.09	17.46	13.00%	228.22	1.77	222.25	0.36	20.39	12.52%	12.59%	13.00%
245,982	61,498	243.37	60.84	17.72	13.16%	231.06	1.78	225.00	0.37	20.68	12.64%	12.71%	13.16%
249,014	62,256	246.37	61.59	17.98	13.32%	233.90	1.79	227.75	0.37	20.97	12.76%	12.83%	13.32%
252,046	63,014</												

2018 Nueces Electric Cooperative 'A' Customers Distribution Loss Factors



Group A - Primary Coefficients		
F1	F2	F3
0.0234	0.0001411	0.00012

2018 Nueces Electric Cooperative 'B' Customers Distribution Loss Factors



Group B - Secondary Coefficients		
F1	F2	F3
0.0256	0.00012	0.025